Designing and evaluating a participatory workplace nutrition intervention to improve the health and wellbeing of blue-collar (construction) workers

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Abstract

Background: Construction is an important industry, estimated to employ 7% of the UK workforce and accounting for 6% of the total economic output. A poor state of health and wellbeing of construction labourers has been widely recognised, with workers suffering from a high number of work-related injuries and occupational health problems, including musculoskeletal and lung illnesses as well as poor mental health. In addition, construction workers struggle with healthy food choices due to lack of knowledge, long working hours, remote site locations, poor food facilities on site, and temporary accommodation. Yet, nutrition interventions in construction are rare, with no UK studies.

Aim: The study aimed to design and evaluate a participatory nutrition intervention to improve the health and wellbeing of construction workers.

Methods: A mixed-methods approach was used and the study included three stages. The first, exploratory phase of the project, comprising the literature review and focus groups with construction workers and managers (n=5), informed and determined the next phases, including the questionnaire development and subsequent intervention design. In the next stage, the baseline questionnaire was distributed (n=51), the intervention was designed using the COM-B model and the Behaviour Change Wheel and implemented on a construction site. In the last, evaluation stage, results from the follow-up questionnaires (n=22), findings from individual interviewees (n=13) as well as an intervention plan, checklists and researcher's notes were used.

Results: Findings from the literature review and focus groups explored construction workers' nutrition behaviours, identified barriers and facilitators to healthy nutrition choices in the workplace and investigated perceptions of current health interventions, and ways to design a nutrition intervention suitable for the industry. Following the intervention, the questionnaire results showed changes in health and wellbeing outcomes as well as nutrition knowledge, nutrition behaviour and body composition measures (e.g., weight, fat mass, fat free mass, BMI). In addition, data from individual interviews with managers and workers who attended the intervention allowed the evaluation outcomes to be appraised and understood further, in relation to the implementation, fidelity, dose received, dose delivered, reach and recruitment.

Conclusions: Overall, this study shows the process of designing a construction industry tailored nutrition intervention in a participatory manner. The findings indicate that despite context related barriers to the implementation, workplace interventions taking place on ‘real-life’ working construction sites are possible and can bring positive changes, at 6 month follow-up.

Chapter One – Introduction

1.1. Introduction

Both globally and within the UK, the share of the working-age population is estimated at two-thirds (Gov.UK, 2020; Organisation for Economic Co-operation and Development (OECD), 2022). While life expectancy is increasing (81.3 years in the UK), health is not improving at the same rate (Brunton et al., 2016), with around 25% of adults in England reported to have two or more health conditions (Stafford et al., 2018). The number of individuals living with multiple chronic diseases is growing, especially amongst older adults and those with low socio-economic backgrounds and education (Singer et al., 2019). Low quality diets, with inadequate intakes of vegetables, whole grains, fish, nuts, seeds and excessive consumption of processed and sugary food, are contributors to coronary heart disease, stroke, diabetes (Lim et al., 2012) and are one of the leading preventable causes of death and disability (Micha et al., 2017). The Global Burden of Diseases Study (Lim et al., 2012) demonstrated the role of poor nutrition as a risk factor for lost disability-adjusted life-years and that high blood pressure, body mass index (BMI), fasting plasma glucose, and total cholesterol are all strongly related with diet (Lim et al., 2012). In the UK, dietary risks (including high sugar and salt consumption) are estimated to account for about 15% of all deaths (Afshin et al., 2019; OCED / European Observatory on Health Systems and Policies, 2019).

In the UK in 2021, 149.3 million working days were lost due to sickness or injury, which is equivalent to 4.6 days per worker (Office for National Statistics (ONS), 2021). Workplace injuries and ill health have serious effects on individual workers, their families, employers, government, and the wider society, with the impact expressed as financial (lost input and healthcare) and non-financial, 'human' costs (the quality of life or loss of life) (Health and Safety Executive (HSE), 2020a). HSE (2020a) estimated the total costs of workplace self-reported injuries and ill health in 2018/19 to be £16.2 billion. Over half the total cost (£9.56 billion) fell on individuals, whilst the remainder was shared between employers (£3.16 billion) and government / taxpayer (£3.5 billion). Human costs accounted for almost all the individual costs (£9.3 billion) arising primarily from loss of employment income (HSE, 2020a). Dame Carol Black's report (2008) estimated that the total cost of the unhealthy workforce to the UK taxpayer, including benefits costs, additional health costs and foregone taxes, was £60 billion annually. However, a joined report produced by the Department for Work & Pensions and the

Department of Health (2016) estimated the total economic cost of sickness absence at £100 billion annually.

Moreover, individuals with a chronic disease and those frequently engaged in unhealthy behaviours, such as an unhealthy diet, smoking, or lack of exercise, tend to report reduced productivity through both presenteeism and absenteeism, with higher levels of subjective wellbeing linked to greater productivity (Isham et al., 2020). In addition, working conditions are closely intertwined with people's physical and psychosocial health, which can lead to injuries, stress, anxiety, unhealthy behaviours, including substance abuse, cardiovascular disease and cancer (Brunton et al., 2016).

Protecting and promoting the health, safety and wellbeing of workers, by improving the working environment and undertaking health promotion initiatives, has been recognised as a priority by the European Agency for Safety and Health at Work (2020) and the World Health Organisation (WHO) (1994). In the UK, a recent Chartered Institute of Personnel and Development report (2020) highlighted that more organisations are taking a strategic approach to improving the health and wellbeing of employees (44% vs 40% in 2019). However, the emphasis is on helping employees who have become ill, rather than on prevention, with 41% of respondents (n=1018) reporting more reactive than proactive organisational practices.

The workplace has been identified as a priority setting for health and wellbeing interventions, including nutrition programmes (Hutchinson & Wilson, 2012; Meng et al., 2017), because it influences health and health behaviours, such as food choices, through providing or limiting access to facilities (e.g. canteens or vending machines), influencing health risks (e.g. through stressful jobs, long working hours), health attitudes (e.g. health supporting culture), and providing health promotion opportunities (e.g. health checks) (Quintiliani et al., 2010; Bonnell et al., 2017). Moreover, it has the potential to eliminate barriers to participation, including a need for transportation and conflicting family responsibilities (Brown et al., 2018). Furthermore, as individuals spend increasing hours at work, they become more reliant on consuming at least one of their meals in the workplace (Fitzgerald et al., 2016). However, given the likely role of the workplace in determining the health and wellbeing of individuals, workplace health and wellbeing programmes should be designed for specific groups, e.g. hard to reach audiences such as adult men, those with specific jobs, specific industries (Quintiliani et al., 2008; Carmichael et al., 2014) and countries, due to distinctive cultural, business and policy environments (Carmichael et al., 2014).

Despite the need for health and wellbeing interventions, specifically designed for particular groups, there is still a great deal of uncertainty whether workplace health interventions are effective, as according to the National Institute for Health and Care Excellence (NICE) guidance, interventions can be influenced by a range of factors, like the intervention focus, delivery methods, target population as well as management style, organisational culture or employees' roles (Taylor et al., 2016). Given this uncertainty, there is a growing appreciation of the need to provide detailed information on the interventions' design (Hutchinson & Wilson, 2012; Maes et al., 2012) and to conduct a rigorous evaluation, combining process and outcomes, to investigate why interventions work, for whom, and in what circumstances (Moore et al., 2015).

1.2. The overview of the UK construction industry

The UK construction sector is flexible but fragmented, which makes gathering information about the industry difficult (ONS, 2018a). The ONS (2018b) refers to the construction industry as businesses and organisations constructing buildings of all kinds, civil engineering, including construction of roads, railways, motorways, bridges, tunnels, utility projects and water projects and specialised construction activities, including demolition and site preparation, completion and finishing activities, electrical, plumbing and other installation activities. Construction workers are often referred to as 'blue-collar workers' and defined by their physical labour component (Lips-Wiersma et al., 2016), typically in low ranked positions (Lucas & Buzzanel, 2004) and paid by the hour or by piece rate based on the amount of work completed (Wilkie, 2019).

The construction industry is an important contributor to the UK economy, accounting for 6% of the total economic output in 2017 (Rhodes, 2018) and 7% of the UK workforce in 2019 (HSE, 2020). The industry is dominated by the private sector, with only a quarter of construction companies publicly owned (ONS, 2022). Construction–related employment has remained relatively unchanged, with 2.15 million workers throughout 2021 (ONS, 2022). This figure accounts for self-employment within the industry, which was estimated at 698,000 workers in 2021, a 27,000 decrease compared with 2020 (ONS, 2022). Despite this, the construction sector had the highest level of self-employed jobs across the whole economy (17.3%) (ONS, 2022). Although the overall annual construction output is still below the 2019 pre-Covid-19 levels, the total new work grew by 15.3% in 2021, reaching £115,579 million and the annual new orders rose 30.5% in 2021 to £72,578 million, recovering to its highest level in over 45 years (ONS, 2022). Finally, there was annual growth of 3.2% in the number of construction firms in Great Britain, leading to a total number of 353,365 operating construction businesses in 2021 (ONS, 2022).

1.2.1. Working practices in the construction industry

Nowadays, as a result of changes in the working environment, more people accept increased work demands and intensity, work long hours, evenings and weekends, agree to 'zero-hours' contracts, work as subcontractors, and frequently work towards tight deadlines and within unrealistic timescales (Papadopoulos et al., 2010; Sherratt, 2018). However, in the construction industry, this is nothing new, as these conditions have always been a part of the working environment (Sherratt, 2018). Working hours on UK construction sites are often excessively long (even 70+ hours) and work environments unstable, with sub-contracting and long supply chains (Sherratt, 2018). Furthermore, construction work characteristics, including payment on price, temporary employment and transient work can pose threats to the health and wellbeing of workers (Eaves et al., 2016; Papadopoulos et al., 2010; Sherratt, 2018; Sherratt & Turner, 2018). According to Sherratt (2018, p. 3) it can be argued that the UK construction industry is structured to be the "*inevitable detriment of construction worker health*".

Additionally, current procedures, under which developers contract with the industry, have created a competitive tendering process, which rewards contractors bidding at the lowest price. Consequently, companies facing the threat of non-survival, often keep employment and training costs low, to remain competitive (Farmer, 2016; Sherratt, 2018). Relying on tendering processes to obtain new projects and working as a sub-contracting business frequently leads to sporadic, inconsistent and unpredictable jobs (Burki, 2018). This is particularly the case for younger employees, with less experience in the industry, 'start ups', small businesses, or having no established brand name and recognition (Burki, 2018).

Another characteristic of the UK construction industry is multi-tiered supply chains, with the main contractor and sub-contractors sharing parts of the building work (Burki, 2018; Hanna & Markham, 2019). Plumbing or electrical work is often outsourced to smaller companies, sometimes consisting of a single worker, who are further down the supply chain, giving them little or no control over the project, timeline, or expenses (Burki, 2018). Undoubtedly, this job uncertainty leads to high levels of stress and anxiety amongst workers (Burki, 2018; Hanna & Markham, 2019). The sub-contracting system also affects social relationships amongst workers, with many complaining about a sense of exclusion, not being treated well nor feeling like a part of the team (Oswald & Turner, 2017).

Average earnings in the construction industry recovered from a fall in 2020-21, increasing to £716 per week in May 2022 (Statista, 2022a). However, payment on price (the amount of work produced per shift) and high levels of self-employment contribute to poor worker wellbeing (Beswick et al., 2007; Hanna & Markham, 2019; Papadopoulos et al., 2010) and encourage intense work practices to support the constant demand for progress (Sherratt, 2018). The construction industry in the UK operates to strict timetables, often facing penalties when failing to meet deadlines (Burki, 2018), and therefore overtime is encouraged by double pay (Oswald & Turner, 2017). However, Oswald & Turner (2017) reported that a decline in productivity during overtime periods has been noticed, which seems to be counterproductive for both workers and employers.

1.2.2. Characteristics of the construction workforce

The peripatetic nature of the construction industry means that the workforce is often transient, moving from one site to the other, experiencing a different working environment with every job, and often moving every few months (Burki, 2018; Eaves et al., 2016). Additionally, building sites are often far from home (Burki, 2018), and require early starts and considerable travelling, impacting on health, quality of life and family relationships (Eaves et al., 2016; Kenny et al., 2021). The findings from the Royal Society for Public Health (RSPH) report, ‘Health in a Hurry' (2016), showed that long commuting can lead to increased heart rate, blood pressure, stress levels, and to higher BMI and waist circumference. It has been noted that some commuting construction workers can do 17-hour days from when they leave the house to when they get back at night (Oswald & Turner, 2017).

Long shifts, irregular working hours, tiredness and isolation can take their toll on workers’ health and wellbeing (Burki, 2018; Hanna & Markham, 2019) with findings from a large construction site revealing that some construction workers work 70+ hours, week-in, week-out, keeping them away from home and family (Oswald & Turner, 2017). Interviewed workers mentioned that they feel pressured to do overtime, because if “*they do not do the job, someone* *else will"* (Oswald & Turner, 2017, p. 4). Long working days are compounded by long working weeks, with many workers doing shifts for 12 days in a row, followed by 2 days off (Oswald & Turner, 2017). The same study found that chronic tiredness led in some instances to workers falling asleep during short breaks while on site.

Although still a large proportion of UK construction workers are migrant and self-employed (ONS, 2022), the number of migrant workers in the UK construction has fallen by 8.3% in 2020 and it estimated at 280,000. In London, where half of the workforce are migrant workers, the number of migrants fell by 15% from 145,000 in 2019 to 125,000 in 2020 (Construction Industry Training Board (CITB), 2021). The 'Migrant labour force within the construction industry' report showed that 7% of workers in the industry are EU27 nationals and 3% are non-EU. In London, 28% of workers are EU27 nationals and 7% are non-EU nationals (ONS, 2018b). It is estimated that 44% of migrant workers are self-employed, compared to 37% of the domestic workforce (CITB, 2021). The highest self-employment rates are amongst non-UK workers; 63% of EU8 nationals (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia) and 66% of EU2 (Bulgaria and Romania) nationals working in the construction industry are self-employed, compared to all other nationalities, where self-employment rates are at the level of 39% (ONS, 2018b).

Self-employed and migrant status might even further increase their risk of work-related ill-health (ONS, 2018b; Stocks et al., 2011). Foreign workers are susceptible to mental health problems, while at the same time language barriers and a poor access to occupational health services might make it difficult to approach supportive services (Burki, 2018; Stocks et al., 2011). Burki (2018) found that workers who are foreign nationals often work and live together, with even 6-7 people occupying one room. The accommodation described by workers on a large multinational construction site comprised of a small room (2m x 4m), shared by 2 workers, without any kitchen facilities, which lead to them relying on cheap take-away and pub meals (Oswald & Turner, 2017). In addition, recent research highlighted the impact of crowded living conditions amongst migrant construction workers on their susceptibility to infectious diseases (e.g. Covid 19) as well as the socioeconomic inequalities, barriers to health and vaccination services and limited rights in the host countries, all affecting their health and wellbeing (Flouris et al., 2021).

1.2.3. Work environment in construction

Construction environments are often dirty, noisy, with a lack of natural lighting and ventilation, and workers perform tasks outdoors, often in extreme weather conditions (Eaves et al., 2016). Findings from a large multinational construction project in the UK showed that poor site layout, inadequate welfare facilities, including toilets, canteen, changing rooms, and office space have an effect on the health and wellbeing of workers (Oswald & Turner, 2017). Interviewed workers identified insufficient space for the number of labourers, a lack of cleanliness, and basic welfare units, i.e. no running water, towels, chairs, or soap, as common problems on construction sites. The units were named "*pig-sties*" or "*Ebola blocks*" by workers (Oswald & Turner, 2017, p. 706).

Construction is a tough, heavy, manual industry, where workers perform repetitive movement, heavy lifting, and work in cramped positions for long periods of time (Arndt et al., 2005; Eaves et al., 2016). Because of that, the construction industry needs 'healthy' workers; to walk, climb, lift, move, balance, level, fit and force, as there remains a heavy reliance on manual labour and skills within traditional work processes and therefore health is a necessity for a construction worker, who can be perceived as "*the big, strong, beefy builder*" (Sherratt, 2018, p. 2).

1.2.4. Health of construction workers

A poor state of health, safety and wellbeing of construction labourers has been widely recognised, with workers suffering from a high number of work-related injuries and occupational health problems (Bevan et al., 2022; Hanna & Markham, 2019; HSE, 2022; Mates in Mind, 2021). The diversity of occupations within the construction industry means that not all workers are exposed to the same hazards, and not all the jobs require the same level of physical effort (Sherratt, 2018). Nonetheless, specific health issues, such as musculoskeletal and lung illnesses, are associated with the industry (HSE, 2022; Sherratt, 2018).

The HSE (2022) reported that annually around 78,000 construction workers suffer from work-related ill health: 53% musculoskeletal disorders, 27% mental health issues, followed by lung disorders and cancers. However, considering the high levels of self-employment amongst construction workers, these numbers might not represent the full magnitude of the ill health problem within the industry. Self-employed workers have limited access to sickness benefits and are often financially insecure in the case of sickness (Spasova & Mathijn, 2018). Taking a day off directly influences the income of a self-employed worker, therefore, they may be more likely, than are paid workers, to exhibit presenteeism (occurring when ongoing physical and/or mental health conditions prevent employees from being fully productive at work) (Kim et al., 2014).

As mentioned above, stress and anxiety due to working in high pressured and dangerous workplaces are common health consequences of construction jobs (HSE, 2020; Mates in Mind, 2021). A 2017 UK survey of 3400 construction workers found that approximately 33% experienced mental health problems in the previous year, and 25% considered this as a reason for leaving the industry in the next 12 months (Randstand, 2017). Furthermore, 46% of workers who took time off due to mental illness, did not disclose the true reason behind their absence to the employer (Burki, 2018; Randstand, 2017), which suggests that stigma around mental illness in the construction remains prevalent (Burki, 2018). However, the Chartered Institute of Building (CIOB) (2020) surveyed 2081 individuals in construction and the results, which were even more alarming, showed that 97% experienced stress, 96% fatigue, 95% poor concentration, while anxiety and depression were reported by 87% and 70%, respectively.

Rising levels of stress and anxiety in construction workers have led to alarming levels of suicide, killing more men in the industry than falls from heights (Burki, 2018; Construction Manager, 2018; ONS, 2021). From 2011 to 2015, 1419 individuals working in skilled construction and building trades in England took their own lives, which made up 13.2% of the total work-related suicides recorded (Burki, 2018; ONS, 2017). The rate of suicide amongst low-skilled construction workers was 3.7 times higher than the national average (Burki, 2018). However, recent research carried out by the Lighthouse The Construction Industry Charity (2021) showed that from 2015 to 2019 a number of suicides per 100,000 construction workers rose from 26 to 29. An increase in suicides among unskilled construction occupations was also presented by ONS data (2021), which showed that in 2020 within elementary construction roles (i.e. performing general labouring and construction duties, like conveying bricks, assisting in scaffolding, cleaning, digging trenches), 94 people died by suicide, the highest level for a decade. In addition, a recent CIOB survey showed that 26% of construction workers had suicidal thoughts (Rees-Evans, 2020). A high suicidal rate could be partly attributed to the demographic characteristics of the industry; construction being male oriented (89% of workforce is male; men are three times more likely to commit suicide than women), as well as construction being a major employer (accounting for 7% of UK workforce) and to some of the work characteristics previously discussed (e.g. long working hours, staying in temporary accommodation, job demands) (Burki, 2018; Mates in Mind, 2021). Furthermore, stigma around stress and mental health in the construction industry, means that not feeling 'tough enough' for the job could easily be identified as a stressor on its own (Sherratt, 2018).

1.2.5. Lifestyle and health behaviours in construction

The prevalence of overweight and obesity in the UK is high, with almost 7 out of 10 men being overweight or obese (67.2%), of which almost 3 out of 10 are classed as obese (27.4%) (Public Health England (PHE), 2017). Being overweight or obese carries increased risks of comorbidities, including cardiovascular disease, diabetes, osteoarthritis, emotional and psychological problems, and also further health, societal, economical and working life consequences (Bajorek & Bevan, 2019; Robroek et al., 2017). Overweight and obesity has also been recognised as a problem amongst construction workers; both carrying individual health risks as well as implications for health and safety at work (HSE, 2016). Obese workers are more likely to encounter difficulties at work when using equipment, sitting, and doing strenuous activity (HSE, 2016). Overweight and obese workers were found to be 26% to 45% more likely to experience injuries compared to normal weight workers, with the prevalence on injury gradually increasing in line with increases in body mass index (Gu et al., 2016). Furthermore, obesity has been found to increase the risk of work disability due to osteoarthritis and cardiovascular disease amongst German construction workers (Claessen et al., 2009) as well as increasing the risk of poor work ability amongst Dutch workers (Tonnon et al., 2019) and disability benefit amongst Swedish labourers (Robroek et al., 2017). The magnitude of the problem was highlighted by the results of a health check undertaken during the Olympic Village build, which showed that over 40% of workers on the site were overweight, 28% obese, and 29% had some form of hypertension (Tyers & Hicks, 2012). Some concerns over lifestyle choices and the health of workers were also raised by managers interviewed during a study on large multinational construction project (Oswald & Turner, 2017). Following a routine t-shirt order for company's workers, managers observed that many workers were over a healthy weight range, as the order comprised of 2 small, 4 medium, 17 large, 17 XL, 4 XXL, 1 XXXL and 2 XXXXL t-shirts (Oswald & Turner, 2017).

Undesired, unhealthy behaviours in construction include alcohol and drug consumption, smoking and gambling (Boal et al., 2020; Boschman et al., 2011; Oswald & Turner, 2017; Sherratt & Turner, 2018) , with some being attributed to low socioeconomic status and low education level (Lingard and Turner, 2015), and the latter also associated with obesity (Cohen et al., 2013; Queiroz Bortolozo et al., 2016). Oswald & Turner (2017) described a situation, when one of the construction workers only ate Easter Eggs for a week, which were on post-Easter sale in a local supermarket, due to losing a large amount of money gambling. No-smoking policies are generally supported by managers of construction sites, as they promote a positive health and wellbeing image for the company; often refusing to designate smoking areas for workers (Oswald & Turner, 2017). Nevertheless, as this is a common habit amongst construction workers, with some smoking up to 50 cigarettes a day, it results in workers often breaking site rules and smoking anywhere (Oswald & Turner, 2017). Moreover, reporting to work under the influence of alcohol or drugs is also not uncommon in the construction industry (Oswald & Turner, 2017). According to the results of a survey published by Considerate Construction Scheme (CCS) (2016) 59% of construction workers agreed there is an issue in the industry related to drugs and alcohol, while 65% declared they have never been tested for drugs and alcohol. Furthermore, the results showed that 35% of construction workers noticed their colleagues under the influence of drugs and alcohol, while 25% agreed that drugs or alcohol affected them at work through tiredness (CCS, 2016).

Issues around health and wellbeing and unhealthy behaviours, including poor diets of construction workers have been, at least partly, attributed to gender and masculinity (Hanna et al., 2020; Moon, 2018; Okoro et al., 2017), with men comprising 99% of the site workforce and 89% of the overall workforce (Hanna et al., 2020). Masculine behaviours, such as stoicism, emotional restraint, competitiveness, risk-taking and toughness, are associated with working in construction, and are often considered desirable (Fuller et al., 2022; Hanna et al., 2020). Discussing health issues, seeking medical support or even taking part in health promotion opportunities is not customary and can be frown upon (Kenny et al., 2021; Lingard & Turner, 2017; Moon, 2018). Lingard & Turner (2017) suggested that that the attitude ‘you only live once’ prevails in the industry when healthy behaviours are considered.

However, health seeking behaviours are also reported in the construction industry, with some studies finding that workers are interested in their health and welcome changes made at work to improve their overall health and wellbeing (Eaves et al., 2016; Nea et al., 2017). Research also shows that younger workers tend to attend gyms and participate in sport and are more conscious about their diets (Eaves et al., 2016; Hanna et al., 2020; Kenny et al., 2021), while workers over the age of 35 more often turn to physiotherapy and vitamin supplementation as a way to keep healthy (Eaves et al., 2016).

1.3. Nutrition related behaviours - definitions

Dietary behaviours are complex, with determinants being both physiological and psychological, and including factors such as individual food preferences, nutrition knowledge as well as family habits, social relationships, socioeconomic status, culture and availability (Zheng et al., 2017). Inconsistently used terms around dietary behaviours, without clearly stated definitions, add to the complexity and impedes communication between researchers, hindering comparison across disciplines, ranging from anthropology to economics, where nutrition determinants are discussed (Stok et al., 2018). This section provides the reader with clarity on the definitions of key terms related to nutrition or dietary behaviours which have been used throughout this study.

Multiple terms used in this study refer to nutrition (e.g. nutrition choices, nutrition habits), rather than a diet (e.g. dietary choices, dietary habits), as this aligns with the study title and the aim of designing a nutrition intervention. The science of nutrition often refers to the nutrient content of the food or a process of utilising consumed food, while a diet is defined as the total amount of food consumed or food habitually eaten (Zohoori, 2020). However, differences between nutrition and dietary interventions or approaches are less prominent, as studies do not provide definitions (e.g. Forouhi et al., 2018). Nonetheless, when looking at the literature on workplace interventions, the term 'dietary' frequently refers to interventions using restricted approaches, like low carbohydrate, low calories, low fat diets (e.g. Carson et al., 2014) or focusing on a disease risk reduction, e.g. cardiovascular disease, cholesterol reduction (e.g. Verweij et al., 2011). Nutrition interventions are mentioned when nutrition education, motivational interviewing or environmental changes are talked about as means to reduce weight (e.g. Grech & Allman-Farinelli, 2015) or improve eating habits (e.g. increase fruit and vegetable consumption) (e.g. Steyn et al., 2009), although this is not always the case (e.g. Geaney et al., 2016).

The intervention in this study focuses on the provision of general nutrition education and advice on healthy eating, including behaviour change techniques to encourage participants to improve their eating habits, and is not focused on dietary restrictions. Therefore, the term 'nutrition' was chosen. Furthermore, the intervention was advertised as 'nutrition intervention' due to weight stigma amongst males (Pearl & Wadden, 2018) and men generally distancing themselves from what are still considered feminised diets (Gough, 2007). Additionally, the idea of ‘a diet’ or ‘being on a diet’ might put some people off, as restricting food, knowing what to eat and maintaining healthy eating behaviours can be challenging (Forouhi et al., 2018).

To establish definitions of key terms around nutrition behaviours, a taxonomy of outcomes related to diet, eating behaviour and nutrition has been used (Stok et al., 2018). The conceptual analysis, which led to the development of a taxonomy, was conducted within an interdisciplinary, international group of researchers. The group was created in the context of the European research network and knowledge hub Determinants of Diet and Physical Activity (DEDIPAC) (Lakerveld et al., 2014, cited in Stok et al., 2018). A different study also looked at the development of definitions related to nutrition, and although the authors provide a comprehensive and extensive effort into describing different nutrition constructs, the entries count in tens of thousands (Pinart et al., 2018). The complexity makes it unsuitable for the purposes of this study. Table 1.1. below presents a list of key terms used in this research, accompanied with relevant definitions.

Table 1.1. Key terms and definitions used in the study (adapted from Stok et al., 2018)

Term			**Definition**
Dietary or nutrition behaviour			Overall umbrella term, which refers to all aspects related to food choice, eating behaviour, and dietary / nutrition intakes
1	Food choice		Umbrella term, used for behaviours and other factors occurring before food consumption (i.e. before food reaches mouth). Food choice can be affected by preferences, income / cost, willingness to pay, frequency of purchase, product of purchase, food preparation, intentions
2	Eating behaviour		Umbrella term for outcomes related to the actual act of consumption. Includes eating habits, eating occasions, frequency, time, portions (size, number)
	a.	Eating habits	Developed over time eating behaviours that are typical or habitual, can be automatic, trigged by the context
3	Dietary or nutrition intakes		Umbrella term for outcomes that break down the content of food, what exactly is being consumed
	a.	Food intake	Food items (often expressed as amount or serving) a person eats within a specific time frame
	b.	Dietary pattern	Specific combination of food and beverages a person eats on a regular basis

1.4. Research aims and objectives and the research framework

Unhealthy nutrition related behaviours are common amongst blue-collar workers, including construction workers, and as they spend a substantial proportion of their waking time at work, there is a need to develop interventions in the workplace to improve nutrition behaviours, health and wellbeing amongst workers.

The overall aim of the research was to design and evaluate a participatory workplace nutrition intervention to improve the health and wellbeing of blue-collar (construction) workers. This research was carried out in three phases. Firstly, the literature search was conducted to explore the existing evidence on the influence of work, work characteristics and working conditions (including the environment) on eating behaviours, food choices, dietary intakes, health and wellbeing of blue-collar workers. Secondly, the literature search focused on the exploration of the evidence base on the effectiveness of workplace nutrition / dietary interventions (or those with a nutrition or a dietary component) on health, eating behaviours, food choices and dietary intakes, with a special focus on blue-collar (construction) workers. The literature was analysed and findings allowed for identification of priori themes and the development of focus group questions. Focus groups aimed to explore construction stakeholders' (workers' and managers') perceptions of current nutrition related behaviours and barriers and facilitators to healthy nutrition choices in the workplace. Furthermore, a qualitative approach in this phase also sought to explore stakeholders' perceptions of current health and wellbeing initiatives in a chosen organisation, how to facilitate healthy nutrition choices amongst the workforce and how to design a nutrition intervention with a consideration of the workforce needs, characteristics, and the context of the industry. The above was achieved by designing focus group questions in line with the literature review findings, recruiting construction companies willing to take part in the focus groups, conducting focus groups and analysing the results. An exploratory approach was appropriate, as little is known about the nutrition behaviours of UK construction workers.

The second phase of the research aimed to systematically design, develop and implement a workplace nutrition intervention, using findings from the first phase: best practice guidance from the literature review and results from the focus groups with construction workers and managers. A participatory approach, i.e. involving intervention participants in the research process, has been recognised as an important step and a suitable approach in this research, as it does not remove data from the context (i.e. data is collected directly with construction workers), and it can improve health through involving individuals, who, in turn, act to improve their own health (Baum et al., 2006). Moreover, this phase aimed to assess construction workers' health and wellbeing, nutrition related behaviours and nutrition knowledge at baseline (pre-intervention). It was achieved by designing a bespoke questionnaire, based on the findings from the exploratory phase, and carrying it out in a chosen construction organisation. Besides the questionnaire development and administration, this phase also provided the rationale for a selection of body composition measures (i.e. weight, BMI, fat percentage, fat free percentage) and analysed the baseline results.

The third, and final phase of the intervention was the evaluation of the intervention and included both outcomes and process evaluation. This phase aimed to identify the impact of the nutrition intervention on nutrition knowledge, behaviour, health and wellbeing and body composition measures of construction workers. Therefore, follow-up (post intervention) questionnaires and body composition testing were carried out and results were analysed to explore the post intervention changes. Furthermore, the impact of the nutrition intervention was identified by designing and carrying out a process evaluation, with a use of individual interviews with intervention participants, field notes, the intervention plan and daily checklists. This offered insights into what was delivered, whether the intervention was delivered as planned, what was received, intervention recruitment procedures, satisfaction with the intervention, as well as what worked and what did not, and in what context. The findings from the evaluation phase intended to inform the literature on health (nutrition) interventions in construction industry (and amongst wider blue-collar, hard to reach audiences) by identifying successes as well as areas for improvement. This phase aimed to build evidence concerning the design process that needs to be followed and conditions that need to be created to maximise opportunities of implementing an intervention that is successful in improving workers' health and wellbeing.

Thus, the research questions this thesis set out to address are:

1. How does work affect nutrition behaviours of blue-collar workers?
2. What is the existing evidence for the effectiveness of nutrition / dietary interventions in the workplace?
3. What is the existing evidence for the effectiveness of nutrition / dietary workplace interventions in the construction industry?

4. What are construction workers' and managers' current nutrition behaviours and what are their perceived barriers and facilitators to healthy eating at work?
5. What are current health and wellbeing initiatives taking place on construction sites, and what should be considered when designing a workplace nutrition intervention in construction?
6. What is the nutrition knowledge, nutrition behaviours and body composition measures (BMI, weight, fat %, fat free mass) of construction workers at baseline (pre intervention)?
7. How do construction workers rate their health and wellbeing at baseline (pre intervention)?
8. How did findings from the literature review, focus groups and baseline questionnaires informed the design of the nutrition intervention?
9. What changes in workers' nutrition knowledge, nutrition behaviour, health and wellbeing scores as well as and body composition measures (BMI, weight, fat %, fat free mass) occurred following the participation in the intervention?
10. Was the intervention delivered as planned and consistently with the theory?
11. What proportion of the target population participated in the intervention and to which extent did participants engaged with the intervention?
12. What were barriers and facilitators to implementation and participation in the intervention (including the context)?
13. Was the intervention acceptable to the participants and if it is to be rolled out, which aspects of the intervention should be refined?

Individual phases of the research, together with research questions, which each phase addressed, as well as corresponding chapters of the thesis, are presented in the research framework (see Fig. 1.1).

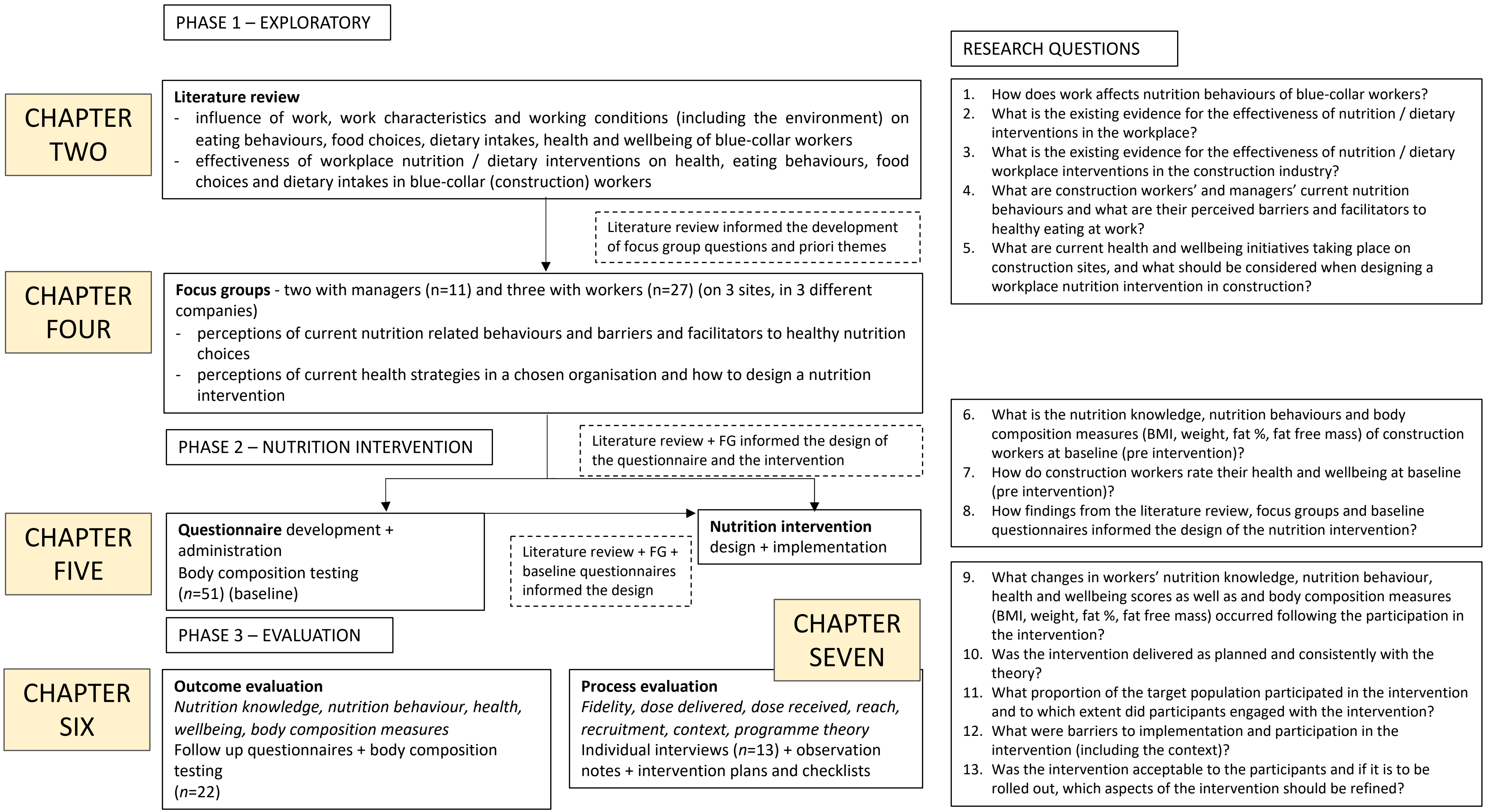

Figure 1.1. The Research Framework

1.5. The impact of Covid-19 on the research

The research took place during the Covid-19 pandemic and pandemic-related restrictions have affected the research with regards to: (i) the timeline of the research and the nutrition intervention, (ii) a number of participants who took part in the study and who completed the study, (iii) the nutrition intervention design.

Firstly, the first lockdown introduced in March 2020 caused the closure of all construction sites, which meant that the data collection and site visits were suspended until July 2020. Following the reopening, none of the three construction organisations that had initially made a commitment to take part in the intervention (and took part in the focus groups) wished to continue, due to increased job demands, delays in the schedule, personnel changes, financial problems. Although the researcher succeeded in establishing a contact and gaining the commitment to conduct the intervention on a new site (in August 2020), it resulted in only one construction site taking part in the intervention (instead of the three that participated in focus groups) and limited the number of study participants. Although attempts were made to approach other companies and sites to obtain a commitment to implement an intervention, companies either failed to respond or declined to take part.

The intervention commenced on the site in September 2020, with an anticipated end date of March 2021, and follow-up interviews planned for June 2021. However, the third national lockdown was enforced in January 2021 and lasted until March 2021. As a result, the intervention was suspended and recommenced only in April 2021, extending the end date of the intervention until May 2021, with follow-up interviews taking place in August 2021. This meant that a proportion of the workforce had moved to other projects, affecting the completion rates of the intervention and engagement.

Lastly, the intervention took place while some of the Covid-19 restrictions were in place, which resulted in adjustments being made to the design of the intervention. For example, social distancing rules enforced limiting the number of participants in coaching groups, while restricted movement on site constrained the intervention to be delivered in multiple places on site. Details on how Covid-19 restrictions posed a barrier to the intervention implementation are discussed further in the evaluation of this study (chapter seven).

Chapter Two – Literature Review

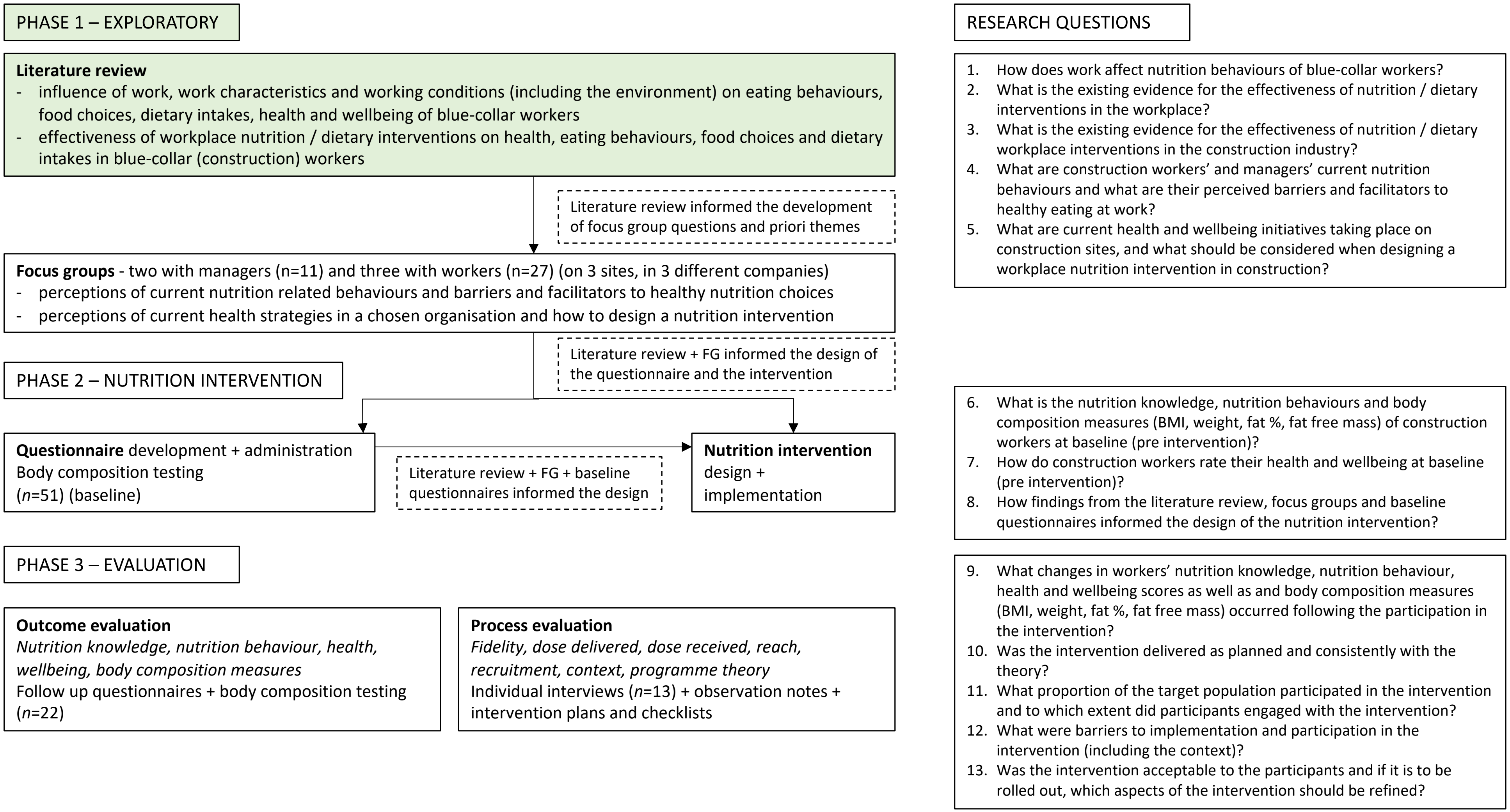

Figure 2.1. The Research Framework – Literature Review

Chapter Two – Literature Review

2.1. Introduction to literature review

This literature review explores the literature on designing and implementing a workplace nutrition intervention in the UK construction industry. It explores how nutrition behaviours are affected by work and work-related factors, and the current evidence behind the effectiveness of interventions. Specifically, it set out to answer the following research questions outlined in the previous chapter:

1. How does work affect nutrition behaviours of blue-collar workers?
2. What is the existing evidence for the effectiveness of nutrition / dietary interventions in the workplace?
3. What is the existing evidence for the effectiveness of nutrition / dietary workplace interventions in the construction industry?

This review begins with a description of the search strategy. Then, it considers the impact of work, work characteristics and working conditions on nutrition behaviours, and the health and wellbeing of blue-collar workers, looking in turn at the four main areas of influence: social, psychological, organisational, environmental. Afterwards, a review of the evidence base on the effectiveness of workplace nutrition / dietary interventions (or those with a dietary component) on health, eating behaviours, food choices and dietary intakes is conducted. The review considers multi-component and educational interventions, followed by motivational enhancement approaches and environmental modification programmes. In the next stage, the synthesised evidence on factors facilitating and hindering the success of nutritional interventions in the workplace, grouped into five main categories (programme design, programme components, management and other stakeholders' support, health culture and educated employers, the context of the industry; and individual factors) has been carried out. Later in this chapter the overview of the effectiveness of nutrition programmes in the construction industry is considered. In turn, interventions targeting individuals, educational and environmental interventions will be analysed. Finally, the review will conclude with a summary of the current gaps in the research and an overview of behaviour change theories.

2.2. Search strategy

The literature review on the topic of influences of work on nutrition and diet, as well as on the effectiveness of nutritional interventions in the workplace, took place initially in late 2018 and early 2019. However, throughout the course of the research, the literature review has been ongoing and continuously updated to ensure that findings from the more recent literature are considered and included where relevant.

To review the relevant literature, three separate searches were conducted (details of the searches in Table 2.1). The first search focused on the exploration of the existing evidence on the influence of work, work characteristics and working conditions (including environment) on eating behaviours, food choices, dietary intakes, and the health and wellbeing of blue-collar workers. Based on the findings from the reviewed literature, both direct and indirect influences on the nutrition habits of workers were found, and four areas of work-related influences identified: social, psychological, organisational and environmental. The literature search was conducted in PubMed, Web of Science, Scopus, Cochrane Library, CINAHL, ProQuest, Science Direct. In total, 345 articles were identified, and after checking for duplicates and reviewing titles and abstracts of the articles for relevance, 68 full text articles were identified. The results were further narrowed down using the following inclusion criteria: studies published in the last 20 years (due to a limited number of available studies), studies in English, studies involving blue collar workers, the influences or effect of work, work characteristics and conditions on diet or nutrition. A total of 36 studies complied with these criteria and these mainly included small, qualitative studies.

The second search was conducted to explore the evidence base on the effectiveness of workplace nutrition / dietary interventions (or those with a dietary component) on health, health behaviours, food choices and dietary intakes. Results from this search were relevant for identifying research gaps and developing recommendations for the intervention. There is a vast body of literature exploring nutrition and dietary interventions in the workplace, including many systematic-reviews and meta-analyses published in the last 10 years (Cancelliere et al., 2011; Geaney, Kelly, et al., 2013; Hulls et al., 2022; Hutchinson & Wilson, 2012; Kuoppala et al., 2008; Lassen et al., 2018; Ni Mhurchu et al., 2010; Panchbhaya et al., 2022; Rachmah et al., 2022; Rongen et al., 2013). Thus, in order to obtain consolidated evidence from a vast and complex array of articles, this part of the review focused on findings from literature reviews, systematic-reviews and meta-analyses. The initial search found 65 articles, although after checking for duplicates, screening titles and viewing abstracts, this was further narrowed down to 33 articles, of which 18 full text articles were included in the review after using the inclusion criteria (outlined in Table 2.1).

The third search took place to explore the evidence base for the effectiveness of workplace nutrition / dietary interventions (or those with a dietary component) on health, health behaviours, food choices and dietary intakes of construction workers. Findings from this part of the literature review were significant for informing future interventions and to identity gaps in the current research. The search included studies published in the last 10 years, based on the following criteria: intervention studies taking place in the workplace, involving a nutrition / dietary component, focused on construction workers, and published in English. A total of 58 articles were found initially, narrowed down to 37 after initial screening and 16 were included in the final review, which included 10 interventions (multiple articles were used to present findings of the same interventions). Only two interventions took place in Europe, which were also part of a PhD (Groeneveld et al., 2008; Viester et al., 2012), with no studies found in the UK.

The literature review was supported by findings from national reviews (Black, 2008; Carmichael et al., 2014; Get it Right Initiative, 2016; Health in a Hurry, 2016; Men's Health forum (MHF), 2009; PHE, 2017) and supplemented with statistical information from bodies including NICE, the ONS, Eurostat, and the HSE. Furthermore, where relevant, papers referenced by articles included in the review were retrieved, read and included in the final review.

Table 2.1. A summary of the search strategy

Search	Aim	Database searched	Terms searched	Inclusion criteria	Number of papers included
1	To explore existing evidence on the influence of work, work characteristics and working conditions (including environment) on eating behaviours, nutritional intakes, health and wellbeing of blue-collar workers	PubMed Web of Science Scopus Cochrane Library CINAHL ProQuest Science Direct	work or workplace or worksite and nutrition or diet and work characteristics or job characteristics or working conditions and blue-collar	- Studies published with the last 20 years - Studies published in English - Focused on the workplace; influences / effects of work, work characteristic and work conditions - Involve nutritional / dietary component - Involve blue collar workers	Initially identified n=345 Retrieved after removing duplicated and initial title and abstract screening n=68 Included in the review, following assessment against inclusion criteria n=36
2	To explore the evidence base on the effectiveness of workplace nutrition / dietary interventions (or those with a dietary component) on health, health behaviours, food choices and dietary intakes in blue-collar (construction) workers	PubMed Web of Science Scopus Cochrane Library CINAHL ProQuest Science Direct	nutrition or diet and intervention and workplace or worksite	- Literature review, systematic review, meta-analysis - Focused on review of workplace interventions - Involve diet / nutritional component - Studies published with the last 10 years - Studies published in English	Initially identified n=65 Retrieved after removing duplicated and initial title and abstract screening n=33 Included in the review, following assessment against inclusion criteria n=18

Search	Aim	Database searched	Terms searched	Inclusion criteria	Number of papers included
3	To explore the evidence base on the effectiveness of workplace nutrition / dietary interventions (or those with a dietary component) on health, health behaviours, food choices and dietary intakes in construction workers	PubMed Web of Science Scopus Cochrane Library CINAHL ProQuest Science Direct	nutrition or diet and intervention and workplace or worksite and construction industry or construction workers	- Intervention studies taking place in workplace - Involve nutritional / dietary component - Focused on construction workers - Studies published with the last 10 years - Studies published in English	Initially identified n=58 Retrieved after removing duplicated and initial title and abstract screening n=37 Included in the review, following assessment against inclusion criteria n=16

2.3. The effects of blue-collar work characteristics and the work environment on nutrition choices and eating behaviour

The aim of this part of the review was to explore the existing evidence on the influence of work, work characteristics and working conditions (including environment) on nutrition behaviours, including food choices, eating behaviours, dietary intakes, and health and wellbeing of blue-collar workers. Very few good quality research studies (systematic reviews) exist on the effects of work-related factors on eating habits and food choices in the workplace amongst blue-collar workers. Much of the research that does exist, is in the form of small, qualitative studies. Based on the studies reviewed, four areas of work-related influences (themes) were identified (social, psychological, organisational, environmental) and are discussed in this section. This review will start with a definition of blue-collar workers, and a short discussion on the demographic characteristics and knowledge related factors, which affect their nutrition choices and behaviours, before it moves on to work-related aspects. Here, it will explore social factors related to nutrition in the workplace, such as socialising around food and peer influence. Within psychological factors, the review will explore the impact of work and work-related stress on non-work life and eating habits and food choices. Further, a significant part of this review will discuss organisational factors affecting workers' nutrition behaviours. It will consider job demands, time pressures, issues related to shift work, insufficient breaks, as well as accidents, unsafeness and injuries, all in relation to the dietary intakes and eating behaviours of blue-collar workers. This part of the review will conclude with a discussion on the environmental factors affecting blue-collar workers' food choices, including the availability of food and issues with workplace canteen facilities.

2.3.1. Demographic and individual characteristics of blue-collar workers affecting their nutrition choices

Blue-collar workers have been defined as "*employees whose job entails (largely or entirely) physical labour, such as in a factory or workshop*" (Business Dictionary, 2019, para. 1) and those that "*need strength or physical skills*" (Cambridge Dictionary, 2019, para. 1). OECD (2002, para. 1) defined blue-collar workers as production workers, and those commonly "*engaged in fabrication, assembly and related activities, material handling, warehousing and shipping, maintenance and repair, janitorial and guard services, auxiliary production (such as power plants)*". Furthermore, the Society for Human Resource Management suggested that blue-collar work "*may involve skilled or unskilled labour requiring an associate degree or less education*" (Wilkie, 2019, para. 5). The work of blue-collar employees has been recognised as "*identifiable or tangible and directly related to the output generated by the firm*" (Business Dictionary, 2019, para. 1) as well as typically paid by the hour or by piece rate and based on the amount of work completed (Wilkie, 2019).

Factors related to health risk behaviours have been attributed to the demographic characteristics of blue collar workers, including low education level, being from an ethnic minority, as well as the characteristics of blue collar jobs, often resulting in high stress levels, burn out and job dissatisfaction (Brodie et al., 2021; Du Plessis et al., 2013; Gans et al., 2015; Lingard & Turner, 2015). Furthermore studies looking into health risks and anthropometric measures amongst blue collars have found higher levels of obesity (French et al., 2007; Queiroz Bortolozo at al., 2016) and BMI (Gans et al., 2015) when compared with white collar and administration employees. Long periods of sitting at work (bouts of 30 min and more) were positively associated with high waist circumference and BMI in blue collar workers (Gupta et al., 2016). Furthermore, an association between lower educational levels and higher prevalence of abdominal obesity has been found (Cohen et al., 2013; Queiroz Bortolozo et al., 2016; Sassi et al., 2011). Lastly, higher income levels have been linked to better eating habits amongst blue collar workers, with higher self-efficacy and income levels associated with the consumption of more fruit and vegetables (Hunt et al., 2010). Similar findings were presented by Nagler et al. (2013), who found that higher income was associated with greater awareness of the importance of eating healthily to meet job demands, and higher fruit and vegetable consumption amongst construction workers.

Despite the importance of nutritional knowledge in improving nutrition and subsequently the health, wellbeing, safety and productivity of construction workers, limited research has been conducted on levels of nutritional knowledge amongst workers (Okoro et al., 2015a). Findings from the Men's Health Forum (MHF) (2009) revealed that construction workers have little knowledge of particular foods and consume high-fat foods in the belief that this will enable them to undertake a physically-demanding job, which was also reported in a study looking at eating habits of rural-based working men (Oliffe et al., 2017) and Irish construction workers (Kenny et al., 2021). Likewise, Viester et al. (2012) found that although construction workers have some basic knowledge of nutrition, they are not aware of their personal intakes, therefore, might be not fully aware of the nutritional content of the foods they eat. A mismatch between health behaviour and knowledge in construction workers has been further supported by other studies (Du Plessis et al., 2013; Okoro et al., 2015a), however, it has also been suggested that while some blue-collar workers might know the basics about healthy eating, this may not be reflected in their eating behaviour, given the influence of other factors, such as economic constraints and personal preferences (Kenny et al., 2021; Okoro et al., 2015a).

Work influences physical health and health behaviours, such as food choices, through providing or limiting access to health resources, influencing health risks, health attitudes, and providing health promotion opportunities (Bonnell et al., 2017; Devine et al., 2003; Quintiliani et al., 2010). Furthermore, work is a source of social contact and prestige as well as providing economic possibilities to pursue healthy choices, while work cultures, schedules, job demands, and working patterns have a major impact on the way people lead their lives, both within and outside work (Bonnell et al., 2017; Mazzola et al., 2019). Based on the review of existing studies, four key areas of work-related influences on blue collar workers' eating habits and food choices have been identified as: social, psychological, organisational, environmental.

2.3.2. Social factors related to nutrition practices in the workplace

Meal times at work provide an opportunity to eat and relax, and a chance to socialise (Naweed et al., 2017), although they have also been found to have the potential to create divisions between employees from different occupational groups (Naweed et al., 2017; Wandel & Roos, 2005). A qualitative Norwegian study (n=46) using semi structured interviews with engineers, carpenters and drivers found that although considered as a social gathering by employees, lunch settings distinguished workers according to their status and position in the company (Wandel & Roos, 2005). Manual and production workers tended to eat lunch in a shed, which they brought from home, while engineers (within the same organisation) were provided with a lunch, paid for by the company, and ate at a laid table. A significant limitation of this study is dated data (i.e. collected 2001-2003). Since then a lot of awareness has been raised about equality at work in Europe (e.g.), therefore, those findings may no be longer relevant. However, similar results were presented in a more recent small qualitative study on Australian train drivers (Naweed et al., 2017), reporting that socialising during lunchtime or after work with workers from the same occupational group was a common occurrence and reflected workplace culture (i.e. drivers tends to spend lunch time with other drivers).

Food choices are often made to solidify social identity, indicating the importance of social influences on nutrition behaviours (Mazzola et al., 2017), and that individuals can be peer-pressured into healthy and unhealthy eating (Kenny et al., 2021; Okoro et al., 2017). For example a study by Bonnell et al. (2017) suggested that the decision to purchase takeaway food is influenced by other workers. Furthermore, good relationships with co-workers can provide social support associated with healthy lifestyle choices, such as a healthy diet or taking up exercise (Kelsey et al., 2000; Wynd & Ryan-Wenger, 2004). Research also suggests that the health behaviours of others (co-workers) are associated with employees' own behaviours (Kelsey et al., 2000; Kenny et al., 2021; Tabak et al., 2015) including dietary choices, both at work and home (Bonnell et al., 2017).

The examination of the influence of co-workers on individuals' dietary decisions indicates that the choice of meals consumed communally was based on a majority decision (Bonnell et al., 2017). However, the strongest predictor of healthy food choice was the presence of a team member who was passionate about nutrition and cooking, and was able to encourage and motivate others to eat healthily (Bonnell et al., 2017; Tabak et al., 2015). On the other hand, these social influences have been shown to negatively affect food choices in male dominated industries, as men are often described adopting unhealthy behaviours, such as high fat and high calorie diets, in order to demonstrate masculinity (Naweed et al., 2017; Wandel & Roos, 2005). Hanna et al. (2020) and Oliffe et al. (2017) suggested that in construction, this masculinity could be harnessed to promote positive behaviours, by using camaraderie between men and the relationships characterised by humour and 'banter' as an informal form of support (i.e. using toolbox talks), drawing on competitiveness providing opportunities for wellbeing challenges and team sport.

2.3.3. Psychological factors related to nutrition practices in the workplace

The effects that work engagement has on non-work life ('spillover effect') is often noticeable through health related habits (Lingard & Turner, 2017; Wandel & Roos, 2005). 'Spillover' asserts that an individual's experiences in one domain carry over to affect mood, behaviour and experience in the other, either positive or negative (Poppleton et al., 2008). Research shows that interference of work on meal times may not only affect food choices, but also preclude opportunities to perform parental and spousal roles and decrease one's overall wellbeing and life satisfaction (Devine et al., 2003). The above findings are important in a light of a recent Eurostat report (2018), which highlighted that UK employees have the longest working week (associated with work-life imbalance), in comparison with other European countries. On average, full-time workers in the UK spend 42.3 hours per week at their main job, while EU works 40.3 hours (Eurostat, 2018). Central to 'spillover' analyses are dimensions of working life that are important for job strain: job demands and the degree of control in the work situation (Lingard & Turner, 2017; Wandel & Roos, 2005) (discussed later in this review).

A recent CIOB survey showed that 97% of construction workers experience stress at work (Rees-Evans, 2020) and high levels of perceived stress at work have also been found to be associated with poor diets (Barrington et al., 2012; Janssen et al., 2011; Naweed et al., 2017). One study found that 31% of interviewed workers mentioned job related stress being a barrier to healthy eating (Leslie et al., 2013), as it either made them overeat for comfort or, under eat due to appetite suppression caused by stress and anxiety (Nobrega et al., 2016). A poor quality diet was also associated with work stress, defined as an imbalance between effort and reward in a cross-sectional study of populations in Central and Eastern Europe (Chen et al., 2016). Feeling undervalued by the employer was often found to affect morale and increase the stress levels of workers, which in turn manifested as apathy towards making lifestyle improvements, including dietary changes (Naweed et al., 2017; Nea et al., 2017; Nobrega et al., 2016). Furthermore, some workers describe food as a release from work stress, a form of 'escape', after a difficult day (Devine et al., 2003), which often made them eat more and consume energy-dense comfort foods (Nobrega et al., 2016).

2.3.4. Organisational factors related to nutrition practices in the workplace

Job demands have been found to be an important indicator of food choices amongst blue collar workers (Mazzola et al., 2017; Naweed et al., 2017; Nea et al., 2017; Nobrega et al., 2016; Pridgeon & Whitehead, 2013; Wandel & Roos, 2005). The intensity of the workload, low autonomy, inflexible schedules, overtime, feelings of disorientation and being 'under-pressure' have been reported to leave employees feeling that they lack personal resources, in the form of time, energy, motivation and will power, to make healthier nutrition choices (Devine et al., 2003; Mazzola et al., 2017; Naweed et al., 2017; Nea et al., 2017).

When faced with difficulties with time management, due to high workload, workers reported turning to convenient and processed foods more often (Escoto et al., 2010; Nea et al., 2017; Nobrega et al., 2016; Zagorsky & Smith, 2017). Findings from a survey of transit workers showed that long work hours (more than 50h per week) were associated with a high BMI and also greater use of less healthy foods like cold beverages, snacks, and cold food from vending machines in comparison with those working less than 40h per week (Escoto et al., 2010). Long hours of work have also been found to be positively associated with fast food consumption in U.S. workers, who consumed 15% to 18% more fast-food meals than non-workers, with each additional 100 hours of work being associated with a half percent increase in the number of fast-food meals (Zagorsky & Smith, 2017). Furthermore, workers reported a lack of time to prepare meals, fast pace of eating (Nobrega et al., 2016) or skipping meals (having breakfast only at weekend) and even forgetting to eat as a result of work related time pressure (Devine et al., 2003; Nea et al., 2017; Pridgeon & Whitehead, 2013) as well as depending more upon foods available at the worksite (regardless of the quality and nutritional value) (Escoto et al., 2010).

Shift work is associated with a poorer quality of life and altered lifestyle behaviours, brought on by erratic and irregular working patterns (Elser et al., 2018; Hemiö et al., 2015; Naweed et al., 2017; Nea et al., 2017; Souza et al., 2019), especially if the facilities for eating outside normal working hours are not well organised and healthy food choices are not available (Hemiö et al., 2015; Lowden et al., 2010; Naweed et al., 2017). This is especially important as the number of shift workers is increasing – for example, the Trade Union Congress (TUC) (2018, para. 2) reported that in the UK *"the number of people who work night shifts has increased by 151,000 (5%) since 2013, to reach more than 3 million (3,138,000). Britain's night workers* *now account for one in nine (11.5%)".* A systematic review showed that shift workers skip meals and consume more food at unconventional times (Souza et al., 2019), which may be due to the fact that changing schedules and long shifts impede workers from staying on top of their day to day activities, which manifests itself in difficulties planning and preparing meals, doing supermarket shopping during opening hours, and often results in using convenience food (Brodie et al., 2021; Nea et al., 2017; Phiri et al., 2014). Additionally, findings from two Australian studies, on fire-fighters (Bonnell et al., 2017) and bus drivers (Brodie et al., 2021), demonstrated that shift work is also linked to the types of food consumed, with more takeaway meals eaten during night shifts due to a lack of time to prepare food and limited choices to buy healthy options at night.

Not having enough time for breaks has been found to be yet another common barrier to healthy eating in blue-collar workers (Kenny et al., 2021; Leslie et al., 2013; Loudoun & Townsend, 2017; Nea et al., 2017; Nobrega et al., 2016). For example, a suggestion of more frequent meal breaks (with a current break schedule every 4h) was mentioned by carpenters, as a way to support their energy levels during the day (Wandel & Roos, 2005). Findings from focus groups amongst low waged multiple occupation Latino and African Americans showed that although break times were provided by employers, it was often divided into small, multiple breaks and timed unpredictably (Nobrega et al., 2016). Participants from the same study also mentioned that much of the allowed break time was filled by checking in and out and waiting in line to purchase a meal (Nobrega et al., 2016). Irish construction workers reported that poor nutrition habits (e.g. skipping breakfast or relying fast food) were due to time pressures, which were a result of a long commute to work (i.e. preferring to stay in bed longer) or insufficient break time (Kenny et al., 2021). In a study on shift workers (Nea et al. 2017), a lack of sufficient breaks was highlighted as part of the organisational culture, with interviewed workers mentioning feeling helpless and unable to advocate for improved working conditions. Protected times to eat, with sufficient cover (in order to prevent being called back to work) was suggested by workers as a way to improve meal patterns at the workplace (Nea et al., 2017; Thomas et al., 2016). Keeping hydrated was also stressed as an issue amongst this group of workers, as some mentioned avoiding fluids due to difficulties taking bathroom breaks (Nea et al., 2017).

Work-related accidents are an important concern amongst blue-collar workers (de Medeiros et al., 2014), with 142 fatal accidents and 441,000 non-fatal self-reported and 51,211 non-fatal employer reported injuries happening at work in the UK in 2020/21 (HSE, 2021). Accidents can occur as a result of feeling weak, indisposition or hypoglycaemia (Bates & Schneider, 2008; Kazar & Comu, 2022). As adequate nutrition can improve concentration (du Plessis, 2011) and energy levels (de Medeiros et al., 2014), addressing the nutritional needs of employees is of importance to maximise the accomplishment of work related tasks. Meliá & Becerril (2009), found, based on data from 180 workers belonging to a Spanish construction company, that poor health and safety on construction sites is partially attributed to workers' unhealthy eating. Findings from a different study suggested that having lunch at work is a risk factor, increasing the likelihood of work related accidents or injuries (de Medeiros et al., 2014). Similar results were presented in an earlier study conducted on Spanish construction workers, where authors found the highest rates of severe and fatal accidents occurring after lunch, between and 1pm and 5pm (Camino López et al., 2011). De Medeiros et al. (2014) hypothesised that workers working for a long time without food, consequently overate at lunch, which without time for adequate post meal rest, caused drowsiness, which increases the risk of accidents. Interestingly, authors of the Spanish construction workers study found that the absence of a 'siesta' might have been an added risk factor, as over 52% of workers experienced tiredness after lunch (Camino López et al., 2011). A recent study amongst Turkish construction workers found an inverse correlation between blood sugar levels and the likelihood of accidents, which increased towards noon, as the blood sugar levels of workers dropped (110mg/dl (6.1 mmol/l) at breakfast to 70mg/dl (3.9 mmol/l) at noon, which is a threshold bottom level) (Kazar & Comu, 2022).

The importance of balanced meals, breakfast in particular has also been presented in a different study, with findings showing an association between the higher frequency of breakfast and lower number of injuries and accidents at work (Chaplin & Smith, 2011). Similar results were reported in an earlier project delivered by the Olympics Delivery Authority (ODA), while work was being done on the Olympic Village in 2012. The report revealed that 28% of the 12,000 builders were 'obese', 41% were overweight and 29% had high blood pressure (ODA, 2012). ODA found that accidents were caused by workers skipping breakfast (after having a heavy, take away meal the night before), which made them suffer from hypoglycaemia. Additionally, most builders travelled to the site from remote locations (up to a 3h journey), hence, had no time or appetite to eat early in the morning. This was also highlighted in the study by Wandel & Roos (2005), which looked into the effects of job demands on eating habits in carpenters. As a result of these findings, the ODA decided to introduce £1 bowls of porridge, which were offered on site to all builders. Following the introduction of this initiative, their health and safety record showed only 125 injuries across more than 80 million man hours worked, which was the lowest and best ever achieved result on a major UK construction project (ODA, 2012). Following the idea of introducing porridge, findings from Okoro et al. (2015b) might also provide some insights into types of food, which should be consumed by workers to limiting the risk of accidents. Authors used 24h dietary recalls and accidents statistics and found an association between the consumption of dairy products, eggs, nuts, fish and cereals, and improved safety performance (Okoro et al., 2015b).

2.3.5. Environmental factors related to nutrition practices in the workplace

The workplace environment is recognised as important in assisting workers in adopting and leading a healthier lifestyle, and determining their eating habits (Demou et al., 2018) with factors such as cost, time to eat and the availability of healthy food exerting a great impact on food choice when at work (Brodie et al., 2021; Kenny et al., 2021; Stern et al., 2021; Thomas et al., 2016). A lack of healthy eating options, food cafeteria or any other food offering have all been recognised by workers as a barrier to healthy eating (French et al., 2007; Mazzola et al., 2017; Nea et al., 2017; Pridgeon & Whitehead, 2013; Wandel & Roos, 2005), especially on remote workplace sites, where there might be a limited access to commercial offerings with fresh and diverse foods (Wandel & Roos, 2005). A mixed method Hawaiian study by Leslie et al., (2013) found that if the food available at the workplace was healthy, that was an additional motivation for 33% of studied blue collar workers to making healthy eating choices, which carried over to outside the workplace as well. Martinez (2020) also found that nutrition claims on snacks increased the snack purchase by 79.8% amongst blue collar workers, with a snack labelled as 'fit' noting a 285.7% rise in purchase. Conversely other studies found that even if healthier choices were provided, they were not chosen, as they were often perceived as unappetising, or too expensive (Kenny et al., 2021; Leslie et al., 2013; Pridgeon & Whitehead, 2013; Stern et al., 2021). Furthermore, workplace food choices and food intake are influenced by the availability of facilities for food storing or preparation (e.g. refrigerator, microwave) (Kenny et al., 2021; Nea et al., 2017; Nobrega et al., 2016; Okoro et al., 2017), as well as the insufficient sitting spaces in staff canteens (Pridgeon & Whitehead, 2013) and the cleanliness of lunch areas (Kenny et al., 2021; Nobrega et al., 2016; Pridgeon & Whitehead, 2013).

The availability of canteen facilities in the workplace has been found to have different outcomes. On one hand, a Brazilian study of Queiroz Bortolozo et al. (2016) found that food consumed at work (served in a staff canteen) was actually higher in fibre (in comparison with food consumed at home), as different salad types and fruit based desserts were available. Positive effects of having an onsite canteen were also explored in a small (n=28) qualitative study of Almeida et al. (2014), which indicated that the presence of a cafeteria and a lower number of vending machines had a direct association with healthier eating habits. Similar findings came from a study by Smith et al. (2017), based on interviews with 11 individuals in North East of England, who had some level of responsibility in delivering workplace interventions. Results showed that without an onsite price competitive canteen, the workforce often relied heavily on external sources of catering, like takeaways, food outlets, which usually offer poor nutritional quality food in large quantities. However, on the other hand, the availability of an on-site canteen, or a vending machine was still considered a barrier if unhealthy and fried foods were offered (Nea et al., 2017). A qualitative study (n=23) looking into food choices in the workplaces in Germany and the UK suggested that employees actually expect inferior quality of food served at worksite, mainly due to previous experiences, yet are ready to accept it, as eating onsite saves time and is convenient (Price et al., 2016). An unlimited availability of food in the work cafeteria was found to be related to a high consumption of salt (Queiroz Bortolozo et al., 2016), fat and an overall high energy intake (Mishra & Mohanty, 2009) and frequent snacking (Nea et al., 2017). While the availability of canteen facilities might have both positive and negative influences, a lack of open canteen facilities at nights and weekends has been found to create additional barriers to healthy eating, as in these circumstances, takeaway food has been found to be the only meal option mentioned by blue collar workers (Bonnell et al., 2017; Nea et al., 2017).

2.4. A review of nutrition interventions in the workplace

Over the years, a number of systematic reviews (Cancelliere et al., 2011; Geaney, Kelly, et al., 2013; Hulls et al., 2022; Lassen et al., 2018; Ni Mhurchu et al., 2010) and meta-analyses (Hutchinson & Wilson, 2012; Kuoppala et al., 2008; Rongen et al., 2013) have investigated the effectiveness of health interventions in the workplace. Overall, the literature indicates that workplace health promotion programmes have been successful, often reporting moderate but positive results of nutrition interventions (Hulls et al., 2022; Ni Mhurchu et al., 2010; Rongen et al., 2013; Tam & Yeung, 2018). Hutchinson & Wilson (2012) suggested that although positive, lower than expected results of some studies might be due to limitations in the methodology (e.g. a lack of information on the study design and intervention, lack of information on workplace and employee characteristics, failing to report on 'control' conditions, using only self-reporting outcomes and a lack of information on intervention reach). Therefore, it is important to consider which aspects of interventions are associated with successful outcomes, reviewed below.

The aim of this part of the review is to explore the evidence base about the effectiveness of workplace nutrition / dietary interventions (or those with a dietary component) on health, wellbeing and nutrition behaviours, including food choices and dietary intakes. Multi-component and educational interventions will be discussed first. Given the large heterogeneity and complexity of implementation methods used in different studies, interventions with specifically targeted goals will also be included in this section. An overview of educational interventions alone, or in combination with environmental modification follows in the next part of this review. The evidence from those interventions mainly focused on nutrition intakes. Particular attention was paid to the recommendations provided by systematic reviews on developing and evaluating complex interventions. Then, motivational enhancement approaches and the importance of programme intensity are discussed. The effectiveness of behavioural counselling for weight loss outcomes forms a significant part of this review, and finally, the review considers environmental implementation strategies. Healthy food provision and canteen availability were discussed as implementation strategies. Finally, general findings across multiple systematic reviews and a summary of facilitators and barriers to successful workplace health programmes are presented.

2.4.1. Effectiveness of multi-component and educational workplace interventions

The effectiveness of workplace health programmes using multiple components has been recognised by multiple systematic reviews (Geaney, et al., 2013; Maes et al., 2012; Rachmah et al., 2022; Schroer et al., 2014). A study of Schroer et al. (2014) looked at 15 systematic reviews and meta-analyses of programmes aiming to promote physical activity, healthy weight and good nutrition. The authors concluded that all the interventions had achieved small but significant changes in physical activity, fitness, dietary behaviour or weight over the fairly short, limited duration of programmes (the longest lasted 6 months). It was suggested that multi-component interventions as well as interventions with specifically targeted goals were the most successful (Schroer et al., 2014). The inclusion of studies with self-reported data and those not meeting Cochrane Collaboration quality criteria were limitations of this review. However, the study used peer-reviewed systematic reviews originating from the U.S., Australia and Europe, which might support the transferability of the results to UK worksites. Similar to Schroer et al's. (2014) findings, an earlier systematic review found that nutrition education and multi-component workplace dietary interventions had a moderate, positive effect on dietary behaviour, in particular regarding increased fruit and vegetable consumption (Geaney et al., 2013). Likewise, a recent systematic review reported that a combination of education, behavioral change and work environment modification resulted in better outcomes, which were recorded for increased nutrition knowledge, self-efficacy, improved BMI, and the reduction of risky health behaviours (e.g. high alcohol, salt and saturated fat intake) (Rachmah et al., 2022). Similar conclusions were drawn in a summary of the evidence of the effects of workplace diet in combination with physical activity interventions on body composition, nutrition behaviour and potential determinants of such behaviour in the workplace in European countries (Maes et al., 2012). Overall, authors found moderate evidence of the effect of educational and multi-component dietary interventions on nutrition behaviours. However, while the authors concluded that all of the included studies presented positive results from worksite interventions on nutrition only, or combined with physical activity, due to the weak design of the studies (e.g. some studies failed to provide information on design of the study and the intervention), they were not fully translated into the overall positive picture as it was not possible to compute effects sizes on all anthropometric measures or nutrition behaviours (Maes et al., 2012). The review concluded that more, well-designed European studies were necessary, using criteria such as worksite needs analysis, stakeholder involvement, that focus on both the individual worker and the overall quality of working life, integration of the activities in the management practices and daily working life of the enterprise and theory-based intervention development (Maes et al., 2012). This review included studies with different research designs. The authors recognised that randomised control trials (RCTs) would enable more effective analysis of the impact of interventions, however they might be inappropriate and unachievable to design in a workplace setting. The authors of different systematic reviews agreed that researchers should aim to increase efficacy, reach, and uptake of interventions and it is impossible to control different elements of comprehensive workplace programmes, therefore, factors like management support and a company-tailored programme, are more important (Allan et al., 2017; Maes et al., 2012; Ni Mhurchu et al., 2010; Steyn et al., 2009). However, none of the studies included in the review of Maes et al. (2012) met the six methodological criteria of The European Network for Workplace Health Promotion (ENWHP, 2015) used to assess the quality of interventions. The effectiveness of multi-component ecological interventions was also supported by Smith et al. (2017), who suggested that addressing the wider context, i.e. shift patterns, remote work locations, nature of work, closed canteen, rather than individual behaviour change, can be more successful. Interestingly, an earlier meta-analysis found studies that targeted multiple health behaviours to be associated with smaller effect sizes than those focusing only on one area of behaviour change (Hutchinson & Wilson, 2012). The authors suggested that although one-component interventions have lower participation rates, there might be a trade-off between the number of participating employees and the success of the intervention.

Workplace interventions using nutrition education alone, or in combination with environmental modifications have been found, through systematic reviews, to positively affect employees' dietary behaviour (Schroer et al., 2014), especially with regards to an increased consumption of fruit and vegetables (Geaney et al., 2013). A systematic review by Ni Mhurchu et al. (2010) suggested that workplace interventions are effective in improving measures of dietary behaviour, with reported decreases of up to 9% in total dietary fat and increases up to 16% in daily fruit and vegetable intake. Similar conclusions were derived from an umbrella systematic review (21 systematic reviews included) (Schliemann & Woodside, 2019), where the authors found the strongest evidence for improving fruit and vegetable intake (up to 0.7 portions) and positive effects on the overall diet (defined as an improvement in any of the 'dietary factors' or 'increased consumption of healthier foods' (e.g. fruit and vegetable, fibre, low-fat products) (Schliemann & Woodside, 2019). This was also confirmed in a recent systemic review concluding that increased fruit and vegetable intakes were mainly observed in interventions with educational and / or a behavioural component (Panchbhaya et al., 2022). Furthermore, increasing knowledge about nutrition was noted as a positive result of workplace health interventions (Schliemann & Woodside, 2019). This study was limited by including only systematic reviews, and important findings from other reviews may have been overlooked.

While evaluating the effects of workplace nutrition interventions, authors of a systematic review (Geaney et al., 2013) suggested that future studies could be enhanced if the recommended guidance for developing and evaluating complex interventions by the Medical Research Council (Medical Research Council (MRC), 2008) was used. This guidance has recently been updated (Skivington et al., 2021). Moreover, transparent reporting of the study, with sufficient detail and clarity, using standardised guidelines such as the Transparent Reporting of Evaluations with Nonrandomized Design (TREND) statement (Des Jarlais et al., 2004) have been advocated by the same study (Geaney et al., 2013). It was also suggested that future studies should include an assessment of dietary patterns outside the workplace, to measure the true impact on dietary behaviour and use objective health outcomes (Geaney et al., 2013; Schliemann & Woodside, 2019).

2.4.2. Motivational approaches and behavioural strategies on health behaviour changes and weight-related outcomes

Behavioural change strategies have frequently been applied in workplace health interventions, with goal setting, weight self-tracking, coaching and motivational interviewing being commonly used (Hutchinson & Wilson, 2012; Tam & Yeung, 2018). A meta-analysis of 29 studies investigating nutrition or physical activity interventions in the workplace found that the most promising results in achieving health behaviour improvements were found when motivational enhancement approaches were used, such as motivational interviewing and the use of rewards or incentives (Hutchinson & Wilson, 2012). Furthermore, the importance of the participants' mind-set in improving their health was emphasised, with authors suggesting the reinforcement of current healthy behaviours being a more successful strategy than focusing on changing unhealthy habits (Hutchinson & Wilson, 2012). The importance of employees' attitudes and mind-sets has been also been found in a later study, where authors highlighted personal belief as a key factor enhancing participation (Kilpatrick et al., 2017). Respondents who believed that workplace health activities could improve their health and wellbeing were more likely to take part in those programmes (Kilpatrick et al., 2017).

The long-term effectiveness of worksite lifestyle interventions, including nutrition and physical activities, to tackle obesity was analysed in a systematic review by Tam & Yeung (2018). Authors concluded that high intensity (12–26 sessions in a year) behavioral management activities, like motivational interviewing, are the most effective (Tam & Yeung, 2018). A different meta-analysis evaluating the effectives of workplace health promotion programmes aimed at smoking cessation, physical activity, healthy nutrition, obesity on self-perceived health, sickness absence and productivity found that the success of the intervention was at least partly dependent on the intensity and the frequency of the contact, with weekly contact providing even four times better results than less intensive interventions (Rongen et al., 2013). In addition, the results were better in younger populations and in interventions where the control group received no health promotion intervention (Rongen et al., 2013).

Weight related outcomes have commonly been used to measure the effectiveness of dietary interventions, with generally small but positive results (Anderson et al., 2009; Power et al., 2014; Schliemann & Woodside, 2019; Verweij et al., 2011; Weerasekara et al., 2016). Using coaching techniques was considered the most effective for BMI reduction (-0.77, $p<0.009$) in a systematic review and meta-analysis amongst workers with metabolic syndrome (Cabrera et al., 2021). A systematic review by Anderson et al. (2009) investigated the effectiveness of worksite nutrition and physical activity interventions to promote healthy weight among employees and found a modest reduction in weight, as a result of the programmes. Based on the analysis, the authors concluded that the effects are consistent, with a net loss of approximately 2.8 pounds (1.3 kg) and 0.47 BMI among workers at 6–12-month follow-up (Anderson et al., 2009). Authors found that offering structured programmes (i.e., scheduled sessions) was more effective than unstructured approaches, and a combination of information provision and behavioural counselling conferred more benefit than information alone (Anderson et al., 2009). The effects of workplace physical activity and nutrition interventions on weight outcomes have also been investigated in a later meta-analytic review of 22 studies (Verweij et al., 2011). The review concluded that there was moderate quality evidence that interventions reduced body weight, BMI and body fat percentages calculated from the sum of skin-folds. The review reported an average of -1.19 kg weight loss, with an additional -0.29 kg if an environmental component (e.g. provision of healthy foods and beverages or modifications in kitchen facilities) was available, suggesting that programmes including environmental changes are more effective (Verweij et al., 2011). More significant weight reductions (-3.95kg; n=237) were presented in findings from a meta-analysis of workplace interventions targeting diet and physical activity in healthcare professionals (Power et al., 2014). The larger effect size might be because healthcare professionals may be more responsive to behaviour change strategies and have a better understanding of the health benefits of certain foods. Interestingly a recent systematic review and meta-analysis looking at the improving dietary intakes amongst healthcare workers also found behavioural and educational interventions being the most beneficial for weight-related outcomes (Panchbhaya et al., 2022). The above results were confirmed in findings from a systematic review of systematic reviews, where the authors concluded that workplace interventions are successful for weight-loss outcomes, with results in weight reduction ranging from 1-4.4 kg (Schliemann & Woodside, 2019).

2.4.3. Environmental strategies as a part of workplace health interventions to facilitate healthy food choices

Worksite environmental changes to facilitate healthy diets have been recognised as further elements that can assist and supplement education and motivational components of interventions (Meng et al., 2017), especially in shift workers (Nea et al., 2017) and in male-dominated industries (Hulls et al., 2022), given the important role of the workplace environment in assisting them to adopt and lead healthier lifestyles. In addition, a systematic review by Allan et al. (2017) highlighted that environmental changes not only supplement, but even provide advantages over individually targeted interventions, as they work via automatic or non-conscious processes, therefore, do not require 'buy in'. If effective, Allan et al (2017) believe they can be more cost-effective and may overcome challenges of underrepresentation of disadvantaged groups. Advantages of environmental approaches were also emphasised in a systematic review of interventions in male-dominated industries, which suggested that addressing the work environment can produce more sustainable effects on employees' health (Hulls et al., 2022). However, one important limitation of environmental interventions, as highlighted by Schliemann & Woodside (2019) in an umbrella review of 21 systematic review studies on dietary workplace interventions, was that environmental changes are often carried out in workplace canteens, therefore, evidence is limited to interventions taking place in bigger organisations with canteen facilities, and may not be applicable to smaller workplaces without canteen facilities. Effectiveness of workplace interventions in canteens will be discussed further later in the review.

Evidence of the effectiveness of using environmental strategies to improve food choices amongst employees has been the focal point of a few reviews (Allan et al., 2017; Geaney et al., 2016; Lassen et al., 2018). The systematic review by Lassen et al. (2018) which looked into the impact of workplace nutrition and physical activity interventions in shift workers supported the use of environmental strategies, including the provision of healthy foods and beverages, in improving food choices. An earlier systematic review (Engbers et al., 2005) and a meta-analysis (Verweij et al., 2011) also showed that programmes including environmental changes are effective for weight loss (Verweij et al., 2011) and can positively influence dietary intake (i.e. fruit, vegetable, and fat consumption) (Engbers et al., 2005). Moderate results from a different systematic review, comprising six studies looking into dietary modification interventions at the workplace were explained by the fact that these interventions relied mainly on information provision and did not include potentially valuable 'nudging' environmental strategies such as food modification (Geaney et al., 2013). This hypothesis was later tested in a study by Geaney et al. (2016) on a manufacturing working population, where the effects of a combined intervention of nutrition education and environmental dietary modification on changes in employees' dietary intakes, nutrition knowledge and health status were examined. Results showed reduced dietary intakes of salt, saturated fat, and BMI. Additionally, higher nutrition knowledge was reported in comparison to the control group, at 7-9 months follow up (Geaney et al., 2016). Importantly, the authors emphasised the use of a participatory approach (catering and workplace stakeholder involvement) in the study design and implementation, as well as theory-based approaches to workplace health promotion, as ways of ensuring the effectiveness of nutrition workplace health promotion (Geaney et al., 2016). Finally, a systematic review of 22 studies looking into the effectiveness of environmental interventions in altering eating behaviours amongst employees found that more than half (59%) of studies produced significant effects on behaviour, including increased fruit and vegetable intake, increased sales of healthy options and reduced numbers of calories purchased (Allan et al., 2017). Allen et al. (2017) highlighted that most of the included studies had a high or unknown risk of bias due to poor reporting of interventions and comparator arms, which made is hard to code the content and intensity of the intervention. Furthermore, many trials did not report (or did not report in enough detail) about control conditions, which made it difficult for the authors to identify *"active ingredients of the intervention"* (Allan et al., 2017 p. 9). Strengths of the study included the range of different study designs and the focus on environmental interventions only, however, a limitation was that coding for the intervention reporting was conducted by one coder only.

It may seem apparent that healthy choices at the workplace should be made easily accessible, while less healthy choices should be harder to gain access to if 'nudge' healthier nutrition behaviour is used (Dobbs et al., 2014). However, research is showing that simply providing more nutritious foods might be insufficient in facilitating behaviour change (Almeida et al., 2014; Thomas et al., 2016). Findings from a systematic review showed that increasing the availability of healthier items can lead to purchases of more favourable items without a decline in profit (Grech & Allman-Farinelli, 2015). However, it was also suggested that environmental strategies to increase the availability of healthy foods at the workplace cafeteria and in the vending machines might not be enough, and further programmes might be needed to reduce unhealthy food choices (Almeida et al., 2014). This view was later supported by findings from a small (n=36) qualitative study by Thomas et al. (2016), who suggested that changing the environment to provoke deliberation about healthy behaviour is positive, as it might result in the substitution for a health-enhancing food alternatives, however, food choice will not be influenced by the point of choice on its own (e.g. food labelling strategy), and must be preceded by an intention to change (e.g. behaviour change and educational activities) (Thomas et al., 2016). The need to include educational strategies alongside environmental changes was also supported by findings from a qualitative study by Price et al. (2016), who concluded that nutrition information on food is welcomed by workers, as it provides transparency and reassurance, although, some might not make a good use of it, due to the lack of understanding.

2.4.4. General findings from review studies on the effectiveness of nutrition workplace health interventions

Heterogeneity of study designs, intervention types, intervention components, measures used, methods of delivery, and outcomes and evaluation strategies used has made it difficult for authors to draw general conclusions from nutrition interventions in the workplace (Geaney, Kelly, et al., 2013; Meng et al., 2017; Panchbhaya et al., 2022; Schliemann & Woodside, 2019; Schroer et al., 2014; Tam & Yeung, 2018). Furthermore, most reviews did not report on employee characteristics, therefore the question of which type of intervention is the most effective for which employee population remains unanswered (Anderson et al., 2009; Schroer et al., 2014).

As strategies employed to promote healthy eating have been found to focus mainly on education, behaviour change, and modifications to the physical environment (e.g. food availability), authors have stressed that a greater use of frameworks for interventions that acknowledge the complexity of the workplace settings is needed and that intervening at many levels may support achieving more meaningful changes (Ni Mhurchu et al., 2010; Rachmah et al., 2022; Schliemann et al., 2019b). Furthermore, different work settings have unique characteristics, highlighting the need to examine the worksite and employee populations before developing health promotion interventions (Meng et al., 2017). The workplace setting poses a number of research challenges, such as different types of employees, including cultural characteristics, recruitment strategies, confidentiality of health information, and characteristics of the intervention (e.g. programme length, frequency, attendance during working hours) (Brown et al., 2018). Finally, it is necessary to tailor intervention studies with respect to work schedules, meal breaks and mobile or mixed workplaces (Lassen et al., 2018).

2.5. Facilitators and barriers to the successful workplace health programmes

The evidence of key success factors as well as barriers in the implementation of health programmes has been investigated by a number of authors (Brown et al., 2018; Kilpatrick et al., 2017; Rojatz et al., 2016; Smith et al., 2017; Steyn et al., 2009; Wierenga et al., 2013), who agree that for the maximisation of positive results, lessons from previous successful interventions need to be taken on board. Some assert that a lack of attention to the underlying barriers and facilitators could be why studies examining health promotion interventions often find small effect sizes (Mazzola et al., 2017; Rojatz et al., 2016; Smith et al., 2017; Steyn et al., 2009; Wierenga et al., 2013).

Evidence synthesised during the literature review on facilitators and barriers to the success of nutrition interventions in the workplace is presented in Table 2.2. Identified factors (presented as facilitators (F) and barriers (B)) have been grouped into six main categories: programme design, programme components, management and other stakeholders' support, health culture and educated employers, the context of the industry; and individual factors. Although a few systematic reviews examined the factors influencing the effectiveness of workplace health programmes (McCoy et al., 2014; Rojatz et al., 2016; Wierenga et al., 2013), the findings presented below focus specifically on studies which have considered both the facilitators and barriers to successful workplace nutrition interventions with blue-collar (predominantly construction) workers.

Table 2.2. Facilitators and barriers in successful workplace health interventions

Category	Facilitator (F)/ Barrier (B)	Study (type and characteristics)	Reference
Programme design	**Facilitators (F)**		
	Participatory programme design (F) Employees, management, union representatives and other stakeholders involved in programme planning, design, development and implementation) - to ensure the programme content responds to needs and priorities of workforce - to target factors related to work ability and performance - to get a clear understanding of the reality of construction work and environment	Systematic review of 30 studies	(Steyn et al., 2009)
		Systematic review of 7 studies (shift workers)	(Lassen et al., 2018)
		The study used cross-sectional data from 3228 surveyed employees of public sector in Australia in 2013, as part of Healthy@Work programme.	(Kilpatrick et al., 2017)
		Systematic Review and Meta-Analysis of 46 studies	(Kuoppala et al., 2008)
		A scoping review of the evidence base on workplace wellbeing programmes and their impact on employees and their employing organisations (University of Birmingham) (54 articles on health promotion: nutrition, physical activity and smoking cessation included in the review)	(Carmichael et al., 2014)

Category	Facilitator (F)/ Barrier (B)	Study (type and characteristics)	Reference
	- to incorporate 'multiple employer workplace environment' - engaging subcontractors and other stakeholders as industry health problems require industry fix - encouraging collaboration, focusing on men's strength in problem solving and enhancing self-efficacy and competitiveness in programme design	Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
		RCT (n = 162) exploring the effectiveness of health promotion intervention for construction workers.	(Viester et al., 2015)
		Qualitative study (n=80) using interviews with trades workers and construction managers to explore perceptions of the impact of workplace health promotion programmes and ill-health and poor health behaviours on site activities with a view to identifying leverage points to introduce health programmes in construction	(Loudoun & Townsend, 2017)
		Literature review article on health issues in Australian construction workers	(Du Plessis et al., 2013)
		Systematic review of 35 studies in male-dominated industries	(Hulls et al., 2022)
	Creatively designed programmes (F) - focusing on men's strength in problem solving and enhancing self-efficacy and competitiveness in programme design	Systematic review of 22 studies	(Brown et al., 2018)
		Literature review article on health issues in Australian construction workers	(Du Plessis et al., 2013)
	Empowerment strategies used in programme design (F)	Systematic review of 7 studies (shift workers)	(Lassen et al., 2018)
	Rigorous designed programmes (using MRC or Intervention Mapping protocol) (F)	Systematic review of 22 studies	(Brown et al., 2018)
		Evaluation of the effectiveness of RCT aiming to improve physical activity levels and dietary patterns among construction workers in order to prevent and reduce weight and musculoskeletal disease occurrence (Intervention Mapping (IM) protocol was used to develop a tailored programme)	(Viester et al., 2012)
	Theoretic framework used in programme design (F) - Accounting for different stages in behaviour change model	Systematic review of 30 studies	(Steyn et al., 2009)
		Qualitative study (n=80) using interviews with trades workers and construction managers to explore perceptions of the impact of workplace health promotion programmes and ill-health and poor health behaviours on site activities with a view to identifying leverage points to introduce health programmes in construction	(Loudoun & Townsend, 2017)

Category	Facilitator (F)/ Barrier (B)	Study (type and characteristics)	Reference
	Flexible delivery - in unstructured ways, at convenient time, programme available during working hours (F)	Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
		Systematic review of 22 studies	(Brown et al., 2018)
		Systemic review of 22 studies (shift workers)	(Demou et al., 2018)
		A systematic review of 51 studies exploring factors influencing the implementation of health promotion programs in the construction industry	(Fuller et al., 2022)
	Advertising programmes via different avenues (F)	Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
	Proximity of location (location convenience) (F)	Systemic review of 22 studies (shift workers)	(Demou et al., 2018)
	Peer champions / role models / group leaders being an integral part of the intervention (F)	Systemic review of 22 studies (shift workers)	(Demou et al., 2018)
Programme design	**Barriers (B)**		
	Programme scheduling conflicts (B): - programme scheduled in a way that only full time employees can really benefits from it) - time restrictions / production conflicts (staff does not have time to participate) - too busy, other commitment	Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
		The study used cross-sectional data from 3228 surveyed employees of public sector in Australia in 2013, as part of Healthy@Work programme.	(Kilpatrick et al., 2017)
		A systematic review of 51 studies exploring factors influencing the implementation of health promotion programs in the construction industry	(Fuller et al., 2022)
	Insufficient duration (B)	Systematic review of 30 studies	(Steyn et al., 2009)
	Location related barriers (an inconvenience of off-site activities, a city-centric or head-office bias) (B)	The study used cross-sectional data from 3228 surveyed employees of public sector in Australia in 2013, as part of Healthy@Work programme.	(Kilpatrick et al., 2017)
	Cost of the programme (B)	Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
		A systematic review of 51 studies exploring factors influencing the implementation of health promotion programs in the construction industry	(Fuller et al., 2022)

Category	Facilitator (F)/ Barrier (B)	Study (type and characteristics)	Reference
Programme components	**Facilitators (F)**		
	A multi-component ecological context rather than individual behaviour change intervention (for shift workers) (F)	Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
		Systematic review of 9 studies	(Rachmah et al., 2022)
	Physical activity component (F)	Systematic review of 30 studies	(Steyn et al., 2009)
		A scoping review of the evidence base on workplace wellbeing programmes and their impact on employees and their employing organisations (University of Birmingham) (54 articles on health promotion: nutrition, physical activity and smoking cessation included in the review)	(Carmichael et al., 2014)
	Educational component (F)	Systematic review of 30 studies	(Steyn et al., 2009)
		A scoping review of the evidence base on workplace wellbeing programmes and their impact on employees and their employing organisations (University of Birmingham) (54 articles on health promotion: nutrition, physical activity and smoking cessation included in the review)	(Carmichael et al., 2014)
		Systematic review and meta-analysis of 39 studies on dietary interventions in healthcare	(Panchbhaya et al., 2022)
	Environmental changes (e.g. increasing the availability of healthy food options, reducing price of health foods) (F)	Systematic review of 30 studies	(Steyn et al., 2009)
		A scoping review of the evidence base on workplace wellbeing programmes and their impact on employees and their employing organisations (University of Birmingham) (54 articles on health promotion: nutrition, physical activity and smoking cessation included in the review)	(Carmichael et al., 2014)
		Systematic review of 35 studies in male-dominated industries	(Hulls et al., 2022)
	Group-based lifestyle workplace intervention component (F)	Systemic review of 22 studies (shift workers)	(Demou et al., 2018)
	Incentives (supporting interest and attendance during programmes) Incentives promoting healthy behaviours (F)	Systematic review of 22 studies	(Brown et al., 2018)
		Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
		Review paper of 27 studies	(Meng et al., 2017)
	Enriching menus (rather than restricting choices) (F)	Qualitative study using 4 focus groups (n=23) in Germany and the UK	(Price et al., 2016)

Category	Facilitator (F)/ Barrier (B)	Study (type and characteristics)	Reference
	Health risk assessment used in the intervention (F)	Article describing the background, design and conceptual model of the FINALE programme, a framework for health promoting interventions at 4 Danish job groups (i.e. cleaners, health-care workers, construction workers and industrial workers)	(Holtermann et al., 2010)
	Personalised, tailored feedback to participants (F)	Systematic review of 30 studies	(Steyn et al., 2009)
		A scoping review of the evidence base on workplace wellbeing programmes and their impact on employees and their employing organisations (University of Birmingham) (54 articles on health promotion: nutrition, physical activity and smoking cessation included in the review)	(Carmichael et al., 2014)
Programme components	**Barriers**		
	No feedback on individual performance (B) - no follow up or feedback offered individuals get no information on how to improve and what strategies to implement to change the behaviour	Systematic review of 30 studies	(Steyn et al., 2009)
		Evaluation of the effectiveness of RCT aiming to improve physical activity levels and dietary patterns among construction workers in order to prevent and reduce weight and musculoskeletal disease occurrence (Intervention Mapping (IM) protocol was used to develop a tailored programme)	(Viester et al., 2012)
	Nutrition education not being tailored to meet the needs of workers (B)	Systematic review of 30 studies	(Steyn et al., 2009)
Management and other stakeholders' support	**Facilitators (F)**		
	Collaboration with unions (F) - a central role in the start-up of the project, acting as a connecting link between project delivery group and workers - acting as project ambassadors - a vehicle for engaging workers; - tapping into the union's infrastructure and the social context of workers' lives; - connecting workers to health promotion resources, providing communication structures	Intervention study (a 6-month participatory and empowerment-based) on employees' dietary habits and on changes in the canteen nutrition environment in eight blue-collar worksites	(Lassen et al., 2011)
		Study exploring factors influencing participation rates and employees' attitudes toward promoting healthy eating at blue-collar worksites (using stakeholders' and employees' interviews)	(Lassen et al., 2006)
		RCT (n=582) testing the efficacy of a tailored telephone-delivered and mailed intervention to promote smoking cessation and increased fruit and vegetable consumption in construction	(Sorensen et al., 2007)

Category	Facilitator (F)/ Barrier (B)	Study (type and characteristics)	Reference
	that can be utilised during programme delivery; - embody a sense of solidarity; - considered to be a trusted information source;	Study using survey identifying socio-demographic and behavioural characteristics; process evaluation data; and final efficacy survey to determine satisfaction of participants of health intervention in construction	(Hunt et al., 2010)
		Study using cross-sectional data included a survey conducted with a sample of unionised construction workers (n = 110), and 16 focus groups (n = 88)	(Barbeau et al. 2005)
	Employers / managers support for health promotion programmes (buy in if they thought programme would improve morale, health and reduce injury risk) (F)	Systematic review of 22 studies	(Brown et al., 2018)
		WHO background / review paper	(Quintiliani et al., 2008)
		Systemic review of 22 studies (shift workers)	(Demou et al., 2018)
		Study based on data collected in 2013 and 2015 as part of the evaluation of the CDC's NHWP (Centres for Disease Control and Prevention's (CDC)'s National Healthy Worksite Program (NHWP) (n=825)	(Payne et al., 2018)
		Qualitative study, 10 focus groups (n=79) with employers from a range of industries and geographical locations in Western Australia.	(Pescud et al., 2015)
		A systematic review of 51 studies exploring factors influencing the implementation of health promotion programs in the construction industry	(Fuller et al., 2022)
	Cooperation with cafeteria staff while implementing health promotion programmes (cafeteria mangers and staff play a crucial role not only in the provision of healthy foods, but also in the promotion of health programme) (F)	Study exploring factors influencing participation rates and employees' attitudes toward promoting healthy eating at blue-collar worksites (using stakeholders' and employees' interviews)	(Lassen et al., 2006)
	Colleagues support (F): - other colleagues participating in the programme - colleagues supporting each other and motivating - sharing programme experiences - no judgment approach (especially in 'macho cultures')	Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
		Study used cross-sectional data from 3228 surveyed employees of public sector in Australia in 2013, as part of Healthy@Work programme.	(Kilpatrick et al., 2017)
		Systemic review of 22 studies (shift workers)	(Demou et al., 2018)
		Study based on data collected in 2013 and 2015 as part of the evaluation of the CDC's NHWP (Centers for Disease Control and Prevention's (CDC)'s National Healthy Worksite Program (NHWP) (n=825)	(Payne et al., 2018)

Category	Facilitator (F)/ Barrier (B)	Study (type and characteristics)	Reference
Management and other stakeholders' support	**Barriers (B)**		
	Resistance from cafeteria / canteen staff (not interested or eager to make changes in food served in staff canteen) (B)	Study exploring factors influencing participation rates and employees' attitudes toward promoting healthy eating at blue-collar worksites (using stakeholders' and employees' interviews)	(Lassen et al., 2006)
Health culture and educated employers	**Facilitators (F)**		
	Employer education about benefits of the programmes, i.e. what constitutes health and wellbeing and perceptions of healthy and unhealthy workers (F)	Systematic review of 22 studies	(Brown et al., 2018)
		Qualitative study, 10 focus groups (n=79) with employers from a range of industries and geographical locations in Western Australia.	(Pescud et al., 2015)
		Systematic review of 35 studies in male-dominated industries	(Hulls et al., 2022)
	Raising a profile of nutrition onsite to make a link between nutrition and safety clearer and more recognised (encourages investment and implementation) (F)	Qualitative study (n=80) using interviews with trades workers and construction managers to explore perceptions of the impact of workplace health promotion programmes and ill-health and poor health behaviours on site activities with a view to identifying leverage points to introduce health programmes in construction	(Loudoun & Townsend 2017)
	Health culture, climate of trust and support in the organisation (F): - Employee- employer trust - Organisation placed a high priority on workplace health promotion activities - Genuine support from employers	Study used cross-sectional data from 3228 surveyed employees of public sector in Australia in 2013, as part of Healthy@Work programme.	(Kilpatrick et al., 2017)
		Systematic Review and Meta-Analysis of 46 studies	(Kuoppala et al., 2008)
		Qualitative study, 15 focus groups (n=109) amongst shift workers	(Nea et al., 2017)
		Study based on data collected in 2013 and 2015 as part of the evaluation of the CDC's NHWP (Centers for Disease Control and Prevention's (CDC)'s National Healthy Worksite Program (NHWP) (n=825)	(Payne et al., 2018)
		A systematic review of 51 studies exploring factors influencing the implementation of health promotion programs in the construction industry	(Fuller et al., 2022)
Health culture and educated employers	**Barriers (B)**		

Category	Facilitator (F)/ Barrier (B)	Study (type and characteristics)	Reference
	A lack of managerial awareness about programme health benefits (B) and managers unclear about their personal and corporate obligations in promoting health opportunities for staff (B)	Qualitative study, one-to-one, semi-structured interviews exploring the perceptions and experiences of commissioners and deliverers (n=11) of the Better Health at Work Award (BHWA)	(Smith et al., 2017)
		Qualitative study, 10 focus groups (n=79) with employers from a range of industries and geographical locations in Western Australia.	(Pescud et al., 2015)
The context of the industry	**Facilitators (F)**		
	Intervention designed to target specific jobs and industries (including characteristics of individual employees (e.g. demographic and socioeconomic characteristics), the workplace (e.g. firm size, culture, resources, support mechanisms) and the sector (e.g. the nature of hazards and risk, the employment structure, types of contract, the skill base of employees) (F)	A scoping review of the evidence base on workplace wellbeing programmes and their impact on employees and their employing organisations (University of Birmingham) (54 articles on health promotion: nutrition, physical activity and smoking cessation included in the review)	(Carmichael et al., 2014)
		Article describing the background, design and conceptual model of the FINALE programme, a framework for health promoting interventions at 4 Danish job groups (i.e. cleaners, health-care workers, construction workers and industrial workers)	(Holtermann et al., 2010)
	Considering project-based work and working away from home in designing interventions (F)	Literature review article on health issues in Australian construction workers	(Du Plessis et al., 2013)
Individual factors	**Barriers (B)**		
	Current medical treatment (B)	A study reporting on factors associated with non-participation and drop-out in a lifestyle intervention for workers with an elevated risk of cardiovascular disease	(Groeneveld et al., 2009)
	No interest in the programme (B)	A study reporting on factors associated with non-participation and drop-out in a lifestyle intervention for workers with an elevated risk of cardiovascular disease	(Groeneveld et al., 2009)
		A systematic review of 51 studies exploring factors influencing the implementation of health promotion programs in the construction industry	(Fuller et al., 2022)
	Disappointed in organisation (B)	A study reporting on factors associated with non-participation and drop-out in a lifestyle intervention for workers with an elevated risk of cardiovascular disease	(Groeneveld et al., 2009)
	‘feeling healthy’ - those workers still had high cholesterol levels and / or high blood pressure, which indicates that their perceptions about own health might have been inadequate (B)	A study reporting on factors associated with non-participation and drop-out in a lifestyle intervention for workers with an elevated risk of cardiovascular disease	(Groeneveld et al., 2009)

The above table provides a synthesis of facilitators and barriers in successful workplace health promotion programmes. The implication of these findings refers to the aspects that need to be considered when designing the nutrition programme in the construction industry.

2.6. A review of nutrition interventions in the construction industry

Little work has been done so far in studying the effectiveness of nutrition workplace interventions among construction workers, with a few studies undertaken in Europe (Groeneveld et al., 2011; Viester et al., 2015), the USA (Lassen et al., 2011) and Australia (Du Plessis et al., 2013). Health interventions in construction are usually multicomponent, with some large construction sites offering workplace health initiatives through government or union sponsored arrangements (Carmichael et al., 2014; Viester et al., 2012). The main schemes used in such programmes include strategies to increase the consumption of fruits and vegetable, change diets, increase participation in physical activity, reduce smoking levels and frequently provide information, counselling and support to the participants (Carmichael et al., 2014; Groeneveld et al., 2010, 2011; Viester et al., 2012). Although some major effects of interventions are linked to changes in the working environment (e.g. provision of healthy foods and beverages at workplace, the availability of cafeteria or vending machines with healthy food choices, menu labelling), in construction, strategies directed to individuals are more common than environmental, cultural or policy changes (Carmichael et al., 2014; Groeneveld et al., 2010, 2011; Lingard & Turner, 2015; Sorensen et al., 2010).

This part of the review will consider the effectiveness of nutrition and health programmes in the construction industry and will begin by analysing interventions targeting individuals, focusing on the most common strategies used in designing those interventions, i.e. motivational interviewing, personalised feedback and coaching together with educational materials. It will cover dietary and lifestyle intervention studies in construction, aimed at improving musculoskeletal, weight, nutrition habits, sickness absence related outcomes, as well as a range of cardiovascular health measures (i.e. cholesterol levels, blood pressure). Furthermore, it will analyse educational and environmental interventions in construction. It will also review the effects of an online educational programme and discuss the results of an intervention, which used environmental changes together with the strategies targeting individuals.

2.6.1. Nutrition interventions in the workplace targeting individuals in the construction industry

Interventions tailored at individuals are the most common amongst construction workers (Groeneveld et al., 2011; Sorensen et al., 2010; Viester et al., 2018), and these predominantly address cardiovascular risk factors (Groeneveld et al., 2011), excessive weight and obesity (Rohlman et al., 2018; Viester et al., 2018) as well as musculoskeletal symptoms (Viester et al., 2015). It could be argued that individual interventions might be especially important in the construction industry, with a heterogeneous group of workers and where an intervention often needs to tackle complex health behaviours (Viester et al., 2018). The most popular types of interventions that have been carried out include motivational interviewing, tailored feedback on health screening, personalised lifestyle coaching, a toolbox (including a waist circumference measuring tape, a pedometer, a BMI card, a calorie guide, healthy recipes and a lifestyle knowledge test) and a use of educational materials (Groeneveld et al., 2010; Hunt et al., 2010; Sorensen et al., 2007; Viester et al., 2012).

Looking at these in turn, motivational interviewing, although originally developed for changing addictive behaviour, is often used in lifestyle interventions (Groeneveld et al., 2010; Hunt et al., 2010; Sorensen et al., 2007; Viester et al., 2012). Groeneveld et al. (2011) evaluated the effectiveness of a 6-month lifestyle intervention consisting of individual counselling (using a motivational interviewing technique) for Dutch construction workers, with an elevated risk of cardiovascular diseases (CVD) (known as the 'Health under Construction' intervention). The intervention was a part of a PhD, with some findings from the study published (Groeneveld et al., 2009, 2010, 2011). During the intervention, workers had the chance to discuss behaviour change benefits, their willingness, eagerness, readiness and perceived confidence in the ability to change. The authors found significant beneficial effects of the programme on reducing snacks and increasing fruit intake at 6 months, however, at 12 months the only sustained effects were on snack intake (Groeneveld et al., 2011). A positive effect on fruit and vegetable intake was also reported as a result of a 3 month nutrition intervention in North America, which used tailored feedback (in response to the baseline survey), telephone counselling (based on motivational interviewing) and educational materials (Hunt et al., 2010). The authors found an increase in construction workers who consumed at least five portions of fruits and vegetables a day (from 49% to 60%), measured 3 months after the intervention finished (Hunt et al., 2010). Similarly, changes in fruit and vegetable intake as a result of one-to-one telephone motivational interviews were investigated by Sorensen et al. (2007), in a study on construction workers in the USA. Next to counselling sessions, the intervention consisted of a tailored feedback report and written educational materials, and focused on both concerns of individuals workers, such as health behaviours, intention to change, self-efficacy to change, risk perceptions, social support, and nicotine addiction, as well as issues in the work environment, such as job demands and low control (Sorensen et al., 2007). Results of the intervention showed a one portion increase in fruit and vegetable consumption in the intervention group (from five servings a day at the start of the study to six at 6 month follow up) (Sorensen et al., 2007).

A different type of intervention, i.e. a personalised lifestyle coaching programme, known as ‘VIP in Construction’ was used in a more recent health intervention, which targeted musculoskeletal symptoms in construction workers in Netherlands (Viester et al., 2012, 2015, 2018). The intervention was a part of a PhD and results of different outcome measures were disseminated across a few publications, discussed below (Viester et al., 2012, 2014, 2015, 2018). The programme included personal dietary and physical activity coaching sessions, with personalised feedback on individual’s health screening and current lifestyle behaviours, instructions and support in self-monitoring of behaviour, goal setting and personal energy plans tailored to individual weight status, activity levels and stage of readiness to change, and a toolbox (including a waist circumference measuring tape, pedometer, BMI card, calorie guide, healthy recipes and a lifestyle knowledge test) (Viester et al., 2012). It is worth mentioning that the protocol of the ‘VIP in Construction’ health intervention had a strong emphasis on stakeholder involvement, where management, employees and other stakeholders were consulted at the needs assessment stage of the intervention, as well as information being gathered from managers and Occupational Health Services (OHS) reports, regarding the main health concerns amongst construction workers, prior to the programme production stage (Viester et al., 2012). The results from the intervention showed a trend in reducing the prevalence of workers reporting musculoskeletal symptoms, however, the results were not statistically significant (Viester et al., 2015). The authors hypothesised that a combination of lifestyle promotion with efforts to decrease workload and improve working condition might be necessary for the health programme to be effective (Viester et al., 2015), as the issue of an excessive workload was highlighted during the needs assessment using focus groups. However, there was no management support to address those concerns as a part of the intervention (Viester et al., 2012). Additionally, the effects of the same health programme, presented in different publications, were investigated on levels of sickness leave (Viester et al., 2015), weight related outcomes (BMI, weight, waist circumference), blood pressure and cholesterol (discussed later in this review) (Viester et al., 2018). As the programme showed no effects on sickness absence, the authors suggested that this might be due to a lack of a distinction between the reasons for absence, as not all the absences are attributed to musculoskeletal problems and other factors (in addition to illness) might have affected the levels of sickness absence, e.g. socioeconomic factors, organisational features, job content, and attitudes to work (Viester et al., 2015). Furthermore, as the study took place during an economic recession, which heavily affected the construction sector and created a period of stress, increased workload, and job insecurity, which might have had a significant effect on the number of sick absences (Viester et al., 2015).

Weight loss outcomes have been frequently used as measures for the effectiveness of dietary workplace health interventions in construction (Groeneveld et al., 2010; Viester et al., 2018). In the 'VIP in Construction' study, the authors hypothesised that an improvement in dietary patterns and increased physical activity levels would lead to weight loss, which in turn would be effective in reducing musculoskeletal symptoms (Viester et al., 2012). However, short term (after 6 months) positive results in weight loss outcomes did not translate into long terms results, as at 12 – month follow up no statistically significant differences were observed between an intervention and control group (Viester et al., 2018). The authors explained that moderate results might be due to the fact that participation in the intervention group was not restricted to overweight or obese workers only and the intervention was not designed to target short term weight loss, but to improve lifestyle behaviours that are easy to implement and maintain over time (Viester et al., 2018). Nonetheless, the 'VIP in Construction' intervention was a low intensity programme, with only 2 to 4 coaching sessions being offered (depending on participants' stages of change) (Viester et al., 2012) and more intensive approaches have been found to be more effective in weight loss programmes (Franz et al., 2015; Gotthelf et al., 2018; Webb & Wadden, 2017). Furthermore, although 40 participants (of 150) were offered 4 individual coaching sessions, the mean number of attended coaching sessions in this group was only 2.2 (Viester et al., 2014). In comparison, the mean number of attended coaching appointments amongst the group of workers offered only 2 sessions was 1.8 (Viester et al., 2014), which suggests that often the lowest participation rates are amongst those individuals who struggle the most with poor health and would benefit the most from coaching and support. In addition, although the prevention of body weight gain may not appear clinically meaningful, the importance of it, as well as the difficulty of losing weight and maintaining the weight loss long term, should also be considered with regards to the 'VIP in Construction' findings (Viester et al., 2018). Looking at other measures used during the programme, it is worth pointing out that although the intervention results showed no visible effects on cholesterol levels and blood pressure, a decreased intake of sugary sweet beverages was reported (Viester et al., 2018).

The ‘Health under Construction’ intervention, carried out with Dutch construction workers with an elevated risk of CVD (discussed above) also considered short, and long term effects on body weight reduction (Groeneveld et al., 2010). The ‘Health under Construction’ programme included face to face and telephone counselling (using motivational interviewing methods) on nutrition, physical activity and smoking cessation. Whilst there were positive but limited changes to fruit and snacking behaviour (discussed above), the intervention showed significant body weight reduction at both 6 and 12-month follow ups (on average - 0.9kg and 2kg in a group aiming at improving diet and increasing physical activity) as well as increased HDL (high-density lipoproteins) cholesterol and reduced HbA1c (haemoglobin A1c) (which is a marker of an average level of blood sugar) (Groeneveld et al., 2010). The intensity of the programme was much higher in comparison with the ‘VIP in Construction’ intervention (Viester et al., 2018), with participants having three 45- to 60-min face to face and four 15- to 30-min telephone contacts with an occupational physician or occupational nurse during the intervention (Groeneveld et al., 2010). Furthermore, participants could choose which health related behaviour they wanted to discuss (diet, physical activity, or smoking) the pros and cons of behaviour change, and willingness, readiness, and perceived confidence in the ability to change were discussed. Finally, workers were asked to set personalised goals and to formulate implementation intentions, which then were discussed and adjusted in subsequent sessions (Groeneveld et al., 2010).

2.6.2. Nutrition education interventions in the construction industry

The nutrition knowledge of blue collar workers may be limited, as evidenced by the unhealthy food choices that construction workforces have been found to make (MHF, 2009; Okoro et al., 2015a). As a result, corroborated by evidence from the literature, there is a need to improve construction workers’ knowledge about healthy habits, and the outcomes for themselves as individuals, and as a part of an organisation in the construction sector (Loudoun & Townsend, 2017; Okoro et al., 2015a). Nonetheless, although some of the previous health interventions have included educational materials (Hunt et al., 2010; Lassen et al., 2011; Sorensen et al., 2007; Viester et al., 2012), very little research has entirely focused on improving nutrition knowledge amongst construction workers (Rohlman et al., 2018). For example, a nutrition education intervention, which consisted of other components, including individual lifestyle counselling, group workshops, group counselling in healthy lifestyles, and environmental changes, took place amongst construction workers in Chile (Salinas et al., 2016). The availability of full text is only in Spanish which prevented both the presentation of further details of the study and the assessment of its quality. However, based on the findings from the abstract, a significant decrease in waist circumference, total cholesterol, triglycerides, and an increase in HDL cholesterol were reported (Salinas et al., 2016). Moreover, a reduction in total calorie intake and an increase in fruits, vegetables and fish consumption were found (Salinas et al., 2016).

Due to the challenging and temporary nature of the construction industry, workers may not be at one site for a long time, therefore, it has been suggested that the use of alternative educational strategies such as virtual and online media, including social media and smartphone applications might help to reach workers beyond these workplace barriers (Du Plessis et al., 2013; Okoro et al., 2015a). Rohlman et al. (2018) looked at the effectiveness of an online nutrition training programme to improve knowledge and healthy behaviours amongst construction apprentices. Although small improvements in knowledge were found directly after course completion, no sustainable nutritional knowledge enhancements were noticed (at 12 week follow up) (Rohlman et al., 2018). Nonetheless, apprentices reported changing at least one nutrition-related behaviour as a result of the training and small reductions in weight, BMI and fast-food consumption were detected (in comparison with a control group undertaking positive thinking training) (Rohlman et al., 2018). This online nutrition training programme also intended to evaluate the acceptability of electronic training methods to promote safety and health among apprentices in the highway construction trades (Rohlman et al., 2018). Findings showed that although 70% of workers who took the training said that they would recommend it to others, only a little more than half mentioned that they enjoyed and found it very useful and only 34, of 64 who originally started, completed the training (Rohlman et al., 2018). Whilst these results were rather modest, they could have been positively influenced by the fact that the average age of a studied worker was 33 (Rohlman et al., 2018) and while older workers have been found to be more willing to participate in health promotion programmes at work (Groeneveld et al., 2009), younger people tended to use and enjoy online training sources more. This poses a question of the feasibility of using online training methods in construction, where the workforce is ageing (Viester et al., 2012), where there has been a 13% increase in the UK in the numbers of workers aged 45 years and over in the construction industry between 1991 and 2011 (ONS, 2018b).

2.6.3. Nutrition interventions targeting environmental changes in the construction industry

In order to facilitate healthy behaviours, environmental adjustments can be used, as behavioural change is determined by a range of environmental factors (Davis et al., 2015; Groeneveld et al., 2011). Creating an environment in which healthy choices are stimulated, can facilitate behavioural changes (Groeneveld et al., 2011), therefore, environmental strategies should be incorporated in worksite health promotion in conjunction with interventions aimed at individuals (Lassen et al., 2011). It is expected that this will enable greater behavioural changes as well as reaching a wider audience (Lassen et al., 2011). The Danish ‘Food at Work’ study used both individual (educational handouts, quizzes, dinner mats, workshops, food demonstrations) and environmental (free fruit, healthy canteen choices, free cold water, canteen staff meetings and trainings) levels of intervention to influence food habits of blue-collar workers (Lassen et al., 2011). Findings included fat reduction (11%) in chosen lunches, 2.2% lower overall and saturated fat intake, reduced consumption of sweets and cakes and an increase in fibre consumption, following the 6-month intervention. Additionally, workers in the intervention group increased their daily fruit and vegetable intake by 95g / day, all measured at the endpoint. However, the authors stressed that improving nutrition quality of food, both in terms of a wider choice and appeal, served in staff canteens can be challenging, as attempts to influence food selection and content may encounter resistance from both chefs and canteen staff as well as from customers (workers) (Lassen et al., 2011).

Due to the limited number of studies looking into nutrition interventions in the construction industry, it is difficult to draw definite conclusions about their effectiveness. Furthermore, there are no nutrition intervention studies conducted in the UK construction industry, and the country in which the intervention is conducted might be an important factor determining programme effectiveness, due to different rules and procedures in the industry and different institutional arrangements in individual countries (Cantonnet et al., 2022). This suggests that UK based research would be based in distinctive cultural, business and policy environments, and that there is a need to design interventions targeting health issues of construction workers, drawing on the international evidence base, and using the most effective practices in the UK.

2.7. Summary of the current gaps in the research

1. A review of the current evidence shows that workplace health interventions should be specifically targeted at different jobs and industries and given their likely role in determining the health and wellbeing of individuals both in and outside the workplace, their design and delivery should be based on a detailed understanding of the characteristics of individual employees (e.g. demographic and socioeconomic characteristics), the workplace (e.g. firm size, culture, resources, support mechanisms) and the sector (e.g. the nature of hazards and risk, the employment structure, types of contract, the skill base of employees). Existing studies often fail to report and consider these characteristics, therefore it is currently unknown as to which type of intervention is the most effective for which employee population. Furthermore, the country in which the intervention is conducted might be an important factor determining programme effectiveness, due to different institutional arrangements in individual countries**.** This suggests that UK based research will be based in distinctive cultural, business and policy environments, therefore, effectiveness of interventions in different countries might not be directly applicable to the UK construction workers, suggesting a need to develop health interventions in the UK construction industry.

2. Different work settings have unique characteristics; therefore, it is necessary to examine the worksite and employee populations before developing health promotion interventions. The workplace setting poses several research challenges when designing the health intervention (e.g. programme length, frequency, attendance during working hours). Although some studies recognise these issues, they fail to show how interventions are tailored with respect to work schedules, meal breaks and mobile or mixed workplaces, project-based work and working away from home for example.

3. The multiple systematic reviews and meta - analyses agree that workplace nutritional interventions can be successful, although researchers should implement agreed best practice and consider existing barriers and facilitators within the organisation. Additionally, current research calls for more good quality studies (e.g. based on MRC guidelines), to include development, implementation, evaluation stages (Skivington et al., 2021)), to be established in different industries and workplaces and the use of frameworks for interventions that acknowledge the complexity of the workplace settings and the need to intervene at multiple levels in order to achieve more meaningful changes. Currently, there is very limited evidence

on workplace nutritional interventions in blue-collar industries, specifically in construction, and although some follow the Intervention Mapping protocol (Viester et al., 2012), none have been identified which considered the MRC guidelines.

4. Nutritional interventions in the construction industry have focused mainly on individual components (i.e. motivational interviewing, personal coaching) and have paid little attention to the importance of educational and environmental components. Therefore, there is a need to better test the importance of those components in the nutritional intervention in the construction, as these were shown to be effective as intervention components in different industries.

5. Some large construction sites offer workplace health initiatives through government or union sponsored arrangements. However, there is a lack of research on designing nutrition programmes which could be part of a commercial offering to construction firms or become an integral part of the health and wellbeing strategy of individual companies, particularly for small to medium size organisations.

6. Considering a growing level of evidence linking physical and mental health, it is suggested that interventions should build on both physical and mental health outcomes (both objective and subjective measures) as well as incorporate multiple levels and components.

2.8. Summary of the literature review

1. Low education level, being from an ethnic minority and higher levels of obesity have been recognised as factors related to health risk behaviours amongst blue collar workers.
2. There is a mismatch between nutrition behaviours and knowledge amongst construction workers, who seem to have little knowledge of particular foods, are not aware of their intakes and consume high-fat foods in the belief that this will enable them to undertake physically demanding jobs.
3. Four areas of work-related influences can be identified and these include social, psychological, organisational, and environmental factors.

4. Social factors related to nutrition practices in the workplace include: (i) socialising at mealtime, (ii) occupational divisions, (iii) food choices being made to solidify social identity, (iv) meals consumed communally being based on a majority decision (v) team member passionate about nutrition can encourage and motivate others to eat healthily, (vi) men often adopt unhealthy behaviours, such as high fat and high calorie diets, to demonstrate masculinity.
5. Psychological factors related to nutrition practices in the workplace include: (i) 'spillover effect' - work affecting food choices at home, decreasing one's overall wellbeing and life satisfaction; (ii) stress at work makes workers overeat for comfort or, under eat due to appetite suppression.
6. Organisational factors related to nutrition practices in the workplace include: (i) job demands - the intensity of the workload, low autonomy, inflexible schedules, overtime, feelings of disorientation and being 'under pressure' leave workers feeling that they lack personal resources, in the form of time, energy, motivation and will power, to make healthier nutrition choices, and therefore, turn to convenient foods more often, (ii) shift work, (iii) too short breaks, (iv) work-related accidents occurring as a result of poor diets, and therefore, feeling weak, indisposition or hypoglycaemia.
7. Environmental factors related to nutrition practices in the workplace include: (i) a lack of healthy eating options, food cafeterias, (ii) a lack of facilities for food storing or preparation (e.g. refrigerator, microwave), as well as insufficient sitting spaces in staff canteens and the poor cleanliness of lunch areas.
8. Overall, several systemic reviews and meta-analyses reported that workplace health promotion programmes have been successful, often reporting moderate but positive results of nutrition interventions.
9. Multi-component interventions (e.g. a combination of education, behavioural change and work environment modification), as well as interventions with specifically targeted goals, were the most successful.
10. Increased fruit and vegetable intakes were mainly observed in interventions with educational and / or a behavioural component or environmental modification.
11. Behavioural change strategies, with goal setting, weight self-tracking, coaching and motivational interviewing, were commonly used and the most promising results in achieving health behaviour improvements were found when motivational enhancement

approaches were used, such as motivational interviewing and the use of rewards or incentives.

12. For weight loss, high intensity (e.g. 12–26 sessions in a year), structured programmes, offering a combination of information provision and behavioural counselling, were more effective.
13. Worksite environmental changes to facilitate healthy diets can supplement education and motivational components of interventions, especially in shift workers, and in male-dominated industries. However, environmental changes are often carried out in workplace canteens, therefore, evidence is limited to interventions taking place in bigger organisations.
14. Heterogeneity of study designs, intervention types, intervention components, measures used, methods of delivery, and outcomes and evaluation strategies used has made it difficult for authors to draw general conclusions from nutrition interventions in the workplace.
15. Different work settings have unique characteristics, highlighting the need to examine the worksite and employee populations before developing health promotion interventions.
16. The main facilitators to the success of nutrition interventions in the workplace include a participatory approach, creativity and rigour and the use of theory in the intervention design. Furthermore, flexible delivery, professionals providing health advice and the use of peer supporters are known facilitators. Stakeholders' support (e.g. unions, management, cafeteria staff), as well as a culture of health, trust in the organisation, and employers being aware of the benefits of health and wellbeing interventions were recognised as factors increasing the chances of the intervention success. Finally, some of the individual factors, like no interest in the programme, current medical treatment, disappointment in the organisation or feeling healthy were found to be barriers to the success of workplace interventions.
17. There is limited evidence focusing on nutrition interventions in construction, with no UK studies. Within existing studies, interventions tailored to individuals are the most common and predominantly address cardiovascular risk factors, excessive weight and obesity as well as musculoskeletal symptoms.

18. The most popular types of interventions include motivational interviewing, tailored feedback on health screening, personalised lifestyle coaching, a toolbox (including a waist circumference measuring tape, a pedometer, a BMI card, a calorie guide, healthy recipes and a lifestyle knowledge test) and use of educational materials.
19. Some of the positive changes following nutrition interventions in construction included reducing snacks and increasing fruit intake, however, changes were not sustainable.
20. Weight loss outcomes have been frequently used as measures for the effectiveness of interventions in construction and although short term results were positive, they did not translate into long terms outcomes.
21. Little research has focused on improving nutrition knowledge amongst construction workers, with some interventions using virtual and online media, including social media and smartphone applications to help to reach a wider audience. Although small improvements in knowledge were found, no sustainable nutritional knowledge enhancements were noticed.
22. Few studies in construction used environmental approaches to influence food habits. Although some results were promising (e.g. fat and sweet reduction, increase in fibre and fruit and vegetable intake), improving the quality of food served in staff canteens can be challenging, due to potential resistance from both chefs as well as workers.

2.9. Behaviour change theories

There is a growing importance placed on applying behaviour change theory when designing health interventions, including those focusing on nutrition (Zheng et al., 2017). The latest MRC guidance advises that the development of complex interventions should systematically draw on the latest evidence as well as be directed by suitable theory (Skivington et al., 2021). The use of theory has a number of benefits; it provides a framework to evidence collection, it can be used as a starting point when designing an intervention in order to be able identify what needs to happen for the behaviour change to take place, and it can support the identification of mechanisms of action (i.e. what should be monitored and measured) in the evaluation process (Atkins & Michie, 2015; Zheng et al., 2017). Furthermore, theories can be used to lead the investigation into why people do or do not adhere to healthy diets (Zheng et al., 2017).

Some authors suggest that the use of theory in nutrition intervention design has become the norm (Baranowski, 2006; Zheng et al., 2017), although the effectiveness of behaviour change interventions guided by theory remains unclear. Some evidence suggests that interventions designed on sound theoretical foundations have better chance of success (Glanz & Bishop, 2010; Story et al., 2008), and when multiple theories are combined, this may lead to even better outcomes (Glasgow et al., 2004; Zheng et al., 2017). Nonetheless, others found no, or even a negative association (Gardner et al., 2011; Roe et al., 1997). In a book reviewing 83 behaviour change theories, Michie & West, et al. (2014) suggest that the lack of clarity on the effectiveness of using theory can be a result of them not being used in a systematic manner to guide the development of interventions, as well as to provide a framework for the interpretation of outcomes.

There are a vast number of behaviour change theories that can be used to underpin health behaviour change interventions, although theoretical models which have been the most frequently used in interventions targeting changes in nutrition practices include the: Theory of Planned Behaviour (TPB) (Ajzen, 1985), Health Belief Model (HBM) (Rosenstock, 1974), Transtheoretical Model (TTM) (Prochaska & Di Clemente, 1982), Social Cognitive Theory (SCT) (Bandura, 1986), and Social Ecological Model (SEM) (McLeroy et al., 1988). Each of these theories is not without limitations, and even though one or multiple theories are often selected to guide the design of health interventions, they do not cover the full range of potential influences, possibly excluding essential variables.

Psychological approaches (i.e. SCT, TTM, TPB, HBM) rely heavily on individual reflections and often ignore automatic processes, like emotional influences, habits and impulses (West et al., 2013). For example, TPB does not account for an important influence of habit (Darnton, 2008) and more importantly, cannot fully support intervention design, as it is not able to address the question of what health promotion strategies are likely be the most effective (Taylor et al., 2006). Similarly, although it has been suggested that HBM may provide explanations for why individuals do not take up health improvement or protection opportunities, it cannot support decisions on how to best structure health interventions (Taylor et al., 2006). TTM, on the other hand, has been criticised for lacking validity for complex health behaviours (Adams & White, 2004) and for focusing on conscious decision-making and planning, while ignoring the role of reward, punishment or "*associative learning in developing habits that are hard to break*" (West, 2005, p.1037). Furthermore, a Cochrane systematic review found limited evidence to support the use of TTM in dietary interventions (Mastellos et al., 2014). Finally, when evaluating the effectiveness of SCT, LaMorte (2019) critised it for being broad and lacking structure, which might affect the implementation of theory, as it does not provide systematic procedures for intervention design.

The Social Ecological Model (SEM) has been widely used in health intervention research (Caperon et al., 2019; Gale et al., 2013; Golden & Earp, 2012; Richard, Gauvin, & Raine, 2011; Smith et al., 2017), as next to individual influences, it considers a variety of environmental factors influencing behaviour change (Golden & Earp, 2012). Nonetheless, similarly to previously discussed theories, SEM's strength lies in the ability to predict behaviour, as opposed to providing practical guidance on the design of health strategies (Curtis, 2016). Additionally, while psychological approaches might be limited in the way they consider environmental factors in changing behaviours, ecological models may lack in their consideration of motivational factors (Curtis, 2016). Hence, these limitations provide a rationale for using a model that builds upon behaviour change theories and offers an appropriate system for designing intervention.

The COM-B model and the Behaviour Change Wheel (BCW) was identified as an appropriate theoretical perspective for this study, in order to support the understanding of the likely process of change, understand how complex workplace nutrition interventions might work, and the way change mechanisms should be used to design an intervention. BCW was developed to address the gap between providing an understanding of the nature of the behaviour to be changed and strategies to change behaviour, which include methods for characterising interventions targeting these behaviours (Michie, van Stralen, et al., 2011). At its core there is a model of behaviour known as the COM-B system (Figure 2.2), where *"capacity, opportunity, and motivation interact to generate behaviour that in turn influences these components"* (Michie et al., 2011, p. 4). For example, opportunity, which is defined as factors lying outside the individual making the behaviour possible (e.g. environment) can influence motivation, that includes emotional responding, habitual processes and analytical decision making (Michie, van Stralen, et al., 2011; Michie, Atkins, et al., 2014). Motivation can also be affected by capability, defined as an individual's psychological and physical capacity to engage in activity, i.e. skills and knowledge, while performing a behaviour can alter capability, motivation and opportunity (Michie, van Stralen, et al., 2011).

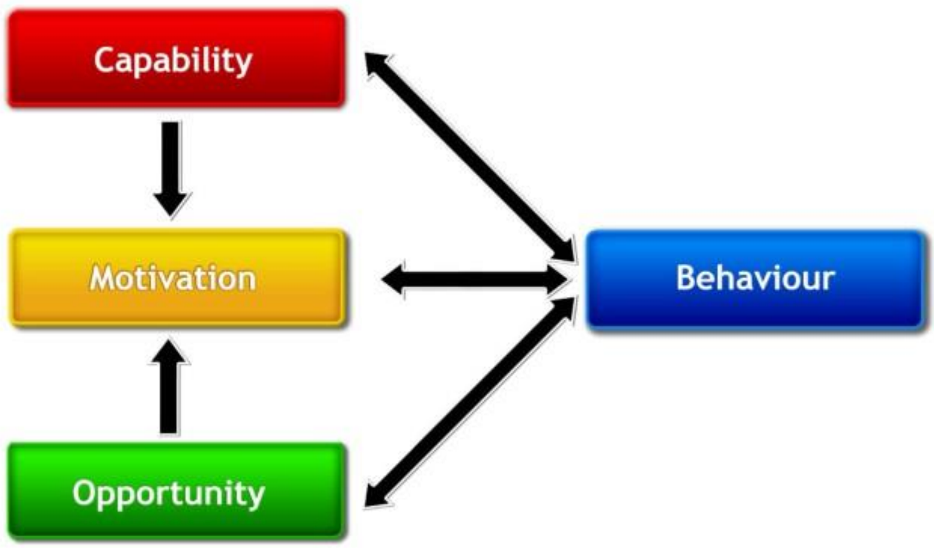

Figure 2.2. The COM-B system for understanding behaviour (Michie, van Stralen, et al., 2011)

A health intervention, aiming to change behaviour will involve changing one or more components in the COM-B system, putting the system into a new configuration, while the casual relationships within the system can *"work to reduce or amplify the effect of particular interventions by leading to changes elsewhere"* (Michie et al., 2011, p. 4). Furthermore, this model also provides a foundation for the design of the intervention. The BCW (see Figure 2.3) allows different intervention options to be identified that can be applied to changing each of the components (Michie et al., 2014). For example, if one wishes to reduce the consumption of junk food amongst workers, the intervention should canvass all the options, including improving workers' 'capability' (e.g. knowledge about the effects of junk food consumption), restricting their 'opportunity' (e.g. limiting the availability of junk food in work canteen), and changing their 'motivation' (e.g. by providing workplace campaigns on healthy eating). Nonetheless, although any or all of these might have some effect, the use of the BCW will support the systematic evaluation of determining which options are likely to deliver the best results (i.e. change the behaviour of a frequent junk food consumption) (Michie et al., 2014).

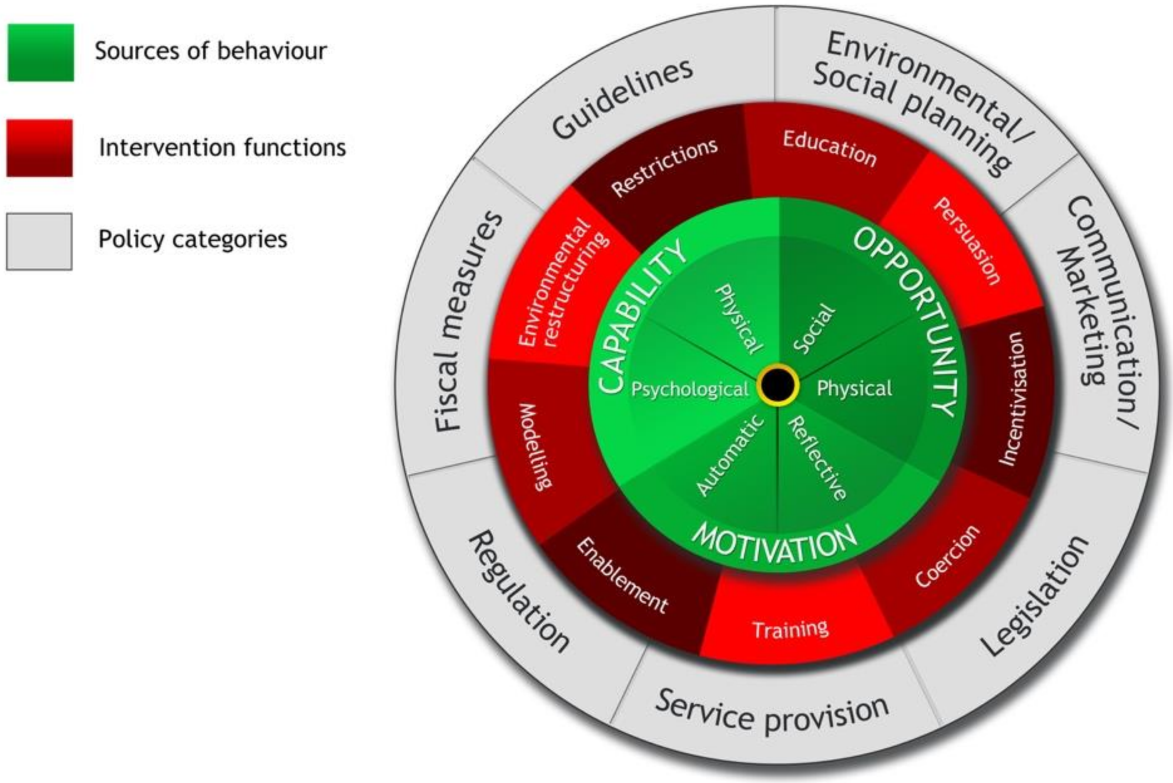

Figure 2.3. The Behaviour Change Wheel (Michie, van Stralen, et al., 2011)

Chapter Three – Methodology

3.1. Introduction to methodology

Following the literature review and the evaluation of behaviour change theories, this chapter will provide an overview of the philosophical assumptions underpinning this study and present its overall methodology, with a focus on participatory approaches. It will provide the rationale behind the choice of mixed method design, discuss the three phases of the research and briefly outline the methods used in each phase. It will conclude with information on the ethical approval for the study. This chapter was designed to present an overview of the overall methodology, with details on each phase of the research process and methods used provided under the appropriate sections in this thesis (see Figure 3.1. The Research Framework - phases).

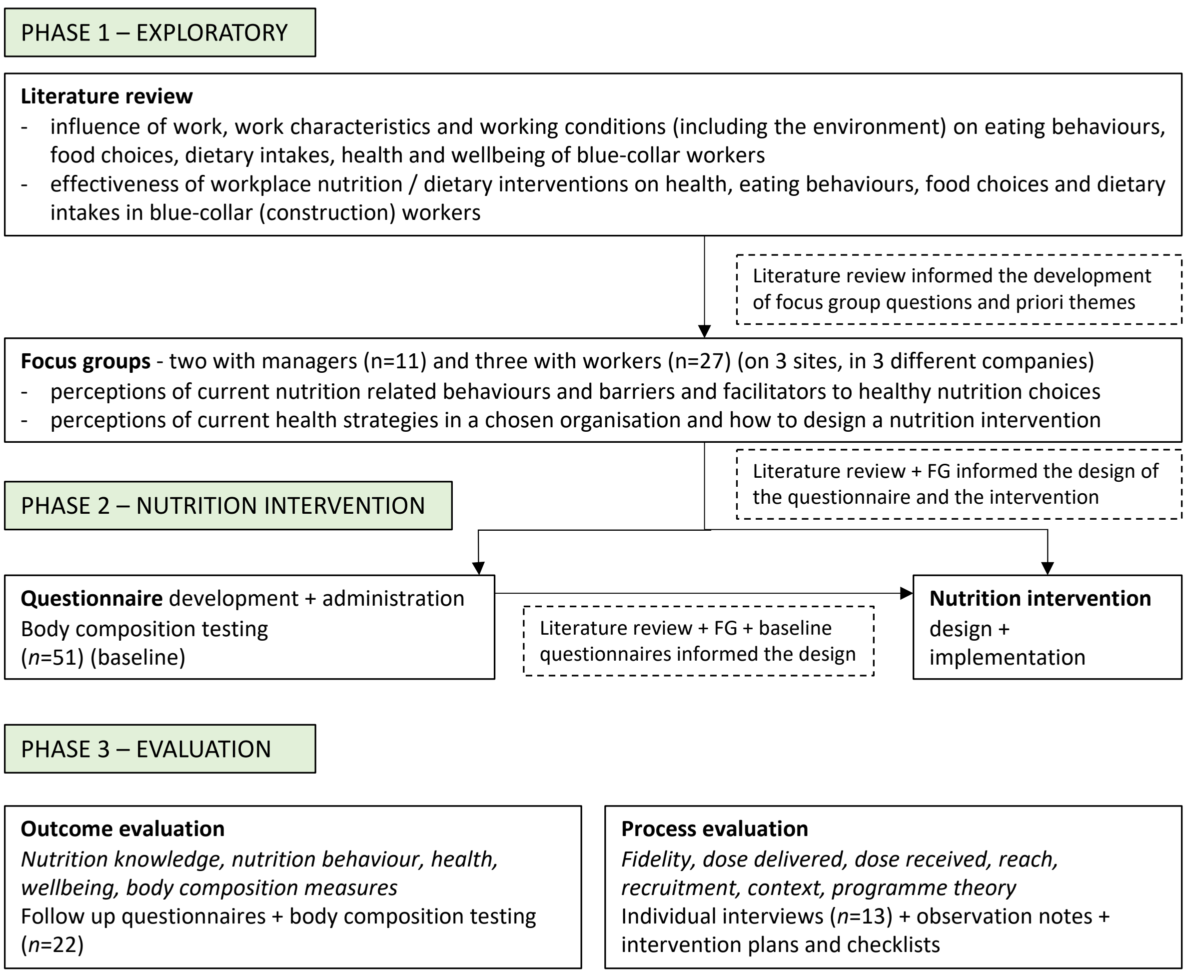

Figure 3.1. The Research Framework - phases

3.2. Philosophical underpinnings of the study

Ontologies and epistemologies influence the structure and the process of research, with ontologies (realism and constructionism) informing methodologies as to the nature or structure of reality, which in turn will inform the focus of the research (Creswell & Creswell, 2018). Epistemologies inform methodologies about the nature of knowledge, what kinds of knowledge are possible and where so to seek the knowledge (Maynard, 1994). Methodology is the science of methods, providing appropriate research designs to be used by researcher, informing them where to focus their research activity and how to identify and obtain knowledge (Creswell & Creswell, 2018; Sarantakos, 2012).

Ontological, epistemological and methodological principles combine to form paradigms, constituting the domain within which the research is conducted (Sarantakos, 2012). Positivist paradigms contains a realist / objectivist ontology, and an empiricist epidemiology, which leads to a quantitative methodological approach (Sarantakos, 2012), where research should remain objective, uninvolved with the objects of study, and emotionally detached, with an aim to eliminates biases to test their hypotheses (Johnson & Onwuegbuzie, 2016). Researchers view inquiry as a series of logically related steps within the research process, with deductive reasoning and standardisation as the means to claim knowledge (Cresswell & Plano Clark, 2017). Conversely, interactionism and phenomenology, based on a constructionist ontology and an interpretivist epistemology, prescribes qualitative methodology which rejects positivism (Sarantakos, 2012). Instead, qualitative researchers argue that generalisations which are time and context free are not possible and that multiple-constructed realities exist (Johnson & Onwuegbuzie, 2016). Constructivist research is designed from the bottom up, from individual perspectives to broad understandings as researchers rely on the participants' views and develops subjective meanings of the studied phenomena (Cresswell & Plano Clark, 2017).

However, in recent years, mixed methods have become the third paradigm, bridging the division between qualitative and quantitative research, with its central premise that the use of a combination of quantitative and qualitative approaches offers a better understanding of research problems (Creswell & Creswell, 2018), and offering a potential for *"practicing researchers would like to see methodologists describe and develop techniques that are closer to what researchers actually use in practice"* (Johnson & Onwuegbuzie, 2016, p.15). However, philosophically, due to conflicting and contradictory views between positivist and constructivist paradigms, mixed method research makes use of the pragmatic approach as a system of philosophy (Johnson & Onwuegbuzie, 2016; Tashakkori & Teddlie, 2010), where researchers emphasise the research problem and a question and use all available approaches to understand it (Bryman, 2012; Creswell & Creswell, 2018). Pragmatic approach is often guided by principles of flexibility, comprehensiveness, and practicality (Crane, Bauman, et al., 2019) and uses knowledge to solve a current proximal problem, with the best method, placing no claim on the hierarchical validity of evidence (Tennis, 2008).

Although this study used a participatory research paradigm (discussed below), it has been suggested that various approaches, including pragmatism, are applied to varying degrees when conducting participatory research, impacting data production and interpretation (Wright et al., 2010). For example, Greenwood (2007) advocated the pragmatic action research stance, which self-consciously and strategically pools different research methods and techniques, based on the needs of particular groups and the context. Furthermore, Allemang et al. (2022) made a case that the pragmatic paradigm is well-suited for participatory research, given the alignment of their underlying principles, such as: an open dialogue, shared responsibility for problem solving, collaboration, the commitment to producing a positive change and generating knowledge that warrants action and stimulates change. Different authors (Cook, 2012; Hudon et al., 2021) also encouraged the need for pragmatic considerations within different participatory research approaches. Hudon et al. (2021) suggested that researchers might consider adopting a pragmatic approach, for example, by conducting a participatory study aiming to analyse the implementation of a health care innovation, while consulting the community or organisational stakeholders in certain places of the research, with varying intensity.

Furthermore, it has been suggested that pragmatic approach might be successfully used in complex health promotion interventions to address methodological and practical challenges (Allemang et al., 2022; Crane, Bauman, et al., 2019), for example, Crane et al. (2019) referred to the importance of three key principles of the pragmatic approach: theoretical flexibility (using the best available methodology to provide knowledge, e.g. in a situation of constrained resources), methodological comprehensiveness (incorporating qualitative and quantitative methods to examine different levels of programme implementation) and operational practicality (addressing what is realistic to achieve within the practical constraints of real-world projects). Authors suggested that using pragmatism in addressing real-world problems, as defined by the communities in which they exist, makes it a natural guiding approach in heath research, which values collaboration (Crane, Bauman, et al., 2019).

3.3. Participatory approach

Participatory research is a methodology that recognises the significance of involving others in the planning and conducting of the research in the process of producing new knowledge (Bergold & Thomas, 2012). The research involves those whose actions, experiences, lives are under study, meaning that the research aim and questions develop as a merger of science and practice perspectives (Bergold & Thomas, 2012). Participatory research has been recognised as a 'new paradigm science', differing significantly from the positivist science, as in the case of participatory studies, the researcher impacts on the phenomena researched (Baum et al., 2006, cited Wadsworth 1998, p.3).

The importance of the collaborative nature of participatory research, involving service users in the research process, has been recognised as an important step and a suitable approach in health research, as it does not remove data from the context and the studied participants are actively involved in the research process and production of new knowledge (Baum et al., 2006; Bergold & Thomas, 2012). It has been suggested that participatory research can improve health through involving individuals, who, in turn, act to improve their own health and participants' contribution to the research increases their sense of self awareness, self-confidence, and hope for the future (Baum et al., 2006).

Additionally, the participatory design of the intervention is in line with NICE (2015), PHE (2017) and MRC (Craig et al., 2008; Skivington et al., 2021) recommendations stating that workplace health and wellbeing research should be developed in collaboration with those who are to use or be offered the interventions (i.e. managers and workers), and that it is essential for senior management to be engaged and committed to improving the health and wellbeing of staff.

3.4. Mixed method design

Effective public health research requires methodological pluralism (Baum et al., 2006), therefore, a mix of qualitative and quantitative methods were used in the study, which is in line with the MRC guidance on developing and evaluating complex interventions (Craig et al., 2008; Skivington et al., 2021). The core assumption of this approach is that by integrating both types of data, the researcher will gain additional insights beyond information, which would be provided by either quantitative or qualitative data alone (Creswell & Creswell, 2018), therefore, gaining a better understating of the research problem (Abildgaard et al., 2016). Furthermore, a mixed methods approach allows comparison between qualitative and quantitative data to be drawn (Creswell & Creswell, 2018), an explanation of quantitative results to be conducted with a use of qualitative data (Creswell & Creswell, 2018) and both depth and breadth of data to be presented (Abildgaard et al., 2016).

Mixed method designs, within a participatory action research approach, have been recognised as providing a better understanding of why interventions do or do not work (Craig et al., 2008; MRC, 2008; Noyes et al., 2019; Skivington et al., 2021). Furthermore, mixed method designs help to identify essential elements to be included in a complex health promotion intervention, which in turn, supports that the intervention influences behavioural change (Sendall et al., 2018). Moreover, although quantitative methods are considered to remain vital in complex health system research, they have been found to be insufficient in addressing certain research questions within those systems (Victora et al., 2004), and complex interventions and health systems can only be understood by combining both approaches (de Savigny & Taghreed, 2009; Noyes et al., 2019). Multiple authors reviewing the design of complex interventions have encouraged mixed methods approaches, as they stimulate better quality evidence for synthesis (Molina-Azorin & Fetters, 2016; Moore et al., 2015; Noyes et al., 2019; Victora et al., 2004) and there is a need for both types of evidence to inform policy and practice (Noyes et al., 2019). Finally, a mixed method approach can help to understand whether there has been a theory or implementation failure (Noyes et al., 2019).

3.5. Phases of the research

This study comprised the design and evaluation of a workplace nutrition intervention to improve employees' health and wellbeing and focused on blue-collar (construction) workers. As part of this project, a 6-month nutrition intervention (with an evaluation) was implemented on a construction site, to provide workers with guidance and support to improve their nutrition behaviours and nutrition knowledge, and therefore, positively affect their health and wellbeing. This participatory study consisted of three phases - an exploratory phase, a nutrition intervention phase and an evaluation phase (see Figure 3.1.). Findings from the first phase (focus group) informed and determined the next phases (including the design of the intervention).

3.5.1. Exploratory phase

Phase 1 of this research used qualitative methods (focus groups) to explore stakeholder (managers and workers) perceptions of current nutrition related behaviours and barriers and facilitators to healthy nutrition choices in the workplace, as well as to explore stakeholder perceptions of current health strategies in their organisation and how to facilitate healthy nutrition choices amongst construction workers. Furthermore, perceptions on how to design a nutrition intervention with consideration of the workforce needs, characteristics, and the context of the industry were also considered. Findings gathered using qualitative methods in phase 1 were subsequently used to design and develop a nutrition intervention for delivery at the workplace. Given that the project is exploratory in nature and participatory, qualitative methods are appropriate in the examination of the problem (Bergold & Thomas, 2012; Kitzinger, 1995; McVicar et a., 2013). Also, the relatively small number of potential research participants (30-40 participants) made a quantitative approach unfeasible. Qualitative research methods were selected at this stage as they can provide important insights into the processes of change, involve users and allow a wide range of views to be canvassed and incorporated into the design and evaluation (Craig et al., 2008). For example, focus groups were used to provide insight into the organisational level barriers and facilitators to the implementation of a nutrition intervention (Evans et al., 2015) as well as individual level potential barriers to change (Campbell et al., 2000). Furthermore, the use of qualitative methods enabled insights into the contextual circumstances of the implementation, delivery and evaluation of the intervention (Jansen et al., 2010), for example, they helped to define the relevant components of the intervention (Campbell et al., 2000).

Focus group data was analysed using Framework Analysis (FA), which is an increasingly popular approach in health research (Furber, 2010; Gale et al., 2013; Lacey & Luff, 2007; Smith & Firth, 2011). FA has been defined as a set of codes organised into categories, used to manage and organise the data (Gale et al., 2013). Its essential feature is the creation of a new structure (matrix) of summarised data in a way that allows the data to be reduced, analysed by case or theme and therefore, answer the research questions (Gale et al., 2013). The general approach in FA uses a combined approach to analysis, enabling themes to be developed both inductively from the accounts (experiences and views) of research participants and deductively (the inclusion of a priori) from existing literature (discussed further in chapter four) (Gale et al., 2013; Lacey & Luff, 2007).

3.5.2. Nutrition intervention phase

In line with the MRC guidance on developing and evaluating complex interventions, the subsequent stages of the project depended on the findings from Phase 1, and an extensive review of the literature was carried out looking at the best and most effective practices for the design, implementation and evaluation of health interventions in the workplace (Craig et al., 2008; MRC, 2008; Moore, et al., 2015; Skivington et al., 2021). Findings from the literature review and focus groups combined to inform the development of a questionnaire in this phase. The questionnaire was administered to all individuals taking part in the nutrition intervention on site at baseline to assess baseline health, wellbeing, nutrition knowledge and the nutrition related behaviours of construction workers, using appropriate measures (McVicar et al., 2013). In addition, body composition testing (BCT) was used to assess baseline weight related outcomes (e.g. BMI, weight, fat mass).

In this phase, the nutrition intervention was designed, developed and implemented on a construction site. As previously mentioned, the intervention was designed in a participatory way, therefore, findings from previous phases of the research (focus groups with managers, workers, and the questionnaire findings) were used at this stage to inform the design, development and implementation decisions. Decisions were supported by the best practice guidelines, identified through the extensive literature review that was undertaken.

The design of the intervention followed the COM-B model and BCW (Michie et al., 2014). In line with the model intervention components and activities were selected and designed to maximise capability to regulate behaviours (gain knowledge and understanding, develop skills), maximise opportunity to support self-regulation (elicit social support, change routines and environment) and increase motivation to engage in the desired behaviour (develop new habits, develop appropriate beliefs and positive feeling about changing, reward change) (Michie et al., 2014). COM-B model (forming the hub of the wheel) (see Figure 2.3) is linked to 9 intervention functions, which are broad categories of means by which an intervention can change the behaviour. In the design of the nutrition intervention in construction, 7 intervention functions were selected: education, training, persuasion, incentivisation, enablement, modelling, and environmental restructuring. Activities were designed to use different behaviour change techniques and each technique used might have covered more than one function. For example, a food demonstration activity used at least two behaviour change techniques: (i) ‘demonstration of the behaviour’ (covering a function of modelling) and ‘instruction on how to perform the behaviour’ (covering training function) (Michie et al., 2014).

3.5.3. Evaluation phase

A mixture of qualitative and quantitative methods were applied in the evaluation phase of this study (phase 3). Both process and outcome evaluations were conducted, to capture and investigate changes in nutrition knowledge, behaviours, health, and wellbeing measures as well as to assess if the intervention was delivered as planned. A follow-up questionnaire was used to capture changes in nutrition education, nutrition behaviours, health and wellbeing, which was supplemented with BCT measures, while the process evaluation used data collected through individual interviews with intervention participants, supported by observation notes, an intervention plan and checklists. While outcome evaluation data was mainly reported using quantitative data (follow up questionnaires), some integration of qualitative data (individual interviews) collection and analysis allowed the interactions between mechanisms, context and outcomes to be captured (MRC, 2008; Moore et al., 2015; Noyes et al., 2019). Furthermore, qualitative research, in the form of individual interviews, were used to determine how well (or not) the intervention worked by providing rich exploratory opinions and views (Campbell et al., 2000; Noyes et al., 2019).

3.6. Ethical approval

The study was approved by the Research Ethics Committee of the University of Salford (HSR1819-124) on 10th September 2019, with amendments approved on 14th July 2020 13th August 2021 (see Appendix 1).

Chapter Four – Focus groups

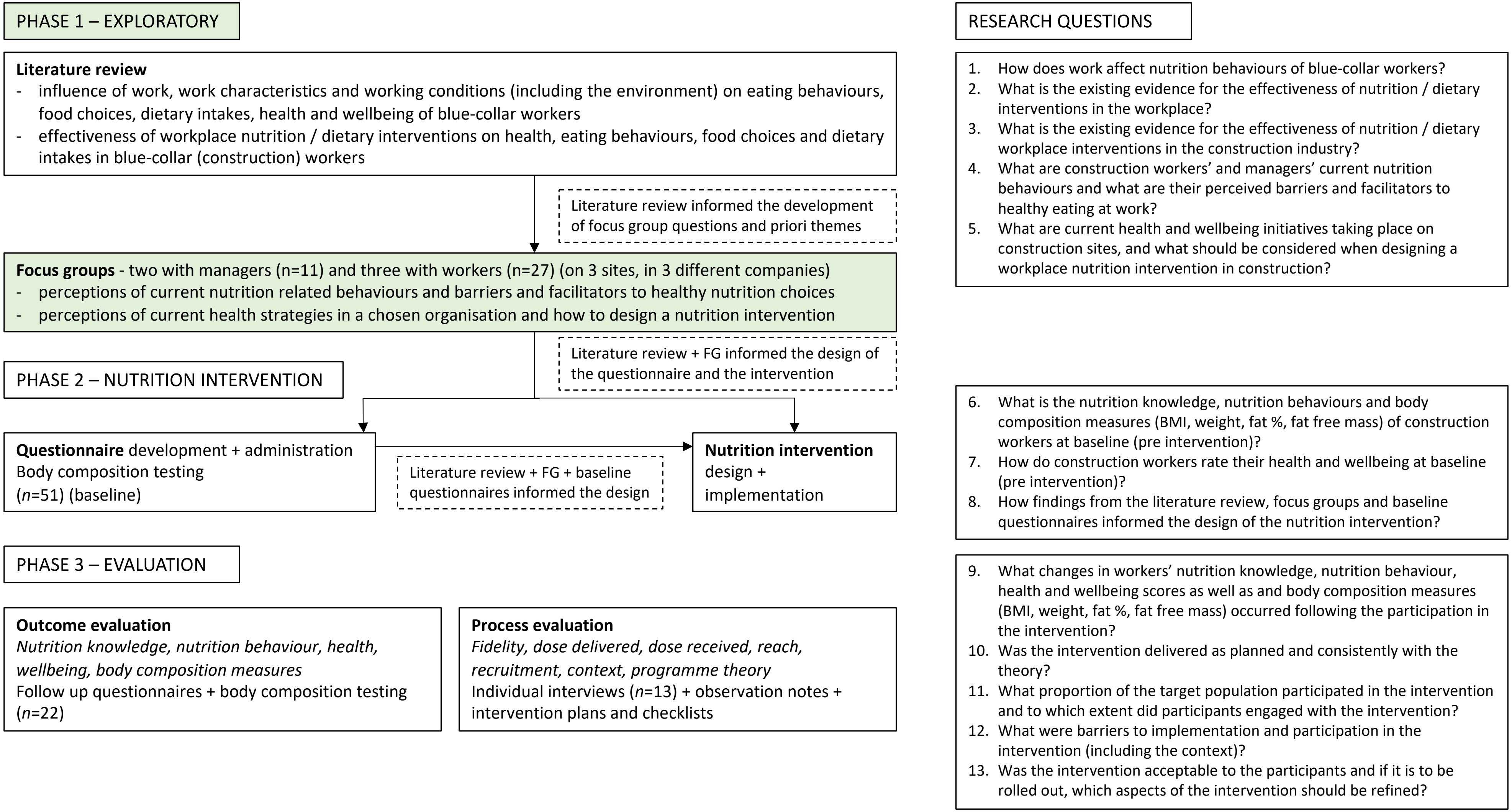

Figure 4.1. The Research Framework – Focus groups

Chapter Four – Focus Groups

4.1. Introduction to focus groups

The aim of this chapter is to present the findings of five focus groups with construction managers and workers, from three different sites, and three different construction organisations in the UK. This chapter starts with a presentation of the focus group aims and objectives, followed by the methods section. In this section, the rationale for the selection of focus groups is provided. Following this, information about the participants, procedure and, finally, a discussion of FA is provided. The focus group findings are then presented, in two parts. The first part includes findings related to stakeholders' perceptions (workers' and managers') of current nutrition related behaviours and barriers and facilitators to healthy nutrition choices in the workplace. The second part reports the findings from the exploration of stakeholders' perceptions of the current health and wellbeing initiatives in their organisation and views on the design of a nutrition intervention which takes into account workforce needs, characteristics, and the context of the industry.

4.2. Aims and objectives of focus groups

The aim of the focus groups was to explore the stakeholders (UK construction workers and managers) perception of current nutrition related practice, as well as barriers and facilitators to healthy dietary choices in the workplace, and ways to facilitate healthy dietary choices amongst construction workers. In addition, the focus groups aimed to explore stakeholders' perceptions of current health and wellbeing initiatives in a chosen organisation and how to design a nutrition intervention with a consideration of the workforce needs, characteristics, and the context of the industry. The objectives were to first recruit construction companies willing to take part, to design focus group questions in line with the literature review findings, and later to conducts focus group with both workers and managers from recruited companies and analyse results in line with priori themes developed from the literature review. Therefore, in this chapter, the following research questions are answered:

4. What are construction workers' and managers' current nutrition behaviours and what are their perceived barriers and facilitators to healthy eating at work?

5. What are current health and wellbeing initiatives taking place on construction sites, and what should be considered when designing a workplace nutrition intervention in construction?

The focus groups findings were used to design a questionnaire used in the intervention phase of this research, as well as to inform the design of the nutrition intervention.

4.3. Methods – focus groups

This section outlines the methods used for this stage of the research. Firstly, the rationale for using focus groups is given, in addition to details of the interview guide and the interview schedule. Following this, the section on participants (including recruitment and selection criteria) and procedure is provided. Finally, a discussion of FA, including its five distinct stages, takes place.

4.3.1. Focus groups – an overview of the method

Focus groups can be used in a multi-method design, allowing an initial exploration of a topic of interest, by collecting group narratives so the information can be used in later stages (Gill et al., 2008; Rabiee, 2004). Furthermore, the synergy of the group interaction enables the generation of large amounts of data in a relatively short period of time (Rabiee, 2004). Focus group research has been successfully employed as a method to provide the data for the design and implementation of workplace health and wellbeing interventions (Brown et al., 2015; Dannelly et al., 2005; Gates et al., 2006; Li et al., 2018; Muegge et al., 2018; Papadaki et al., 2016), including nutrition related and dietary programmes (Brown et al., 2015; Dannelly et al., 2005; Gates et al., 2006; Li et al., 2018; Muegge et al., 2018; Papadaki et al., 2016). Focus groups have been used in research in a number of industries and professions, such as manufacturing (Gates et al., 2006), business and professional services and local governments (Papadaki et al., 2016), health care (Strickland et al., 2015) and union members representing retail workers (Strickland et al., 2015), fire academy recruits (Sotos-Prieto et al., 2019), firefighters (Bonnell et al., 2017; Muegge et al., 2018), community health centres (Li et al., 2018), train drivers (Naweed et al., 2017), university employees (Thomas et al., 2016), low wage workers (Nobrega et al., 2016) and shift workers (Nea et al., 2017).

There is growing popularity in the use of focus groups in health research as a method to explore health behaviours, the effectiveness of workplace health and wellbeing programmes (Bonnell et al., 2017; Dannelly et al., 2005; Gill et al., 2008; Kitzinger, 1995; Price et al., 2016; Strickland et al., 2015), and as a vehicle to involve users in needs assessment, strategy development, planning and evaluation of nutrition interventions (Rabiee, 2004). Focus groups are a popular method for assessing health education messages, examining public understandings of health behaviours (Kitzinger, 1995) and investigating people's experiences of health services, as well as beliefs, attitudes and needs of staff and workplace cultures (Gill et al., 2008; Kitzinger, 1995). Moreover, focus groups have been used as a method to investigate employees' and managers' perceptions of workplace health strategies that would aid in reducing barriers and enhancing employees' participation in health programmes (Dannelly et al., 2005; Gates et al., 2006; Strickland et al., 2015). This approach has also been used to investigate the desired components of workplace nutritional interventions (Dannelly et al., 2005; Papadaki et al., 2016) and to discuss worksite factors that support or constrain healthy eating choices (Bonnell et al., 2017; Li et al., 2018; Strickland et al., 2015), healthy food provision at work (Li et al., 2018) and motivations behind food choices at work (Price et al., 2016). Furthermore, the effectiveness of health and wellbeing workplace initiatives have also been investigated with a use of focus group research (Strickland et al., 2015).

In this study, focus group discussions with different stakeholders (managers and workers) were used to generate information on collective views and the meanings underlying such views (Gill et al., 2008). In addition, this approach captured different perspectives, as this provided an insight into the organisational level barriers and facilitators of implementation (Evans et al., 2015) as well as potential individual level barriers to change (Brown et al., 2015; Campbell et al., 2000; Gates et al., 2006; Papadaki et al., 2016), which helped to define the relevant components of the intervention (Campbell et al., 2000). Furthermore, the aim of using focus groups in this study was to understand and explain beliefs and cultures that influence eating behaviours at work and explore the complexity surrounding food choice within the context of a workplace (Rabiee, 2004). Moreover, stakeholders involvement in the choice of questions addressed during the study, and their involvement in the design of the intervention, was anticipated to ensure its relevance (Craig et al., 2008; Glasgow et al., 2003) and a positive engagement with the process of the research (Rabiee, 2004).

Focus groups have also been chosen in the workplace health and wellbeing intervention studies to encourage commitment from workers and managers by actively involving them in the decision-making process (Dannelly et al., 2005; Gates et al., 2006). In addition, they enabled the intervention to be adapted to the specific work environment, therefore, potentially achieving a better reception and adherence to the programme (Sotos-Prieto et al., 2019). The use of focus groups as a means of exploring employees' experiences, perceptions and opinions in workplace intervention research has been considered a study design strength, as the findings provide rich and detailed insights into the "*real world problems, perspectives and potential solutions*" (Gilson et al., 2011, p. 43). Moreover, dynamic idea generation and in-depth discussions have frequently been mentioned as an advantage of focus group research designs (Bryman, 2012; Kitzinger, 1995; Mackenzie et al., 2019; Rabiee, 2004). It has also been suggested that focus groups are especially effective for exploring employees' perceptions and experiences if little is known about the topic (Bloor, 2001; Kitzinger, 1995), as in the case of nutrition workplace interventions in construction.

Workplace health programmes have utilised focus groups, as they encourage social communications and the interaction between participants, which can enhance the level of detail and wealth of information gathered (Bryman, 2012; Kitzinger, 1995; Rabiee, 2004; Tausch & Menold, 2016). Participants can be prompted by what others say, allowing the expression of a wide variety of views to take place (Bryman, 2012; Kitzinger, 1995). It also enhances broad group discussions and can be a useful tool in the identification of group values and norms (Hennink et al., 2010), as well as in the assessment of cultural challenges or social stigma that could be faced by the proposed nutrition intervention seeking to improve eating habits within specific workplace settings (Sotos-Prieto et al., 2019).

In this study, two, internally homogenous focus group categories were used: managers and workers. Homogenous groups were selected as they allow for more open and free-flowing conversations amongst participants (Gill et al., 2008; Morgan, 1997) and they also allowed the researcher to examine the differences in perspectives between the groups (Morgan, 1997; Rabiee, 2004). Furthermore, this approach has been suggested to support confidence of participants when talking to each other, as potential gaps in educational levels, social class and lifestyles between employees and managers might affect the openness of conversations and defeat the productivity of the discussion (Morgan, 1997). While Krueger & Casey (2000) assert that rich data can only be generated from focus groups if participants are comfortable and engaged, there is a strong argument against mixing participants across different status or authority lines, as in a case of managers and workers, as this might also determine the willingness of participants to openly discuss a topic, make participants uncomfortable and could even lead to conflicts (Gill et al., 2008; Morgan, 1997; Stewart et al., 2007).

Focus groups are not without their limitations however, e.g. focus group data can be limited by the willingness of participants to take part and contribute in depth to the discussion (Olsen et al., 2018). Also, due to the convenience-based sampling methods in this study, it is likely that the participants who volunteered were already engaged, eager and interested in nutritional changes at workplace (Mackenzie et al., 2019). In order to reduce volunteer bias, multiple techniques to increase volunteer numbers were employed, i.e. various recruitment strategies were used, as well as ensuring the anonymity and confidentiality of volunteers (Kitzinger & Barbour, 1999).

Nevertheless, the issue of confidentiality is another limitation in the use of focus groups (Kitzinger, 1995; Kitzinger & Barbour, 1999; Morgan, 1997). Focus group participants cannot be given an absolute guarantee that information shared during the discussions will not be shared, as the temptation to gossip might be especially strong in the case of participants sharing the same social network, as in workplace settings (Kitzinger & Barbour, 1999). It has been suggested that such issues should be addressed by setting the ground rules prior to the focus group taking place (Kitzinger & Barbour, 1999). In this study, focus groups were conducted on the two key principles of informed consent and anonymity. Participants were informed in writing that their information would be treated anonymously and about their right to withdraw from the study on an information sheet. This information was also reiterated verbally at the beginning of each focus group, reminding employees that the information shared in the group is confidential. Furthermore, participants were required to sign a consent form, where they agreed to keep the focus group discussion confidential.

In focus group studies, the researcher has less control over the proceedings, therefore, it requires a skillful moderator to set a balance between free flowing conversations and the group taking over the discussion (Kitzinger & Barbour, 1999). In this study, the moderator is a workplace health consultant, who has been working with many companies in the UK, supporting them in designing and implementing nutrition interventions, therefore, has a lot of experience in running group discussion sessions.

In addition, focus groups generate a large amount of data, which can be difficult and time-consuming to transcribe and analyse (Rabiee, 2004), especially in cases when inaudible elements affect the transcription (Morgan, 1997). This was addressed at the beginning of the focus groups by asking participants not to talk while another person is speaking (Kitzinger & Barbour, 1999). Furthermore, in this study focus groups were conducted without an observer, which might have limited the collection of non-verbal data through observation (Olsen et al., 2018).

Lastly, focus groups can be difficult to organise and 'no shows' are a common occurrence (Kitzinger & Barbour, 1999; Krueger & Casey, 2000; Rabiee, 2004; Tausch & Menold, 2016). Although, the optimum size suggested for a focus group is six to eight participants (Gill et al., 2008), it has been proposed that it is better to over-recruit (by approximately 20%) rather than under-recruit and risk having an unsatisfactory discussion (Gill et al., 2008; Morgan, 1997; Stewart et al., 2007). A small study by Tausch & Menold (2016) suggested that recruitment could also be enhanced by face-to-face contact. The authors interviewed nine researchers who had conducted focus groups and found that face to face contact is an important factor promoting participation. Findings highlighted that this type of contact is better suited to answer potential participant questions, and to explain the method and aim of the focus groups. However, it has been suggested that participants might find it more difficult to decline a face-to-face invitation than a written one, which might be considered an ethical issue (Tausch & Menold, 2016). In this study, a face-to-face contact was used as a method of recruitment, with the researcher being available on site to deliver a 'toolbox talk' inviting managers and workers to take part in the study. A 'toolbox talk' is defined by HSE (2019) as a short presentation to the workforce, during the morning staff briefing, lasting usually between 5 and 15 minutes, on a single aspect of health and safety.

4.3.2. Interview guide and interview schedule

Questions asked during the focus groups should be open-ended, neutral, sensitive, clear to the participants and stimulating without directing too much of the discussion (Krueger & Casey, 2000; Rabiee, 2004). It has also been suggested that to facilitate participants to reflect on contributions from others, help participants challenge each other, elaborate on their accounts, and therefore, maximise the information obtained, enough space should be left allowing deviation, asking additional and probing questions (Breen, 2006; Krueger & Casey, 2000; Ritchie et al., 2013). Considering the above, the interview guide was developed for this study (Appendix 2).

The focus group questions were developed with the help of two experienced workplace health researchers, in line with the research aims and objectives as well as with findings from the literature review. The discussion began with questions about general experiences and later progressed to specific problems, as suggested by Krueger & Casey (2000). Firstly, participants were asked about their food choices and eating habits at work. This was followed by questions on barriers and facilitators to healthy food choices when at work. In addition, questions on current and previous health and wellbeing programmes in the workplace and their effectiveness were posed, and finally, workers and managers were asked about what the nutrition programme at their workplace should look like and what it should include to encourage workers to participate and make positive changes in their eating habits.

In order to gain further insights into the design of the nutrition intervention, participants were provided with a prompt, a handout presenting a number of suggestions for the potential content of the nutrition programme (e.g. supporting optimal weight, staying hydrated, healthy snacking). Ideas presented on the handout were based on the priori themes from the literature review. Focus group participants were asked to choose three ideas, which they would most like to see during the programme and number them 1-3, with 1 being their first choice.

An interview schedule was prepared prior to conducting the focus groups, in order to remember what to do and say and to ensure consistency across all focus groups (Breen, 2006; Kitzinger & Barbour, 1999). The focus group interview schedule contained the following: the welcome, an overview of the topic and a statement highlighting the ground rules of the focus group, as well as the reassurance of confidentiality, and the questions (Breen, 2006; Ritchie et al., 2013). The researcher also noted on the margin of the interview schedule an estimated time to be spent on each question, to ensure all questions were answered (Breen, 2006).

4.3.3. Sample

In total, seven construction companies were contacted and invited to take part in the study. Although five construction companies initially expressed an interest in the participation, only three were able to schedule the focus groups on their sites.

Five focus groups (lasting 40-60 minutes each) were conducted in 2020, on three different construction sites (A, B, C) (in different companies); two with managers (n=11) and three with workers (n=27). Site A was small (12-14 workers), with approximately 85% of the workforce living locally. Site B was a large site (300 workers), with a majority (70%) transient workforce. Site C was medium-sized (50-100 workers), with over half of the workforce living locally. Further information on the characteristics of sites is available in Table 4.2.

Participants were recruited through organisational representatives, including HR / Health and Safety / and site managers. Information sheets and invitation letters were e-mailed to managers and workers via the representatives, and participants were advised to contact the researcher directly, or advise their line manager, if they would like to take part in the focus group. The researcher was available on site to deliver the 'toolbox talk' to the workforce, during the morning staff briefing (discussed earlier). Information on the location and times of the focus groups were provided during a staff briefing to those interested in taking part.

Guidelines on the optimal size of 6-8 participants per focus group were followed, including over-recruitment by approximately 20% to avoid the risk of having an unsatisfactory discussion (Gill et al., 2008). The number of focus groups was determined by the size of organisations and the organisational constraints (e.g. room availability, workload, time allocated). For example, site A was small; of 12 workers, 9 participated in the focus group. Site B was large, but due to a limited office space, workload and aligned time, only 3 focus groups were conducted. Site C had approximately 50 workers, 10 took part in the focus group, 7 more expressed an interest but failed to attend. The number of focus groups was in line with other studies exploring employees' perceptions as a part of the health intervention development, e.g., Brown et al., (2015) used 3 focus groups, Muegge et al., (2018) used 4, while for studies in construction, Peters et al., (2020) used 2 and Ross et al. (2021) used 6. An earlier study exploring dietary behaviours in construction used 5 focus groups (du Plessis, 2011). Although organisational constraints, rather than data saturation, determined the number of focus groups, a recent systematic review assessing sample sizes for saturation suggested focus group saturation occurred at 4-8 groups (Hennink & Kaiser, 2022). Similar findings were previously discussed by Guest et al. (2016), who concluded that 2-3 focus groups are sufficient to capture 80% of themes, and 3-6 for 90% of themes.

To qualify for inclusion, participants had to confirm that they were either a construction worker, or a construction manager / supervisor, and that they were happy to share their experiences on eating habits at work. No other inclusion or exclusion criteria were applied. A total of 55 candidates across three sites expressed their interest in taking part in the groups and were scheduled to participate (meeting inclusion criteria). Of those, 38 individuals were included in the final cohort, and 17 did not attend. Some workers declined to participate due to a high workload on the day, being off sick, a last-minute change in the scheduled working plan or due to them leaving the job.

Each participant provided written informed consent for the study. No monetary compensation was offered; however, light refreshments were provided during the day.

4.3.4. Procedure

Focus groups took place on construction sites, in meetings rooms to allow a quiet and comfortable environment. The researcher was the interviewer. Groups were recorded, with permission, using an encrypted digital recorder and transcribed verbatim by professional service providers, as it was considered more time efficient. Participants were anonymised, to ensure confidentiality. The field notes, taken immediately after the focus groups, were read with the transcripts to ensure the context was fully considered (Phillippi & Lauderdale, 2018).

At the beginning of each group, the moderator introduced themselves and the study, informed participants about the group rules (e.g. respecting each other's opinions, confidentiality) and reminded them about the voluntary nature of the meeting, recording the session and the right to withdraw. Following this, predetermined open-ended questions were asked (see section 4.3.2. on Interview guide).

4.3.5. Qualitative analysis

Focus group data was analysed using FA, which uses a combined approach to analysis, enabling themes to be developed both inductively from the accounts (experiences and views) of research participants and deductively (the inclusion of a priori) from existing literature (Gale et al., 2013; Lacey & Luff, 2007), which made the approach specifically suitable for the purpose of this study. The process of analysis (consisted of 5 systematic and visible stages: familiarisation, identifying a thematic framework, indexing, charting, mapping and interpretation) enabled the tracking of decisions, and movement back and forth across the data until a coherent account emerged and enabled links between the original data and findings to be maintained and transparent, which added to the rigour of the research process and enhances the validity of the finding (Furber, 2010; Lacey & Luff, 2007; Smith & Firth, 2011). In addition, at each stage, the process of the analysis can be referred back to the original data (Furber, 2010) and the distinct phases allow the method to be reproductible and consistent, ensuring the reliability of data (Lacey & Luff, 2007). Data was coded by multiple coders to ensure rigour. Microsoft Excel was used to organise data and synthesise under themes.

Nonetheless, using the FA is not without limitations. FA methods are considered to be time consuming and resource-intensive, however, this limitation has been suggested to be a common feature of all qualitative analysis methods (Gale et al., 2013). Furthermore, FA needs to be undertaken in a committed fashion in order to ensure that all data is considered and the process of following all five stages has to be conducted in a rigorous manner (Ward, Furber, Tierney, & Swallow, 2013). Finally, some authors have suggested that the FA lacks the same theoretical underpinning as other qualitative approaches such as grounded theory and ethnography (Smith et al., 2011). Despite the above, it was considered appropriate for this study, given it permits both a priori and emergent themes.

Stage 1 – Familiarisation

The main objective of this stage, often also described as a process of immersion, was for the researcher to become familiar with the focus group recordings and transcripts to get a holistic view of what had been said during the discussions prior to dividing them into sections and identifying recurring themes (Rabiee, 2004; Ward et al., 2013). In practice, the researcher listened to all recordings and read the transcripts, nonetheless, the familiarisation process began at the outset of the research, whilst the focus groups were being undertaken, which essentially improved the time taken to become fully familiar with the data (Ward et al., 2013). Each focus group lasted between 40 and 60 minutes and produced between 4500 and 8200 words. The field notes, which the researcher took immediately after focus groups, were also read with the transcripts in order to ensure that the context was taken under consideration (Phillippi & Lauderdale, 2018; Ward et al., 2013). It has been suggested that field notes are useful, not only to record thoughts, feelings, and issues which might be important while analysing data, but also to consider the overall setting of the research (Phillippi & Lauderdale, 2018). In the case of this study; the geographical location of construction sites, access to the food outlets, size of the site, facilities available, the temporary or permanent character of the site, and the nature of built on the site (e.g. housing).

Stage 2 - Identifying a thematic framework

The objective of this stage of FA is to organise data in a meaningful and manageable way for further exploration (Parkinson et al., 2016). During familiarisation, the researcher read the transcripts and applied a label (a code) that described what had been recognised in the passage as important. This process of developing framework was informed both by *a priori* as well as emergent themes (Ritchie et al., 2013). The recurring themes were then added to a chart using Microsoft excel software, forming a working analytical framework.

Stage 3 – Indexing

The draft analytical framework, which was developed in stage 2, was now systematically applied back to all the transcripts (Furber, 2010; Ritchie et al., 2013). For example, if evidence of skipping meals was noted in the margin of the fourth transcript, then during the indexing process, evidence of this theme would have been sought in the previous three transcripts, to ensure it has not been initially missed. In order to index the data, hand notes were made on the margins of the transcript printouts, regarding which theme was reflected in each section (Ritchie et al., 2013). This allowed the researcher to even further immerse in the data and refine the themes, where necessary, to more accurately reflect the data (Ritchie et al., 2013). For example, an initially developed theme 'alcohol consumption' was changed into 'other unhealthy behaviours' to merge issues of smoking, gambling and drug consumption, next to the alcohol intake. This was because individually, these themes were not significant enough to allow for the creation of separate themes.

Stage 4 – Charting

At this stage, a Microsoft excel spreadsheet was used to generate a matrix and data was charted into the matrix. This stage also allowed the data to be reduced to brief, but understandable statements (Furber, 2010; Ritchie et al., 2013). It required an ability to find a balance between reducing the data, and at the same time ensuring that the original meaning and the 'feel' of the words remained (Gale et al., 2013). Furthermore, all illustrative and interesting quotations were charted.

Two different types of charts were identified by Lacey & Luff (2007): thematic, where the data is provided for each theme across all cases and case charts, with a provision of the data for each case across all themes. In this study, thematic charts were used. Table 4.1. (below) illustrates an example on how the data was managed. It presents the theme of 'water intake', which was identified in the literature review and in three, out of five, focus groups. The example table includes the relevant statements from the transcripts. This way of summarising data into the charts was useful to visualise it as a whole (Furber, 2010).

Table 4.1. An example of the thematic chart

Theme	**Literature review**	**Focus group 1 (workers)**	**Focus group 2 (managers)**	**Focus group 3 (managers)**	**Focus group 4 (workers)**	**Focus group 5 (workers)**
Water intake	Keeping hydrated as an issue; avoiding fluids due to a difficulty in taking bathroom breaks (Nea et al., 2017).	"Just a little of water, not much"	"I probably drink too much coffee and not enough water" "I don't take much water"			"Coffee and tea, never water or juice" "People like June will take a bottle of water out with her"

Stage 5 – Synthesising the data by mapping and interpretation

After the thematic frameworks were applied to all transcripts, the data was synthesised (Ritchie et al., 2013). During this stage, the thematic charts were reviewed, themes were compared and checked against the original transcripts, field notes and audio recordings were revised to ensure appropriate context and to interpret the data (Furber, 2010; Ward et al., 2013). This allowed for the evidence of patterns to emerge between themes and participants from different construction sites. For example, participants from focus groups that took place on permanent construction sites often mentioned a habit of bringing food from home, while those working on temporary sites and staying in rented accommodation frequently discussed barriers related to a lack of cooking facilities and a remote site location negatively affecting their food choices. Furthermore, gradually, characteristics of and differences between data were identified and the relationships were explored, for example, the participants who spoke about meal preparation at work, cooking with colleagues and peer pressure often stayed in rented accommodation while working on the site. All themes are presented and discussed in the following section.

4.4. Participant and construction site characteristics

In total, 38 participants (11 managers and 27 workers), working on three different construction sites (in three different organisations) took part in the focus groups. The table below (table 4.2) provides details regarding the number of focus groups taking place on each site, participants in each group and their characteristics. Furthermore, the table shows the sites' sizes, their primary purpose, and whether the site was permanent or temporary. It also provides details regarding the workforce characteristic (if transient or living locally), facilities available on the sites, and proximity to food outlets.

Table 4.2. A summary of participant and sites characteristics

	Site A	**Site B**	**Site C**
Number of focus groups + participants (n)	1 Workers; n=9	3 Managers; n=11 Workers; n=8	1 Workers; n=10
Size	Small - 12-14	Large - 300	Medium - 50-100
Site status	Permanent	Temporary	Temporary
Workforce characteristics	85% - live locally 15% - transient *	30% - live locally 70% - transient	60% - live locally 40% - transient
Facilities on site	Kitchen with a blender, grill, microwaves, kettles and fridges; sitting area	Kitchen with microwaves, kettles, fridges, a blender, grill; sitting area (only in 2 main cabins)	Kitchen with microwaves, kettles, fridges and storage area; sitting area
Local food outlets	Walking distance – a supermarket, other site canteen	A fast-food van available on site Drive (15min) –coffee shops, a petrol station, fast-food restaurants	Drive (15min) – a sandwich shop, fast-food restaurants, a coffee shop, supermarkets

*Transient workforce – workers who work away from their normal place of work or have no fixed work base (HSE, 2021)

In this study, terms ‘participants’ or ‘construction workers’ referred to all working on construction sites, including both workers doing physical jobs and managers, supervising or organising jobs. If differences between workers and managers were found in the analysis of focus groups, these were explicitly discussed in the results section. Figure 4.2 provides a schematic presentation of all types of participants, who took part in the study.

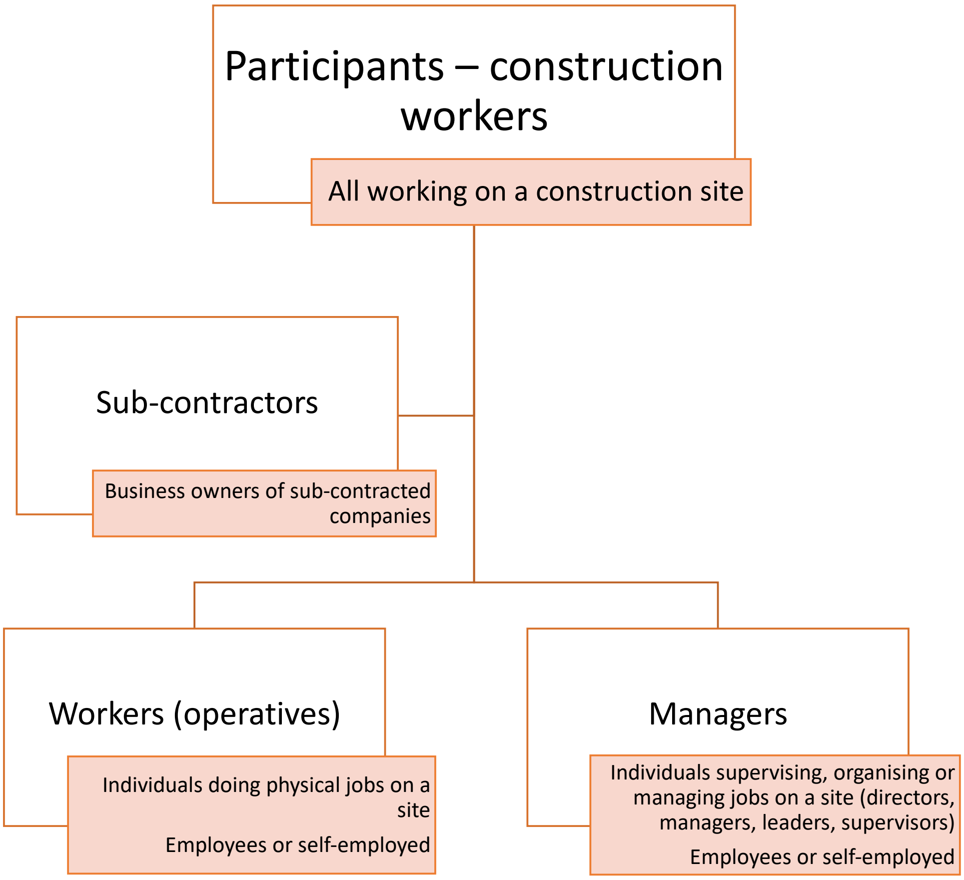

Figure 4.2. Schematic presentation of all types of participants taking part in the study

4.5. Results – focus groups part one

The aim was to explore nutritional practices amongst UK construction workers and managers as well as barriers and facilitators to eating healthily at work. This was achieved through: the review of relevant literature and identification of priori themes and the analysis of five focus groups with managers and workers from three different construction companies. Based on the literature review, 25 themes were established and 21 of them were common with the focus groups findings. In addition, 8 new themes were identified from the focus group discussions (see Appendix 3 for a summary of all themes**).**

To answer the aims of this study, the focus groups were analysed against the constructs of the COM-B model (Figure 4.2). This approach has been used to understand the behaviour *"in the context in which it occurs"* (Michie et al., 2014, p. 59). The interlinking arrows in the model illustrate the significance of the dynamic interrelations between the components, for example increasing capacity or opportunity can lead to an increase in motivation (Michie et al., 2014). Themes relating to current nutritional practices as well as barriers and facilitators to healthy eating in the workplace were organised using COM-B, and grouped under four categories: behaviour, capability, motivation, and opportunity (Figure 4.2). This approach has been previously implemented in health research with success (Atkins & Michie, 2015; Curtis, 2016; McEvoy et al., 2018; Ojo et al., 2019). Themes highlighted in colour are new themes, which were identified in the focus groups, while themes in black were previously known from the literature, and also found in the focus groups.

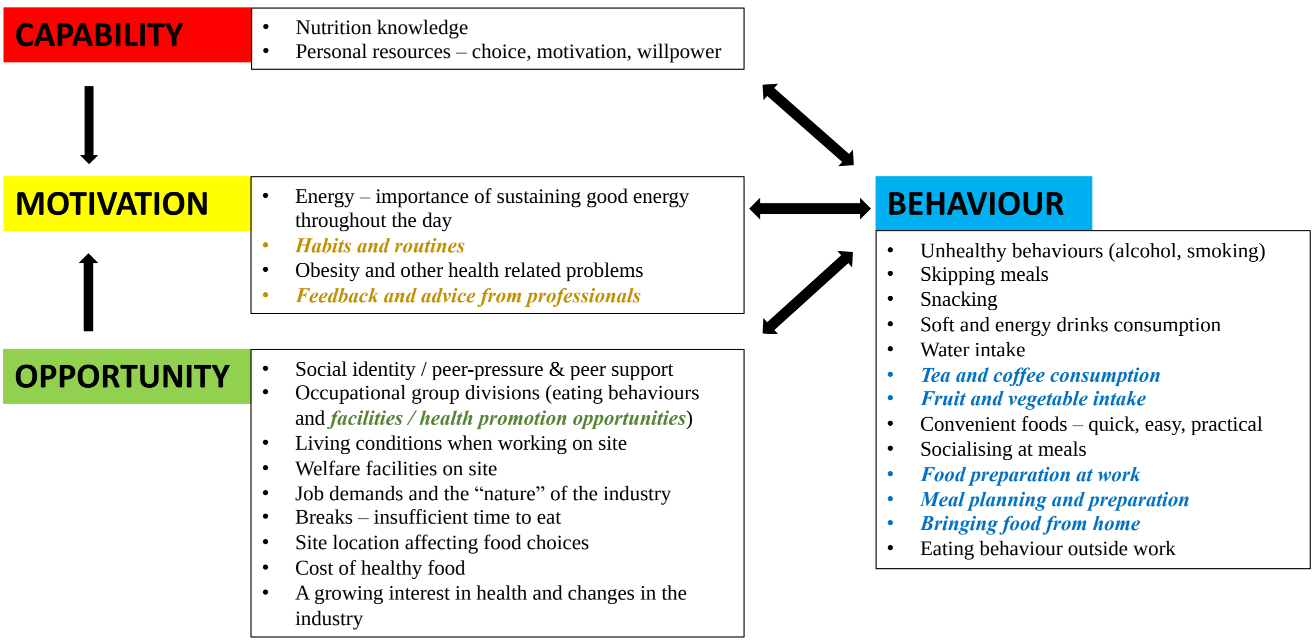

Figure 4.3. COM-B model of nutrition practices amongst UK construction workers (Michie et al., 2014)

4.5.1. Nutrition behaviour of construction workers

Intervention designers have been encouraged to define problems in behavioural terms, because a problem expressed as an outcome does not indicate the behaviour one is trying to change (e.g. weight gain does not suggest what behaviour needs to change) (Michie et al., 2014). Furthermore, it has been suggested that the intervention design should initiate with a list of potential behaviours that might be relevant to the problem (Atkins & Michie, 2015). Therefore, this section begins with a presentation of focus group findings related to nutrition or health related behaviours amongst construction workers (the blue section in Figure 4.3 above). Although this section is mainly associated with behaviours at work, it will also mention eating / health habits outside work. This section starts with a discussion of unhealthy practices amongst workers (e.g. alcohol consumption), followed by the presentation of a number of the most common eating behaviours, including snacking, skipping meals, energy drinks, water, and coffee intake, as well as fruit and vegetable and convenience food consumption. Furthermore, it focuses on socialising behaviours during mealtime, food preparation, and meal planning before it considers bringing food from home and finally, eating behaviours outside work.

Excess alcohol consumption and smoking were identified in three focus groups (all sites) as common unhealthy behaviours. Although the amount of alcohol was not specified, there was a general feeling this was higher than recommended. Respondents acknowledged that there is a problem with excessive alcohol consumption in construction, and although workers are not allowed to drink when on site and random spot checks are carried out, they frequently drink after work, potentially without even realising the amount and the impact it has on their health. Smoking was also mentioned as a common behaviour, with a concern that quitting was associated with putting on weight:

> *"I probably drink too much alcohol" (FG2, managers)*

> *"I went from smoking a packet of cigarettes a day to eating a packet of biscuits a day, when I gave up" (FG4 workers)*

Managers and workers from five focus groups reported that they frequently skipped meals. Poor accessibility to food, short breaks, busy schedules or not being hungry were the most common explanations. None of the participants showed any awareness as to how skipping meals affected their energy and concentration levels.

> *"Sometimes you don't eat at all. Sometimes you're that busy you don't eat at all so it can be very varied" (FG3 managers)*

The habit of snacking was declared by participants in all five focus groups, however, differences in the nutritional quality of snacks were noticed, with some snacking on fruit and nuts, while others on crisps, chocolates, jam, bagels, peanut butter, and biscuits. Snacking was also considered a way to deal with monotony and boredom by managers (but not workers), with some reporting bingeing on snacks like biscuits. This might be related with managers having more sedentary jobs allowing them to snack throughout their shift.

> *"I might have a biscuit, then lunch I might have a biscuit" (FG4 workers)*

Following snacking habits, construction workers reviewed their daily consumption of drinks, including soft and energy drinks. Participants in two focus groups highlighted the high consumption of energy and sugary drinks as means to sustain energy throughout the day, with some individuals reporting drinking 6 cans or more during the day (see also sub-theme on 'Energy'). This was highlighted as a general problem across UK construction sites, with participants suggesting that workers replace meals with caffeinated drinks to *"to get through the day".*

> *"... So you smash an energy drink, I've seen it on other sites, up the river, people don't even have lunch sometimes, they'll just have an energy drink just to get through the day, which, yes, that's suits me but it's just full of sugar, it's absolutely packed" (FG1 workers)*

At the same time, low intake of water was repeatedly mentioned by participants in three focus groups (managers and workers across three sites). Participants declared drinking little or no water and replacing it frequently with coffee and tea (discussed below). A habit of keeping a bottle of water while on site was mentioned only on one occasion in reference to a female worker from a medium site.

> *"Coffee and tea, never water or juice" (FG5 workers)*

An excessive consumption of tea and coffee, described as: *"plenty", "too much", "drinking all the time", "as much as I want*", was discussed in four focus groups (all sites). Some workers reported having eight cups of coffee daily, often with large amounts of sugar and milk, to keep energy levels up, especially as these were free of charge, *"generously supplied*" by the company.

> *"I am happy with coffee. Keeps me awake" (FG1 workers)*

Fruit and vegetable intake was considered in all five focus groups with mixed responses. Some ascertained their frequent consumption, declaring a daily intake of fresh carrots, apples, grapes, while others did not, although they recognised their importance:

> *"I feel bad, because I occasionally have an apple and I like carrots and pickled onions and stuff, but that's about as far as I'll go" (FG4 workers)*

The main barriers to fruit and vegetable consumption were that vegetables were not perceived as providing sustainable energy. Moreover, participants from the large site with the majority of transient workforce, had to rely on the food provided in rented accommodation (see sub-theme 'Living conditions when working on site' where it was also reported), where the fruit and vegetable provision was outside of their control. Workers who lived locally and brought packed lunches from home seemed to struggle less in this respect. This was the case on the small, permanent site.

> *"There was a beef stew and dumpling with vegetables last night so that was an option that I chose purely to get some veg intake" (FG3 managers)*

The consumption of convenience foods, including fast food, ready meals, junk food and eating out was repeatedly mentioned by all participants due to limited food outlet accessibility, short break times, lack of time to think about food when shopping, convenience in preparation (e.g. microwave heating) and the need to stay satisfied for longer. For example, workers from a small construction site repeatedly mentioned that they rely on quick options from a local supermarket (e.g. Tesco meal deal) as they only have 15 minutes to buy food, while others said that they need quick and practical food choices as they do not want to *"waste time cooking*". Similarly, managers and workers from the large site frequently reported buying lunch from a food van, even though they were aware it was not a healthy option:

"I'll maybe go to the Grub's Up van that comes around and get rice and chicken covered with cheese. It tastes good, but I know it's slowly killing me" (FG2 managers)

Other frequently chosen quick and easy food options, which were mentioned by managers and workers from all focus groups included meals like: pre-packed sandwiches, crisps, ready meals, frozen hamburgers, McDonald's breakfast, pizzas, chicken wings, chicken nuggets, pastries, ham rolls, cooked bacon, sausage rolls, fish and chips, kebab, or Chinese. Moreover, participants from three focus groups reported that they tend not to spend much time thinking about the food they selected in shops, but rather *"grab the closest and easiest thing"* (see sub-theme 'Habits and routines' where it was also reported):

"Straight into the shop, just grab … you don't tend to think about what you're grabbing off the shelf, you just think what's easy to cook, what's going to last longer and what's going to fill you up" (FG4 workers)

Storage problems (i.e. a lack of space to keep food) on site were also mentioned by workers from a large site for their reliance on pre-packed, non-perishable foods. Thus, workers regularly said that any changes suggested to their diet need to be practical and easy, as the nature of their jobs, stressful lifestyle, and/or being away from home does not allow for the implementation of complicated recipes and the creation of long shopping lists:

"Recommendation of food or something like that, it would have to be under the bracket of easy to make … easy and quick to make" (FG4 workers)

Participants in three focus groups talked about socialising at meals; eating, cooking together, and sharing food (e.g. an 'around the world' Friday meal on a small site) as a convenient way to organise meals, stay healthy and bring the team together. This was particularly prominent on sites where most workers were not local, hence stayed in temporary accommodation during the week, with some clubbing together to share the burden of shopping and meal preparation.

"We found it beneficial to get a syndicate if you like and then we buy, I'll go and buy food for the week …" (FG3 managers)

Managers and workers from three focus groups (all sites) declared that they use the equipment provided to cook food on site. However, this was influenced by the variety and a number of facilities available on site, who these were available to (see sub-theme ‘Welfare facilities’) and break times (see sub-theme ‘Breaks’) and reflected the nutritional quality of meals, which ranged from fast food meals heated in microwaves (on a large and a medium site), to breakfast porridge and omelettes, and even grilling a full chicken (on a small site, which is often closed due to weather). Workers cooking on site were most often those who stayed in temporary accommodation lacking in food preparation facilities.

> *“Fast food in terms of what we cook out in the kitchen like paninis” (FG3* managers)

The importance of meal planning and preparation was mentioned in three groups, with some recognising the significance of planning meals, while others discussed a lack of motivation in staying organised. Although participants appreciated the benefits of advanced meal preparation on their health and nutrition choices (e.g. not relying on convenient fast food), they expressed concern about the time it takes. All three groups where it was discussed took place on a large site, which is remote, without any food outlets in a close proximity and where the majority of the workforce is transient, staying in a temporary accommodation.

> *“It’s worth half a day’s prep, because all I’ve got to do is stick it in the microwave So, I’ve got fresh chicken, fresh veg … And the difference that makes with a bit of food… two weeks feel so much better” (FG2 managers)*

Managers and workers from two sites spoke about habits of bringing packed lunch from home, which often consisted of leftovers from the day before or a meal prepared by a partner. This, however, was determined by the nature of the site (temporary or permanent) and a location. Participants from both groups lived locally to the sites, which were permanent or long term. Furthermore, good storage facilities on site were important in determining if workers brought food from home:

> *“Because they’ve got a big enough fridge to suit everybody here, depending on if people are going home or whatever, people bring stuff” (FG1 workers)*

It was not uncommon (mentioned in four groups) for both managers and workers to conclude that a long day of physical work affected the quality of meals consumed outside of the workplace and a lack of food preparation for the next working day (see sub-theme 'Personal resources').

> *"If you look at most of the guys here they're doing physical work, by the time they get home they're trying to deal with the family, cook and stuff like that. So by the time you've got to sort out your lunches for tomorrow, you're like, oh I'm going to leave it" (FG5 workers)*

4.5.2. Capability – psychological and psychical capacity to perform the behaviour

Capability can refer to either worker's psychological (e.g. knowledge, psychological skills, strength or stamina) or physical (e.g. physical skill, strength or stamina) capacity to engage in the activity concerned or to perform the behaviour (Michie et al., 2011; Michie et al., 2014). Results associated with this component focused on workers' knowledge about nutrition and a lack of personal resources (stamina, energy, willpower) preventing them from improving their eating behaviours.

Nutrition knowledge was discussed in all focus groups, including an interest in learning about food, its impact on the body and mind, as well as participants reporting limited understanding of healthy eating or frequently forgetting about the healthy nutrition habits due to job demands. One of the workers from a small construction site even voiced the need to introduce nutrition education to schools:

> *"The biggest thing is education and it's one thing in school that people aren't taught, it's about nutrition" (FG1 workers)*

Participants offered suggestions as to how to recognise whether food is healthy or not, including: checking portion sizes, sugar and salt content, preservatives, and using the traffic light system on food labels. They also reported they considered food "*looking healthy",* being "*nutty*", avoiding processed foods, eating fresh foods, cooking from scratch, having colourful foods on the plate and eating a variety of foods. Younger workers were usually considered more knowledgeable about nutrition, however, a general confusion was caused by the media about what is healthy, as well as misleading information on food packaging, was a concern for some.

> *"There is so much conflicting information about … sugar is the enemy, then fat's the enemy, then carbs are the enemy" (FG2 managers)*

Although workers expressed an interest in learning more about the impact of the food on the body and mind, and practicality of education was mentioned in all focus groups as an important requirement to make a nutrition intervention a success:

> *"But stuff that's readily available, around. You don't have to, if you want to get one of these items you don't have to go to Taunton or somewhere to get it. It's accessible to us…" (FG3 managers)*

A lack of personal resources, motivation, stamina, energy, or the willpower to prepare food or pursue healthier food choices, due to demanding and stressful jobs, was recognised by participants in four focus groups *"Lazy"* and *"cannot be bothered"* were frequent expressions. Participants stated that they did not feel motivated to cook, and food preparation is time consuming, with one worker even considering it as *"main graft":*

> *"I'm like…for me just being lazy really, I like to eat all the healthy stuff but it does take time to prepare it" (FG3 managers)*

None of the participants from the focus groups declared spending time in the kitchen, feeling empowered, or motivated to pursue healthier food choices.

4.5.3. Motivation to do the behaviour

Based on the COM-B model, motivation can be reflective, involving self-conscious planning and evaluation, or automatic, involving wants and needs, desires, and impulses (Michie et al., 2011; Michie et al., 2014). According to Michie et al. (2014) workers must be highly motivated to do the behaviour at the relevant time, rather than not to do the behaviour. In this study, a need to sustain high energy levels while working emerged as important in relation to motivation, with workers often expressing beliefs about the need to consume high-calorie foods, and large quantities of caffeinated drinks to stay alert during the day. Another factor related to motivation was around habits and routines, with workers often declaring buying food without much of a consideration. In addition, workers' perceptions about obesity, and the ability to judge their weight status and health, as well as feedback from professionals on their health were important factors allowing them to evaluate food choices.

The importance of sustaining good/high energy levels to aid alertness, concentration and enable workers to carry out physical jobs was emphasised across all focus groups. Food and coffee consumption were highlighted as ways of achieving this, although there was debate about the role of high energy/sugary foods compared to protein foods, or slow releasing carbohydrates, with sugary diets being associated with being "*perpetually tired*" by some and affecting workers' willingness to cook in the evenings.

> *"But the key thing is, the industry is not like any other. None of my friends work from 7.00 until 6.30, so to keep you working at the rate you need to, personally I feel I need to have food, I need to" (FG2 managers)*

Nonetheless, there was a perception that food stuffs such as fruit were less sustainable than high sugar/high energy products:

> *"I think for these guys, because they're scaffolders, it's important for them to feel that they're fuller, and once they've stopped for their break ... and I'm not being funny, if you have like an apple and a banana at ten o'clock, these guys are going to be starving hungry" (FG5 workers)*

Next to meal planning, managers and workers from two construction sites discussed the value of having healthy nutrition habits and difficulties in changing unhealthy ones. Both themes were discussed only on a large site, which is temporary, remote, with the majority of the workforce being transient. Working on permanent sites, staying on the same site (even for a week), as well as good welfare facilities were recognised as providing additional motivation to maintaining a healthy routine. Nonetheless, participants highlighted that their shopping habits were often an automatic process led by the need to buy food quickly, rather than taking into account nutritional values.

"I can't remember the last time I didn't have this for lunch'. And it becomes a routine, and I guess it's getting out of that mindset as well" (FG4 workers)

Obesity and other health related problems (e.g. high cholesterol and high blood pressure) were mentioned in three focus groups as frequent motivators to improve health behaviours. Participants emphasised how work and lifestyle choices affected levels of obesity, with one manager highlighting a weight gain of almost five stone over a fifteen-year period. Another emphasised that whilst he could be successful at losing weight, he could not sustain this. Workers also highlighted the problem of abdominal obesity (even in slim individuals), noting its association with visceral fat responsible for health problems, and highlighting how this increase in 'belly fat' can be a wake-up call to improve their lifestyle and nutrition.

"Some of them [other workers on site] were really skinny, but they had quite high visceral fat, and that was a bit of a wake-up call for them…" (FG4 workers)

Workers expressed an interest in taking part in health checks (e.g. blood pressure and visceral fat measures) and appreciated opportunities to get feedback on their health status (two groups – a small and a large site) as it allowed them to evaluate (and potentially change) own health behaviours. However, participants suggested that these should be conducted throughout the day to allow flexibility for attendees. Managers did not express the same interest, which might be related to their employment status, and therefore, ana access to occupational health or employee assistance programmes.

"Health checks. You could go during lunch, you could go after work, you could go before work, and they would do a health check and make sure everything is alright like your blood pressure, visceral fat […] you're a bit more aware of your health" (FG4 workers)

4.5.4. Opportunity – physical and social components facilitating or hindering the behaviour change

Opportunity refers to both the physical (what the environment allows or facilitates in terms of time, triggers, resources, locations, physical barriers) and social (interpersonal influences, social cues, cultural norms) components in people's environment that either hinder or facilitates their behaviour (Michie et al., 2011; Michie et al., 2014). Focus group discussions relating to this component identified factors such peer pressure or support and divisions between different occupational groups affecting eating behaviours amongst construction workers. Furthermore, the facilities workers have available in their environment (both while on site and after work), job demands, break time, the food environment pertaining to local supermarkets, takeaway shops, and cafes were shown to facilitate or hinder healthy eating behaviours. The impact of food pricing on restricting workers' opportunities to make better food choices is also discussed in this section, which finishes with a theme around positive changes in health behaviours in recent years, which have been noticed by some focus group participants as an opportunity for health promotion in construction.

Although it was not widely discussed, managers from two focus groups (on the same site) mentioned the pressure placed on those who use the work kitchens to cook; feeling hassled when occupying facilities for too long, watched and judged, as well as cooking considered by co-workers as an excuse not to work. This was mentioned by managers, and not workers, as workers' facilities on site does not allow for cooking, but for reheating only (discussed below).

> *"The only issue in that kitchen there, it's like the main hub for everybody so everyone is in there, so everyone is watching what you're doing. What you're trying to cook. You get people trying to dip their fingers in your food and like 'oh what you doing there?" (FG3 managers)*

The differences between occupational groups (workers and managers) as well as employment status (employees vs subcontractors) were visible in the facilities provided on the large site, where workers and managers did not share the same welfare space (discussed in three focus groups conducted on the large site). Managers' cabins were often equipped with blenders, ovens, fryers, hot pots etc., while workers were often only provided with access to a kettle and microwave.

> *"I noticed here, at the main compound, there's a lot more in terms of food preparation availability" (FG4 workers)*

Similarly, potentially divisive differences were visible with regards to the wellbeing and health opportunities, i.e. the Fresh Fruit Monday initiative was not available to subcontractors, while fitness activities were designed for *"the same group of people" – "fitness freaks"*.

"We don't get any fresh fruit from "x" as part of Fresh Fruit Monday" (FG4 workers)

Workers living in temporary accommodation, particularly those lacking food preparation or storage facilities, reported repeatedly eating out, having ready-meals and takeaways, relying on non-perishable snacks in the evening or skipping dinner.

"Where myself and a lot of others suffer is we go back to hotel accommodation where you don't have cooking facilities. So you're reliant on meals that are served to you, like at the hotel and stuff" (FG3 managers)

One worker even discussed storing his food outside the window or in the car during cold months due to a lack of suitable facilities. Additionally, accommodation might be far from local shops or town centres, for example, limiting the range of foods that could be purchased if transport is unavailable.

"I've literally hung stuff out of a window, I left it in a car. England is cold enough; your food won't go bad if you leave it outside" (FG4 workers)

A well-equipped kitchen on site was reported to make food preparation, storage, and therefore healthier eating, easier, although the quality and quantity of facilities differed between sites and even cabins on the same site (see sub-theme 'Occupational groups divisions').

"I think the facilities we've got there are like nothing I've ever seen in a workplace before" (FG2 managers)

Furthermore, dirty cabins, the number of workers using the facilities simultaneously and safety factors, e.g. rats, were limiting factors for food preparation, often only allowing the storage of food for immediate consumption, which makes weekly meal planning more challenging, especially for those workers staying in rented accommodation, where food storage is not possible.

"Some of the sites, you might have 300 people in a canteen and you might not necessarily want to use some of the stuff that's up for grabs" (FG1 workers)

> *"We can leave a certain amount of food on site, but we're not really supposed to because of the possibility of rats" (FG4 workers)*

High levels of stress, tiredness, and long working hours consistently affected eating practices both at work and home, with some feeling *"sick and tired of work",* and even thinking of leaving construction, referred to as *"an industry like no other"* (discussed by all participants). Additionally, some declared eating fast food for comfort, or skipping meals due to tight deadlines. However, participants also recognised that feeling tired was not only due to job demands, but also poor diets.

> *"In the afternoon, you're not functioning properly and start thinking about leaving" (FG2 managers)*

> *"Usually, by the time I get back, I am just far too tired. In part, due to work, but in part – and this is where it becomes a vicious circle – is due to the diet" (FG4 workers).*

There was consensus across all focus groups that it is difficult to have a nutritious meal within a short break (max 30 minutes), particularly as construction sites are usually in remote locations, therefore, food choices are determined by the proximity of food outlets, rather than food quality. This was especially the case for workers, as managers were more relaxed when taking their breaks and preparing food.

> *"I have lunch when I have the time for it, a window for it. The lads on site, they don't have that. Half ten they're coming for their break and they've got half an hour suddenly to try and do all this" (FG2 managers)*

> *"But it is a distance. It's ten minutes that way. Your break is half an hour so that's ten, ten, and then you have to eat" (FG5 workers)*

A short break and many workers using the same kitchen space further limited food preparation opportunities, even where good facilities were provided. One of the managers explained that even if education about nutrition is provided and workers are given ideas for easy and quick healthy meals which could be prepared at work, a restricted break time and insufficient quantity of food preparation equipment, in comparison with a number of workers on site, might still provide a barrier preventing them from changing their eating habits:

> *"If you've got thirty blokes going to canteen all wanting to do poached eggs, well you're only going to get ten of them with a three-minute poached egg, aren't you, until they have to go out again?" (FG2 managers)*

Workers and managers from three focus group (on all sites) discussed how the site location, far from town centres and food outlets, affects their food choices. Workers have to rely on what is available nearby, with some having no access to a car, making their food choices even more challenging. Even limited parking was cited as a barrier with some participants choosing to use a food van on site due to a concern of not being able to park their car upon a return from the lunch break.

> *"You're kind of limited to what's around. Mainly using the van when I'm here" (FG2 managers)*

The cost of food, particularly foods perceived as healthy, was recognised as prohibitive in three focus groups (on all site), who reported that healthy food was more expensive, less convenient, with smaller portion sizes. The price of a salad was compared to a 'meal deal' by one worker, who highlighted he would need to spend £100 monthly to eat more healthily.

> *"... it's so expensive that you can't justify eating a sandwich that's like so tiny and it's probably the healthiest, but it will be like five quid" (FG5 workers)*

Positive nutritional behaviours were reported to have happened over the last 10-15 years with fewer employees buying food from burger vans and more bringing *"salads and hummus and carrots and stuff like that".* This is especially visible in younger workers (referred to as a generational change in the industry) being more health conscious, practicing better nutrition habits and attending gyms (discussed in two focus groups), which was highlighted as an opportunity for health promotion aimed at improving nutrition behaviours amongst workers. However, health and wellbeing practices amongst sites differed, with some companies running a variety of initiatives to *"lead from the front"* and *"leave a legacy"*, with other sites *"being not interested".*

"Maybe a little bit of it will go along to the next projects and hopefully may change the world of construction" (FG1 workers)

4.6. Results – focus groups part two

The aim of this study was to explore the perceptions of construction workers and managers in terms of their experience with previous and current health and wellbeing interventions, and how to design a workplace nutrition intervention, which would facilitate healthy nutrition choices amongst construction workers. This was achieved through conducting five focus groups with managers and workers from three different construction companies, and the analysis of results.

In total, 9 themes arose from the focus group discussion with construction workers and managers. In order to provide the clarity to the results section, the focus group themes were divided into three main categories (see Figure 4.4): A - health and wellbeing initiatives on the construction sites, which covered both current and previous workplace programmes (1 theme - in green), B - themes related to the content of nutrition intervention, including nutrition topics of interest (3 themes – in blue), and C - themes related to the implementation of intervention, including topics around participation, accessibility, promotion, and support (5 themes – in orange / red).

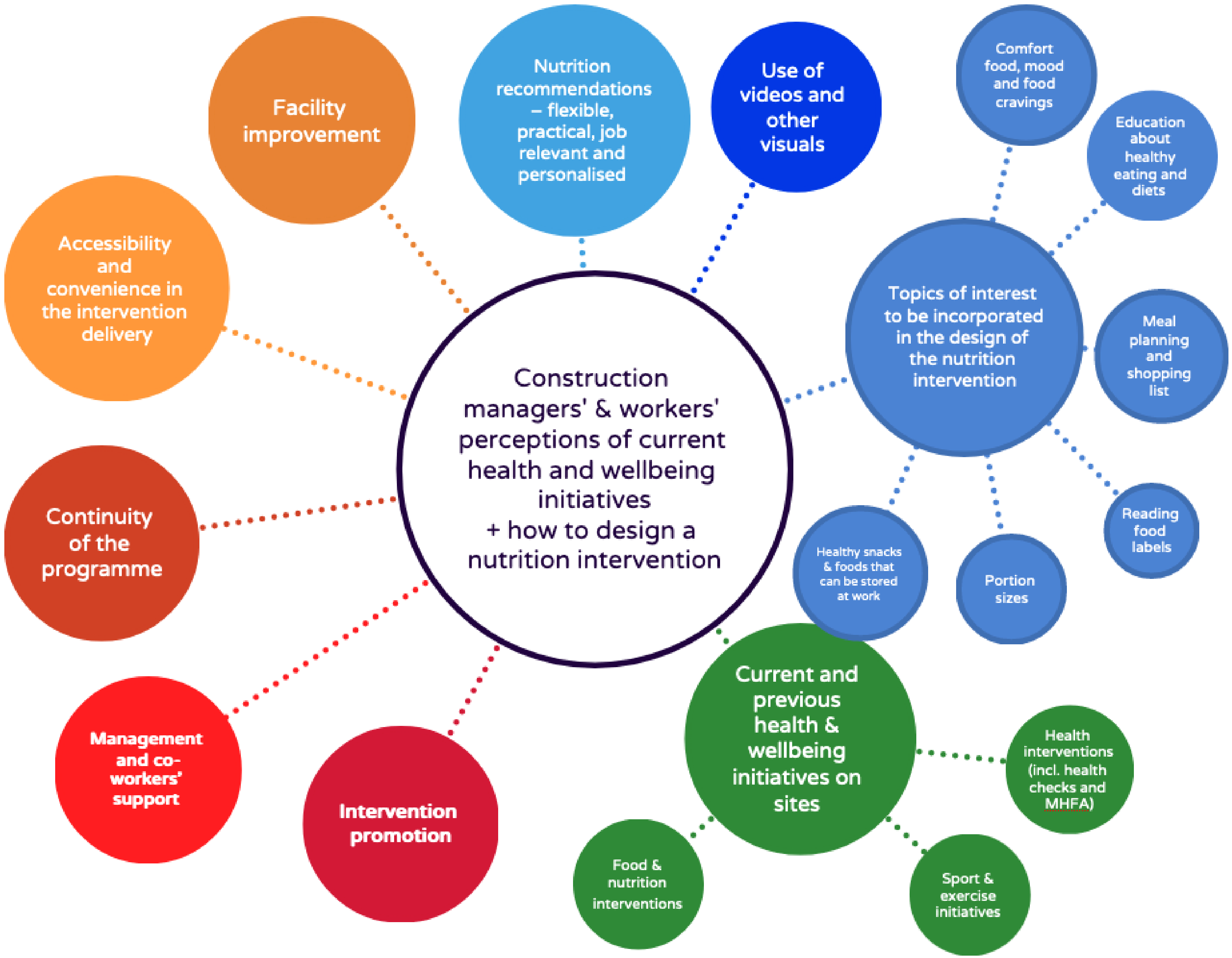

Figure 4.4. Focus group themes exploring construction managers’ and workers’ perceptions of current health and wellbeing initiatives and ways to design a workplace nutrition intervention

4.6.1. Themes related to current or previous health and wellbeing initiatives on construction sites (A)

4.6.1.1. Current and previous health and wellbeing initiatives on construction sites

The first theme identified related to current and previous health and wellbeing initiatives on construction sites, and included three sub-themes: health interventions, including health checks and mental health initiatives, sport and exercise initiatives and food and nutrition interventions. These are discussed in turn in this following section.

Health checks provided by nurses or other health professionals were discussed amongst participants in three focus groups (on three different sites). However, only workers from the permanent site, where the vast majority were employees, discussed regular health checks taking place on site to monitor weight, blood pressure, cholesterol.

> *"We get a regular visit from our health nurse" (FG1, workers)*

However, some of the workers from the same site were not aware of the ongoing initiatives allowing them to see a professional nurse in their workplace.

> *"We haven't had any programmes like this, it is more just keeping track of our own personal health" (FG1,* workers)

Despite mentioning health checks, participants from other focus groups (FG4 -large and FG5 – medium, both temporary) highlighted that these were no longer taking place or had never been on the site they currently work on. Nonetheless, workers who previously attended a health check said the information and feedback was useful in making them aware of their health and often served as a *"wake-up call"*.

> *"Quite a few of my colleagues who hadn't realised. Some of them were really skinny, but they had quite high visceral fat, and that was a bit of a wake-up call…" (FG4, workers)*

Workers from the middle size site discussed the skin health and sun protection initiative (FG 5). Participants mentioned that the company aimed to create awareness of the importance of protecting skin, especially amongst those working outside and to encourage the use of sun blockers by distributing creams to all workers free of charge. However, some of the workers do not use the product, explaining they frequently forget.

> *No. You just don't think about it really, do you? You come to work to go to work. You don't think about putting on some sun screen just to go and do whatever you want to do" (FG5, workers)*

Mental health programmes were mentioned by participants from four focus groups (on all sites), with the initiative of Mental Health First Aiders (MHFA) being the most popular. Although the MHFA's programme is well-known, both managers and workers do not have complete trust or confidence in it. For example, managers from the large construction site admitted that they do not feel comfortable telling personal stories to nominated first aiders, due to a fear of lack of confidentiality. Participants also reported that they would not speak to managers about their mental health problems, due to a fear of losing their job. Other concerns included the short duration of the MHFA course, therefore, insufficient education on the subject to make a difference to the mental health in construction.

> *"If I was to speak to personal problems to any of those mental first aiders I don't think they would, it would be…Confidential?" (FG3, managers)*

> *"Managers will be put through mental health training, but it's a day's course, so in reality it's not really going to educate" (FG5, workers)*

> *"If I go and speak to the site manager about something, that I'm concerned about what's wrong me, he might not want me on his site" (FG5, workers)*

Both managers (FG3) and workers (FG5) suggested that mental health support should be provided by third party professionals, external to the company. FG5 was conducted amongst workers who were mainly self-employed and work on site temporarily, however, FG3 participants were managers employed by the main company, on permanent or long terms contracts.

On a positive note, although managers from the large site admitted that these are still early days when it comes to rolling out mental health programmes on the site, there is a growing awareness of mental health issues and as a company, they "*always do something on mental health, once a month, at least",* usually as a part of the whole workforce monthly meetings. Another encouraging example came from a discussion on the small site; workers mentioned a "*quiet corner*", a place they built with the purpose of having a space for quiet, calming, reflective time, or simply to relax. This is a small permanent site (12-14 workers), where employees have been working together for many years and are mainly employed by the company.

> *"Have a bit of quiet time in a quiet sort of corner out there and just yes, welfare and things like that" (FG1, workers)*

Sport and exercise were mentioned by participants in four focus groups (on all sites), with on-site gyms and fitness classes most frequently declared. Workers and managers from the large site discussed the availability of gym facilities on site, which are open to all staff. A creative way of staying fit was presented by workers from the small site (FG1), who explained that the gym on site is a result of their work and individual contributions. The workers built gym equipment out of timber, redundant equipment, chains, and old metal frames, while the gym room was made from an abandoned shipping container. This is a permanent, logistic site, which due to the weather conditions, might sometimes be closed, allowing workers to spend this time on different activities.

> *"We had a shipping container on a boat that had been left for a long, long time and the windows had been blown in, the birds had been in there and nested in there, sea birds, seagulls and it was full of their mess and we cleaned it all out and the guys relined it and we've got power put to it and light put to it and we can have music in there" (FG1, workers)*

Furthermore, workers from the same site explained that part of the equipment inside the gym comes from websites selling second-hand items cheaply or was collected from the street, if *"it had been left outside somebody's house*". Participants described they are often on *"a look out"* for gym equipment when their neighbours do house clearing and, in this way, they managed to find bikes, punching bags and pull-up bars. This level of commitment would seem to be influenced by the permanent character of the site, meaning workers will not be moved to a different location.

"It's like this time of year now, a lot of people would join gyms, buy in, bikes at home and things like that and in March, they will all be throwing them out. But we've managed to collect one or two of those things, off different sites, websites, things like that" (FG1, workers)

Fitness classes were another form of staying healthy at work. Managers and workers from three focus groups (all conducted on the same, large site) mentioned group exercise classes (circuit and yoga), which take place on site, and are taught by employees themselves (those with fitness qualifications). Although managers declared that classes are delivered multiple times a week and have good attendance, workers from the same site expressed a concern that due to the class scheduling, they cannot take part. Workers mentioned that although they consider workplace classes *"a great idea",* they would never be allowed by their supervisors to attend a lunchtime yoga or circuit class. Another barrier was the advanced level of classes (see 'Accessibility and convenience in the intervention delivery' subtheme where it was also discussed).

'Cycle to Work' scheme, rowing and cycling challenges, walking groups, and football were also discussed by participants. Looking at these in turn, the 'Cycle to Work' scheme was mentioned by workers from the large site, who expressed a concern that the scheme is only offered to company employees, not self-employed, who comprise approximately 70-80% of workers on site. Furthermore, there is a minimum length of employment criterium, which applicants need to meet in order to qualify. This is an issue in construction, with temporary and contractual jobs, meaning most workers might never qualify for the scheme.

"You have to work for the company for a year for that to even count for you, though, which, when you do contractual jobs that are three months long, that's not particularly useful" (FG4, workers)

Rowing and cycling challenges were discussed by workers from the small site (FG1). Static bikes or rowing machines were available on site, encouraging workers to use them, and note their distance, with an aim to reach certain destinations, as a team (e.g. row from London to Sydney). Some other challenges mentioned by the same group of participants included recording collective data on the distance and sending it back to company Head Quarters, where the most active site was selected and awarded a special prize.

> *"We've still got it set up outside, actually. They want us to row a certain distance, Jake, you remember where it was from? -Trying to get from here to Australia" (FG1, workers)*

Additionally, managers from two focus groups (Site B – the large site) acknowledged recent initiatives of group hill walks in the area, and football games on Tuesdays, which are well attended by site workers. There were approximately 300 workers on this site, and up to 80% of the workforce did not live locally, therefore relied on activities and social opportunities provided by the company. Furthermore, the site is managed by a young management team, who share a passion for fitness and healthy living.

> *"And we play football on Tuesdays. We do get site people who come to that" (FG2, managers)*

A nutrition, environmental project taking place at work was mentioned by workers from the small site (which due to weather conditions is sometimes closed). The ambition was to clean up the river Thames by removing plastic bottles from it, which were used to make vegetable plots and a greenhouse. The project is in its second year and provided a very successful harvest in the first year, and although workers were joking that it might not be enough to *"feed them all",* enough vegetables were produced for Friday meals together.

> *"We took the opportunity, the nature of the project that we work on, is an environmental project, trying to clean up the river, to make London a nicer place. So we decided ... to try and make some veg plots to try and grow our own stuff on site, not necessarily enough to completely sustain everyone here, but…" (FG1, workers)*

'Fresh Fruit Monday' was one of two nutrition-related programmes mentioned by participants (FG2, FG3, FG4 – all from the same, large site). Managers declared a recent introduction of an initiative of supplying a big box of fresh fruit, which is left in the staff canteen for employees to help themselves. However, during the discussion with workers from the same site, it became apparent that the initiative is available to office staff, as fruit is delivered to the main cabin only. Workers felt that the availability of fresh fruit could be a good way of encouraging them to consume more fruit and vegetables and asserted that they had not been aware of the 'Fresh

Fruit Monday' scheme until it was mentioned during the company meeting earlier on the same day.

> *"We only heard about fresh fruit Mondays today. We don't know anything about it, we don't know that this has been implemented" (FG4, workers)*

The fresh fruit initiative was not mentioned by workers from the medium site, however, when prior to the focus groups, unofficial introductory meetings were conducted with managers from the site, they highlighted the fruit initiative. This suggests that similarly to the previously discussion on construction site B, workers were not aware of the initiative as fruit was not delivered to their cabins.

The final nutrition-related programme discussed by workers on the medium, temporary site was a summer hydration campaign, aiming at raising awareness about the importance of drinking water and safety. The campaign was in the form of a poster with the colour of urine, reminding workers to drink water.

> *"Literally, it's just a poster, the colour of your urine, just reminding the guys to keep hydrated throughout the course of the day, drink water" (FG5, workers)*

4.6.2. Themes related to the content of nutrition intervention (B)

4.6.2.1. Topics of interest to be incorporated in the design of the nutrition intervention

The second theme identified related to views on the content of nutrition intervention and included topics of interest, to be incorporated in the design of the nutrition intervention. This theme has six sub-themes: (i) education about healthy eating and diets, (ii) portion sizes, (iii) reading food labels, (iv) comfort food, mood and food cravings, (v) ideas of snacks and foods that can be stored at work and (vi) meal planning and shopping lists (See Figure 4.3).

Participants from three groups stated that education and raising awareness around nutrition needed to be an integral part of the intervention design, so that they could learn about healthy eating and reflect on their own eating habits. Struggles with accessing reliable nutrition information and difficulty in navigating conflicting nutrition advice were mentioned.

"But I think as well, access to reliable nutrition information. Because I know the whole field of nutritional research can be a bit of a minefield" (FG4, workers)

Participants spoke about wanting to find out about health benefiting properties of foods as well as negative impacts of foods they frequently consume. One participant provided an example of health benefits of coconut water, which as he claimed, many people might not be aware of.

"… as well as knowing what's good for you, also knowing what's bad for you. Because I assume there's lots of stuff that I do eat that I don't actually know is horrible for me" (FG4, workers)

An interest in learning more about different diets (e.g. vegan, ketogenic) was raised in four focus groups. Both managers and workers stated that they would be eager to study more veganism, vegetarianism, ketogenic diets, and gluten free diets, and their health effects. Some participants declared following these regimes already (e.g. ketogenic diet) and expressed concerns about the sustainability of it and long-term health consequences.

"Last year, I did the keto diet, cutting out carbs, you know, and I'd be interested to know whether that has … actually some of that is sustainable and whether it's actually good for you" (FG2, managers)

"Well, I am vegetarian, but it's only me, so it would be good to know what else to eat" (FG5, workers)

The importance of eating for sustainable energy during the day was frequently discussed (see also section 4.5.3). Participants from three focus groups reiterated that it is essential for them to learn about foods that would support the energy and better concentration while doing physically demanding jobs. Furthermore, when discussing the significance of sustaining energy with the right nutrition, managers from the large site showed an awareness of the influence sugary foods have on blood sugar and energy levels and cravings. In addition, the same group of managers mentioned an interest in learning about fructose and its effects on health as well as salt, and ways to reduce it. Managers from the large site are mainly young professionals, who seem to be very health conscious and interested in fitness (with one of them teaching fitness class on site).

> *"And sustaining your energy and concentration, because we all know that sugar, you have this quick high and then you crash and that's it, you just crave sugar for the rest of the day, so you're on a spiral" (FG 2,* managers)

The timing of food consumption was mentioned by managers from one group (the large site). During the discussion participants expressed an interest in learning *"when's best to eat and when not to"* and admitted a confusion about the appropriate timing of the meals. For example, *"the whole no carbs after six o'clock"* rule, which participants would like to get clarification on, as a part of the intervention.

Participants from one group mentioned an interest in finding out more about how nutrition affects immunity and what foods should be consumed to prevent illness, recover quicker or generally "*build up immune system".* Participants mentioned that when they come back to work, while still recovering from illness, they often *"feel terrible",* which makes physically demanding job even harder. It is worth mentioning that the focus groups took place at the beginning of 2020, before the Covid-19 pandemic started.

In three focus groups, both workers and managers said they would like to learn about portion sizes. Particularly, *"how much food is enough",* and *"what constitutes a portion"* of different foods, like vegetables, fruit or nuts, with some arguing that a portion is subjective and largely depends on an individual and their nutrition needs. Disagreements about the significance of understanding portion sizes were evident in conversations amongst workers from the small construction site. Some argued that when on a diet, individuals should be considerate of their portion sizes, while others shared a belief that the quality of food matters more than portion sizes.

> *"Portion is a big subject really, because you can go on this diet and think I can eat as much as I like, and you can't. It is portion" (FG1, workers)*

> *"I think you can eat as much as you want, as long as it's the right stuff, a million percent. I eat six meals a day" (FG1, workers)*

Furthermore, managers from the large site discussed a strategy of using smaller plates and how this might help in reducing portion sizes.

Workers from the small site wanted to learn about reading food labels, particularly knowing the nutritional value of the foods they consumed, as they felt food manufacturers might use packaging that leads consumers to believe they are buying a healthy meal. This was the only site with food outlets within walking distance, including a large supermarket, where workers frequently reported purchasing lunch ‘meal deals’,

> *“It’s the stuff that’s wrapped up that you might think that is, this is okay, it is healthy and you don’t actually look at the nutritional value of stuff …” (FG1, workers)*

Participants from three focus group discussed the effects of food on mood, emotions, and mental wellbeing. Both workers and managers agreed that they could see a connection between the food they eat and how they feel. For example, one worker mentioned that when sad or depressed, they are more likely to *“not take care of yourself and eat poorly”.* A different worker from the same group reported that *“biscuits and booze”* positively affected their mood, calling these *“medicine against the sadness”.*

> *“Because biscuits make you happy, as does booze [laughter] We all know this to be true, it’s medicine against the sadness (FG4, workers)*

The discussion continued, highlighting an enthusiasm to learn about foods that support the *“release of serotonin”* and those that might *“do the opposite”.* Additionally, participants suggested that topics around emotional eating might be helping them to reflect on their individual circumstances, and therefore, to improve their *“relationship with food”.*

> *“Some people turn to it when they’re sad or upset, some people turn off food when they’re upset and sad. Some people are comfort eaters, lots of people have different relationships with food, and I think that would be something interesting to explore…” (FG2, managers)*

Food cravings and eating comfort foods was discussed by construction managers in one group, which they reported was more frequent during the winter seasons. Furthermore, one of the participants stated that when attempting to eat healthily during the day, they often struggle with feeling hungry and unsatisfied at night, which makes sustaining these eating habits impossible.

> *"I try to be good, very good, and when I go to bed I'm like, 'I need to go to sleep' but my stomach is going, 'You are starving'" (FG2, managers)*

Furthermore, participants also discussed how sugary food consumption increases their food cravings and how a lack of sleep perpetuates itself with increased cravings and food intake on the next day. One of the managers from the large site offered dietary suggestions they believed might be helpful to counterbalance cravings:

> *"A handful of nuts or with some peanut butter, because then you've got some fats and the sugar, but kind of balance out" (FG2, managers)*

Participants from two groups discussed the importance of providing ideas on swapping unhealthy snacks in a form of a list containing healthy snack options. Notably, one of the managers stated there is a common belief that, when consumed, bacon, crisps or a chocolate bar feel like a treat, however, eating food like hummus and carrots might not have the same *'treat effect'*, and might be considered *"not tasty"* by some.

> *"Healthy snacks. So, other ideas than grabbing a chocolate bar or a packet of crisps or a bacon butty, healthy satisfying snacks. It feels a bit like a treat, the crisps or … I mean, I do feel like hummus and carrots are really tasty, others might not, but snacks that people are … dark chocolate instead of the milk chocolate …" (FG2, managers)*

Both managers and workers (2 focus groups) suggested that it would be helpful to learn about non-perishable and convenient foods that could be stored in a cupboard at work, as it might encourage workers to reach out for these healthy foods. This was a suggestion from a large site which does not have any food outlets within walking distance and that there are differences in the kitchen equipment provided in workers' and managers' cabins (see section 4.5.4).

> *"You've always got something healthy if you want it" (FG2, managers)*

Helping to create food plans and shopping lists, as a part of the intervention design, were discussed by participants in three focus groups. Managers and workers declared that they would find it easier to have a plan in advance, such as a weekly menu, which they could use to do weekly shopping. Nonetheless, nutrition plans needed to be *"sensible",* i.e. containing foods which participants like and are readily available (see section 4.6.2.2).

> *"For me if we were to rock up here on a Monday morning and we had a menu for the week, we go down to Lidl at ten o'clock on a Monday morning, we buy the ingredients throughout the week" (FG3, managers)*

> *"For the week a sensible one not like coriander and bay leaves, getting all the bits and pieces…" (FG3, managers)*

4.6.2.2. Nutrition recommendations – flexible, practical, job relevant and personalised

The next theme was around nutrition recommendations provided during the future intervention, which participants asserted need to be flexible, practical, relevant to the job and context of the construction industry as well as personalised**.** Both managers and workers from all five groups expressed the need for flexibility when following a particular dietary regime, and would appreciate practical recommendations relevant to the jobs. Participants agreed that it would not be realistic for them to follow strict dietary regimes, try recipes requiring sourcing ingredients, which are not available in local supermarkets, and they would still want to be 'allowed' to have an occasional treat, in moderation.

> *"It would be nice to have a little bit of flexibility, because if you got given a programme that you are like you have to eat this Monday to Sunday, every single day, religiously, 99% of people are not going to do it" (FG1, workers)*

> *"But stuff that's readily available, around. You don't have to, if you want to get one of these items you don't have to go to Taunton or somewhere to get it. It's accessible to us…" (FG3, managers)*

In addition, workers from two sites suggested that all recommended foods needed to be *"under the bracket of easy to make …and quick to make and quite cheap as well"… "plus good for* *you"*. Workers emphasised that they are keen to attend food demonstrations where ways to prepare quick (i.e. maximum 15 minutes), easy (i.e. with limited ingredients) and cheap meals are shown. This was especially the case for workers staying in temporary accommodation while working on site, who might not have access to storing and food preparation facilities.

> *"You only needed these five ingredients and it would take you fifteen minutes to cook it and it was a lot easier" (FG4, workers)*

There was consensus across participants from all five groups on the importance of designing a nutrition intervention which considered the nature of construction jobs as well as individual characteristics, preferences, and lifestyles. Within the industry there is an array of different professions, with diverse levels of physical activity and therefore, nutrition requirements, e.g. machine operatives sitting for most of the working day, compared to scaffolders doing more physically demanding work.

> *"It's very personalised. I think what I eat, if everyone here ate exactly the same thing, for six months, we'd all have different – because we all lead different lives, everything is personalised in this day and age and things like that" (FG1, workers)*

Moreover, participants discussed one to one, personalised sessions, potentially with a use of food diaries, where individual health assessments, feedback and advice on diets could be provided.

> *"Like one to one…. maybe write down what everyone would eat in a day?" (FG5, workers)*

4.6.2.3. Use of videos and other visuals

The last theme, that arose in relation to the content of the intervention, was around the use of videos and other visuals. Participants from one group mentioned that some consideration should be given to using visual cues, like videos, colourful posters or presentations containing pictures, as it might enhance understanding of nutrition messages, especially amongst those with lower education.

"Even a short video, because some people are more visual than they are on paper" (FG5, workers)

4.6.3. Themes related to implementation the nutrition intervention – participation, accessibility, promotion, and support (C)

4.6.3.1. Accessibility and convenience in the intervention delivery

The implementation of the intervention, particularly accessibility and convenience, including location, time, different levels of interest and engagement was discussed. This theme also covered issues around the reach, and engagement with current programmes offered on sites.

Site location or being a large site (i.e. covering multiple locations) were seen as barriers to the implementation of health and wellbeing interventions across three groups. Workers from the small site mentioned that due to their remote location, company nurse visits were less frequent in comparison with sites located in the city centre (site located near Dartford, with the majority of company sites located in central London). Managers and workers from the large site emphasised that huge sites, with scattered cabins pose a challenge to intervention implementation. If nutrition activities take place in the main office, that would prohibit workers from distant locations from attending. As a solution, one of the managers suggested that at least some of the activities should be delivered in workers' cabins, in multiple locations on site.

"We might have to go out to site to do it sometimes, do it in a cabin out on site, that's one challenge that we might have to cross if we can do it in here" (FG2, managers).

The importance of intervention visibility was discussed on the medium size construction site (FG5). In order to increase the engagement, nutrition activities should be taking place in a common, visible and accessible places, e.g. staff canteen or parking areas, rather than an office or board room, as workers *"don't like to be called into the office"*.

"If we're saying because of the weather, but if you were in the car park and you just had like just put a table out there… Everyone would be there… … literally everyone would come …" (FG5, workers)

Participants from three groups (on a small and a large site) emphasised the importance of designing the intervention "*for everybody",* taking into consideration different levels of education, fitness, interest, profession, engagement, and whether participants work for the main company or a sub-contractor. Current health and wellbeing initiatives were criticised for being designed for *"the same groups of people"*, for example *"fitness freaks",* and there is nothing on offer for beginners.

> *"So they want people to engage, they want to include everybody, but everyone's not going to engage because they don't want to run up bloody Snowden in 24 hours or whatever it is! They just want to do things at a slower pace for old people like myself" (FG3, managers)*

Workers from the large site emphasised that as contractors they also felt excluded from health and wellbeing offerings (see section 4.6.1.1).

Time pressures related to job demands and intervention scheduling conflicts were discussed by managers and workers in four groups (all sites). This was due to the fast-paced construction environment, where work is often paid by an hour. In addition, workers often need to finish their job for the next phase to commence and attending even a half an hour nutrition talk might create a bottle neck on site. This related to a temporary, housing developer site, with a completion deadline of mid 2021.

> *"I think it'll be so difficult because remember we are at work, so it's not like an office environment. This is a scheduled and it's fast paced, moving, so if the scaffolders have to do something in a certain amount of time, so that someone else comes in, you're trying to tell people, come for half-an-hour… it would be tricky" (FG5, workers)*

Weather was mentioned in respect of the intervention scheduling by workers from the small site, who explained that they are not allowed to work in strong winds, therefore, in poor weather, they might be able to spend hours learning about nutrition. Conversely, on a sunny day, it is unlikely anyone would take part.

Half an hour to an hour, once a month, was the timeframe suggested as realistic *"to sacrifice"* to attend the intervention. In addition, drop-in sessions, rather than scheduled prebooked slots were suggested by workers from the large site as a part of the solution. Finally, workers from a different group hinted that knowing the day of the intervention in advance would help them in planning their work and organise job swaps if necessary.

> *"If you pre … like, if you say, I'm here in two weeks, can I just have half*-an-hour *of your time? Yes, because at least you can notify someone and some people work together, like these three work together, so they can say, these two work together so they can say, oh if you can carry on and maybe do a swap as well?" (FG5, workers)*

Four out of five focus groups discussed 'reach and attendance' at current and previous workplace health initiatives. Workers from the small site said that they eagerly attended health initiatives offered to them. However, managers from the large site stated that the monthly company presentations reach approximately half of the workforce and the attendance at the health initiatives was low, with the majority being office staff. Managers from the same site, but participating in a different focus group, highlighted the fact that most of the workplace health initiatives are attended by *"the same ten or twelve people"*. Workers from the same site explained that although current health initiatives are of interest to them, they are not able to attend as most of the programmes take place during lunchtime.

> *"I think it's worth mentioning the attendance to that is mainly office staff though, we don't ten to get any of the lads attending it as much" (FG2, managers)*

4.6.3.2. Intervention promotion

A variety of ways to promote the nutrition intervention were offered by managers and workers from three groups (a medium and a large site). The most frequently mentioned idea included displaying posters in the common areas (e.g. canteen, toilet, office, cabins and site entry / exit points) and communicating through supervisors or managers (also known as 'black hats'), who verbally pass most of on-site messages. Workers from the large site explained that as contractors, they do not receive any direct communication from the company, and therefore, if *'the information is not available to them, they might not be able to find it, as they would not be actively looking for it'*. As a solution, participants recommended ensuring poster and flyers about the intervention are available in '*the fingerprint cabin'*, which is a site entry and exit point. In addition, workers declared that a common way of passing information around is a word of mouth.

"Everything comes through our supervisors. There is no direct communication from XYZ to us at all" (FG4, workers)

"Tell black hats" (FG5, workers)

Furthermore, managers from the large site recommended an array of ideas, which are used by the company, especially while endorsing mental health awareness campaigns. These include social calendars available in different compounds and monthly company meetings, or an internal communication system (Yama), although this is only available to company employees, and not to contractors. Lastly, one of the managers mentioned that their frequent presence on site is also often a way to communicate and promote initiatives.

"We also do a lot of ... a lot of the office staff who go on site a lot, do a lot of site visits and stuff, and if there's anything we do that as a team and promote that to the guys ourselves as well, during our visit" (FG2, managers)

4.6.3.3. Management and co-workers' support

Participants (all sites) felt that management have a big influence on the effectiveness of workplace health interventions. Participants declared that although some managers encourage participation, by creating an environment where workers are motivated to look after their health, in other cases managers build barriers to workplace intervention involvement by not allowing them to time off to partake. It was explained that managers see it as *"losing staff",* and *"losing work",* and this is especially the case amongst those working for subcontractors.

"These guys have got bosses, so there's a certain element that these guys might want to come in here and do this, but if their boss turns around and says, you're not doing that again next month, then they've got to do what their boss says" (FG5, workers)

Moreover, participants from a large site mentioned that their managers were reluctant to allow them to attend the focus groups, while workers from the medium site admitted their bosses did not know they attended the meeting. Both sites were temporary, with most workers being self-employed.

"I mean these guys' boss don't even know they're here" (FG5, workers)

"... honestly, they were a bit reluctant for us to come to this" (FG4, workers)

Workers from the medium site discussed the importance of management taking interest in health of the workforce and introducing health promotion initiatives to keep people at work, to motivate employees, and minimise sick leave.

> *"So you're always good to get the company bosses to buy in to the health of their workforce and see they're looking after their workforce. Give them a better motivation on site and keeps them at work" (FG5, workers)*

Furthermore, managers and supervisors are often a source of information on initiatives taking place on site and are usually responsible for passing communication between the main company, contractors, and workers.

The importance of co-worker support was also discussed during the focus groups. The idea of 'champions' was suggested by managers from the large construction site, proposing that selecting workers, who are interested in nutrition, sport and healthy lifestyle becoming champions could be a good way to encourage others to engage. One of the managers suggested that young workers could be much better advocates of the nutrition programme than managers themselves.

> *"I've just met [name], he's such a lovely, really driven, really focused guy, still really young, so if he could do it, perhaps he's got a bit more kudos than one of us going out there" (FG2, managers)*

4.6.3.4. Continuity of the programme

Issues related to the continuity of the programme were discussed by workers in three focus groups, on three different construction sites, Participants agreed that there would be *"no point in doing it once and then never talking about it again*", but instead, the programme needs to be continuous, including feedback sessions and follow-ups offering nutrition help and support.

Workers from the small site mentioned a book, serving the purpose of a 'health tracker', which has been offered to them by the company and allowed them to record measures like blood pressure, weight, cholesterol and monitor their own health progress.

"This book is like, sort of tracks my health in 2019 and that's a figure of a human made of spoilt things, and drink and all of that. So I check the record, so blood pressure, cholesterol, blood sugar, height, weight, BMI, waist…" (FG1, workers)

4.6.3.5. Facility improvement

Finally, workers from the large construction site discussed the need for welfare facility improvement as a means of enhancing their eating habits. Workers suggested that fridges in cabins would make food storing easier, equally not restricting their food choices to non-perishable items only and adding power sockets to allow multiple pieces of equipment to be used at once (e.g. a kettle and a microwave) (see section 4.5.4).

"You can't boil the kettle and use the microwave at the same time… because there is one power socket" (FG4, workers)

Furthermore, workers complained that cabins are dirty, full of paperwork and equipment making food preparation challenging. Unfortunately, workers from the large site seem to have little faith that any improvements in the provision of facilities would take place on site.

"Some of the things that I think need to change rely on things that I don't think can be changed so there's little point in pushing in that direction" (FG4, workers)

4.7. Summary of the main findings from focus groups

1. Several health and nutrition related behaviours have been identified in the focus groups amongst both workers and managers: excess alcohol consumption and smoking, skipping meals (either breakfast or lunch) either due to a poor accessibility to food, short breaks, not being hungry or having a busy schedule and snacking, with differences noted in the nutritional value of snacks declared by participants (e.g., fruit and nuts vs. crisps, chocolates, biscuits). In addition, participants highlighted a low intake of water and a high consumption of energy drinks (and sugary drinks) as well as tea and coffee (more than 6 cups a day), as means to sustain energy throughout the day. Although participants recognised the importance of the consumption of fruit and vegetables,

mixed responses were provided in relation to the actual intake, with some asserting their frequent consumption, while others did not.

2. A high consumption of convenient foods, including take-away, fast food, junk food, ready meals and eating out were all repeatedly mentioned behaviours by participants in five focus groups. A lack of other options, limited food outlet accessibility, and convenience in preparation were all stated as reasons behind those food choices. Furthermore, workers regularly said that any changes suggested to their diet needed to be practical and easy, as the nature of their jobs, stressful lifestyle, and/or being away from home would not allow for the implementation of complicated recipes involving the creation of a long shopping list.

3. Other nutrition related behaviours found in the focus groups included socialising at meals; participants often eat and cook together, share food, especially on sites where most workers are not local, and staying in temporary accommodation. In addition, food preparation at work was declared by participants, however, opportunities for this were influenced by facilities available on site and break times. Nonetheless, a few occasions workers mentioned bringing packed breakfast or lunch from home. This, however, was determined by the nature of the site (temporary or permanent) and location. Workers from both groups lived locally to the sites, which were permanent or long term. Finally, although the importance of meal planning and preparation was commonly recognised and appreciated by some workers, others discussed the difficulty of staying organised and planning ahead.

4. A lack of knowledge on nutrition and personal resources (e.g. motivation and willpower) were two the most important factors determining construction workers' capability to pursue better food choices. Participants expressed an interest in learning more about nutrition and reported a confusion caused by articles in media about what is healthy and what is not. Nonetheless, concerns about having no energy, no willpower or motivation to change due to demanding and stressful jobs were expressed.

5. The importance of sustaining good energy and concentration, staying awake were mentioned in all focus groups. Participants discussed how the foods they ate affected their energy levels, as well as the need to consume high energy foods to be able to keep

up with a physically demanding job. However, participants demonstrated an understanding that poor nutrition and lifestyle choices lead to obesity, with some reporting struggles with excessive weight, weight fluctuations and a high visceral fat.

6. The value of habits and routines in motivating changes in nutrition behaviours was discussed during focus groups, but equally, participants were concerned about difficulties in changing unhealthy ones. In addition, the importance of information provided by professionals carrying out health checks and opportunities to get feedback on their health status were discussed.

7. The differences between occupational groups (e.g. workers and managers) were visible in eating practices on sites, with groups eating separately. In addition, the differences between groups were visible in the facilities and health promotion opportunities provided on the large site, where workers and managers did not share the same welfare space. Those differences seem to be also linked to a form of employment, with workers employed by the main company enjoying better facilities and health promotion opportunities (e.g. 'Cycle to work' scheme) than those working for subcontractors (although within the same site). Nonetheless, some participants discussed pressure placed on those who cook in the work kitchens, they feel hassled when they occupy cooking facilities for too long.

8. Stress, tiredness, long working hours, being sick and tired of work, thinking of leaving, and working industry like no other were often mentioned when job demands in construction were discussed.

9. Construction workers often live in rented or temporary accommodation when working on site. This means that if the accommodation does not provide any food preparation or storage facilities, they will repeatedly eat out, have ready-meals and take away meals. In addition, construction sites might be far from local shops, town centres etc., allowing the purchase of only a limited range of foods. Furthermore, workers and managers agreed that it is difficult to have a nutritious meal within a short break time (30min), especially on remote sites, therefore, choices are determined not by the food quality but by the proximity of food outlets. A short break and many workers using the same

kitchen space further limits food preparation opportunities on sites (even if good facilities are provided).

10. Health checks, mental health programmes (e.g. MHFA), sport and exercise initiatives (e.g. on site gym) and food and nutrition interventions were discussed health initiatives, however, the character (permanent or temporary) and the size of sites seems to determine the creativity and the variety of offered initiatives as well as the engagement with them. For example, a small, permanent site, with staff employed by the company, had a number of novel health and wellbeing initiatives (e.g. rowing challenges, a quiet corner, a greenhouse project), which aimed not only at improving health but also building morale and bringing team together. However, the site is often closed due to weather, allowing the workforce extra time to enjoy initiatives. On the other hand, although a large site had a selection of initiatives (e.g. gym, walks, 'cycle to work' scheme), these were mainly aimed at or attended by employees, office staff and fitness fanatics. In addition, poor engagement with some of the initiatives was related to the lack of trust and confidence in the initiatives offering a genuine support. Nonetheless, a young management team on a large site, interested in health, was considered as a facilitator in offering health promotion opportunities to the site workforce.
11. A number of topics were suggested to be incorporated in the design of the nutrition intervention and these included healthy eating and diets, portion sizes, food labels, comfort food, mood and food cravings, snacks and foods that can be stored at work and meal planning and shopping lists. Nonetheless, education and advice needed to be flexible, practical, easy to follow, relevant to the job and context of the construction industry, for example, consider limited food outlets, food storing opportunities and busy schedules.
12. A number of solutions were offered to increase participation in the intervention, and these included: designing the intervention for everybody (different levels of education, fitness, interest, profession, engagement), using common areas, like canteen, welfare area, or even a parking to offer health activities and offering flexibility in a form of drop-in, short sessions.
13. Managers highlighted that the engagement with health and wellbeing initiatives amongst workers on site is low, however, workers discussed they are keen on taking

part, suggesting that it is not a lack of interest preventing them from taking part, but rather other factors like scheduling conflicts, being busy or permission to attend.

14. Displaying poster, distributing flyers in common areas on site and a communication through supervisors and managers (also confirmed by managers) were considered the most effective way of the intervention promotion, potentially reaching all the workforce (not only those employed by the company with an access to internal communication systems).
15. Management seems to have a big influence on the effectiveness of workplace health interventions, by introducing initiatives that can keep people at work, motivate them and minimise sick leave, by allowing time to attend, and communicating information on initiatives taking place on site. In addition, champions selected amongst the workforce might serve as health intervention advocates and encourage engagement amongst their peers.
16. Follow-up sessions, feedback on progress, health tracking were ideas mentioned as ways to ensure the continuity of the programme.
17. Improvement in welfare facilities was highlighted as a mean of enhancing eating habits, but workers have limited faith that improvements would take place.

Chapter Five – Baseline questionnaire and intervention design

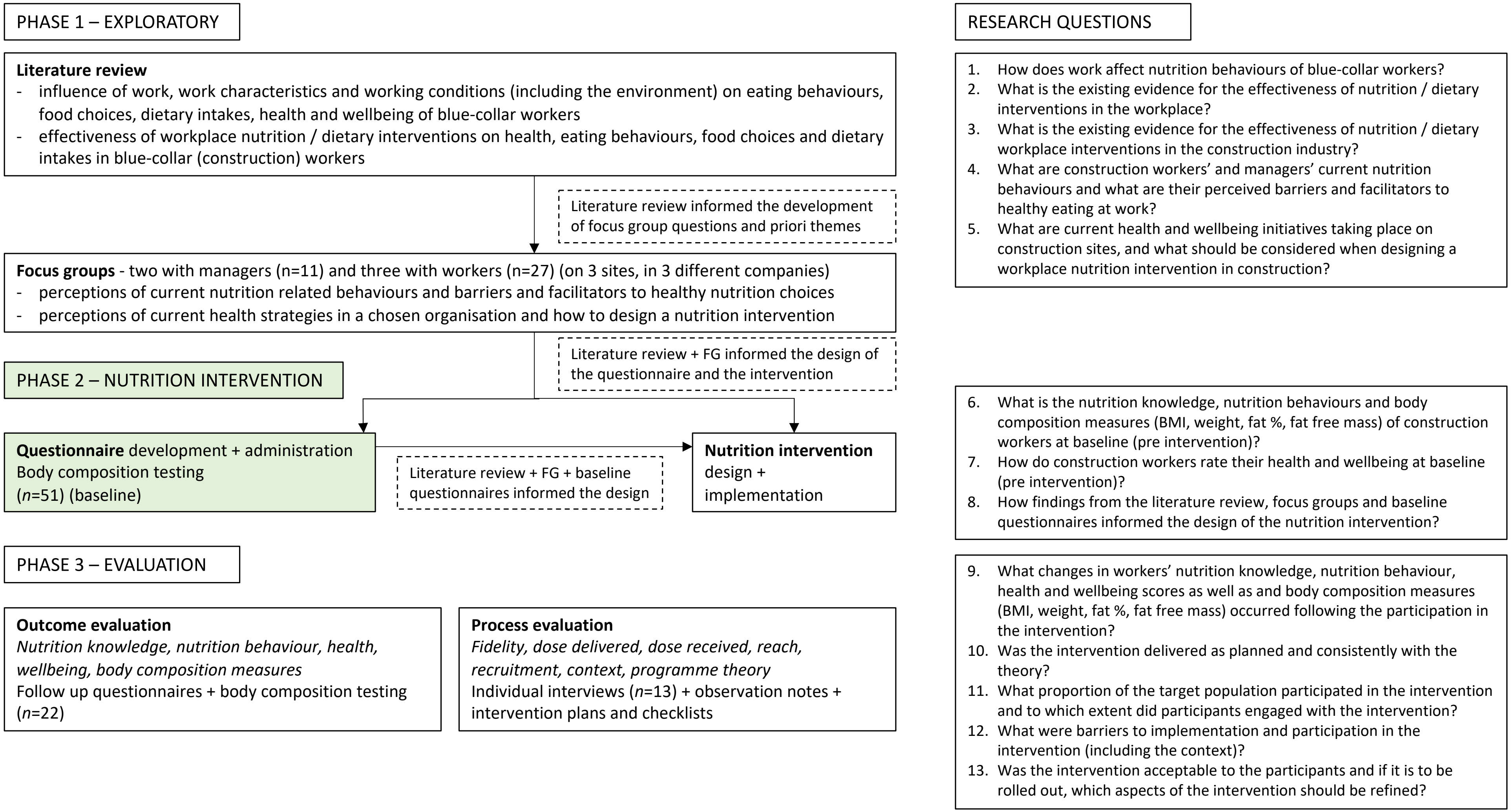

Figure 5.1. The Research Framework – Questionnaire development

Chapter Five – Baseline questionnaire and intervention design

5.1. Introduction to the baseline questionnaires

Following the literature review and focus groups (exploratory phase), this chapter presents the second phase of the study, a nutrition intervention phase (see Figure 5.1), which consisted of the questionnaire development, and the design of the nutrition intervention. A questionnaire was designed in this study to assess baseline health, wellbeing and nutrition behaviours, together with nutrition knowledge of construction workers in a chosen organisation and was subsequently used to evaluate the impact of the nutritional intervention on these outcomes post intervention (follow-up – reported in chapter six).

This chapter begins with a presentation of the aim and objectives, followed by a general discussion on the validity and reliability measures. In addition, it includes a general discussion on questionnaire development, and incorporates guidelines on designing nutrition related questions, for example the use of scales, wording of questions and question order, as well as a response format. A review of existing questionnaires assessing nutrition knowledge, eating behaviours, as well as health and wellbeing has been conducted. This chapter looks in turn into existing questionnaires that were considered, but ultimately rejected, including a discussion of their limitations. It then provides the rationale for the selected measures in the health and wellbeing sections, and with regards to the nutrition section, and presents an overview of the design process of the nutrition questionnaire. The rationale behind the selected administration modes of the questionnaire is then discussed, followed by an account of the questionnaire pilot, intervention recruitment and questionnaire distribution before providing critically discussing the use of body composition measures and describing the testing protocol. The methods used for to analyse the data are then presented, followed by the results from the baseline questionnaire. This chapter finishes with a detailed presentation of the design of the intervention, using the BCW and a COM-B model.

5.2. Aim and objectives of the baseline questionnaire

The aim of this chapter is to assess baseline (pre intervention) health, wellbeing, nutrition knowledge and behaviours as well as body composition of construction workers in a chosen organisation. It was achieved by designing and carrying out a questionnaire, conducting body composition testing and analysing the baseline results (n=51) using descriptive statistics. In this chapter, the following research questions are addressed:

6. What is the nutrition knowledge, nutrition behaviours and body composition measures (BMI, weight, fat %, fat free mass) of construction workers at baseline (pre intervention)?
7. How do construction workers rate their health and wellbeing at baseline (pre intervention)?

5.3. Best practice guidelines on questionnaire development

Questionnaires are a convenient way of collecting information from a large number of people within a period of time (Jenn, 2006), and therefore, are one of the most widely used means of collecting data (Rowley, 2014). The most commonly used questionnaires ask about facts (e.g. age or occupation), options, attitudes and beliefs, as well as behaviours (Rowley, 2014), which is the subject of the investigation in this study. Furthermore, questionnaires have been suggested as useful tools in data collection if the research objectives are to profile a situation and develop patterns, as in the case of this study looking at changes in patterns of eating behaviours amongst construction workers (Rowley, 2014). Moreover, a questionnaire was suggested to be more effective when sufficient understanding has already been developed about the situation under study, allowing for the formulation of meaningful questions (Rowley, 2014).

One common task in scientific research is ascertaining the validity and reliability of a questionnaire, to ensure that the tool employed measures the intended concept or construct (validity) and that it provides stable or consistent responses (reliability) (Bolarinwa, 2015; Bowling, 2017; McDowell, 2009). Validity explains how well the collected data covers the actual area of investigation (Taherdoost, 2018), and a valid questionnaire should "*ask what it intends to ask, i.e. the questions should be phrased in such a way that the respondent understands the objective of the question*" (Jenn, 2006, p.32). The main validity tests include face validity, content validity, construct validity, criterion validity (concurrent and predictive) (Bolarinwa, 2015; Taherdoost, 2018), and can be further categorised into internal and external (see Table 5.1 for further details) (Bolarinwa, 2015; Bowling, 2017; McDowell, 2009). All types of validity address the same issue, i.e. the degree of confidence that can be placed on the inferences drawn from the scale scores (Bowling, 2017).

Reliability, on the other hand, concerns the extent to which the measurement of a concept or construct provides stable results and the degree to which these results can be replicated (Bolarinwa, 2015; Bowling, 2017; McDowell, 2009; Taherdoost, 2018). A questionnaire is considered to be reliable if repeated at different time periods using the same measurements and subjects, under constant conditions, and gives the same results (Bowling, 2017; Taherdoost, 2018). There are multiple methods for reliability testing, including: test-retest, sensitivity and internal consistency (homogeneity) (see Table 5.1 below for further details) (Bolarinwa, 2015).

For the questionnaire development in this study, multiple sources of advice on designing and using research questionnaires were reviewed, starting from research methods textbooks offering a basic grounding in the subject (Bowling, 2014; Creswell & Creswell, 2018; Salazar et al., 2015), through to more detailed articles devoted to questionnaire design and development (Boateng et al., 2018; Bolarinwa, 2015; Jenn, 2006; Presser et al., 2014; Rowley, 2014; Taherdoost, 2018) and finishing with the literature dedicated to nutrition questionnaire development (d'Ardenne et al., 2011; Feren et al., 2011; Kowalkowska et al., 2018; Murray et al., 2017; Parmenter & Wardle, 2000; Trakman et al., 2017), discussed in turn below.

To date, only a few publications have focused on providing guidelines on the development of nutrition knowledge questionnaires (Feren et al., 2011; Parmenter & Wardle, 2000; Trakman et al., 2017). The first set of criteria for the development of valid and reliable questionnaires measuring psychological attributes, including nutrition knowledge, was identified by Kline (1993) and further evaluated in articles by Parmenter & Wardle (1999, 2000) on the evaluation and design of nutrition knowledge measures, which provided guidelines originally employed to develop a widely used General Nutrition Knowledge Questionnaire (GNKQ). In later years, other authors built on those findings to further guide the measuring and scaling of nutrition knowledge (Feren et al., 2011; Trakman et al., 2017), where in a recent paper of Trakman et al. (2017), the authors integrated recommendations given by Parmenter & Wardle (2000) with procedures on questionnaire development from other disciplines.

Following the review of the rules on nutrition knowledge questions design, guidance on the development of nutrition behaviour measures were also investigated. A list of recommendations in designing nutrition questionnaires for low-literacy adults was proposed by the Expanded Food and Nutrition Education Program (EFNEP) in the US (Murray et al., 2017). The programme aims at improving nutrition education and food-related behaviours amongst low-income and low-literacy level adults, and therefore, its guidance was considered for the development of this questionnaire. Instructions presented in a report titled 'Designing survey questions on food-related issues', prepared for the Department of Health by the National Centre for Social Research (NatCen) (d'Ardenne et al., 2011), were also consulted when designing the questionnaire. The questionnaire design toolkit was developed to provide direction on how to analyse changes in eating trends, food choices and eating behaviours and to provide advice on writing questions based on the behaviour change construct (d'Ardenne et al., 2011), and therefore, was considered to be suitable in providing guidelines for the questionnaire design for this study.

A table synthesising the guidelines reviewed and used when developing the questionnaire is provided below (Table 5.1).

Table 5.1. Guidelines on questionnaire development, including nutrition-related questions

Term	**Guidelines**	**Reference**
Content validity	- The items should sample the full domain of the construct (i.e. cover the essential aspects of the nutrition knowledge), with specified relevant subsections; - The relevance of questions and the full topic coverage should be review by the panel of experts (e.g. dietitians or nutritionists) and preferably, experts in study design and in topic in question (e.g. workplace health and wellbeing, health in construction);	(Parmenter & Wardle, 1999, 2000; Trakman et al., 2017)
Construct validity	- Scores should be significantly different when the questionnaire is administered to a group of individuals different than a sample in question (e.g. nutrition students and construction workers);	(Kline, 1993; Parmenter & Wardle, 1999)
Face validity	- In order to assess the effectiveness of a questionnaire to measure what it claims to, a review of questions should take place (see above for the review of an expert panel - content validity);	(Trakman et al., 2017)
Internal reliability	- Individual items within the scale should be correlated to the total score; - In addition to an expert panel review, a small sample of the target audience should also complete the questionnaire in order to: (i) affirm that instructions given are easy to follow; (ii) assess the completion time; (iii) assess face validity (e.g. using a think-out-loud model whereby participants comment on the questionnaire while completing it);	(Kline, 1993; Parmenter & Wardle, 1999)
Test-rests reliability	- Scores should remain stable when the test is performed twice with the same group of individuals, allowing enough time for questions to be forgotten and short enough to minimise the risk of any significant changes occur (e.g. in a level of knowledge);	(Kline, 1993; Parmenter & Wardle, 1999)
Piloting the questionnaire	- A preliminary pilot (checking that questions make sense) with friends and colleagues, and at least a few individuals from the selected population; - Piloting tests for the questions (for variation, meaning, difficulty, and respondent interest and attention), and the questionnaire (for 'flow', question order, skip patterns, timing, respondent interest, and respondent well-being);	(Rowley, 2014)

Term	Guidelines	Reference
Definition of the construct	- A definition should be provided to explain what the construct is (e.g. having a clear definition what the behaviour entails, e.g. if the research interest is in measuring ‘convenience’ in food consumption, what counts as a ‘convenience’ food?; - Providing a clear distinction between nutrition knowledge, attitudes and behaviours;	(d’Ardenne et al., 2011; Trakman et al., 2017)
Questionnaire context development	- Prior to designing any questions scoping work, in the form of a literature review, and consultation with members of a target population such as focus groups, should be used to establish what types of influences are likely to be involved in relation to the behaviour of interest; - Questions can also be taken from previous questionnaires, either in their original form or modified to suit the purpose of the research;	(d’Ardenne et al., 2011; Jenn, 2006; Parmenter & Wardle, 2000; Rowley, 2014; Trakman et al., 2017)
Deciding on units of behaviour	- In order to decide on the units of measurement, it has to be considered if respondents are likely to understand what information they are asked (e.g. what is a portion), if they are likely to retrieve this information, and if they are willing to provide it;	(d’Ardenne et al., 2011)
Defining a reference period	- If a detailed breakdown of food consumption is required a short reference period should be used (e.g. a day) - food consumption is habitual, therefore, difficult to recall over a longer period than a few days; - Longer reference periods are more acceptable when asking for banded frequencies - respondents are not expected to recall specific instances but rather to approximate; - A consideration is whether to ask for a specific (e.g. last week) or a typical period (e.g. a typical week). Asking for a ‘typical’ behaviour is more difficult than asking about behaviour fixed to a specific time period;	(d’Ardenne et al., 2011)
Questions difficulty	- Individual question should be neither easy, nor difficult; to ensure that not all (or neither) of participants complete them; - Questions are considered not to be useful if they are answered correctly by more than 80% or less than 20% of respondents, however 30-90% limits were used by others;	(Feren et al., 2011; Kline, 1993; Parmenter & Wardle, 1999)
Language (wording of questions)	- Questions should be written as full sentences and slang, jargon, technical terms or abbreviations should be avoided (it has been suggested to interview a sample of a target audience prior to the questionnaire development to capture their vernacular); - Question wording must meet the needs to low-literacy adults; - Names used for foods must be commonly understood and relevant to the target audience (existing questionnaires’ language might need to be adjusted); - Questions should be phrased simply, concisely and ambiguously, double negatives and two-edged questions need to be avoided;	(d’Ardenne et al., 2011; Jenn, 2006; Murray et al., 2017; Parmenter & Wardle, 1999, 2000; Rowley, 2014; Trakman et al., 2017)
Order of questions	- Start with easy, necessary non-threatening questions; - The order of questions should be clear, often with questions clustered under theme or section headings; - Often earlier questions set the context for later questions; - The answer to one question should not be learnt from a preceding question. - Demographic questions should not be asked at the beginning, as these can be seen as probing and therefore off-putting (the best practice is to include them at the end in order to encourage respondents to complete the rest of the questionnaire first);	(Parmenter & Wardle, 2000; Rowley, 2014; Trakman et al., 2017)

Term	Guidelines	Reference
Question types	- Open-ended or close-ended questions can be used; - Close-ended questions are easier and quicker to respond, easier to code, however, are more difficult to design due to an in-depth level of knowledge required about a construct in question; - Open-ended questions allow the capture of unexpected responses and more in-depth insights;	(Rowley, 2014; Trakman et al., 2017)
Response format	Banded response options should be considered if less detail is required about the level of consumption (e.g. 'Not in the last week', '1-3 times', '4-6 times', '7 times or more'); - When using banded frequency questions, specific quantifiers rather than vague quantifiers should be used, as respondents might have different opinions as to what constitutes for example 'often'; o an example of a specific quantifiers - every day / 4-6 times per week / 1-3 times per week / less often o an example of a vague quantifiers– often / sometimes / rarely / never - For close-ended questions, possible response formats include true/false, yes/no, Likert scale (e.g. 'strongly agree', 'agree', 'disagree', 'strongly disagree') and multiple-choice (usually with four to five options); - Agree/disagree-type scales - tend to reduce the feeling of being tested and judged; - Multiple-choice options – useful, can provide valuable data on nutrition misinformation (sometimes participants might be able to select several correct options, however, they should be avoided, as they are difficult to code and score); - 'Not sure' or equivalent category is sometimes added as an answer option - it may prevent respondents from correctly guessing the correct option, however, it may provoke laziness, or encourage those with a low confidence to avoid responding; - Categories need to be complete, present in logical order and should not overlap; - 'None of these', 'Not applicable' or 'Other' response categories should be included where appropriate; - A range of question styles and responses are recommended as the most suitable option (including some picture-based questions) to avoid monotony and reduce respondent fatigue;	(d'Ardenne et al., 2011; Feren et al., 2011; Parmenter & Wardle, 1999; Pongkiatchai et al., 2019; Presser et al., 2014; Trakman et al., 2017)
Rating scales	- The most used are verbal and numeric scales; - Verbal labelling (i.e. 'very unhealthy', 'fairly unhealthy' 'neither unhealthy or healthy', fairly healthy', 'very healthy') of scale points increases the reliability and validity of obtained data, as verbal labels may be easier to understand; - Within numeric scales, positive and negative numeric scales can be used. When negative numeric scales are used, respondents are less likely to pick low end responses, which positively skews the date; - Scales should have an odd number of points (at least 7) to allow an expression of neutral opinion; it also increases reliability and reduces random measurement error; - Agree / disagree scales are also commonly used, as they can be applied to almost any question construct and repeated multiple time, however, questions using agree/disagree scales have lower rates of statistical validity than equivalent questions using item-specific scales;	(d'Ardenne et al., 2011)

Term	Guidelines	Reference
Scoring	- The most common scoring system is to award a point for each time the correct option is selected. Negative scoring can also be used awarding 1 point for correct, 0 points for 'not sure' and deducted 1 point for incorrect options); - It has also been suggested to consider whether a total summed score or subscores of individual sections are appropriate (subscores are suggested when gaps in knowledge are to be assessed);	(Trakman et al., 2017)
Supporting instructions	- Definitions and clarifications should come before the answer space to ensure they are read; - When designing answers, clear instructions on how respondents should use the answer categories should be provided, e.g. 'select one answer only' or 'select Yes/No for each';	(d'Ardenne et al., 2011; Peasgood et al., 2014)

As presented in the above table, a good questionnaire should be valid, reliable, clear, interesting and succinct (Jenn, 2006) and therefore, the process of its design is of utmost importance to ensure accurate data is collected, so that the results are interpretable and generalisable (Rowley, 2014). Considerable effort goes into creating a good questionnaire, which apart from collecting information and answering research questions is also able to attract a sufficient number of responses (Rowley, 2014). Given that, the above table was created to consult decisions made during the design process.

5.4. Methods

This section is divided into two parts. The first outlines the methods used to develop the questionnaire, while the second presents those used to distribute and analyse it.

5.4.1. Nutrition, health, and wellbeing measures used in the questionnaire development

Alongside the themes arising from the literature and focus groups, a review of existing questionnaires previously used in workplace nutritional interventions was carried out. The following section is divided into three parts: nutrition measures, health measures and wellbeing measures, with each part first reviewing existing questionnaires used in nutrition workplace interventions and then providing a rationale behind the selection of measures included in the final questionnaire. Before considering the measures, the criteria used to review and appraise the suitability of existing questionnaires to capture the nutrition knowledge and eating behaviours of construction workers are outlined. These comprised of:

1. **Brevity** – shorter questionnaires are more likely to get higher response rates (Dillman et al., 1993; Edwards et al., 2002; Kalantar & Talley, 1999; Smeeth & Fletcher, 2002). Since three categories of measures (nutrition, health and wellbeing), in addition to

demographic questions, were included in the questionnaire, and time pressure is a concern in the construction industry (Devine et al., 2003; HSE, 2018; Mazzola et al., 2017; Naweed et al., 2017; Nea et al., 2017; Oswald & Turner, 2017), it was essential for each component of the questionnaire to be as short as possible. Furthermore, short dietary questionnaires have previously been used with success in other studies to assess the overall healthiness of diets (Bivoltsis et al., 2018; Bogers, 2004; Cleghorn et al., 2016; Hemiö et al., 2014; Lafrenière et al., 2019; Van Assema et al., 2002);

2. **Simplicity** - questions included in the final questionnaire needed to be easy to understand and answer. Research shows that asking difficult questions lowers the response rates (Dillman et al., 1993). Furthermore, previous literature indicates lower levels of education amongst those employed in the construction industry (Du Plessis et al., 2013; Gans et al., 2015; Lingard & Turner, 2015; Wilkie, 2019), as well as a significant portion of workforce not speaking English as their first language (10% of those employed in construction are foreigners, with the highest proportion of foreign national working in London area – 35%) (ONS, 2018b);

3. **Relevance to eating habits, health and wellbeing concerns of blue-collar workers, including those working in construction –** research shows that questionnaires designed to be of more interest to participants were more likely to be returned (Edwards et al., 2002; Jenn, 2006).

5.4.2. Nutrition measures – a review of existing questionnaires

A number of nutrition questionnaires and measures previously used in workplace nutrition studies were reviewed (Beresford et al., 2001; Geaney, Di Marrazzo, et al., 2013; Pratt et al., 2007; Schliemann et al., 2019b; Sorensen et al., 1999), including those in blue collar industries (Fitzgerald et al., 2013; Schliemann, McKinley, & Woodside, 2019a) and specifically in interventions in the construction industry (Groeneveld et al., 2008; Viester et al., 2012). This section includes a summary and a discussion of these questionnaires, as they were considered for assessing baseline measures, changes in eating behaviours and the nutrition knowledge of participants in this study. This is followed by Table 5.2 which provides justification for the rejected questionnaires.

The most well-known nutrition assessment methods are Food Frequency Questionnaires (FFQ) and 24h diet recall (Dao et al., 2019; Walton, 2015). Both have frequently been used in workplace nutrition interventions (Beresford et al., 2001; Pratt et al., 2007; Schliemann et al., 2019b; Sorensen et al., 1999), including those in blue collar industries (Fitzgerald et al., 2019; Geaney, Di Marrazzo, et al., 2013; Schliemann et al., 2019a). The 24-hour dietary recall method quantitatively measures current nutrient intake over a period of 24 hours, including the workplace and the home environment (Gandy, 2019). It is a time-consuming method, requiring precision in recording food intakes (Aoun et al., 2019; Dao et al., 2019; Gandy, 2019) and therefore, was not used in this study (see details Table 5.2). The FFQ is used to measure habitual dietary intake over a selected period (e.g. an average use over a year) (Gandy, 2019), however, the existing validated questionnaire previously used in workplace interventions (an adapted version of the European Prospective Investigation of Cancer FFQ) (Goldbohm et al., 1994; Ocké et al., 1997), was lengthy (10 pages) and therefore was not used for the purpose of this study (see details in Table 5.2).

Other commonly used questionnaires in workplace nutrition interventions include The Health, Lifestyle and Food Questionnaire (HLFQ) (Harrington et al., 2008), The Food Motives Questionnaire (FMQ) (Steptoe et al., 1995), The Dutch Eating Behaviour Questionnaire (DEBQ) (Strien et al., 1986), and the General Nutrition Knowledge Questionnaire (GNKQ) (Parmenter & Wardle, 1999). However, none of the questionnaires met the criteria of brevity and simplicity required to measure eating habits, or health and wellbeing concerns relevant to construction workers (see details in Table 5.2). Finally, two Short Fruit and Vegetable questionnaires (Bogers, 2004; Van Assema et al., 2002) previously used in nutrition studies in construction (Groeneveld et al., 2008; Viester et al., 2012) were considered. However, they were both found to be too lengthy and complicated to answer. The table below (Table 5.2) provides a further evaluation of the rejected nutrition measures and is followed by the rationale for the development of the final questionnaire.

Table 5.2. Nutrition (knowledge & behaviours) measures considered in the final questionnaire

Measure / questionnaire	Why considered?	Why rejected?
Food Frequency Questionnaire (Goldbohm et al., 1994; Ocké et al., 1997)	Both FFQ and 24h diet recall are well-known and commonly used nutrition assessment methods (Dao et al., 2019; Gandy, 2019; Shim et al., 2014; Walton, 2015). Also, commonly used in workplace nutrition interventions (Beresford et al., 2001; Fitzgerald et al., 2019; Geaney, Di Marrazzo, et al., 2013; Pratt et al., 2007; Schliemann et al., 2019a, 2019b; Sorensen et al., 1999).	Lengthy, 10 page questionnaire, time consuming, questions were too detailed and not relevant to the nutritional issues experienced by construction workers (identified from the literature and focus groups).
24h diet recall		This method requires short-term memory, and places a burden on participants to precisely note food intake, including portion sizes, preparation method, food brand, which might be challenging and time consuming (Aoun et al., 2019; Dao et al., 2019; Gandy, 2019; Robinson et al., 2017; Shim et al., 2014; Van Assema et al., 2002; Walton, 2015). Furthermore, it fails to measure habitual diet (Dao et al., 2019; Walton, 2015), i.e. foods, which are habitually consumed, but might have been avoided on the recall day due to a different work patterns or a celebration). As it only asks for a random one day (24h), it might provide a recall of a very healthy or a very unhealthy day. Multiple 24h diet recalls could be presented, but it would require a lot of time and commitment from workers to complete, which considering time and work pressures might not be possible (findings from literature review and focus groups).
Short Fruit and Vegetable questionnaire: - the validated Short Fruit and Vegetable questionnaire (Van Assema et al., 2002) (10 questions) - short questionnaire for measuring fruit and vegetable intake, developed by Maastricht University (Bogers, 2004) (8 questions)	Different versions used in two large nutrition interventions in construction workplaces ('Health under Construction' and 'VIP in Construction') (Groeneveld et al., 2008; Viester et al., 2012).	Lengthy and complex to answer; questions asking about the intakes of individual fruit / fruit groups, and vegetables are based on different preparation and processing methods (e.g. cooked, boiled, steamed, fried). Furthermore, some of the questions are not relevant to construction workers, as focus group findings showed that a proportion of site workers bring homemade food, prepared by a wife or a partner, rather than by workers themselves, or cooked in the accommodation whey they stay, or in a pub, restaurant (which means participants might be guessing how the vegetables were prepared).

Measure / questionnaire	Why considered?	Why rejected?
Health, Lifestyle and Food Questionnaire (HLFQ) (Harrington et al., 2008)	Following a review of existing questionnaires used in workplace nutritional interventions in blue collar industries, these were identified as the most used (Geaney, Di Marrazzo, et al., 2013; Schliemann et al., 2019b).	Takes 25 minutes to complete, 132 questions, 19 pages; questions not relevant to the aims and objectives of this study (e.g. asking about supplements, attitudes to eating, physical activity, smoking)
Food Motives Questionnaire (FMQ) (Steptoe et al., 1995)		A 2-page questionnaire asking about motivation to eat, including e.g. origin of food, packaging, smell, coping strategies, which are not relevant to the study aims and objectives and are not consistent with the findings from focus groups.
Dutch Eating Behaviour Questionnaire (DEBQ) (Strien et al., 1986)		Total of 33 questions asking about food desire, slimming foods, emotional eating, which are not relevant to the study aims and objectives or issues raised by the literature review or focus group participants.
General Nutrition Knowledge Questionnaire (GNKQ) (Parmenter & Wardle, 1999)		Total of 11 pages, 59 questions, including complex and difficult questions requiring a good level of nutrition knowledge and high literacy levels; not suitable for individuals with lower education levels (prevalent in construction).

As none of the above reviewed questionnaires is brief, easy to read and understand, and relevant to the aims of this study tool, the decision was taken to develop a new questionnaire, based on the findings from the literature review, focus groups as well as the PHE Eatwell Guide (discussed below). Furthermore, although the FFQ was not used in this study, a FFQ approach was used in the design of the final questionnaire by asking about the frequency of consumption of selected foods. For example, questions on the consumption of convenient and fast foods were introduced based on the findings from the literature review and focus groups (further discussed in 5.5.3.2).

5.4.3. Nutrition questionnaire development

As previously mentioned, no suitable questionnaire was found, therefore a questionnaire was developed, with a self-administered section on nutrition (part 1) and an interviewer administered section (part 2). Part 1 consisted of 18 nutrition-related items, and 31 questions in total, additionally including health and wellbeing measures, alongside demographic questions. Part 2 consisted of 10 nutrition-related questions. Nutrition questions in both part 1 and 2 were based on the findings from the literature review, the focus groups (n = 5), best practice in designing questionnaires, as well as the Eatwell Guide (NHS, 2020) .

The following section explains the questionnaire development. It starts with the rationale for using the Eatwell Guide, followed by an evaluation of the steps taken in the design of the nutrition knowledge, behaviour and context questions. It explains how the knowledge questions were designed, and how they were mirrored in the behaviour section of this questionnaire. This section focuses on providing an explanation for why a detailed dietary assessment was not possible, before going on to discuss the design of the food frequency, food intake, and fruit and vegetable consumption questions. It then examines the application of the agree-disagree (AD) scale to evaluate eating behaviour at work, as well as eating behaviour in general and attitudes to nutrition amongst construction workers. It then explains the design of questions around the context of eating behaviour on site and the impact of working and living conditions on food choices. Finally, it provides a short overview of how questionnaire development best practice guidelines were applied to the design of questions in this study, including validity and reliability testing.

5.4.3.1. The use of the Eatwell Guide – rationale

The nutrition knowledge section of the questionnaire has been developed based on the Eatwell Guide, which is a long-standing food guide, first established in the UK in 1990. Following a PHE review and based on the evidence provided by the UK's Scientific Advisory Committee on Nutrition, the latest version was published in March 2016 and replaced the previously used Eatwell plate (Levy & Tedstone, 2017; NHS, 2020). The aim of producing the Eatwell Guide was to help people meet UK dietary recommendations (Levy & Tedstone, 2017), and encourage the selection of a variety of different foods from each food group in order to obtain the wide range of nutrients the body needs to stay well, function properly and live longer, healthier life (Buttriss, 2016; Clark, 2016; Levy & Tedstone, 2017). The Guide is a policy tool used to define government recommendations on eating healthily and achieving a balanced diet (Clark, 2016), and there are many advantages to using the Guide as a basis for a creation of the knowledge questionnaire as well as the designing the intervention in later stages.

First, the Eatwell Guide applies to most people regardless of weight, dietary restrictions, food preferences or ethnic origin (Buttriss, 2016; Clark, 2016; Scarborough et al., 2016), which is important considering the diversity of the construction workforce in the UK (ONS, 2018). In order to ensure its overall appeal, accessibility and understanding, as well as its relevance to different ethnic groups, a qualitative study, using in-depth interviews with 152 individuals across four nations (60 from higher socioeconomic groups, 92 from lower socioeconomic groups), was used when redesigning the Guide (PHE, 2016). Caucasian, Afro-Caribbean, African, Chinese, South Asian and mixed-race individuals were interviewed to assess the public understanding and opportunities to improve the communication of healthy eating messaging (Levy & Tedstone, 2017; PHE, 2016).

Additionally, the Eatwell Guide divides foods into groups, based on their role, and provides a simple illustration on how much of each food group is required for a healthy, varied diet, and can therefore be easily used when making decision on the food choices in a supermarket, restaurant or work canteen, when eating on the go, or cooking at home (Buttriss, 2016). As highlighted in the focus group findings (see Appendix 3 for details), eating habits and nutrition practices vary between construction workers, depending on the site, distance to home, working environment (i.e. some bring home made food, others buy take-away and ready meals or cook on site). Therefore, it is important to provide construction workers with healthy eating guidelines applicable to different lifestyles and working environments. Furthermore, as the Eatwell Guide shows the proportions of different food groups to be eaten over a day, not necessary at each meal (Buttriss, 2017; Clark, 2016) it provides individuals, like those working on construction sites, with an opportunity to plan their meals better.

The Eatwell model of a circular visual is well recognised and understood by the public (Levy & Tedstone, 2017). The results from the interviews (previously mentioned), showed that most respondents were able to immediately see the differences between the content of the plate and their own diet (Levy & Tedstone, 2017; PHE 2016). Furthermore, not only were individuals able to recognise that they did not meet the recommendations, they were also able to identify how they could improve their food intake to meet the healthy eating recommendations (Levy & Tedstone, 2017). This indicates that the Eatwell Guide can fulfil its role in providing a point of comparison in an accessible as well as assessable way (PHE, 2016). Offering a clear message, being easily understood and accessible are important characteristics of the Guide, especially when used in interventions amongst individuals with lower education levels. Using more complicated and refined messages, which can be difficult to understand, might result in discouraging individuals from taking part in the intervention and following the healthy eating guidelines.

Finally, the Eatwell Guide has been successfully used in British Nutrition Foundation Healthy Eating Week programmes since 2016, attracting over 6800 school registrations and 80 workplaces throughout the UK (Ballam, 2016). The Healthy Eating Week is designed to encourage individuals to make better food choices, provide workplaces and schools with relevant resources (e.g. posters), build knowledge around healthy eating and wellbeing as well as make positive changes in health behaviours and attitudes towards food preparation and cooking (Ballam, 2016).

Although the Eatwell Guide is known as a benchmark for providing healthy eating advice to populations, its development has not been without criticism. The Guide is not supplemented with detailed and easy to follow details on serving sizes and the frequency of recommended food intake, which exist in similar national guides, e.g. US MyPlate, Ireland's food pyramid, Canada's guide and Australia's guide (Buttriss, 2016). Further concern is that the new Guide emphasises more plant-based protein sources (Buttriss, 2016) without providing an explanation that vegetarian sources listed first are incomplete proteins (Harcombe, 2017).

Moreover, condemnation of the Guide has arisen because although originally developed in 1994 as The Balance of Good Health, relaunched in 2007 as Eatwell Plate and finally in 2016 as the Eatwell Guide, the changes made to it were purely cosmetic (e.g. disappearance of a knife and a fork, some segments tweaked, image became drawings, not photographs) (Harcombe, 2017). Nonetheless, the findings from in-depth interviews with 152 individuals in the UK showed that although regarded as cosmetic changes, the use of drawn images rather than photographs was preferred for recognition, clarity and educational potential, as photographs of food was seen as being too aspirational (Levy & Tedstone, 2017; PHE, 2016).

Finally, although the Eatwell Guide outlines a diet that meets population nutrient needs, it has been argued that low income households in the UK may be struggling to follow the guidelines (Scott et al., 2018). Research conducted by The Food Foundation looking into the affordability of the UK's Eatwell Guide found that 26.9% of UK households would need to spend more than a quarter of their disposable income to meet the Eatwell Guide and only 53% of UK households spend enough on food and non-alcoholic drinks per week to meet the estimated Eatwell Guide cost (Scott et al., 2018). A recent report of The Social Market Foundation (SMF) on the barriers to eating healthily in the UK, found that for 17% of UK population buying groceries put a strain on their finances (Corfe, 2018). Nonetheless, although food affordability can have an impact on individuals' eating behaviours (less healthy choices are selected if the household income is low) (Corfe, 2018; Lee et al., 2013), a number of methods has been suggested by NHS Eatwell (NHS, 2019) and Corfe's report (2018) on how to eat cheaper and still healthily (i.e. buying in large supermarkets, buying supermarkets' own branded food, buying frozen food etc.), which will be a part of the intervention design in this study.

5.4.3.2. Design of nutrition knowledge, behaviour and context questions

Education about the constituents of a healthy diet has been recognised as a central approach in improving the health of individuals (Barbosa et al., 2016; Parmenter & Wardle, 1999; Spronk et al., 2014), with the underlying assumption that if people understand why and how to choose healthy foods, they will improve their diets (Barbosa et al., 2016; Parmenter & Wardle, 1999; Spronk et al., 2014). While gaining knowledge is recognised as an essential component of the behaviour change process (Feren et al., 2011; Worsley, 2002), research remains inconclusive in respect of how much nutrition knowledge really impacts on changes in dietary behaviours (Hendrie et al., 2008; Klohe-Lehman et al., 2006; Worsley, 2002). Although previous research into workplace nutrition interventions has shown a positive influence of educational components on dietary changes (Browne et al., 2019; Cohen et al., 2013; Geaney et al., 2013; Greaves et al., 2011; Kuoppala et al., 2008; Maes et al., 2012; Power et al., 2014). Furthermore, considering the results of the focus group show the level of importance construction workers place on nutrition education in changing their dietary behaviours, it was decided to include nutrition knowledge measures in the questionnaire.

The nutrition education part of the questionnaire consists of 10 multiple-choice questions, and was designed to cover a spectrum of nutrition knowledge content, including: 1. awareness of the official dietary recommendations (Q1, Q3-5 Part 1); 2. knowledge on the nutrient content in foods (Q2, Q6 Part 1); 3. choosing everyday foods and using information to make healthy dietary choices (practical food choices – food labelling) (Q9-10 Part 1), and 4. knowledge on a relationship between diet and health (Q7-8) (see Appendix 5 for the final questionnaire). These subsections were in line with recommendations provided by Parmenter & Wardle (1999) when developing the General Nutrition Knowledge Questionnaire (GNKQ), who asserted that to maximise content validity, the above aspects of nutrition knowledge should be covered by the questionnaire (Parmenter & Wardle, 1999, 2000; Trakman et al., 2017). In addition, information from the EatWell Guide, available to the general public through the NHS website

(NHS, 2020), was used to design individual knowledge questions in all four subsections. The knowledge test was based on information provided by the Guide, but focused primarily on the areas of nutrition knowledge, derived from the literature review and focus groups, to be relevant to construction workers (e.g. Q8 Part 1 focused on general link between poor nutrition and health, while Q7 Part 1 focused on obesity, both identified in the literature review and focus groups theme 1). Questions used multiple-choice answer categories with 1 point assigned for every correct answer, and 0 points assigned for an incorrect or 'not sure' answer.

The next section of the questionnaire, asked about food intake and eating behaviours amongst construction workers and was developed based on the questions in the knowledge section, and findings from the literature review and focus groups, with a consideration of best practice guidelines on questionnaire development (previously discussed in Table 5.1). Firstly, all knowledge questions were mirrored in the behaviour section to identify if nutrition knowledge is translated into food choices and eating behaviours amongst construction workers (e.g. Q3 Part 1 asked about recommended water intake, which was mirrored in Q4 Part 2 by asking about daily intake of drinks) (a mapping exercise showing the list of all knowledge questions and their equivalents in the behaviour section is available in the Appendix 4). Next, all questions designed at this point were mapped against themes identified by the literature review and focus groups to identify any themes that were not yet covered, and where this was the case additional questions were developed with a consideration of best practice guidelines in questionnaire development.

Detailed dietary assessment was not feasible in this study due to ever increasing work demands and limited time available for construction workers to effectively participate in health research, together with poor literacy levels amongst workers, making it essential for the developed questionnaire to be straightforward and brief. Therefore, the nutrition behaviour questions focused only on foods and meal types known to be relevant to construction workers (identified from the literature and focus group findings) and that accounted for their levels of literacy and cultural diversity (Du Plessis et al., 2013; Gans et al., 2015; Lingard & Turner, 2015; ONS 2018; Wilkie, 2019). For example, questions about a typical breakfast and lunch (not dinner) were asked, as these meals are usually consumed at work - Q9 Part 2, Q10 Part 2) (see Appendix 4 for details on mapping exercise). Whilst it is recognised that this approach reflects only a part of an individual's diet and that short questionnaires cannot collect comprehensive data on nutrition intakes (Cleghorn et al., 2016), the evaluation of effectiveness of an intervention on intakes of specific nutrients was not the aim of the study. Therefore, looking at changes in eating patterns and food choices amongst construction workers, rather than intakes of individual foods or nutrients, was a more appropriate and pragmatic approach. Furthermore, findings from a study validating a short form of FFQ against an extensive FFQ and a 24 h diet recall, found that even a limited number of questions can assess the overall quality of a diet, to form a general understanding of dietary habits and track changes in dietary patterns over the time of the intervention (Cleghorn et al., 2016). Moreover, by limiting the number of questions asked, the burden on participants was reduced (and time), which is an example of a compromise necessary to achieve the objectives of the study in a real-life situation, on a fully functioning construction site, which is a method previously suggested by others (Murray et al., 2017).

Although the FFQ was not used in this study, an approach to asking about frequency of consumption of different meal types was used in the design of this questionnaire. A similar approach was used in two large studies investigating the effectiveness of nutrition interventions (‘Health under Construction’ and ‘VIP in Construction’) (Groeneveld et al., 2008; Viester et al., 2012). The authors modified food frequency questions to account for knowledge learned from interviews with construction workers, which took place prior to the intervention (Groeneveld et al., 2008; Viester et al., 2012). For example, interviews findings from a study of Groeneveld et al. (2008) showed that total daily food intake in the construction population is high, and since the intervention aimed at improving the energy balance related behaviour, the items 'bread' and ‘self-rated portions for dinner' were added to the questionnaire. Authors further explained that items were added to the questionnaire to better assess the daily amount of these foods, as their intake was specifically targeted during the intervention (Groeneveld et al., 2008).

In this study, participants were asked about their average consumption of meals cooked with fresh and pre-prepared ingredients, take away meals, ready meals as well as salty and sweet snacks across the previous month (Q1 Part 2). Although the findings from the literature review and focus groups highlighted a high consumption of convenient foods (including take-away, ready meals, eating out), raw and pre-prepared ingredient meals were also included in this question. This was because focus groups findings showed that some workers bring food from home as well as prepare food at work (see Appendix 3 for a summary of themes), therefore, these questions allowed a better overall picture of the eating behaviours, as well as the ability to evaluate changes post intervention (see Appendix 4 for a mapping exercise). The frequency in the above questions were categorised into nine groupings (from ‘never’ to ‘5+ a day’). Additionally, open-ended questions were included, asking participants to specify their meals, by providing examples of two the most frequent choices from each category (e.g. ‘Please give examples of two ready meals you eat regularly’ Q1 Part 1). This approach was selected as the focus groups findings suggested that a proportion of the workforce live in temporary accommodation, meaning, they might rely on ready meals every day. Considering that it would not be expected that the frequency of the ready meals would change as a result of the intervention, but rather the type of the meal, and therefore, its nutritional quality. Open-ended questions allowed further exploration of whether the frequency question was correctly understood by participants. For example, some might consider a ‘ready meal’ referring only to chilled food, i.e. requiring heating in a microwave, whereas others would consider it to be a sandwich from a coffee shop.

Questions about fruit and vegetable intake were also included in the final questionnaire. The question in the knowledge section (Q1 Part 1), which was based on the Eatwell Guide, previously asked respondents about their knowledge of recommended daily consumption of fruit and vegetables. In the behaviour section, the question was further developed into two individual topics, examining the consumption of fruit and vegetables separately (Q2, Q3 Part 2). While the consumption of fruit and vegetables provides only a partial picture of a balanced diet, it has been recognised that their intake can be used as an indicator of a healthy diet (Cleghorn et al., 2016; Roberts, 2010). A banded response option was selected for this question allowing respondents to choose a relevant number of portions (‘0-1’, ‘2-3’, ‘4-5’, ‘6+’).

Two questions around eating behaviours at work (Q13 Part 1), eating behaviour in general, and attitudes to nutrition were developed (Q14 Part 1). Respondents were asked to indicate their level of agreement with a series of statements, which covered a range of themes, identified in both the literature review and focus groups. For example, one of the themes (theme ‘Personal resources’) identified that due to a demanding job, construction workers often feel like they have no motivation or willpower to make changes to their diet or lifestyle, therefore, the question presented respondents with a statement to this effect (e.g. ‘I have no motivation to eat healthily’), asking them to indicate their level of agreement with it on a five-point agree-disagree (AD) scale: ‘strongly agree’, ‘agree’, ‘neither agree / disagree’, ‘disagree’, ‘strongly disagree’. Five-point AD scales were introduced, as they have been suggested to provide better quality data than seven or eleven point scales (Revilla et al., 2014). Furthermore, although AD questions are subject to acquiescence bias (tendency of the respondent to agree with a presented statement), the statements used in both questions were both positive and negative. Fowler (1995) proposed that if respondents are inclined to acquiesce, an alternation between positive and negative statement will, to some extent, mute the bias. In this questionnaire, however, statements alternated between positive and negative, where most are worded negatively, since findings from both the literature review and focus groups were largely expressed in negative terms.

Finally, additional questions around the context of eating behaviours in construction workers were developed (Q15-18 Part 1), which examined their living situations while working on site, the availability of food outlets near the site and the accommodation and welfare facilities on site. These were developed in line with findings from the literature review and focus groups, which frequently highlighted the impact of food storage and preparation facilities, as well as accessibility to shops and cafes, on eating behaviours on site. For example, one of the themes ('Site location affecting food choices') explored how the location of the site affected food choices amongst workers. Therefore, a question enquiring about the availability of food outlets on, or close to, the construction site (Q16 Part 1) was included to determine whether the choice of cafes, shops, take-aways was related to healthier or unhealthier food choices and eating behaviours (e.g. skipping meals).

Given the restricted time in designing the questionnaire and questionnaire design not being the main aim of the study, full validity and reliability testing was not appropriate in this context. Instead, best practice guidance in developing nutrition questionnaires (see Table 5.1) was followed. To assess the true validity of the questionnaire designed for this study, it would require highly accurate measurement of food and fluid intakes over several months, which is not feasible. Nonetheless, meetings and telephone conversations with professionals from the area of Public Health and Nutrition as well as Health and Wellbeing in construction were held, to consult on whether the relevant and appropriate (to the respondents) items appeared on the questionnaire (face validity). This process served to maximise the content validity of the questionnaire.

5.4.4. Health measures – a review of existing questionnaires

The next stage in the development of the questionnaire considers the selection of measures to assess the health of the participants pre and post the intervention. This section provides an outline of the health measures that were considered for the questionnaire, but rejected, as well as those included.

A range of health status measures were considered for use in this questionnaire, as they have shown to be both reliable and valid (Bowling, 2017). Within those measures evaluated and suggested by Bowling (2017) and McDowell (2009), the most widely used and well-researched are The Nottingham Health Profile (NHP) (Hunt et al., 1985), Rand 36-item Short Form Survey (RAND SF-36) (Stewart & Ware, 1992; Ware & Gandek, 1994), the Short Form-36 Health Survey (SF-36) (plus Short 12-item versions) (Stewart & Ware, 1992; Ware & Gandek, 1994) and EuroQoL-5D (EQ-5D) (Group, 1990; Kind, 1996) and a single-item, self-rated health measure (Bowling, 2005a). A closer investigation presented in this chapter (see Table 5.3 for details) focused on the assessment of two of the measures: EQ-5D and RAND-36. This is because the EQ-5D was used in two studies exploring the effectiveness of nutrition interventions in blue collar workers in Ireland (Geaney et al., 2016; Schliemann et al., 2019b) while RAND-36 was used to measure the health of construction workers in 'VIP in Construction' study (Viester et al., 2012). Table 5.3 (below) provides a further evaluation of these two measures, outlining why they were ultimately rejected.

Table 5.3. Health measures considered, but rejected, in the final questionnaire

Measure / questionnaire	Why considered?	Why rejected?
The EuroQol-5D (EQ-5D) (Group, 1990; Kind, 1996)	It has been used in two studies exploring the effectiveness of nutrition intervention in blue collar workers in Ireland (Geaney, Di Marrazzo, et al., 2013; Schliemann et al., 2019b). It is a well-known and widely used instrument within population health studies such as the HSE. It was first used in 2012 and recently in 2018.	A total of 5 questions include: mobility, self-care, usual activities, pain/discomfort, anxiety/depression. It has been mainly used in clinical trials and economic evaluations of health care across a large range of conditions (Peasgood et al., 2014). Measures of health are not relevant to the issues raised by participants in focus groups or known from the literature as well as the overall aim and objectives of the study (e.g. participants have not mentioned pain, discomfort, self-care).
RAND-36 (Stewart & Ware, 1992; Ware & Gandek, 1994)	It is a widely known and reasonably reliable and valid measurement of health-related quality-of-life (Brazier et al., 1992); used by Viester et al. (2012) ('VIP in Construction') to measure subjective physical functioning.	Lengthy, consists of 36 questions, with clusters of: physical functioning, social functioning, role limitations (physical problem), role limitations (emotional problem), mental health, pain, general health perception, and health change, used in primary healthcare. Health measures not relevant to issues known to exist in construction (from literature review and focus groups) or to the aim and objectives of the study.

Considering the other health measure scales reviewed, no multiple item tool was found which would meet the criteria of brevity, simplicity and be relevant to the health of construction workers. Therefore, the single-item, self-rated health measure was chosen for the purpose of this research, as a simple, brief tool, offering a broad-ranging assessment of health (relevant to the aim and objectives of this study) (McDowell, 2009). The single-item, self-rated health measure is a popular tool used in population surveys (e.g. Annual Population Survey, Integrated Household Survey and Health Survey for England). At the expense of detail, it offers the advantage of simplicity, as well as being reliable and valid (Bowling, 2005a). Furthermore, the measure makes fewer demands on respondents and researchers (Bowling, 2005a) and has also been significantly and independently associated with use of health services, changes in functional status, rates of recovery from episodes of ill health (Bowling, 2017) and mortality, as supported by the findings from a systematic review (DeSalvo et al., 2006). A single item question 'In general how is your health? Would you say your health is…' asks respondents to rate their health as 'excellent', 'very good', 'good', 'fair' and 'poor' (Bowling, 2017;

McDowell, 2009). While the self-rating of the question is often criticised as being subjective, Bowling (2017) suggests that the subjectivity is its strength, as it reflects personal health evaluation.

5.4.5. Wellbeing measures – a review of existing questionnaires

This section outlines the measures used to assess employees' wellbeing pre and post intervention. As with the previously discussed measures, several wellbeing scales were considered, with details provided in Table 5.4, later in this section.

The importance of measuring wellbeing was recognised by the report of the Commission for the Measurement of Economic Performance and Social Progress (CMEPSP), which stated that *"it is possible to collect meaningful and reliable data on subjective wellbeing […] and subjective wellbeing should be included in larger-scale survey"(*CMEPSP, 2009, as cited in Tinkler & Hicks, 2011, p.2). Additionally, subjective wellbeing measures are considered to be significant as they take account of human perception (Tinkler & Hicks, 2011), which is fundamental to understanding an individual's wellbeing, as only the person knows how they feel (Layard, 2005). This view was also supported by the New Economic Foundation (NEF) who stated that asking individuals whether they feel happy or not is the best way to measure their happiness and satisfaction (NEF, 2012). Furthermore, it has been suggested that measuring subjective wellbeing avoids paternalism, which is an infringement on the personal freedom and autonomy of a person with a beneficent or protective intent, allowing individuals to assess themselves rather than using a list of external circumstances to evaluate their wellbeing (Tinkler & Hicks, 2011).

Three main approaches have been identified when measuring subjective wellbeing: evaluative, experience and eudaimonic (OECD, 2013; Tinkler & Hicks, 2011). Evaluative approaches require an appraisal of overall life satisfaction (Diener, 1994) and are the most prevalent both in national and international surveys (e.g. the World Values Survey, European Social Survey, British Household Panel Survey (BHPS), and DEFRA's Public Attitudes and Behaviours towards the Environment Omnibus Survey) (Tinkler & Hicks, 2011). An alternative evaluative question, known as the Cantril 'Ladder of Life', is a question in which respondents rate their current life on a ladder scale for which 0 is 'the worst possible life' and 10 is 'the best possible' (OECD, 2013; Tinkler & Hicks, 2011).

The experience (or affect) measure aims to assess the emotional quality of one’s experience with regards to an emotion (i.e. negative - sadness, anxiety or positive – happiness, joy), intensity and frequency (Tinkler & Hicks, 2011). Information is usually collected using the Day Reconstruction Method (DRM) and the Experience Sampling Method (ESM), asking respondents to assess their feeling at different times of the day or, like in social surveys, over a short reference period (e.g. yesterday) (Dolan & Metcalfe, 2012; Hicks et al., 2013; Tinkler & Hicks, 2011). The OECD (2013) guidelines of measuring subjective wellbeing recognise that in the case of affect measures, some ambiguity can be introduced, as individuals may interpret certain terms differently, e.g. the term ‘stressed’ might have a variety of interpretations, while ‘anxious’ could relate to a severe, clinically-significant condition or a mild sense of unease, or even a sense of urgent anticipation for something. Finally, the eudaimonic approach is based on the psychological need for our lives to have meaning and it attempts to measure a range of factors, including autonomy, control, competence, engagement, good personal relationships, a sense of meaning, purpose and achievement (Tinkler & Hicks, 2011). In the eudaimonic approach, wellbeing is seen as the full functioning of the person, also considered psychological wellbeing, with the focus on resources and strengths (Di Fabio & Palazzeschi, 2015).

Three wellbeing measures recommended by NEF (2012) were considered for inclusion in the final questionnaire: Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) (Tennant et al., 2007), Shortened Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS) (Stewart-Brown et al., 2009) and ONS four subjective wellbeing questions (Dolan et al., 2011). WEMWBS was originally developed to measure population wellbeing and evaluate mental health promotion initiatives (Bowling, 2017; Tennant et al., 2007). The measure includes only positively worded items related to a range of aspects of positive mental health, regarding ‘good mental wellbeing’ as more that avoiding mental health problems (Bowling, 2017; Tennant et al., 2007). A shortened version, SWEMWBS, was designed in 2009 using Rasch modelling (Stewart-Brown et al., 2009). The measure uses seven of the WEMWBS’s 14 statements about thoughts and feelings and although, in comparison with WEMWBS, provides a more restricted view of mental wellbeing, with most items representing aspects of eudaimonic wellbeing, and few covering experience (affect), although it has robust measurement properties and meets the criteria of brevity (Stewart-Brown et al., 2009). Finally, four ONS subjective wellbeing questions, proposed by Dolan, Layard, & Metcalfe (2011) were reviewed. The measure provides a comprehensive assessment of wellbeing and since the development it featured in APS, Opinions Survey and IHS. The table below (Table 5.4) provides a further evaluation of the rejected wellbeing measures and is followed by the rationale for the inclusion of the selected measure in the final questionnaire.

Table 5.4. Wellbeing measures considered, but rejected in the final questionnaire

Measure / questionnaire	Why considered?	Why rejected?
Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) (14 questions) (Tennant et al., 2007)	WEMWBS has been used in HSE, European Social Survey (ESS) and National Study of Work and Wellbeing (WSWB). New Economics Foundation (NEF) (2012) recommends the use of WEMWBS, if the aim is to measure well-being before and after an intervention.	Excessively long for the purpose of this research. Furthermore, WEMWBS uses only positive worded items, however, it has been suggested that psychological wellbeing is not at the exact opposite end of ill-being or distress, indicating participants need to be asked both (Winefield et al., 2012).
Shortened Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS) (7 questions) (Stewart-Brown et al., 2009)	SWEMWBS is a scale of seven positively worded items, shorter version of WEMWBS, NEF (2012) recommendation for measuring flourishing overall (questionnaire measures both the feeling and functioning aspects of positive mental well-being). These questions meet various statistical tests of robustness, and they also have face validity.	Offers a restricted information in comparison with the WEMWBS, yet it is still excessively long for the purpose of this research.

The ONS approach to measuring subjective wellbeing, which has been selected for the purpose of this research, provides a balanced assessment of wellbeing by taking into account different ways to measure wellbeing (affect, eudaimonic and evaluative) (Tinkler & Hicks, 2011). ONS has adapted this measure following previously mentioned recommendations Dolan, Layard, & Metcalfe (2011) made as well as the OECD framework (Hicks et al., 2013; OECD, 2013; Tinkler & Hicks, 2011). The ONS measure consists of only four questions, which when tested in the IHS took 30 seconds to complete (ONS, 2011, as cited by OECD, 2013), indicating it was straightforward to understand. Furthermore, subjective well-being measures have low non-response rates (Rässler & Riphahn, 2006), which has also been supported by ONS cognitive testing, suggesting that respondents do not find subjective questions difficult or upsetting to answer and such questions do not negatively impact the response rates to subsequent questions or to the survey as a whole (ONS, 2012, as cited by OECD, 2013). Conclusively, the four ONS questions featured are as follows:

• Overall, how satisfied are you with your life nowadays? (experience)
• Overall, how happy did you feel yesterday? (positive affect)
• Overall, how anxious did you feel yesterday? (negative affect)
• Overall, to what extent do you feel the things you do in your life are worthwhile? (eudemonic)
All questions use a 0 – 10 scale.

The last section of the questionnaire included 'about you' (demographic) questions (age, gender, education level, occupation, living situation). These were adapted from the UK Census and were included at the end of the questionnaire, since it has been suggested that demographic questions at the beginning can be seen as probing and therefore off-putting (Parmenter & Wardle, 2000; Trakman et al., 2017).

All the measures included in the final questionnaire complied with the criteria set above. The final questionnaire (31 questions in part 1 – see Appendix 5, and 10 questions in part 2 – see Appendix 6) consists of 4 sections: nutrition questions, health question, wellbeing questions and about you (demographic) (see Table 5.5 for details)

Table 5.5. A summary of questionnaire development

Component	**Nutrition**	**Health**	**Wellbeing**	**About you (demographic)**
Measure	Newly developed based on the literature review, focus group findings, Eatwell Guide	Single-item, self-rated health measure	ONS4	Adapted from UK Census
Questions number	1-18 Part 1 1-10 Part 2	19 Part 1	20-23 Part 1	24-31 Part 1

5.4.6. Questionnaire administration

In this study, two modes of questionnaire administration are used: a self-administered pen and paper method (Part 1), and an interviewer-administered, face to face method (Part 2). Nutrition knowledge, AD (agree-disagree) behaviour, context, health, wellbeing and demographic questions are included in the self-administered part of the questionnaire, while the majority of eating behaviour questions asking about food recall and frequency formed part of the interviewer-administered part of the questionnaire. The section below provides the rationale for this choice.

Data collection using questionnaires varies in respect of contacting respondents, delivery of questionnaires and in how questions are administered (e.g. self-administered and interviewer-administered) and these variations can have different effects on the quality and the accuracy of collected data (Bowling, 2005b). Five main indicators of the effects of the questionnaire administration mode on data quality have been suggested: absence of bias (validity of responses); absence of social desirability; item response rates; the amount of information (e.g. amount of open-ended questions); and similarity of response distributions obtained by different mode of administration (Rutherford et al., 2016). Furthermore, Bowling (2005a) suggested that when considering a mode of administration, the steps involved in answering questions, which make cognitive demands on respondents, should be considered, including; understanding of the question, recall of information asked, making the link between the recalled information and the question, and communication of the response (Bowling, 2005b).

Visual and written methods of questionnaire delivery have been found to be the most burdensome (Bowling, 2005b; Rutherford et al., 2016). Bowling (2005b) highlighted that the self-administered mode particularly affects the cognitive burden placed on respondents, particularly the demand for literacy (respondents need to read, understand, write, follow instruction etc.). Considering the low levels of education and literacy as well as cultural diversity amongst construction workers (Du Plessis et al., 2013; Gans et al., 2015; Lingard & Turner, 2015; ONS 2018; Wilkie, 2019), the most burdensome questions (open-ended questions), requiring detailed information recall and the highest literacy levels, were included in the interviewer-administered part of the questionnaire, which has been suggested the least burdensome method requiring respondents to only speak the same language, have basic listening and verbal skills (Bowling, 2005b). Furthermore, as only general measures (e.g. fruit), rather than specific measures (e.g. tinned fruit, dried fruit, fresh fruit), were used in this questionnaire (e.g. Q2-3 Part 2), a presence and additional explanations from an interviewer (e.g. definitions of a portion) might enhance the understanding of general measures amongst participants and support respondents with low literacy levels as well as with cognitive difficulties in recalling consumed foods accurately (Johns & Townsend, 2010; Murray et al., 2017).

Issues of response rates, item response, and ways of increasing these, have been under investigation since being recognised as indicators of the effects of the questionnaire administration mode on data quality (Bowling, 2005b; Rutherford et al., 2016). The lower the response rate to the study, the higher the chances of study bias and weak validity of the results (Bowling, 2005b). Communication barriers (e.g. low literacy), next to unwillingness to participate in the study and the researcher's inability to contact respondents, have been highlighted as the main causes for non-response (Bowling, 2005b). Mode of questionnaire administration has also been indicated as a potential reason behind non-response, with face-to-face interviews having higher response rates than self-administered surveys (e.g. people with low literacy levels are unlikely to response to written survey) (Bowling, 2005b; Christensen et al., 2014; Ekholm et al., 2010). Christensen et al. (2014), while examining response patterns in two general population health surveys, found the non-response rate to be higher in the self-administered survey (37.9%) than in the face-to-face interview survey (23.7%). Similar findings were also presented by Ekholm et al. (2010) who found the overall response rate was higher in the face-to-face interview survey (74.5%) in comparison with other administration modes. Importantly, findings of Ekholm et al. (2010) confirmed non-response rates to be the highest amongst individuals with low socio-economic positions, therefore, possibly having low literacy levels, while Christensen et al. (2014) suggested that individuals with higher education levels were more likely to participate in either self-administered or interviewer-administered surveys. Finally, it has been suggested that the presence of an interviewer and their ability to motivate individuals to participate (especially those from lower socio-economic positions) may also account for higher response rates in face-to-face interviews, which should be taken into consideration while conducting surveys with participants with low literacy levels (Christensen et al., 2014).

A friendly, motivating interviewer might not only be in a position to increase response rates, but also item response rates, by motivating answers to longer questions, exploring responses, redirecting respondents back to the topic, helping to prompt memory and providing clarification to ambiguous questions (Bowling, 2005b; Ekholm et al., 2010; Rutherford et al., 2016). This is particularly important in supporting answers to the open-ended questions in this study, which require the recall of food consumed over a period of time, therefore are more demanding cognitively, time consuming, and could be missed by respondents. Results from an early meta-analysis are in line with the above findings (Van Der Zouwen & de Leeuw, 1991).

The authors reported higher item response rates in face-to-face interviews, enhanced by the ability of interviewers to motivate responses, ensure questions are answered, not missed and recorded correctly (Van Der Zouwen & de Leeuw, 1991). Findings from a different meta-analysis suggested that the use of different questionnaire administration modes within a study may be an effective way to maximise response rates (Rutherford et al., 2016). The authors proposed that self-administered questions, which are difficult to answer (e.g. due to difficulties with information recall) may be followed up using an alternative, like an interview (Rutherford et al., 2016). Taking this evidence into account, the questionnaire in this study used the self-administered mode for multiple-choice, AD, or numeric scale questions, while the interviewer-administered part of the questionnaire included questions more difficult to recall, comprising of food frequency and food choice open-ended questions, in order to ensure the information is provided by respondents.

It is worth noting that interaction with another person, as it occurs in interviewer-administered questionnaires, might lead to social desirability bias (respondents giving more positive and socially desirable answers), resulting in over-reporting of desirable behaviour (e.g. eating healthy foods) or exaggerating positive health status and under-estimating undesirable behaviours and activities (e.g. fast food consumption or smoking) (Bowling, 2005b; Tipping et al., 2010; Tourangeau & Smith, 1996). For example, differences in response patterns were found between interviewer and self-administered modes for health-related quality of life questions (Christensen et al., 2014; Tipping et al., 2010), with more socially desirable answers (i.e. feeling well) reported in the presence of an interviewers (Christensen et al., 2014). Alternatively, different patterns in responses could be explained by the fact that as these questions use scales, looking at the scale on paper might have allowed respondents to visualise it more easily and influenced them to select less extreme responses in self-administered mode (Christensen et al., 2014). Considering the above findings, questions using scales (e.g. single-item, self-rated health measure and the four ONS questions) were included in the self-administered part of the questionnaire, to allow respondents to better visualise their answers and avoid influences from the researcher.

Nonetheless, some research has reported no differences between interviewer versus self-administration modes and responses. A large study (n=2261, 80.6% males, median age - 43.1) provided evidence that administration formats do not have a meaningful effect on repeated patient-reported outcomes (d’Ardenne et al., 2011; Puhan et al., 2011). Additionally, results from a meta-analysis showed that a pattern of providing socially desirable responses was observed in telephone interviews, not face to face interviews (Cong et al., 2011). A more recent meta-analysis (56 studies) suggested that studies using a mix of self-completion and assisted completion will generally produce equivalent scores (Rutherford et al., 2016). Furthermore, findings of a study looking at the effect of survey mode on response patterns suggested that the interview data showed higher estimates of daily smoking and obesity when compared with self-administered data (Christensen et al., 2014). The authors suggested that it may be due to respondents being more honest, which directly conflicts with the previously discussed view that self-administered modes are more likely to elicit honest responses to sensitive questions (asking about socially desirable behaviours) (Bowling, 2005b; Tipping et al., 2010; Tourangeau & Smith, 1996). Nonetheless, Christensen et al. (2014) proposed that respondents might be less reluctant to lie in the face-to-face interview due to the risk of being caught. This is an important finding in the light of this study, as questionnaire respondents took part in the nutrition intervention delivered by the researcher, therefore, they might have been more honest in providing answers as their food choices and behaviours, including ways to improve, were a subject of discussion during individual coaching sessions throughout the intervention. Finally, strategies to minimise the effect of socially desirable responses were implemented while administering the questionnaire pre and post intervention, including; assurances of confidentiality and anonymity and indirect questioning (e.g. Could you tell me about your typical breakfast?) (Bowling, 2005b). Furthermore, as some of the questions asked about ready meal and take-away meal consumption, which are considered less healthy, therefore less socially desirable, the questions were created assuming negative behaviour to counter the problem (as suggested by d'Ardenne et al. (2011)) (e.g. How often do you eat…? rather than Do you eat…?).

5.4.7. Pilot

A pilot of the questionnaire was conducted with a small sample of nutrition students and professionals in the researcher's workplace. The feedback mainly focused on specifying the size of some drinks and providing more examples for questions on frequencies of different meals, both being addressed in revised questionnaire. The only comment was in respect of the 4 ONS wellbeing questions sound 'very serious'. However, while this was acknowledged the language of the questions was not changed as these are validated and tested, by many national survey measures.

5.4.8. Nutrition intervention recruitment and questionnaire distribution

Following the questionnaire design, this section outlines the intervention recruitment and the questionnaire distribution. Focus groups were conducted with three construction organisations in January – March 2020, with the aim of all three sites taking part in the intervention. However, following the first Covid-19 lockdown between March and July 2020 (Brown & Kirk-Wade, 2021), none of the construction organisations that had initially made a commitment to take part in the intervention wished to continue (see further details in chapter seven). Subsequently the researcher established contact with a different construction company, which agreed to partake, and the intervention commenced on site in late September 2020.

Participants were recruited using multiple avenues. Posters about the nutrition intervention taking place were displayed on site (in canteen, changing rooms, kitchen) inviting workers to sign up to the programme. Posters included the researcher's email address and a request to get in touch directly with the researcher or with a supervisor / a manger if interested, whereby they would be provided with a consent form, participant information sheet, and the BCT protocol (discussed in further sections). Invitation letters were also emailed to workers. This was followed by a toolbox talk delivered on site, introducing the nutrition intervention, and inviting workers to take part. The toolbox talk replaced the originally planned awareness day due to Covid-19 restrictions at the time (see further details in chapter seven). As with previous recruitment methods, participants were provided with relevant documents and asked to take at least 24h before deciding to take part. Those wishing to take part could email the researcher, inform their line manager or fill in a 'return slip to opt in' available on the participant information sheet and either email a scan or a picture of the slip to the researcher or place it in a secured box lock) in the staff canteen. After that, information on intervention times and places was provided to those interested in taking part by email, during staff briefings and on posters displayed on site.

Questionnaires were distributed to participants, in paper form, during the first intervention day, prior to any intervention activities commencing. Participants were allowed time to fill in part 1 (self-administered) of the form, while the second part was administered by the researcher. Participants were individually invited into a separate room, where the answers were taken and the questionnaires were coded with a numeric identifier, known only to the research team, to ensure confidentiality and anonymity. Since the design of the intervention allowed flexibility, and workers could join anytime, the consent form, participant information sheet, and BCT protocol were available on site (with site managers) throughout the intervention and baseline questionnaires were distributed at the beginning of each intervention day to new participants. All hard copies of consent forms and questionnaires were stored in a locked filing cabinet in the researcher's study room.

5.4.9. Rationale for body composition testing

Following the rationale for the questionnaire development and a review of the processes and methods used to design it, this section provides a rationale behind the body composition testing (BCT), used in this intervention (weight, Body Mass Index (BMI), body fat (BF) will be measured as a part of the intervention using Tanita SC-331S Body Composition Analyser). This section begins with a short critical review of the two main measures of obesity: BMI and BF. Then, an overview of the main ways to measure BF is presented, with several identified techniques, to finally focus on bioelectrical impedance analysis (BIA). Studies looking at the performance of BIA in comparison with other methods as well as reproducibility of the results are presented. This section concludes with a summary of the advantages and disadvantages of using BIA in relation to the objectives of this study.

Both obesity and being overweight are usually defined by two markers. First, a BMI, which classifies individuals as overweight (i.e. a BMI of 25-29.9 kg/m^2) and obese (a BMI of 30 kg/m^2 and above) (Bajorek & Bevan, 2019; WHO, 2020). Second, *"an abnormal or excessive fat accumulation that may impair health"* (WHO, 2020, para 2) and wellbeing (Deurenberg & Yap, 1999). Looking at BF measures, an individual is considered obese if BF is equal or greater than 25% of body weight in men and 30% - 35% in women (different values are provided by authors) (Frankenfield et al., 2001; Nuttall, 2015; Snitker, 2010). Although, there is an absence of literature discussing optimal values for BF, as well as the potential moderating effects of age and race, therefore, the boundaries remain highly subjective (Nuttall, 2015; Snitker, 2010).

Although BMI was not originally intended as an index of obesity, it is now commonly used in epidemiological studies (e.g. (Bjørge et al., 2019; Fletcher, 2014; Pasco et al., 2014) to predict obesity-related morbidity and mortality (Frankenfield et al., 2001; Nuttall, 2015) and as an index of relative weight (Wells & Fewtrell, 2006). However, BMI measures are now under scrutiny as they only account for an individual’s height, but not build, because two individuals might have the same BMI but different body compositions (Bajorek & Bevan, 2019; Gurunathan & Myles, 2016; Nuttall, 2015). While correlated with percentage fat (Frankenfield et al., 2001; Wells & Fewtrell, 2006), BMI cannot distinguish between fat and lean mass (Bajorek & Bevan, 2019; Wells & Fewtrell, 2006) and it has been suggested that BF, rather than excess weight, better determines the health risks associated with obesity (Aune et al., 2017; Dehghan & Merchant, 2008; Kelly & Metcalfe, 2012; Lee et al., 2018; Padwal et al., 2016). Furthermore, in a critical review paper, Nuttall (2015) commented that BMI does not provide information on fat distribution around the body, while a meta-analysis by Deurenberg et al. (1998) found that the relationship between BF percentage and BMI differs between ethnic groups. These are important conclusions considering the diversity of the construction workforce in the UK (ONS, 2018), highlighting the need to consider ways to measure BF .

However, fat is also difficult to measure, with several identified techniques to assess percentage BF, including underwater weighing (densitometry), air-displacement plethysmography, Computed Tomography (CT), dual energy x-ray absorptiometry (DEXA), BIA and magnetic resonance imaging (MRI) (Dehghan & Merchant, 2008; Fields et al., 2002; Kelly & Metcalfe, 2012). While DEXA, CT and MRI demonstrate the most accurate and reliable results in BF measurement (Kelly & Metcalfe, 2012), they are expensive, inconvenient for participants, require specialised equipment, laboratory space, and operator training (Dehghan & Merchant, 2008; Kelly & Metcalfe, 2012) and therefore were not feasible and practical to be used in this study. Moreover, while DEXA can give a detailed accurate distribution of fat tissue mass, fat-free mass (FFM) and bone mineral content (BMC), the technique is expensive and due to radiation cannot be frequently repeated (Jaffrin, 2009). While, air-displacement plethysmography is quick, comfortable, noninvasive, and reliable, it requires on measurements being taken inside a large, enclosed chamber (Fields et al., 2002), which is not portable, and therefore, not feasible to be used in this study. BF can also be determined with the use of anthropometric measurement of skin-fold thickness (ST), which characterises subcutaneous fat thickness at various body regions (Duren et al., 2008). Yet, the ST method is not without limitations. It has limited utility in the overweight and obese adults due to the difficultly of grasping a large skinfold and reading the caliper dial simultaneously (Duren et al., 2008). Furthermore, the majority of national reference data is available for triceps skinfolds, which vary by sex and can be associated with the triceps muscle size, rather than actual body fatness (Duren et al., 2008). Finally, the main disadvantage of the ST method is that especially overweight and obese study participants might feel self-conscious about having these measures taken and therefore avoid taking part in an intervention where ST measures are required (Kelly & Metcalfe, 2012). Considering the above, and the fact that construction workers often wear multiple layers of protective clothing, it was decided that taking a ST measure was not practical for this study.

BIA has been a popular method of measuring BF mass, mainly due to its practicality (Barbosa-Silva & Barros, 2005; Duren et al., 2008; Huber, 2019; Ward, 2019). BIA technology transmits a small, single- or multi-frequency electrical current through a body of an individual via electrodes or metal contacts (Huber, 2019). Muscle (lean tissue) contains more water in comparison with adipose (fat) tissue and bone, therefore, muscle is a better electricity conductor. On the other hand, fat, as an insulator, does not conduct a current well, offering resistance and impedance to the current. Impedance is analysed and calculated by a BIA machine and produces estimates of total body water (TBW), BF percentage, and lean body mass (or FFM) (Duren et al., 2008; Huber, 2019).

A number of studies have looked at the performance of BIA technology in comparison with other methods of BCT (Anderson, Erceg, & Schroeder, 2012; Jaffrin, 2009; Kelly & Metcalfe, 2012). In a review paper by Jaffrin (2009) on bioimpedance methods for measuring body composition, the authors reviewed studies, which compared data from DEXA and BIA (with a use foot to foot impedance (FFI) Tanita machine). The authors concluded that impedance meters are reliable for a healthy population and are especially useful in nutrition, sports and in medical general practice (Jaffrin, 2009). Similar findings were presented in a paper by Kelly & Metcalfe (2012) looking at the validity and reliability of the Tanita meter, where the authors concluded that the assessment of body composition by BIA demonstrates reasonable agreement with other techniques. The effectiveness of BIA as an alternative to DEXA was also evaluated by comparing BIA and DEXA results in 25 men and 25 women (including lean, healthy, and obese individuals according to body mass index), age 18 to 49 years, finding that BIA devices provide reliable body composition estimates and may be used in place of DEXA (Anderson et al., 2012).

The reliability of BIA for the estimation of body composition (BF, fat mass (FM) and FFM) and the ability of the technology to repeat the same results in a space of time, has also been investigated (Chula de Castro et al., 2018; Talma et al., 2013). A systematic review found no method reproducibility, due to considerable variability in methodology (e.g. time intervals between tests ranging from 90 seconds to five weeks), however, differences in BF percentage were relatively low, ranging between 0.9% and 1.61% (Talma et al., 2013). A more recent meta-analysis found almost perfect reproducibility for BF percentage, with other components (FM and FFM) being inconclusive due to insufficient number of studies (Chula de Castro et al., 2018). It has been suggested that the almost perfect reproducibility is due to the simplicity of equipment handling and therefore, little influence from the machine handler, which then reduces the errors when measures are repeated (Chula de Castro et al., 2018). The authors concluded that BIA is a low-cost, easy technique, which can be helpful for health professionals and is *"an applicable research tool in studies that investigate body composition changes at different times"* (Chula de Castro et al., 2018, p.15).

Low cost and practicality are only some of the advantages of BIA, with the technology offering non-invasive, safe, low maintenance, quick, portable and requiring limited operator expertise and training body composition results (Barbosa-Silva & Barros, 2005; Jaffrin, 2009; Kelly & Metcalfe, 2012; Ward, 2019). Measures are conducted in an upright position, can be repeated as often as desired, and the results are available immediately (Buchholz et al., 2004; Dehghan & Merchant, 2008; Jaffrin, 2009). However, it is also important to recognise the limitations of the BIA method. Firstly, bioimpedance technology is an indirect method as the machine does not measure body composition, but resistance when exposed to an electric current and then uses algorithms to translate this information (Ward, 2019). As the measured resistance is then transformed into a prediction of total body water (TBW) by an algorithm (Ward, 2019), other BIA parameters are largely dependent on the individual's hydration status (Walter-Kroker et al., 2011). Some assumptions have been made in the process of developing these equations and therefore the following performance limitations need to be accepted: the body shape, the relationship between trunk and leg lengths, the hydration level (FFM is calculated by assuming a hydration fraction for FFM, typically 0.73) and the fat fraction, which is commonly determined by subtraction of predicted FFM from measured body weight (Barbosa-Silva & Barros, 2005; Ward, 2019). Despite the limitations, BIA is considered an acceptable method for measuring body composition (FM and FFM) in healthy individuals, with no fluid imbalance or body shape abnormalities (Barbosa-Silva & Barros, 2005; Kelly & Metcalfe, 2012). In addition, coupled with its ease of use, and less invasive nature makes it suitable for the assessment of body composition amongst construction workers in this study. Furthermore, BIA technology has been suggested as adequate for monitoring changes in an individual's body composition over time, rather than to conduct a single measurement (Buchholz et al., 2004), which is in line with the aims of this study looking at the changes in selected measures pre and post intervention. Furthermore, reflecting on the limitations of both measures (BMI and BF), and to obtain the most comprehensive and complete picture of one's health (within the limits of this study), both BMI and body composition measures were taken as a part of the intervention.

5.4.10. Body composition testing protocol

As a part of the intervention BCT was conducted and measures of weight, BMI, FM, FFM taken using Tanita SC-331S Body Composition Analyser. The machine is a foot-to-foot bioimpedance analyser, which retrieves weight automatically, while requiring additional data to be manually inserted, including gender, age, height. Participants completed a maximum of six measurements (once a month), all conducted in the workplace. Prior to the first measurement, participants were given a written protocol based on existing BCT guidelines (Cornell Univeristy Recreational Services, 2018; Khalil, Mohktar, & Ibrahim, 2014; National Institute for Health Research (NIHR), 2019), explaining the process of taking measurements (see Appendix 7 for a table with recommendations and a protocol). Additionally, participants were instructed not to exercise or consume excessive caffeine for 12 hours prior to the test, and to avoid alcohol intake for 24 hours prior to their appointments. All measurements were conducted in the morning (if possible), after a staff briefing, and before the physical work commenced.

Prior to measurement participants were made aware of the warning signs and asked about contraindications to conducting the test. All measurements were recorded on measurement logs and participants names were coded with a numeric identifier, known only to the research team, to ensure confidentiality and anonymity. Date and time were noted. Menstrual cycles, if applicable, were annotated. Measurements were provided to participants as a printout, with an accompanied handout explaining the results. In addition, the researcher provided further feedback, coaching and advice on the results.

5.4.11. Data analysis

Data analysis was carried out using SPSS v.26. Descriptive statistics were used to present the baseline measures from the questionnaires and BCT, together with the participant characteristics, workplace context, nutrition knowledge and behaviours. This allowed data to be presented in a meaningful way and added clarity to the results (Saks & Allsop, 2019; Tashakkori & Teddlie, 2010), which further aided the interpretation, necessary for the next stage, the design of the nutrition intervention. Only descriptive analysis was conducted at this stage, as the research questions in this chapter did not require data analysis beyond this point.

All variables were explored, with different approaches used for categorical and continuous data.

For categorical variables, frequencies were reported, which told us how many participants gave each response, for example, to a question about a recommended water intake (Q3 Part 1), 27 participants (52.9%) gave a correct answer (i.e. 6-8 glasses). Continuous variables allowed the mean, standard deviation and range (including minimum and maximum values) to be reported.

5.5. Results - questionnaire and body composition testing

This section presents the descriptive results of the questionnaire. Firstly demographic data is provided, followed by an analysis of the health and wellbeing scores, nutrition knowledge, and nutrition and health behaviour questions. The last part of this section provides descriptive statistics on BCT results.

5.5.1. Participant and workplace characteristics

Table 5.6. Participant characteristics

Category / sub-category	**N**	**%**
Month of joining intervention	***n = 51***	
Month 1	14	27.5
Month 2	6	11.8
Month 3	7	13.7
Month 4	11	21.6
Month 5	9	17.6
Month 6	4	7.8
Gender		
Male	47	92.2
Female	4	7.8
Other	0	0
Ethnicity		
English / Welsh / Scottish / Northern Irish / British	25	49.0
Irish	5	9.8
Gypsy or Irish Traveller	0	0
Other White – Italian	1	2.0
Other White – Romanian	7	13.7
Other White – Bulgarian	1	2.0

Category / sub-category	N	%
Other White – Polish	2	3.9
Other White – Spanish	1	2.0
Other White – Georgian	1	2.0
Other White – Slovenian	1	2.0
Other White – Portuguese	3	5.9
White and Black Caribbean	0	0
White and Black African	0	0
White and Asian	1	2.0
Indian	1	2.0
Pakistani	0	0
Bangladeshi	0	0
Chinese	0	0
African	0	2.0
Caribbean	1	2.0
Arab	0	0
Other	0	0
Language		
English first language	34	66.7
English not first language	17	33.3
Age		
Under 18	0	0
18-24	6	11.8
25-34	16	31.4
35-44	15	29.4
45-54	10	19.6
55-64	4	7.8
Job		
Managers	18	35.3
Operatives	32	62.7
Apprentice	1	2.0
Shift work		
Working shifts	8	15.7
Not working shifts	43	84.3
Employment / Contract type		
An employee	18	35.3
Self-employed or freelance	32	62.7
Business owner with employees	1	2.0
Education		
None	0	0
Primary	0	0
Secondary	8	15.7
Higher or secondary or further education (A-levels, BTEC, etc.)	9	17.6
College or university *	26	51.0
Post-graduate degree	5	9.8
Prefer not to say	3	5.9

*Please note that seven operatives from Romania selected ‘college or university’ as their selected education level. Romanian Diploma de bacalaureat is comparable to UK level 3 qualification, however, due to the name it could have been confused by Romanian workers with UK Bachelor, and therefore, a higher than expected number of individuals selected college or university education.

Table 5.6 shows that the total number of intervention participants was 51, with 14 joining in the first month of the intervention. Due to the characteristics of construction jobs, participants joining the intervention in the following months might not have worked on the site when the intervention originally started. For example, a group of plumbers joined the programme in month 4, as plumbing jobs on site only started in December 2020. Over 92% of participants were male (n=47), with the majority aged between 25-44 (60.8%). Participants were mainly British (49%), followed by Europeans (37.4%), with the biggest minority group coming from Romania (13.7%). Overall, 66.7% (n=34) declared English as being their first language. Most participants were self-employed (62.7%), and operatives (62.7%), including trades like plumbers, scaffolders, ground workers, and joiners. Fewer respondents (15.7%; n=8) worked shifts and most of respondents declared a college or university education (51%).

Table 5.7. Participants' workplace characteristics (context)

Living situation	**Responses**	
	N	**%**
	n = 51	
Living at home	44	77.2
Staying temporarily with friends and family	5	8.8
Staying in temporary accommodation (e.g. hotel, B&B, guest house) with food preparation and food storage facilities available (e.g., kitchen, fridge)	3	5.2
Staying in temporary accommodation (e.g. hotel, B&B, guest house) with NO food preparation or food storage facilities available	0	0
Staying in temporary accommodation (e.g. hotel, B&B, guest house) with a restaurant, a bar of a cafe	0	0
Staying in a rented flat or a house	5	8.8
Total (including double counting when more than one response selected)	**57**	**100**
Food outlet availability near workplace / site		
Good choice of food shops, take-aways, cafes	10	19.6
Limited choice of food shops, take-aways, cafes	35	68.6
No food shops or cafes in the areas	6	11.8
Food outlet availability near temporary accommodation / home		
Good choice of food shops, take-aways, cafes	29	56.9
Limited choice of food shops, take-aways, cafes	21	41.1
No food shops or cafes in the areas	1	2.0
Food-related welfare facilities available on site		
Canteen serving hot and cold food	7	4.5
Van / café / shop serving hot food	2	1.3
Van / café / shop serving cold food	2	1.3
Vending machine with snacks and drinks	15	9.7
Kitchen allowing for food preparation and storage (e.g. microwave, fridge, toaster)	26	16.9
Kitchen allowing for food preparation only	6	3.9
Kitchen allowing for food storing only	9	5.8
Water stations	32	20.8
Tea and coffee facilities	35	22.8
Only eating area (tables, chairs)	18	11.7
No facilities	2	1.3
Total (including double counting when more than one response selected)	**154**	**100**

Table 5.7 highlights that most participants (n=44, 77.2%) lived at home, while working on site, followed by 8.8% (n=5) who stayed in a rented flat or a house, 8.8% (n=5) who lived temporarily with friends and family, and 5.2% (n=3) who stayed in temporary accommodation with food preparation and food storage facilities available. Some participants (n=6) selected multiple responses when answering the living situation question, as they lived at home but stayed in rented or temporary accommodation or with friends during the working week. Most respondents (68.6%, n=35) stated that there was a limited choice of food shops, take-aways, or cafes available near the site, while 56.9% (n =29) declared that there was good availability close to where they lived. Finally, regarding the welfare facilities available on site, participants

differed in their responses, with 35 respondents declaring ‘tea and coffee facilities’, followed by ‘water stations’ (n=32), ‘kitchen allowing for food preparation and storage (e.g. microwave, fridge, toaster)’ (n=26), ‘only eating area (tables, chairs)’ (n=18), and ‘vending machine with snacks and drinks’ (n=15). Participants were asked to select multiple responses to this question, if applicable to the situation.

5.5.2. The health and wellbeing of construction workers

The health and wellbeing of construction workers was assessed using the self-rated general health item and ONS4 wellbeing questions. Participants were presented with a single item question ‘In general how is your health? Would you say your health is…’ and asked to rate their health as ‘excellent’, ‘very good’, ‘good’, ‘fair’ and ‘poor’. Participants were asked to rate their wellbeing by answering four questions (i) ‘Overall, how satisfied are you with your life nowadays?’; (ii) ‘Overall, to what extent do you feel the things you do in your life are worthwhile?’; (iii) ‘Overall, how happy did you feel yesterday?’; (iv) ‘Overall, how anxious did you feel yesterday?’. All questions used a 0 – 10 scale, where higher scores indicated higher levels of wellbeing, with the exception of the last question (i.e. about anxiety), where lower scores suggest higher wellbeing levels.

Table 5.8. Self-rated health and wellbeing

Self-rated health				**N**	**%**
				n = 51	
Excellent				0	0
Very good				7	13.7
Good				24	47.1
Fair				19	37.3
Poor				1	2.0
Wellbeing (4ONS)	**Mean**	**SD**	**Range**	**Min**	**Max**
Life satisfaction	6.69	1.70	8	2	10
Worthwhile	7.02	1.83	8	2	10
Happy yesterday	6.88	1.96	9	1	10
Anxious yesterday	4.14	2.46	10	0	10

Table 5.8 indicates that most respondents rated their health as ‘good’ (n=24) or ‘fair’ (n=19) (47.1% and 37.3% respectively). Seven respondents stated their health was ‘very good’, while one reported it as ‘poor’. None of the respondents rated their health as ‘excellent’.

With regards to the well-being scores, it is evident that there were differences amongst individual respondents, with the ‘anxiety’ score range being 10 (mean score 4.14). Out of three positive wellbeing questions, respondents assessed their ‘life satisfaction’ the lowest (mean score 6.69), followed by ‘happiness yesterday’ (6.88) and life being ‘worthwhile’ (7.02).

Figure 5.2 (below) presents a comparison between the wellbeing scores of intervention participants (n=51) with ONS published national data for the period of March 2020 to April 2021 (ONS, 2021). For participants in this study the ‘anxiety’ mean score was higher than ONS average ratings (4.14 – intervention score vs. 3.31 ONS data). The positive wellbeing scores were all lower than the ONS averages, i.e. ‘life satisfaction’ 6.69, compared to 7.39, ‘worthwhile’ 7.02, compared to 7.71, and ‘happy’ 6.88, compared to 7.31.

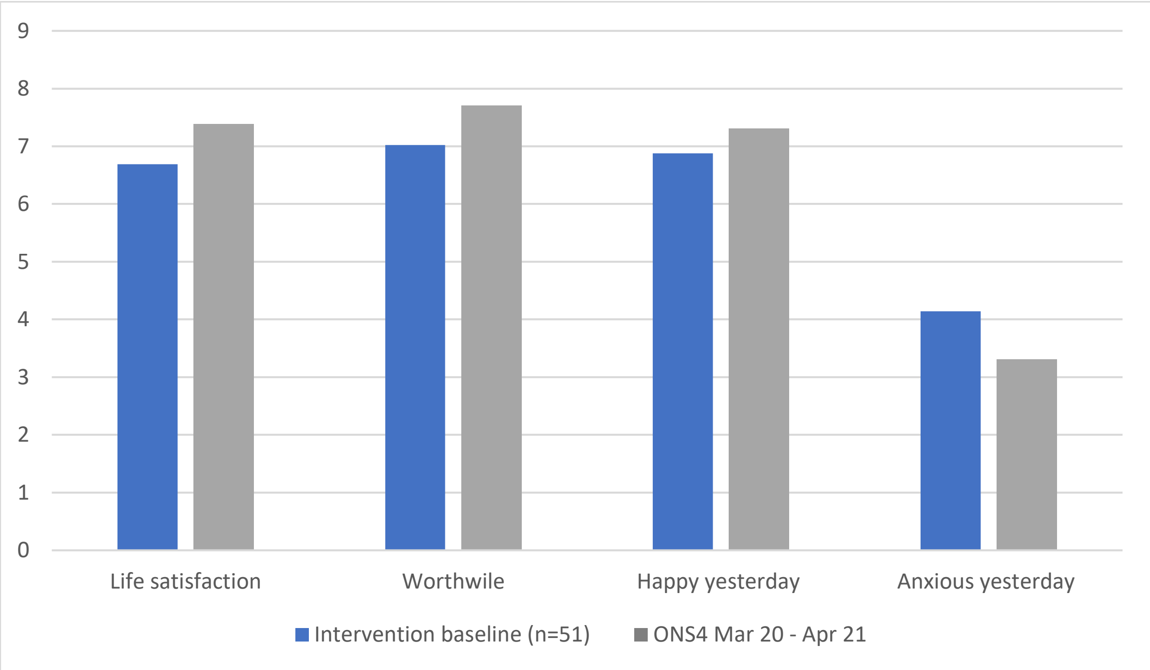

Figure 5.2. ONS4 Wellbeing – a comparison between the intervention and ONS published wellbeing scores

5.5.3. Nutrition knowledge

Table 5.9. Nutrition knowledge based on the EatWell Guide

Recommended daily portions of fruit and vegetables	**N**	**%**
	n = 51	
1-2	2	3.9
3-4	10	19.6
5+	39	76.5
not sure	0	0
Knowledge on foods high in fat, salt and sugar		
Are not needed in our diet	26	51.0
Should not make up more than a quarter of your plate	20	39.2
Are high in fibre	1	2.0
Not sure	4	7.8
Recommended daily water intake		
1 glass	0	0
2-3 glasses	2	3.9
4-5 glasses	10	19.6
6-8 glasses	27	52.9
as much as you can	12	23.5
not sure	0	0
Recommended daily juice and smoothie consumption		
1 glass (1/3 pint)	21	41.2
2-3 glasses (2/3 pint – 1 pint)	8	15.7
A large bottle	1	2.0
There is no recommended limit	8	15.7
Not sure	13	25.5

*Highlighted responses are correct answers

Participants' nutrition knowledge was assessed by questions developed using the EatWell Guide. The question asking about the recommended number of fruit and vegetables daily portions was correctly answered by 76.5% of respondents (n=39). Fewer correct responses were provided to the question about 'foods high in fat, salt and sugar', with about half of the respondents (n=26, 51%) providing the correct answer ('not needed in diet'). The second most popular, although incorrect, response ('should not make up more than a quarter of your plate') was selected by 39.2% (n=20). When asked about the recommended daily water intake, 52.9% (n=27) participants chose the correct answer (6-8 glasses), while 23.5% (n=12) responded that there is no limit on water intake and one can drink 'as much as they can'. Finally, 41.2% (n=21) provided the correct answer to the question on 'recommended daily juice and smoothie consumption' (i.e. 1 glass), while 25.5% were not sure, 15.7% stated that 'there is no recommended limit', and 15.7% overappreciated the consumption and answered '2-3 glasses'.

Table 5.10. Knowledge – healthy plate composition

Recommended part of a diet composed of	N	%	N	%
	n = 51		*n = 51*	
	potatoes, bread, rice, past and other starchy carbohydrates		**fruit and vegetables**	
One third	25	49.0	15	29.4
One half	12	23.5	30	58.8
One sixth	8	15.7	3	5.9
One tenth	5	9.8	0	0
No response	1	2.0	3	5.9

*Highlighted responses are correct answers

Table 5.10 summarises the responses given by participants to the question on which part of a daily diet should be composed of starchy carbohydrates as well as fruit and vegetables. Although 49% (n=25) answered correctly, it is worth noting that 25.5% underestimated the recommended carbohydrate portions, suggesting that one sixth or one tenth (15.7% and 9.8%, respectively) is recommended. Interestingly, the daily portion of fruit and vegetables was overestimated by 58.8% (n=30), where one half was reported as the recommended size. The correct answer, one-third, was provided by 29.4% (n=15) of participants.

Table 5.11. Knowledge – nutrients sources

Nutrient sources	Potatoes		Rice		Eggs		Beans		Avocado		Olive oil	
	N	%	N	%	N	%	N	%	N	%	N	%
	n=51		*n=51*		*n=51*		*n=51*		*n=51*		*n=51*	
Starchy carbohydrates	45	88.2	42	82.4	1	2.0	14	27.5	3	5.9	0	0
Fat	0	0	0	0	6	11.8	0	0	21	41.2	42	82.4
Protein	4	7.8	6	11.8	43	84.3	31	60.8	20	39.2	5	9.8
No response	2	3.9	3	5.9	1	2.0	6	11.8	7	13.7	4	7.8

*Highlighted responses are correct answers

Table 5.11 presents participants knowledge on the nutrient content of some common foods, a. Most respondents correctly identified potatoes and rice as sources of starchy carbohydrates (88.2%, n=45 and 82.4%, n=42, respectively). In addition, a high number of respondents correctly recognised olive oil as a fat (82.4%, n=42), and eggs as a protein source (84.3%, n=43). However, when asked about ‘beans’, 27.5% (n=14) answers pointed towards ‘starchy carbohydrates, with 60.8% (n=31) correctly identifying ‘protein’. Notably, 6 participants did not answer this question. Finally, participants struggled with identifying the nutrient source in avocadoes, with 41.2% (n=21) pointing correctly towards fat, however, 39.2% (n=20) classified avocadoes as a good source of protein. This question was not answered by 7 participants.

Table 5.12. Knowledge – food labelling

Traffic light system food label – meaning of red colour	**N**	**%**
	n = 51	
Low sugar	1	2.0
Medium sugar	2	3.9
High sugar	44	86.3
Not sure	4	7.8
Order of ingredients on the food label	**N**	**%**
	n = 51	
Alphabetical order	5	9.8
Randomly	7	13.7
Ascending order	2	3.9
Descending order	16	31.4
Not sure	21	42.1

*Highlighted responses are correct answers

There were two questions about food labelling within the questionnaire, which asked about (i) the traffic light system; and (ii) the order of ingredients. Table 5.12 shows that most respondents (86.3%; n=44) provided the right answer to the 'traffic light system' question, however, significantly fewer correct responses (31.4%; n=16) were found in respect of the question on the order of ingredients ('descending order'). It is worth mentioning that 42.1% of respondents answered 'not sure' to this question, while remaining answers, 'randomly', 'alphabetical order', and 'ascending order', were selected by 13.7%, 9.8%, and 3.9%, respectively.

Table 5.13. Knowledge – obesity causes and poor diet health outcomes

Obesity causes	**N**	**%**
	n = 51	
Eating large portion sizes	39	32.0
Eating lots of fast-food / take-away food	45	36.9
Drinking sugary drinks	35	28.7
Eating more than 5 portions of fruit and vegetables a day	3	2.5
Total	122	100
Poor diet contributing to (health outcomes)		
Obesity	46	29.7
Type 2 diabetes	38	24.5
Cardiovascular disease	36	23.2
Digestive problems like constipation, diarrhea or heartburn	35	22.6
Total	155	100

*Highlighted responses are correct answers

The results from two multiple-choice questions, asking about the relationship between diet and health, are presented in Table 5.13. Participants were asked about 'obesity causes', which most respondents identified accurately, with each correct answer (i.e. eating lots of fast food, eating large portions, and drinking sugary drinks) selected 45, 39 and 35 times. The incorrect option 'eating more than 5 portions of fruit and vegetables a day' was chosen by 3 participants. Furthermore, the correct response to the 'health outcomes of poor diet' question was selected by between 35 and 46 respondents.

Table 5.14. Correct responses to 'obesity causes' and 'poor diet health outcomes' questions

Total correct answers	**N**	**%**
	n = 51	
Total number of respondents selecting all correct answers to the 'obesity causes' questions	28	54.9%
Total number of respondents selecting all correct answers to the 'poor diet health outcomes' question	29	56.9%

Table 5.14 presents a summary of the number of respondents selecting all correct answers to questions on the relationship between diet and health. When looking at the responses on the 'obesity causes question', 28 participants (54.9%) selected all the correct answers. The 'Health outcomes of a poor diet' question, however received more correct answers, with 56.9% (n=29) participants selecting all four correct responses.

5.5.3. Nutrition and health behaviours of construction workers

This section presents the descriptive results of nutrition and health behaviour questions. It starts with fruit and vegetables consumption, followed by smoking status and alcohol consumption, before it presents results on using food labels, eating behaviours at work and attitudes towards nutrition. Then, this section shows results on frequency of different meals consumption over a month and daily drinks intake. It finishes with daily meal consumption and food groups composing a part of a daily diet.

Table 5.15. Fruit and vegetables consumptions (portions)

Vegetable consumption (portions a day)	**N**	**%**	**Fruit consumption (portions a day)**	**N**	**%**
	n = 51			***n = 51***	
0-1	20	39.2	0-1	29	56.9
2-3	20	39.2	2-3	19	37.3
4-5	10	19.6	4-5	3	5.9
6+	1	2.0	6+	0	0

Fruit and vegetable consumption combined (portions a day)	**N**	**%**
	n = 51	
≤2	14	27.5
≤4	14	27.5
≤6	16	31.4
≤8	6	11.8
≤10	1	2.0
≥11	0	0

The EatWell Guide (2020) recommends eating at least five portions of fruit and vegetables a day however, Table 5.15, shows that most participants reported consuming 0-1 portions of vegetables (n=20; 39.2%), and 0-1 portions of fruit (n=29; 56.9%) daily. Only 1 respondent declared eating more than 6 portions of vegetables. When looking at the consumption of vegetables and fruit combined, 27.5% of participants reported eating £ 2 portions daily, 27.5% consuming below 4 daily portions, and 31.4% (n=16) consuming £6.

Table 5.16. Smoking status and alcohol consumption

Smoking status				**N**	**%**
				n = 51	
Smoker				12	23.5
Non-smoker				39	76.5
Consuming alcohol					
Yes				49	96.1
No				2	3.9
Alcohol type	**Mean**	**SD**	**Range**	**Min**	**Max**
Beer (pint)	7.92	11.77	56	0	56
Wine (glass 120ml)	1.96	3.49	18	0	18
Liquor (1 drink or 1 shot)	1.69	2.75	14	0	14
Alcohol units per week	**29.01**	**36.50**	**186.2**	**0**	**186.2**

Table 5.16 shows that 23.5% (n=12) of participants reported smoking, which is higher than the UK estimate of 14.1% (ONS, 2019), although in line with the estimated number of smokers amongst people in routine and manual occupations (23.4%) (ONS, 2019).

Respondents were also asked whether they drink alcohol, and if so, about their average weekly intake of beer, wine and liquor. Almost all the participants (n=49; 96.1%) declared consuming alcohol, with the mean score for beer consumption at 7.92 (pints), 1.96 for glasses of wine, and 1.69 for liquor (shots or drinks). Based on the declared alcohol consumption, alcohol units were calculated, with the mean score of 29.01 units consumed weekly. According to Statista (2019), the mean number of alcohol units consumed per week in England was the highest amongst men aged between 65-74 – 20.9 units, followed by men aged 55-64 – 19.5 units, 45-54 – 17.4 units and 35-44 – 13.4 units. The government recommended weekly limit to keep the risk from alcohol at a low level is 14 units (Statista, 2019).

Table 5.17. Using nutrition labels

Traffic lights labels affecting food choices	**N**	**%**
	n = 51	
Not at all	10	19.6
Not very much	9	17.6
A little	21	41.2
A lot	9	17.6
Don't know	2	0
Information on individual nutritional items affecting food choices (e.g. fat, calories, sugar, protein content)		
Yes	40	78.4
No	11	21.6
What nutrition information on labels affects food choices		
Fat	18	15.5
Calories	23	19.8
Sugar	18	15.5
Salt	13	11.2
Saturated fat	12	10.3
Protein	16	13.8
Carbohydrates	10	8.6
Other	0	0
Don't know	6	5.2
Total	88	100

Respondents were asked to what extent their food choices were determined by the traffic light labelling system, and the results (Table 5.17) show that 'a little' was the most frequent answer (n=21, 41.2%). This was followed by 'not at all', by 10 participants (19.6%). Both 'not very much' and 'a lot' responses were selected by 9 respondents respectively (17.6%).

Most (n=40, 78.4%) respondents said that information about individual nutrients affected their food choices, with calories (n=23), sugar (n=18), fat (n=18) being the most frequently mentioned. In addition, information on protein (n=16), salt (n=13) and saturated fat (n=12) content of food were also important for some respondents, followed by carbohydrates (n=10).

Although having declared that individual nutrient information affected their food choices, 6 participants responded ‘don’t know’, when they were asked to specify the information.

Table 5.18. Eating behaviour at work

	always *n = 51*		**often** *n = 51*		**sometimes** *n = 51*		**seldom** *n = 51*		**never** *n = 51*	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
I bring food (breakfast / lunch) from home	16	31.4	13	25.5	8	15.7	6	11.8	8	15.7
I buy food in a local shop / take-away / cafe	3	5.9	11	21.6	20	39.2	12	23.5	5	9.8
I buy food from a canteen on site	0	0	1	2.0	8	15.7	11	21.6	31	60.8
I prepare food at work	1	2.0	1	2.0	11	21.6	9	17.6	29	56.9
I eat together with my colleagues when at work	4	7.8	7	13.7	13	25.5	8	15.7	19	37.3
I prepare / cook food with my colleagues when at work	0	0	1	2.0	3	5.9	2	3.9	45	88.2
I eat with my colleagues, managers and workers from other divisions	2	3.9	2	3.9	6	11.8	6	11.8	35	68.6
I share the food I bring from home with my colleagues	1	2.0	1	2.0	6	11.8	8	15.7	35	68.6
I shop, prepare food and eat with my colleagues, we live in the same accommodation	1	2.0	0	0	1	2.0	1	2.0	48	94.1
I have difficulty eating and drinking during work, due to insufficient break time	3	5.9	10	19.6	14	27.5	3	5.9	21	41.2
I have difficulty eating and drinking during work, due to being busy at work	4	7.8	11	21.6	20	39.2	3	5.9	13	25.5
I cannot eat healthily due to limited options available around my work	3	5.9	15	29.4	12	23.5	7	13.7	14	27.5

Table 5.18 showed that bringing food to work from home was the most common answer, with 31.4% (n=16) declaring doing it ‘always’ and 25.5% (n=13) ‘often’. The behaviour of buying food in a local shop or café was reported as ‘sometimes’ by 39.2% (n=20) and ‘seldom’ by 23.5% (n=11), with 21.6% (n=11) stating ‘often’ and 5.9% (n=3) as always. Most respondents never buy food from a canteen on site (n=31), while only 1 reported doing it ‘often’. Most participants do not prepare food at work, with 56.9% stating ‘never’, 17.6% ‘seldom’, and 21.6% ‘sometimes’. ‘Never’ was also the most frequently given answer when asked about the behaviour of eating with colleagues (37.3%), including those from other divisions (68.6%). Following that, ‘preparing food at work with colleagues’, ‘sharing food from home’, as well as ‘shopping, preparing food and eating with work colleagues’ were also unpopular eating

behaviours amongst respondents, scoring in ‘never’ section 88.2%, 68.6%, 94.1%, respectively. When asked about difficulty eating at work due to insufficient breaks, 41.2% responded ‘never’, however, when asked about difficulty eating due to busy schedules, 39.2% answered ‘sometimes’, followed by 25.5% ‘never’, 21.6% often, 7.8% ‘always’ and 5.9% ‘seldom’. Finally, most respondents stated that limited food outlet options around work affect their healthy eating, as declared as ‘often’ by 28.9%, and ‘sometimes’ by 26.3%.

Table 5.19. Attitudes towards nutrition and general eating behaviour

	Strongly agree		**Agree**		**Neither agree / disagree**		**Disagree**		**Strongly disagree**	
	n = 51									
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
My work affects my food choices at home	3	5.9	19	37.3	6	11.8	18	35.3	5	9.8
I am interested in health checks	15	29.4	20	52.6	5	13.2	2	5.3	2	5.3
I am interested in professional advice about healthy eating	11	21.6	31	60.8	7	13.7	1	2.0	1	2.0
I am not interested in healthy eating	2	3.9	4	7.8	2	3.9	19	37.3	24	47.1
I am confused about what is healthy or not	6	11.8	12	23.5	9	17.6	18	35.3	6	11.8
I plan my meals in advance	6	11.8	13	25.5	18	35.3	10	19.6	4	7.8
I have my routine when it comes to buying and preparing food	5	9.8	20	39.2	13	25.5	8	15.7	5	9.8
I have no motivation to eat healthily	0	0	8	15.7	12	23.5	19	37.3	12	23.5
I have no energy to eat healthily	2	3.9	7	13.7	9	17.6	23	45.1	10	19.6
I have no time to prepare food	2	7.8	12	23.5	12	23.5	16	31.4	7	13.7
My food choices affect my concentration during the day	1	2.0	24	47.1	11	21.6	11	21.6	4	7.8
I choose foods that give me energy during the day	3	5.9	27	52.9	16	31.4	4	7.8	1	2.0
Healthy eating is too expensive	2	3.9	13	25.5	15	29.4	13	25.5	8	15.7
Healthy food does not taste good	0	0	3	5.9	13	25.5	21	41.2	14	27.5

Respondents were asked about their attitudes towards nutrition as well as general eating behaviours, and Table 5.19 summarises the results. Participants were asked to indicate their level of agreement with each item on a five-point Likert scale. Nearly half (43.2%) agreed that work affected their food choices at home, however, a similar number of respondents (45.1%)

disagreed. When asked about having an interest in health checks and getting professional advice on healthy eating, the vast majority ‘agreed’ and ‘strongly agreed’ (82% and 82.4%, respectively), while when responding to the ‘not interested in healthy eating’ statement, 37.3% ‘disagreed’, while 47.1% ‘strongly disagreed’. Respondents were divided when answering the ‘confused about what is healthy or not’ statement, with most stating ‘disagree’ (35.3%), followed by ‘agree’ – 23.5%, ‘neither agree / disagree’ – 17.6%, ‘strongly disagree’ – 11.8% and ‘strongly agree’ – 11.8%. Similarly, answers were divided when responding to the question about planning meals in advance, with 35.3% ‘neither agree / disagree’, 25.5% ‘agree’, and 19.6% ‘disagree responses, however nearly a half (49%) of participants agreed or strongly agreed they have a ‘routine in buying and preparing food’.

Regarding ‘no motivation’, ‘no energy’ to eat healthily and ‘no time’ to prepare food, a high proportion of respondents ‘disagreed’ or ‘strongly disagreed’ with the statements (60.8%, 64.7%, 45.1%, respectively). In respect of food choices affecting concentration, 24 participants (47.1%) ‘agreed’ with the statement, while 21.6% (n=11) either ‘disagreed’ or ‘neither agreed / disagreed’. Over half the respondents (52.9%, n=30) ‘agreed’ or ‘strongly agreed’ that they ‘chose food which gives energy’, while 31.4% (n=16) selected the ‘neither agree / disagree’ option. When asked about healthy food being too expensive, 21 participants ‘disagreed’ or ‘strongly disagreed’ (41.2%), while 15 ‘agreed’ or strongly ‘agreed’ (29.4%). Finally, 35 respondents (73.2%) stated ‘disagree’ or ‘strongly disagree’ in respect of the statement about ‘healthy food does not taste good’.

Table 5.20. Frequencies of different meals consumed over the last month

Frequency of consumption	Rarely or never		1-3 per month		Once a Week		2-3 times a Week		4-6 times a Week		1-2 times a Day		3-4 times a Day		5+ a Day	
	n = 51															
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Meals cooked using fresh or raw ingredients	2	3.9	0	0	1	2.0	15	29.4	11	21.6	19	37.3	0	0	3	5.9
Meals cooked using pre-prepared ingredients	9	17.6	7	13.7	10	19.6	13	25.5	7	13.7	5	9.8	0	0	0	0
Take-away meals or eat out	2	3.9	10	19.6	14	27.5	12	23.5	11	21.6	2	3.9	0	0	0	0
Ready meals	7	13.7	4	7.8	5	9.8	7	13.7	16	31.4	12	23.5	0	0	0	0
Salty snacks	10	19.6	5	9.8	4	7.8	14	27.5	9	17.6	9	17.6	0	0	0	0
Sweet snacks	3	5.9	3	5.9	6	11.8	10	19.6	11	21.6	16	31.4	1	2.0	1	2.0

Table 5.20 shows that over a third of participants (37.3%; n=19) stated that they eat meals cooked using fresh or raw ingredients 1-2 times a day, while 21.6%, 4-6 times a week, and 29.6%, 2-3 times a week. Consumption of meals cooked using pre-prepared ingredients was less frequent, with 19.6% eating them once a week, while 25.5% declaring 2-3 times a week consumption. The frequency of take-away meals (or eating out) was mostly spread across '1-3 per month' (19.6%), 'once a week' (27.5%), '2-3 times a week' (23.5%) and '4-6 times a week' (21.6%). However, the consumption of 'ready meals' was more popular, with 31.4% (n=16) declaring it '4-6 times a week' and further 23.5% (n=12) '1-2 times a day'. Sweet snacks were consumed more often when compared with salty snacks, with over 53% (n=27) declaring eating them '4-6 times a week' or '1-2 times a day'. Salty snacks were consumed '2-3 times a week' by 27.5% (n=14), '4-6 times a week' by 17.6% (n=9) and '1-2 times a day' by 17.6% (n=9). 'Rarely or never' was a response provided by 10 participants (19.6%) to 'salty snacks' and by 3 respondents (5.9%) to 'sweet snacks'.

Table 5.21. Drink consumption (daily)

Drink type (1 glass = 180-200ml = a third of pint (1/3 pint)	**Mean** ***n = 51***	**SD**	**Range**	**Min**	**Max**
Water	4.65	2.76	10	0	10
Juice	1.10	1.65	8	0	8
Smoothie	0.14	0.35	1	0	1
Coffee	1.96	1.82	8	0	8
Tea	1.18	1.50	6	0	6
Energy drink	0.43	1.04	5	0	5
Soft drink	0.94	0.97	4	0	4
Squash	0.18	0.79	5	0	5
Other (milk)	0.27	0.85	5	0	5

The mean score for water intake (in glasses) was 4.65 glasses per day, however, it ranged between participants, with some declaring no water intake, while others reported up to 10 glasses a day. The second most popular drink was coffee (mean score 1.96; ranging from 0 to 8 cups a day), followed by tea (mean score 1.18) and juice (mean score 1.1). Although the energy drink consumption mean score was 0.43, some participants stated consumption of up to 5 glasses a day.

Table 5.22. Daily meal consumption

Meal type	0-1 day / week		2-3 days / week		4-5 days / week		6-7 days / week	
	n = 51							
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Breakfast	7	13.7	3	5.9	9	17.6	32	62.7
Mid-morning snack	31	60.8	8	15.7	7	13.7	5	9.8
Lunch	0	0	2	3.9	2	3.9	47	92.2
Mid-afternoon snack	29	56.9	9	17.6	5	9.8	8	15.7
Dinner	1	2.0	0	0	2	2.0	49	96.1

Respondents were asked about the frequency of eating meals to establish if they skipped meals and / or snacked (Table 5.22). Having breakfast on all, or almost all, days of the week (6-7 days a week), was reported by most respondents (62.7%; n=32), while 17.6% (n=9) declared having breakfast 4-5 days a week, 5.9% (n=3) 2-3 days a week, and 13.7% (n=7) 0-1 day a week. Both lunch and dinner were less frequently missed, with 92.2% declaring having lunch 6-7 days a week, and 96.1% reporting having dinner 6-7 days a week. Most respondents did not snack regularly, with 60.8% reporting having a mid-morning snack on 0-1 days a week and 56.9% a mid-afternoon snack on 0-1 day a week. Mid-morning snacking on 2-3 and 4-5 days a week was stated by 15.7% and 13.7% respectively, while in mid-afternoon on 2-3 and 4-5 days a week by 17.6% and 9.8%, respectively. Frequent snacking (6-7 days a week) was stated by a minority, 9.8% (mid-morning) and 15.7% (mid-afternoon).

Table 5.23. Food groups composing a part of daily diet (as a part of the plate)

Food group	One third		One half		One sixth		One tenth	
	n = 51							
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Potatoes, bread, rice, pasta or other starchy carbohydrates	14	27.5	30	58.8	3	5.9	4	7.8
Fruit and vegetables	15	29.4	11	21.6	16	31.4	9	17.6

*Highlighted responses are recommended intakes by EatWell Guide

The EatWell Guide (NHS, 2020) recommends that a healthy plate should contain a third carbohydrates (e.g. potatoes, bread, rice) and a third fruit and vegetables. Based on the questionnaire results (Table 5.23), 27.5% (n=14) followed this guidance and declared that 'one third' of their plate contains potatoes, rice, pasta or other starchy carbohydrates. Furthermore, 58.8% of respondents (n=30) said that half of their plate is starchy carbohydrates, while 'one sixth' and 'one tenth' of the plate were declared by 5.9% (n=3), and 7.8% (n=4), respectively. Similarly to carbohydrates, a recommended 'one third' of a plate of fruit and vegetables was declared by 29.4% (n=15) respondents. 'One half' was stated by 21.6% (n=11), however, 31.4% of respondents (n=16) reported 'one sixth', and 17.6% (n=9) 'one tenth' of their plate being fruit and vegetables.

5.5.4. Body composition testing results

Table 5.24. BCT results by gender – Weight, fat %, fat free mass (FFM) and visceral fat (VF), Body Mass Index (BMI)

BCT category	**Male *n=47***					**Female *n=4***				
	Mean	**SD**	**Range**	**Min**	**Max**	**Mean**	**SD**	**Range**	**Min**	**Max**
Weight (kg)	87.9	14.2	68.6	62.8	131.2	63.1	5.4	12.7	55.8	68.5
Fat %	22.6	5.9	26.2	10.1	36.3	29.3	3.6	7.6	27.0	34.6
FFM (kg)	67.4	7.9	40.8	52.1	92.9	44.5	2.7	6.1	40.7	46.8
VF	8.4	4.1	18.0	1.0	19.0	3.8	1.7	4.0	2.0	6.0
BMI	27.0	3.6	15.9	20.4	36.3	23.2	2.7	5.0	20.8	25.8

Table 5.24 summarises the results of BCT, conducted using a Tanita analyser, which included measures of weight, fat percentage, FFM, VF and BMI. The above results were divided by gender due to different recommended fat ranges for males and females. The mean weight score for males (n=47) was 87.9kg, while for females (n=4) 63.1kg, However, it is worth noticing that the weight range for male participants was 68.6kg (min - 62.8kg; max – 131.2kg). The

mean fat percentage score was 22.6 for males, and 29.3 for females, while the mean FFM score for males was 67.4kg, and 44.5kg for females. An individual will be considered obese if the body fat is equal or greater than 25% of body weight in men and 30% - 35% in women (different values are provided by authors) (Frankenfield et al., 2001; Nuttall, 2015; Snitker, 2010). When observing the visceral fat scores, the mean for males was 8.4, and 3.8 for females. Importantly, the range for males was considerable with individual participants scoring anything between 1 and 19. Finally, the mean BMI score was 27 for males, which is considered as overweight, and 23.2 for females (healthy weight range). BMI classifies individuals as underweight with BMI below 18.5 kg/m², healthy weight range with BMI between 18.5 kg/m² and 24.9 kg/m², overweight as having a BMI of 25 kg/m² to 29.9 kg/m² and obese as a BMI of 30 kg/m² and above (Bajorek & Bevan, 2019; WHO, 2020).

Table 5.25. Mean comparison between age and metabolic age of participants

Category	**Male *n=47***					**Female *n=4***				
	Mean	**SD**	**Range**	**Min**	**Max**	**Mean**	**SD**	**Range**	**Min**	**Max**
Age of participants	37.7	10.9	40	18	58	36.2	9.4	20	25	45
Metabolic age of participants	40.3	15.7	60	12	72	32.2	10.0	21	26	47

Table 5.25 shows a comparison between the mean scores for biological and metabolic age, calculated during the BCT using the Tanita analyser. Metabolic age is calculated by the analyser by comparing the Basal Metabolic Rate (BMR) (the number of calories a body burns at rest) to the average BMR of individual's chronological age group. Metabolic age, which is higher than biological age, might be a sign that an individual needs to gain more muscle mass and lose fat mass. The mean score for biological age was 37.7 for males and 36.2 for females, while metabolic age was 40.3 for males and 32.2 for females. In addition, the range of metabolic age in males was higher (60) than biological age (40), with metabolic age of male participants' scores extending from 12 to 72 (biological age range 18-58). In females, ranges were similar; 20 (from 25 to 45) for biological, and 21 (from 26 to 47) for metabolic age.

5.6. Summary of my main findings from baseline questionnaires and BCT

1. Most of participants (77.2%) lived at home while working on site, which was assessed by 68.6% to have limited choice of food shops, take-aways, cafes. Although the intervention was delivered on one site, participants varied in the way they assessed

welfare facilities on site (e.g., 11.7% said only eating area is available, while 16.9% mentioned a kitchen allowing for food preparation and storing).

2. Participants rated their health as ‘good’ or ‘fair’ (84.4%), while within wellbeing scores, life satisfaction was scored the lowest. Wellbeing scores were lower than ONS data presenting a sample of population scores from the same time.

3. Over 75% of participants knew the recommended daily portions of fruit and vegetables, however, only 45.2% declared the consumption of recommended (or above) intake.

4. Approximately 50% had knowledge on recommended water intake (6-8 glass), however, the mean score for water consumption was 4.65 glasses. The mean for coffee consumption was 2 glasses, while other drinks (e.g. juice, smoothies, soft drinks) mean scores did not exceed 1 glass per day.

5. Nearly 50% had knowledge that carbohydrates should make a third of a plate, however, approximately 60% declared a half of their plate being composed of potatoes, rice, pasta etc.

6. The lowest knowledge participants presented answering a question on the order of ingredients on the food label (31.4%). When behaviours were concerned, over 50% reported using traffic lights and nearly 80% declared using nutrition information on labels (e.g. calories, fat, sugar) when selecting food.

7. Although most participants provided correct responses to questions on obesity causes and outcomes of a poor diet, only approximately 50% selected all correct answers to questions.

8. Smoking status was declared by 23.5%, while alcohol consumption by 96.1%, with an average 29 units consumed weekly, all being higher than national average.

9. Eating behaviours at work varied between participants, with over 50% declaring bringing food from home (‘always’ or ‘often’) and over 50% buying it in a local shop / café (‘often’ or ‘sometimes’).

10. There was no evidence of socialising on site, with most participants not declaring sharing food, preparing food, or eating together. This, however, might have been linked with social contact restrictions during Covid-19.

11. Most participants were interested in health checks, professional advice about healthy eating, however, questions around confusion on what is healthy or not, meal planning, and having a routine when buying and preparing food received mixed responses.

12. Less frequently than a daily consumption of meals prepared using fresh or raw ingredients was declared by nearly 60% of participants. Consumption of take-away meals or eating out on multiple times during the week was declared by nearly 50%, while ready meals by 45%. In addition, ready meals were declared as daily consumed food by 23.5%.

13. Although snacking was not a frequent behaviour (with approximately 60% declaring snacking '0-1 day / week'), salty snacks were declared on multiple times per week by 45%, while sweet by 41%. Additional 31.4% of participants declared consuming sweet snacks daily.

14. Breakfast was the only main meal that some participants were skipping, with over 60% declaring a regular consumption.

15. The average weight for male participants was 87.8kg, and BMI 27. Metabolic age of males was 3 years higher than their actual age.

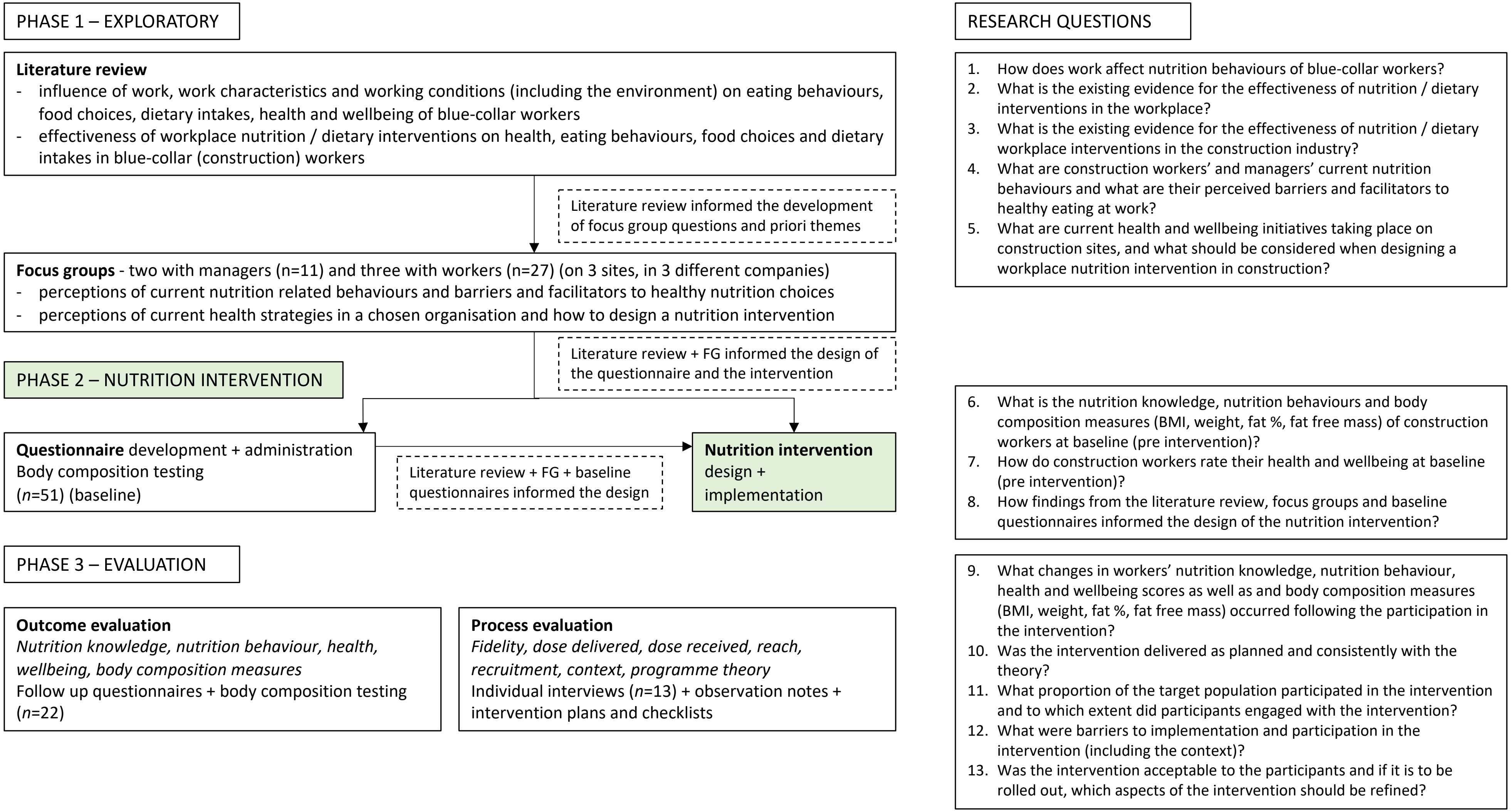

Figure 5.3. The Research Framework – Nutrition intervention design

5.7. Nutrition intervention design

5.7.1. Introduction to the intervention design

This section outlines the design stages of the nutrition intervention, using the COM-B model and BCW. It begins with a short introduction into the complexity of nutrition behaviours and workplace interventions before presenting the aim and objectives of this section. The design is presented in three stages and eight steps, beginning with understanding the target behaviour (stage 1), before it moves onto identifying intervention options (stage 2). Finally, it focuses on identifying the content and implementation options (stage 3), presented in a summary table.

Nutrition behaviours are complex and frequently influenced by a combination of interacting factors at psychological, social, and environmental levels (Bonnell et al., 2017; Devine et al., 2003; Quintiliani et al., 2010). Interventions, aimed at changing nutrition behaviours, often contain multiple components, which either act independently or interdependently to create a behaviour change and therefore, there is a need to carefully design and evaluate interventions (Hutchinson & Wilson, 2012; Maes et al., 2012), to understand what works, for whom, and in which circumstances (Moore et al., 2015).

Effective interventions are needed to change eating behaviour (Atkins & Michie, 2015) and to increase the chances for success, interventions require planning (Craig et al., 2008; Skivington et al., 2021). The MRC guidance on the systematic development and evaluation of complex interventions recommends that the intervention design needs to be informed by theoretical, evidence-based frameworks, which facilitate an understanding of how an intervention causes behaviour change, before progressing to modelling and experimentation (Craig et al., 2008; Skivington et al., 2021). Atkins and Michie (2015) highlighted benefits to using this theory: (i) it can provide an evidence-collection framework; (ii) it can be used in the design of the intervention allowing understanding of what needs to shift for a change in behaviour to occur; and (iii) it can support the evaluation of the intervention by identifying mechanisms of action.

This study applies the BCW and COM-B model in the design of the intervention (see 2.8. for an overview of behaviour change theories). The COM-B model is a central hub of the BCW and according to its assumptions, a successful eating behaviour change requires transformation in one or more of the interacting components: capability, opportunity and motivation (Atkins

& Michie, 2013). For the behaviour to occur, individuals need to have physical and psychological capability (e.g. knowledge, skills, stamina) to enact it, the physical and social opportunity in the form of an environment set up to ensure they have all they need, (e.g. access to healthy food outlets), and be motivated to perform a new behaviour more than any potentially competing (old) behaviours and well as be convinced that it is worthwhile and prioritise it (Atkins & Michie, 2013).

5.8.3. Aim and objectives of intervention design

The aim of this phase of the research was to systematically design a theory-based nutrition intervention in the construction industry. It was achieved by following the design process guided by the COM-B model and the BCW framework (Michie et al., 2014) and the MRC framework (Craig et al., 2008; Skivington et al., 2021). The MRC framework was used as an overarching guide, while the BCW and COM-B model were used to identify the target behaviour and select the most appropriate intervention and implementation options. In addition, findings from the literature review, focus groups and baseline questionnaires were used to ensure the relevance of the intervention to the target population (i.e. construction workers). Therefore, in this section, the following research question is addressed:

8. How findings from the literature review, focus groups and baseline questionnaires informed the design of the nutrition intervention?

5.8.4. Nutrition intervention design

The process of the intervention design has been broadly categorised in three stages, over eight steps, as illustrated in Figure 5.4.

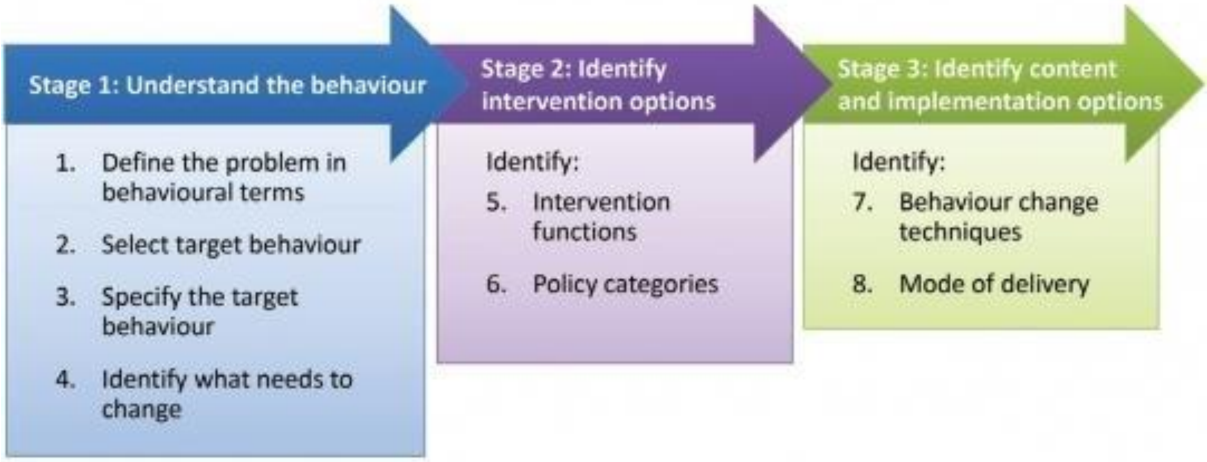

Figure 5.4. The BCW Intervention Design Process (Michie, van Stralen, et al., 2011)

Considering these stages in turn:

Stage 1 – Understand the target behaviour

Understanding the target behaviour includes four steps: defining the problem in behavioural terms, selecting the target behaviour, specifying the target behaviour, and identifying what needs to change (Michie, Atkins, et al., 2014).

Step 1 - Define the problem in behavioural terms

The first step requires defining the problem which the intervention is intending to address, with a consideration of the context in which the behaviour occurs and target population (Michie, Atkins, et al., 2014). This step entailed a literature review looking at nutrition behaviours of construction workers, findings from focus groups exploring current nutrition behaviours and barriers and facilitators to healthy eating at workplace, together with the results from the baseline questionnaires. A summary of all the nutrition related behaviours identified is presented in Table 5.26.

Table 5.26. A summary of nutrition related behaviours of construction workers (literature review, focus groups & baseline questionnaires)

Nutrition related behaviour	**Found in the literature review**	**Found in focus groups (FGs)**	**Found in baseline questionnaires**
Alcohol consumption and smoking	Alcohol, smoking and other unhealthy behaviours, like drug consumption, gambling (Boschman et al., 2011; Oswald & Turner, 2017; Sherratt & Turner, 2018)	3 FGs Excessive alcohol consumption and smoking were identified as common unhealthy behaviours;	23.5% smokers, 96.1% drinking alcohol, with an average of 29 units a week
Skipping meals	Skipping meals due to busy schedules, long working days, forgetting to eat due to work pressure; (Chaplin & Smith, 2011; Devine et al., 2003; Nea et al., 2017; ODA, 2012; Pridgeon & Whitehead, 2013; Souza et al., 2019; Wandel & Roos, 2005)	5 FGs Both workers and managers reported that they frequently skip meals (either breakfast or lunch) due to a poor accessibility to food, short breaks, not being hungry or having a busy schedule;	Some individuals skip breakfast (62.7% declared breakfast consumption 6-7 days / week)
Snacking	Snacking on biscuits, chocolates if nothing else is available (Bonnell et al., 2017; Hemiö et al., 2015; Naweed et al., 2017; Souza et al., 2019; Wandel & Roos, 2005; Wirth et al., 2014)	5 FGs There were differences in the nutritional value of snacks, with some participants declaring snacking on fruit and nuts, while others reporting snacking on crisps, chocolates, biscuits;	Approximately 60% of respondents declared snacking on 0-1 day / week However, salty snacks were declared on multiple times per week by 45%, while sweet by 41%. Additional 31.4% declared consuming sweet snacks daily.
Soft and energy drinks consumption	High intake (Bonnell et al., 2017; Hemiö et al., 2015; Naweed et al., 2017; Souza et al., 2019; Wandel & Roos, 2005; Wirth et al., 2014)	2 FGs High consumption of energy drinks (and sugary drinks) amongst construction workers, as means to sustain energy throughout the day;	Mean score for soft drinks – 0.94 glass, for energy drinks 0.43 glass
Water intake	Keeping hydrated as an issue; avoiding fluids due to a difficulty in taking bathroom breaks (Nea et al., 2017)	3 FGs A low water consumption (often at the expense of coffee and tea) was reported; keeping a bottle of water while on site was mentioned only on one occasion;	Mean score for water – 4.65 glasses (per day)

Nutrition related behaviour	Found in the literature review	Found in focus groups (FGs)	Found in baseline questionnaires
Tea and coffee consumption	No previous discussion of this in the literature in relation to construction workers	4 FGs Participants repeatedly reported high consumption of tea and coffee (six cups and more per day or during the working day);	Mean score for coffee – 1.96 glasses, tea – 1.18 (per day)
Fruit and vegetable intake	No previous discussion of this in the literature in relation to construction workers	5 FGs Mixed responses in respect of fruit and vegetable intake, with some workers asserting their frequent consumption, while others did not, although they recognised their importance;	45.2% declared the consumption of recommended (or above) intake.
Convenient foods – high fat, sugar, processed and fast food, ready-meals	Turning to convenient and processed foods due to high workload and time pressures, living away from home while working on site (poor facilities in accommodation, lack of places to eat) (Bonnell et al., 2017; Burki, 2018; Escoto et al., 2010; Nea et al., 2017; Nobrega et al., 2016; Oswald & Turner, 2017; Phiri et al., 2014; Smith et al., 2017; Zagorsky & Smith, 2017)	5 FGs High consumption of fast food, junk food, ready meals and eating out were repeatedly mentioned; a lack of other options, limited food outlet accessibility, and convenience in preparation were stated as reasons behind those choices; any changes suggested to diet needed to be practical and easy;	60% declared a consumption of meals with fresh ingredients less than once a day 50% declared a consumption of take-away meals and 45% eating out on multiple times during the week Additionally, 23.5% declared daily consumption of ready meals
Socialising at meals	Food time as an opportunity to socialise, sharing food and cooking ideas (Devine et al., 2003; Loudoun & Townsend, 2017; Naweed et al., 2017)	3 FGs Workers often eat together, cook together, share food, especially on sites where most workers are not local, and staying in temporary accommodation, some also collected money to share the burden of shopping and meal preparation;	Not frequently reported, Covid-19 restrictions might have affected habits around socialising on site

Nutrition related behaviour	Found in the literature review	Found in focus groups (FGs)	Found in baseline questionnaires
Food preparation at work	No previous discussion of this in the literature in relation to construction workers	4 FGs Food preparation at work was influenced by facilities available on site and break times;	57% declared they never prepare food at work
Meal planning and preparation	No previous discussion of this in the literature in relation to construction workers	3 FGs The importance of meal planning and preparation was recognised and appreciated by some workers, others discussed the difficulty of staying organised and planning ahead;	37.3% plan meals while 27.4% do not
Bringing food from home	No previous discussion of this in the literature in relation to construction workers	2 FGs Bringing packed breakfast or lunch from home was determined by the nature of the site (temporary or permanent) and location; workers bringing food from home lived locally to the sites, which were permanent or long term;	72.6% bring food from home (sometimes to always)
Eating behaviour outside work	Job demands, stress, long working impacting on food choices outside work, time (Devine et al., 2003; Eurostat, 2018; Wandel & Roos, 2005)	4 FGs Participants concluded that after a long day of physical work, they felt like they had no energy left to cook or shop;	43.2% declared work affecting food choices at home, 45.1% did not

Overall, as presented in the above table, a high consumption of convenient foods, fast food, and ready meals in construction is a common occurrence (found in the literature review, 5 focus groups and baseline questionnaires). Other nutrition related behaviours found in focus groups included an excessive consumption of caffeinated drinks (e.g. coffee and energy drinks), alcohol and low water intake, snacking, and skipping meals. However, these behaviours were not consistent across findings from the literature review, focus groups and questionnaires. In addition, behaviours such as meal planning, bringing food from home, preparing food at work were found in both the focus groups and questionnaires, however had not previously been identified in the literature.

Step 2 & 3- Select and specify the target behaviour

Behaviours do not exist in isolation. Behaviours are accompanied by other behaviours, dependent on other behaviours, and influenced by behaviours of other people (Michie, Atkins, et al., 2014). For example, consuming convenient, high calorie foods can be influenced by the behaviour of other members of the household who are responsible for buying food, by a lack of availability of other options, or by a busy working schedule. Therefore, it has been suggested that when designing the intervention, a long list of all potential behaviours should be generated (see Table 5.26), which is subsequently reduced by considering the possible impact each of these behaviours might have (Michie, van Stralen, et al., 2011). Once the target behaviour is selected, it needs to be specified in terms of: (i) who needs to perform it? (ii) what needs to be done differently? (ii) when? (iv) where? (v) how often? and (vi) with whom the behaviour needs to be performed? (Atkins & Michie, 2015). This is to provide the specificity required for a behavioural analysis and to ensure a more comprehensive evaluation (Atkins & Michie, 2013).

However, the selection of one specific behaviour to focus the intervention on was considered unfeasible in this study, necessitating these two steps of the intervention design (i.e. steps 2 & 3) to be adjusted, due to the following:

1. Nutrition and health behaviours were not consistent across the literature review, focus groups and questionnaires, therefore, selecting only one behaviour risks not meeting the needs of and thus being irrelevant to construction workers on site. Also, other research showed that even in the same context (e.g. working on a construction site) and with a consideration of the same health goal, nutrition behaviours are individual and a

personalised approach needs to be considered (Kim, 2021; Okoro et al., 2015a; Zheng et al., 2017). For example, changes in multiple nutrition behaviours (e.g. reduced snacking, reduced energy-dense food consumption, reduced sweet beverages) can lead to weight loss (Koutras et al., 2021; Kruger et al., 2006), and there is no single best way to achieve this (Kim, 2021).

2. A previous meta-analysis showed that focusing the design on limited behaviours might reduce the relevance of the intervention to the individuals and potentially, limit the engagement (Hutchinson & Wilson, 2012). This is important in the light of results from the focus groups in this study, which suggested that access to welfare facilitates, and health promotion opportunities were not equally available for all those working on site. Workers in the focus groups emphasised the importance of designing the intervention with the whole workforce in mind, considering not only different locations and flexibility on scheduling, but also different levels of engagement, commitment to the behaviour change as well as lifestyles.

3. Furthermore, other studies also chose to deviate from these steps of the BCW intervention design process and selected multiple behaviours to be addressed in their interventions (e.g. Barker et al., 2016; Costello et al., 2018; McEvoy et al., 2018; Ojo et al., 2019).

4. Steps 2 and 3 of the BCW intervention and design process suggest that the selection of a target behaviour should consider the possible impact that each behaviour might have using four criteria: (i) the impact and (ii) the likelihood of behaviour change, (iii) the 'spill over' effect and (iv) ease of measurement (Michie, van Stralen, et al., 2011). However, the process does not explain how this choice should be made if the decision cannot be fully supported by the evidence. Currently, there is the small research base focusing on understanding nutrition practices amongst blue collar workers (Van De Ven et al., 2020) and targeting low socioeconomic workforce (Robroek et al., 2021). Therefore, considering the above and previously mentioned differences in nutrition behaviours between the literature, focus groups and questionnaires, the selection of one behaviour was not considered feasible.

5. Finally, this study used a participatory research methodology, which meant involving those whose actions, experiences, and behaviours were being studied in the planning and conducting of the research (Bergold & Thomas, 2012). Participatory research can improve health behaviours as participants' contribution to the research increases their sense of self awareness, self-confidence, and hope for the future (Baum et al., 2006). Therefore, selecting one behaviour in this study would have required consultation with all stakeholders, which was not feasible during this stage of the research due to the project time constraints and Covid-19 restrictions, affecting the implementation.

Considering the above points, all known from the literature review, focus groups and baseline questionnaires nutrition behaviours were considered in the intervention design to ensure the relevance of the intervention to the target group and different needs of construction workers.

Step 4 – Identify what needs to change

This step involves understanding why behaviours occur, and what needs to shift for the behaviour to change and a new desired behaviour to arise (Atkins & Michie, 2015). This is often achieved using a COM-B model, which shows that a behaviour is part of an interactive system involving capability, motivation and opportunity, and therefore, allows for a 'behavioural diagnosis' (Atkins & Michie, 2015). In this research, 'behavioural diagnosis' was conducted through the literature search, and the analysis of baseline questionnaires and focus groups to identify barriers and facilitators to changing nutrition behaviours at work, and therefore, to recognise which components of the COM-B model needed to be included in the intervention design. Furthermore, this stage of the process was aided by exploring preferences for the intervention design in the focus groups where participants were asked about their views on the components needed for a successful nutrition intervention and their experiences with previous and current health and wellbeing workplace interventions. Table 5.27 provides a summary of the behavioural diagnosis of the target behaviours chosen for the nutrition intervention, using the COM-B model components.

Table 5.27. Behavioural diagnosis using COM-B model

<table>
<tr><td>Behaviours</td><td colspan="2">Excessive consumption of high fat, high sugar, processed and convenient meals (including ready meals, fast food, take-aways) Excessive alcohol consumption
Skipping meals
Snacking
Excessive soft and energy drinks consumption
Excessive tea and coffee consumption
Low water intake
Low vegetable and fruit intake
Meal planning and preparation
Socialising at meals
Food preparation at work
Bringing food from home
Eating behaviours outside work affected by job demands</td></tr>
<tr><td>COM-B components</td><td>What needs to happen for the target behaviour to occur?</td><td>Is there a need for change?</td></tr>
<tr><td rowspan="2">Physical capability</td><td>Have skills to plan and prepare healthy meals with limited time and facilitates available</td><td>Yes, workers were interested in taking part in food demonstrations and learning how to prepare food at work read food labels, however, meals need be quick, simple, with limited ingredients, and possible to make on site, using facilities available</td></tr>
<tr><td>Have stamina, energy and willpower to do shopping, prepare food</td><td>Yes, construction jobs often leave workers feeling perpetually tired and with no personal resources (no willpower, energy, stamina) to do shopping, prepare food or cook</td></tr>
<tr><td>Psychological capability</td><td>Know how to eat healthily</td><td>Yes, workers expressed a desire to learn more about nutrition. Also, there was a mismatch between knowledge and behaviour and previous findings suggested some might be not aware of their own personal intakes</td></tr>
<tr><td rowspan="2">Physical opportunity</td><td>Be able to use facilities provided on site to prepare, store, and eat food</td><td>Yes, as stated, a variety and an accessibility of food storing and preparation facilities across sites varies (different facilities available to managers and workers)
Remote sites offer a limited access to food outlets</td></tr>
<tr><td>Be able to partake in health promotion opportunities on site</td><td>Yes, current health and wellbeing initiatives are not offered to all working on site. Accessibility needs to be considered in the intervention design: multiple locations, flexible scheduling, different levels of engagement, available to all working on site</td></tr>
<tr><td>Social opportunity</td><td>See peers (both managers and workers) engage in healthy nutrition behaviours.</td><td>Yes, peers can be a source of support but also a pressure (e.g. individuals can be peer pressured to both healthy and unhealthy behaviours</td></tr>
</table>

	Use camaraderie amongst workers to encourage behaviour change	Masculinity and competitiveness can be used in the intervention design
Reflective motivation	Hold belief that healthy food (including vegetables) can provide energy during the day to do physically demanding jobs	Yes, current diets of construction workers are dominated with high fat, high calories, high sugar, processed food in a belief that it supports energy to do physically demanding jobs
	Hold belief about health consequences of unhealthy diets	Yes, some workers already consider an awareness about their health status (e.g. visceral fat reading) as important motivation for behaviour change (i.e. a wakeup call)
Automatic motivation	Establish healthy nutrition habits and routines for healthy eating, e.g. an impulse response of turning to healthy snacks when hungry)	Yes, construction workers discussed that established routines and habits enable better health choices
Behavioural analysis of the relevant COM-B components	**All COM-B components needed to change for the target behaviours to improve**	

Stage 2 – Identify intervention options

Having conducted the behavioural diagnosis, the next stage was to commence the design of the intervention. This included identification of the intervention functions and policy categories using the BCW (see Figure 5.5). The COM-B model is at the hub of the BCW, surrounded by nine intervention functions and seven policy categories.

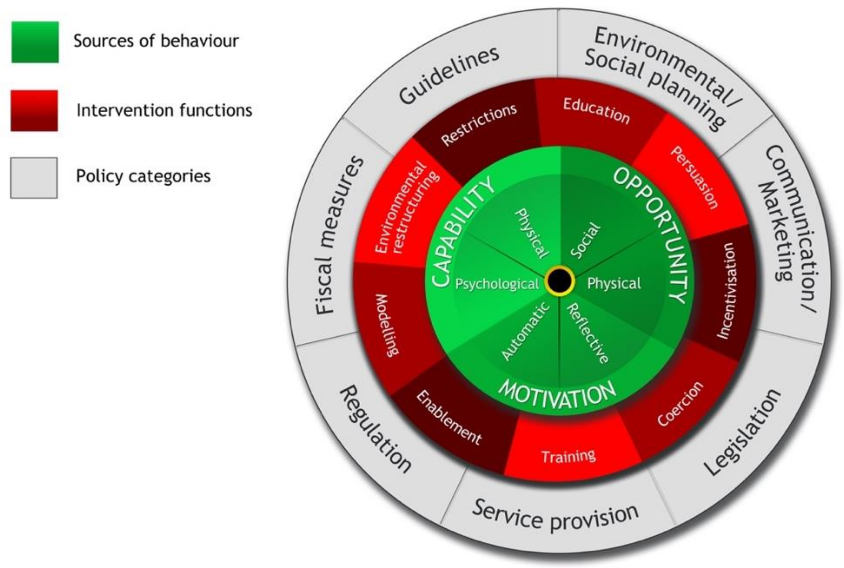

Figure 5.5. The Behaviour Change Wheel (Atkins & Michie, 2015)

Step 5 & 6 – Identify intervention functions and policy categories

In this step, the BCW was used as a guide to select intervention functions, which are broad categories of means by which an intervention can change behaviour that include education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling and enablement (Atkins & Michie, 2015). Intervention functions are linked to a COM-B model to suggest which are most likely to bring behaviour change based on the diagnosis conducted in the previous step (see Figure 5.5) (Michie, Atkins, et al., 2014). Each health and wellbeing intervention can use multiple intervention functions. The method suggested by Michie et al. (2014) to assist in this choice is use of APEASE criteria: affordability, practicability, effectiveness and cost-effectiveness, acceptability, side effects / safety, and equity. Table 5.28 (below) presents the use of APEASE criteria to select intervention functions for the nutrition intervention in construction.

Table 5.28. Selection of intervention function using APEASE criteria

Intervention function	**Example of an intervention function**	**Does the intervention function meet the APEASE criteria (affordability, practicability, effectiveness and cost-effectiveness, acceptability, side effects / safety, and equity) in the context nutrition behaviours of construction workers**
Education	Providing information on how to read food labels	Yes – construction workers were eager to learn more about healthy eating and the skill of reading food labels can prove to be practical and effective due to the transient character of jobs and different facilities and food outlets accessibilities on construction sites
Persuasion	Using food tasting / demonstration to motivate the consumption of healthy food	Yes – workers have beliefs about healthy food not being tasty or too expensive
Incentivisation	Using competitions and challenges to influence increased consumption of fresh fruit and vegetates	Yes – competitions with prizes were considered an effective way to engage the male workforce
Coercion	Increasing the cost of unhealthy food	No – this function was not acceptable to the workforce. It was also not practicable as there was no food provision on site and prices in external food outlets could not be modified as a part of the intervention
Training	Conducting practical activities on meal planning or food preparation at work	Yes – developing food preparation, cooking skills, as well as skills around meal planning and reading food labels, can bridge the gap between knowledge and behaviour
Restriction	Prohibiting sales of unhealthy food in staff canteen	Not practicable as there were no options to restrict sales of unhealthy food in food outlets outside the site
Environmental restructuring	Providing facilities to prepare and store food at work	Yes – might not be equally practicable on all construction sites, depending on the state and availability of welfare facilities, canteen, vending machines for example.
Modelling	Discussing own health and wellbeing journeys to inspire others	Yes – using the power of a lived experience and peer supporters
Enablement	Coaching on building healthy habits on hydration	Yes – coaching small groups can provide individuals with peer support and an opportunity to discuss potential barriers to healthy eating
Selected intervention functions	**Education, persuasion, incentivisation, training, environmental restructuring (within the context of a particular site), modelling and enablement**	

As shown in the above table, two of the nine intervention functions (coercion and restriction) were rejected, while 7 were selected: education, persuasion, incentivisation, training, environmental restructuring (within the context of a particular site), modelling and enablement. In addition to the intervention functions, the BCW also identifies supporting policies, which are the most likely to be effective in changing the behaviour (Michie, Atkins, et al., 2014). Michie et al. (2014) highlight that if there is access to policy levers, then policy categories should be included in the intervention design. However, since that was not the case in this study, policy categories were not identified.

Stage 3 – Identify content and implementation options

The last stage of intervention planning focuses on the identification of the content and implementation options and consists of identifying behaviour change techniques and an appropriate delivery mode.

Step 7 – Identify behaviour change techniques

Having selected intervention function, this step identifies which behaviour change techniques can deliver the desired changes. Behaviour change techniques have been defined as the *"active ingredients in an intervention, designed to bring about change"* (Atkins & Michie, 2015, p. 168). Michie et al. (2013) developed a Behaviour Change Technique Taxonomy, consisting of 93 behaviour change techniques, grouped in 16 categories, which are linked to intervention functions. Behaviour change techniques have been identified in relation to particular behaviours, including healthy eating (Michie, Ashford, et al., 2011). Table 5.29 shows the behaviour change techniques which were selected for this study, based on the previously chosen intervention functions (Table 5.28), and COM-B components (Table 5.27). In addition, the APEASE criteria were applied to select behaviour change techniques, of which an example is presented in Table 5.30.

Table 5.29. Behaviour change techniques, intervention functions and COM-B components

Behaviour change technique	**Description and an example of intervention strategy to deliver behaviour change technique**	**Intervention function**	**COM-B component**
Goal setting (behaviour)	Participants to set their own, healthy eating goals, defined in terms of the behaviour to be achieved, e.g. to eat 5 pieces of vegetables per day	Enablement	Reflective motivation
Review behaviour goals	Participants to review own performance against agreed goals and modify them, if needed, e.g. changing a target of consuming 5 pieces of vegetables depending on current performance	Enablement	Reflective motivation
Feedback on behaviour	Participants to be provided with feedback on performance in relation to adapting healthy nutrition behaviour, e.g. when asked about breakfast in the last month	Incentivisation Education Training	Reflective motivation Psychological capability
Goal setting (outcome)	Participants to set their own goals related to the outcome of changed eating behaviours, e.g. a weight loss of 2kg a month	Enablement	Reflective motivation
Review outcome goals	Participants to review achieved outcomes against agreed goals and modify them, if necessary, e.g. increase or decrease weight loss targets depending on current achievements	Enablement	Reflective motivation
Feedback on outcomes of behaviour	Participants to be provided with feedback on the outcome of performance in relation to adapting healthy nutrition behaviour, e.g. weight loss, changes in body composition	Persuasion Education Training	Reflective motivation Psychological capability
Problem solving	Participants to identify triggers of poor nutrition choices or barriers to behaviour change and to develop strategies to avoid them (e.g. low energy as a trigger for sugary snacks to be overcome by ensuring healthy snacks are always available)	Enablement	Reflective motivation
Action planning	Participants to conduct detailed planning of a performance of the behaviour, e.g. to plan specific meals which could be prepared at work, including context (facilities available), frequency, duration, e.g. cooking eggs in microwave for breakfast three times a week for the next month	Enablement	Reflective motivation
Self-monitoring of behaviour	Participants to monitor and record their behaviours, e.g. to record all vegetables and fruit consumed in one week under different colour categories, on a specially prepared handout	Education Training Enablement	Psychological capability Automatic motivation
Instruction on how to perform a behaviour	Participants to be advised how to plan meals, how to prepare meals at work, how to read food labels when doing shopping	Training	Psychological capability Psychical capability

Behaviour change technique	Description and an example of intervention strategy to deliver behaviour change technique	Intervention function	COM-B component
Demonstration of the behaviour	Participants to observe the behaviours, e.g. food demonstrations conducted on site showing participants how to prepare food at work	Training Modelling	Psychological capability Automatic motivation
Behaviour substitution	Substitution of an unwanted behaviour to be prompted with a wanted behaviour, e.g. participants advised to replace coffee with herbal teas	Training	Automatic motivation
Habit formation	Participants to be prompted to repeat the desired behaviour in the same context, e.g. to read food labels when doing shopping or bring healthy snacks to work	Training	Psychological capability Automatic motivation
Generalisation of a target behaviour	Participants to be asked to perform a new healthy behaviour, which is already performed on site, in another situation, e.g. to cook eggs or porridge in microwave at home (in the same way they learnt to do it on site)	Enablement Training	Psychological capability Automatic motivation
Information about antecedents	Participants to be informed about social and environmental situations and events, emotions that predict the behaviours, e.g. poor sleep and increased consumption of food high in sugar or after work meeting and consumption of fast food	Education	Psychological capability Reflective motivation
Information about health consequences	Participants to be informed about health consequences of performing the behaviour e.g. the likelihood of energy fluctuations and poor concentration with consumption of high sugar food or improved mood and reduced sugar craving following diet changes	Education Persuasion	Psychological capability Reflective motivation
Salience of consequences	Participants to be informed about the consequences of poor diets in a more memorable way, e.g. by using sugar cubes to show the amount of sugar in different food or a model of 1kg of fat vs 1kg of muscle mass	Persuasion Enablement	Reflective motivation Automatic motivation
Prompts / cues	Environmental cues to be provided to prompt or cue the behaviour, e.g. posters displayed with simple ideas on preparing breakfast in microwave in canteen areas	Environmental restructuring	Physical opportunity Automatic motivation
Credible source	Participants to be presented with information on healthy eating from a credible source, e.g. a presentation on benefits of eating vegetables delivered by the researcher who has MSc in Nutrition, drawing on government guidelines etc.	Persuasion	Automatic motivation Reflective motivation

Behaviour change technique	**Description and an example of intervention strategy to deliver behaviour change technique**	**Intervention function**	**COM-B component**
Incentive (behaviour or outcome)	Participants to be informed about a reward to be provided for the progress in behaviour change, e.g. a goodie bag with healthy snacks to be offered to those consuming the most colourful vegetables in a week	Incentivisation	Automatic motivation Reflective motivation
Reward (outcome)	Participants to be rewarded by feeling better, having more energy, losing weight	Incentivisation	Automatic motivation Reflective motivation
Social reward	A reward to be offered on the progress in a behaviour change, e.g. congratulations for the biggest weight loss in a given month, others noticing positive changes	Incentivisation	Automatic motivation Reflective motivation
Self-incentive	Participants to be encouraged to reward themselves for their efforts and progress in changing behaviours, e.g. investing money saved from not having take-away food into their hobbies	Incentivisation	Automatic motivation Reflective motivation
Restructuring the physical environment	The company to be advised about changes needed to the physical environment to facilitate behaviour change, e.g. advice provided to the company on ideas for snacks to be included in vending machines	Environmental restructuring Enablement	Physical opportunity Automatic motivation
Adding objects to the environment	The company to be advised to add objects to the environment to facilitate behaviour change, e.g. water stations and water bottles attached to the construction workers' belts	Environmental restructuring Enablement	Physical opportunity Automatic motivation
Restructuring the social environment	Participants to be advised to change the social environment to facilitate behaviour change, e.g. advice provided to form formal or informal social clubs (construction football club), groups (gym buddies) or peer support networks (wellbeing champions) on site to support healthy behaviours	Enablement	Social opportunity
Avoidance / reducing exposure to cues for the behaviour	Participants to be advised to change routines to avoid exposure to cues (physical, social, contextual) for the behaviour, e.g. to bring own packed lunch to avoid visiting a local take-away or shopping when hungry and to follow a prepared shopping list	Enablement	Psychological capability Automatic motivation Social opportunity Physical opportunity
Identification of self as role model	Participants to be advised that their own behaviour can serve as an example to others, e.g. to encourage others to prepare food at work, to role model positive behaviours	Persuasion	Automatic motivation Reflective motivation

Behaviour change technique	Description and an example of intervention strategy to deliver behaviour change technique	Intervention function	COM-B component
Framing / reframing	Participants to be advised to adopt a new perspective on behaviour to change emotions about performing it, e.g. to think about increasing a portion of fresh vegetables on a plate rather than reducing a portion size	Persuasion Enablement	Automatic motivation
Verbal persuasion about capability	Participants to be told that they can perform a new, healthy behaviour, e.g. to tell participants that they can take ownership of their own health and eat more healthily despite limited food choices on site	Persuasion Enablement	Psychological capability Physical capability Automatic motivation Reflective motivation
Focus on past success	Participants to be told to thin about past successes in adopting healthy behaviours, e.g. ask participants to list occasions they had a healthy meal or reduced their alcohol consumption	Persuasion Enablement	Psychological capability Physical capability Automatic motivation Reflective motivation

Table 5.30. An example of how the APEASE criteria were used to select behaviour change techniques used in the nutrition intervention

An example of behaviour change technique	An example of how APEASE were used (affordability, practicability, effectiveness and cost-effectiveness, acceptability, side effects / safety, and equity)
Goal setting (behaviour)	Practicable to use goal-setting during the workplace intervention, without generating additional intervention costs (affordable / cost-effective). In addition, previously shown by others as an effective technique in workplace health interventions (Hutchinson & Wilson, 2012; Schroer et al., 2014; Tam & Yeung, 2018; Viester et al., 2012).
Feedback on behaviour	Practicable to provide as a part of the intervention, without generating additional costs. Furthermore, focus group findings (two sites) and previous literature showed that feedback is an acceptable and effective technique as workers appreciated the opportunity for health professional providing a ‘reality check’ and receiving tailored feedback on health screening (Groeneveld et al., 2010; Hunt et al., 2010; Loudoun & Townsend, 2017; Sorensen et al., 2007; Viester et al., 2012).
Problem solving	Practicable and affordable to conduct during the workplace intervention. In addition, focusing on men’s strength in problem solving can enhance engagement with the intervention and its effectiveness (Du Plessis et al., 2013; Hanna et al., 2020; Loudoun & Townsend, 2017; Viester et al., 2015).

A total of 31 behaviour change techniques were selected for the nutrition intervention. The choice was made based on the techniques most likely to address COM-B components for (i) desired changes in nutrition behaviours amongst construction workers, (ii) being acceptable to workers, and (ii) feasible to implement on an operating construction site. Hence, capability was mainly addressed by offering instruction on how to perform a behaviour, a demonstration of the behaviour, information about health consequences and antecedents, focus on past success, and verbal persuasion about capability. Opportunity to improve nutrition behaviours is enhanced by restructuring the social and physical environments, adding objects to the environment, and prompts / cues, while motivation is facilitated by a cluster of goal setting, feedback on behaviour, action planning, problem solving, habit formation, salience of consequences, incentives, and rewards.

To facilitate nutrition behaviour change and optimise the delivery of selected behaviour change techniques, each intervention day consisted of six components, with a number of accompanying resources, developed to support delivery. Table 5.31 (below) presents a summary of the intervention day components, details of resources used and examples of behaviour change techniques used within each intervention component. For example, recipe cards and practical tips flyers (resources) were developed to support instruction on how to perform a behaviour and a demonstration of the behaviour (behaviour change techniques), which were conducted within food demonstration and tasting (component).

Table 5.31. A summary of intervention day components, resources used, and examples of behaviour change techniques

Nutrition intervention components	**Resources used**	**Examples of behaviour change technique used**
Presentation	Presentation slides / practical tips flyer	Information about antecedents Information about health consequences Salience of consequences
Practical activity	Activity handout	Self-monitoring of behaviour Behaviour substitution
Food demonstration and tasting	Recipe card / practical tips flyer	Instruction on how to perform a behaviour Demonstration of the behaviour
Coaching session	Goal setting sheet	Verbal persuasion about capability Focus on past success Framing / reframing Goal setting Problem solving
Quiz, a challenge or a competition	Challenge / quiz	Self-incentive Incentive (behaviour or outcome) Reward (outcome)
BCT	Body composition printout	Feedback on outcomes of behaviour Social reward Reward (outcome)

Step 8 – Identify mode of delivery

The last step in the intervention design involves choosing the delivery mode, e.g. face-to-face, through an app, in groups or to individuals. Authors of the BCW guide, which offers multiple modes of delivery, suggest that, as with previous steps, all options should be reviewed and considered, with the APEASE criteria also applicable to this step (Atkins & Michie, 2015).

For this research, face-to-face delivery was selected, as it was not practicable to deliver the intervention using any of the distance modes (e.g. phone, digital media) as construction workers are unlikely to have access to a phone or laptop while working on site. Also, due to the low education and socio-economic backgrounds of construction workers, it was anticipated that this population would engage less with technology.

5.9. Summary of the intervention design

Due to the complexity of the nutrition intervention design, which included multiple components, stages and steps, a full summary of the intervention design is presented in Table 5.32 (below).

Table 5.32 A summary of the nutrition intervention design

Intervention type	Nutrition intervention
Target population	Construction workers (and managers), including employees, self-employed, sub-contractors – all working on site
Recruitment and promotion	Awareness day, toolbox talks, posters, communication through managers and supervisors on site, face to face communication with the site workforce
Location	Construction site, meeting room, canteen – multiple location on site used
Length	6 months
Flexibility assumptions	Flexible start (participants can start anytime between month 1 and month 5) Flexible attendance (both prebooked slot and drop-in sessions offered)
Frequency	A full day visit, once a month
Length of sessions	1.30 hours / multiple sessions delivered throughout the day
Target behaviours	Excessive consumption of high fat, high sugar, processed and convenient meals (including ready meals, fast food, take-aways) Excessive alcohol consumption Skipping meals Snacking Excessive soft and energy drinks consumption Excessive tea and coffee consumption Low water intake Low vegetable and fruit intake Meal planning and preparation Socialising at meals Food preparation at work Bringing food from home Eating behaviours outside work affected by job demands
COM-B components	Physical capability, psychological capability, physical opportunity, social opportunity, reflective motivation, automatic motivation
Intervention functions	Education, persuasion, incentivisation, training, environmental restructuring, modelling, enablement
Behaviour change techniques	Goal setting (behaviour), review behaviour goals, feedback on behaviour, goal setting (outcome), review outcome goals, feedback on outcomes of behaviour, problem solving, action planning, self-monitoring of behaviour, instruction on how to perform a behaviour, demonstration of the behaviour, behaviour substitution, habit formation, generalisation of a target behaviour, information about antecedents, information about health consequences, salience of consequences, prompts / cues, credible source, incentive (behaviour or outcome), reward (outcome), social reward, self-incentive, restructuring the physical environment, adding objects to the environment, restructuring the social environment, avoidance / reducing exposure to cues for the behaviour, identification of self as role model, framing / reframing, verbal persuasion about capability, focus on past success
Delivery mode	Face to face

Intervention components	Presentation, practical activity, food demonstration and tasting, coaching session, quiz, a challenge or a competition, BCT
Resources used	Presentation slides, practical tips flyer, activity handout, recipe card, goal setting sheet, challenge / quiz, body composition printout
Topics	Alcohol, body composition, breakfast at work, Christmas meals, colourful vegetables and fruit, diets – different types, exercise, fitness and staying active, food cravings, healthy plate composition, healthy snacks, lunch at work, meal planning, nutrition and optimal weight and body composition, nutrition and energy, nutrition and immunity, food and mood, reading food labels, shopping lists, ingredients swaps

5.10. Logic model of nutrition interventions

A logic model is a diagrammatical representation of the theory of how an intervention produces its outcomes, so in a simplified way, it shows how an intervention works (Mills et al., 2019). For their advocates, logic models can be useful in the intervention design, to prioritise data collection and analysis and to explore the main aspects of an intervention and relationships between them as well as to demonstrate intervention logic (Mills et al., 2019). Logic models are simple, easy to understand and use, however, they may not include all factors explaining outcomes, making them impractical at times. Furthermore, logic models have also been criticised for representing interventions as linear and mechanistic, which might give a false impression that change happens steadily over time (Gov.UK, 2018). Nonetheless, logic models could be adapted to accommodate some aspects of complexity by an introduction of feedback loops, and although these might not fully reflect the complexity of interventions conducted in the ‘real world’, logic model can offer a simplicity that has advantages for planning and conducting evaluations (Gov.UK, 2018; Kneale et al., 2021).

The logic model (Figure 5.6) provides a broad concept supporting the synthesis and interpretation of evidence available, and it was developed to capture the essential elements of the nutrition intervention and mechanisms through which the intervention is meant to work and whether they are plausible in relation to the outcomes. The model provides a sequential illustration of the components of interventions and their outcomes, but not necessarily the preconditions that are needed to achieve these outcomes, or the relative magnitude of different components (Kneale et al., 2015).

In this logic model, it is first necessary to identity the activity (i.e. the intervention), its target and inputs, which are necessary for the intervention to be designed and implemented. The next level relates to the key influencing factors, which consists of effects of work and workplace environment (social, psychological, organisational & environmental) and demographic characteristics of blue-collar workers on health and nutrition behaviours. In addition, the contextual factors of working in construction industry in the UK, such as physically demanding jobs, transient jobs, self-employment, were identified. Before applying an implementation strategy to improve the likelihood of uptake and successful integration of the intervention into a workplace practice, the identification of workplace-based intervention strategies to promote healthy nutrition choices and a review of behaviour change theories took place. It allowed for potential mechanisms of change to be established (i.e. increasing capability, motivation, and opportunity for a behaviour change). As a number of factors can impede implementation of health promotion initiatives in the workplace, and at different stages (Cherniack & Lahiri, 2010), identification of barriers and facilitators to workplace health programme implementation took place and are presented across the logic model. The next level, the design and implementation stage of the intervention includes a needs assessment, based on the results from focus groups and baseline questionnaires and the identification of factors that the intervention aims to address, including mechanisms of change. The design phase also sets out how intervention activities will influence the behaviour through the COM-B targets, i.e. identification of malleable factors, with the greatest scope for change and intervention functions and behaviour change techniques, which will be applied. A set of outcomes will be used to assess the effects of the intervention. Within those outcomes, individual measures will include health and wellbeing measures as well as nutrition behaviours, knowledge changes and body composition changes. The assumption of the logic model is that the implementation of the intervention is required for any benefits on individual outcomes to be attributed to the intervention.

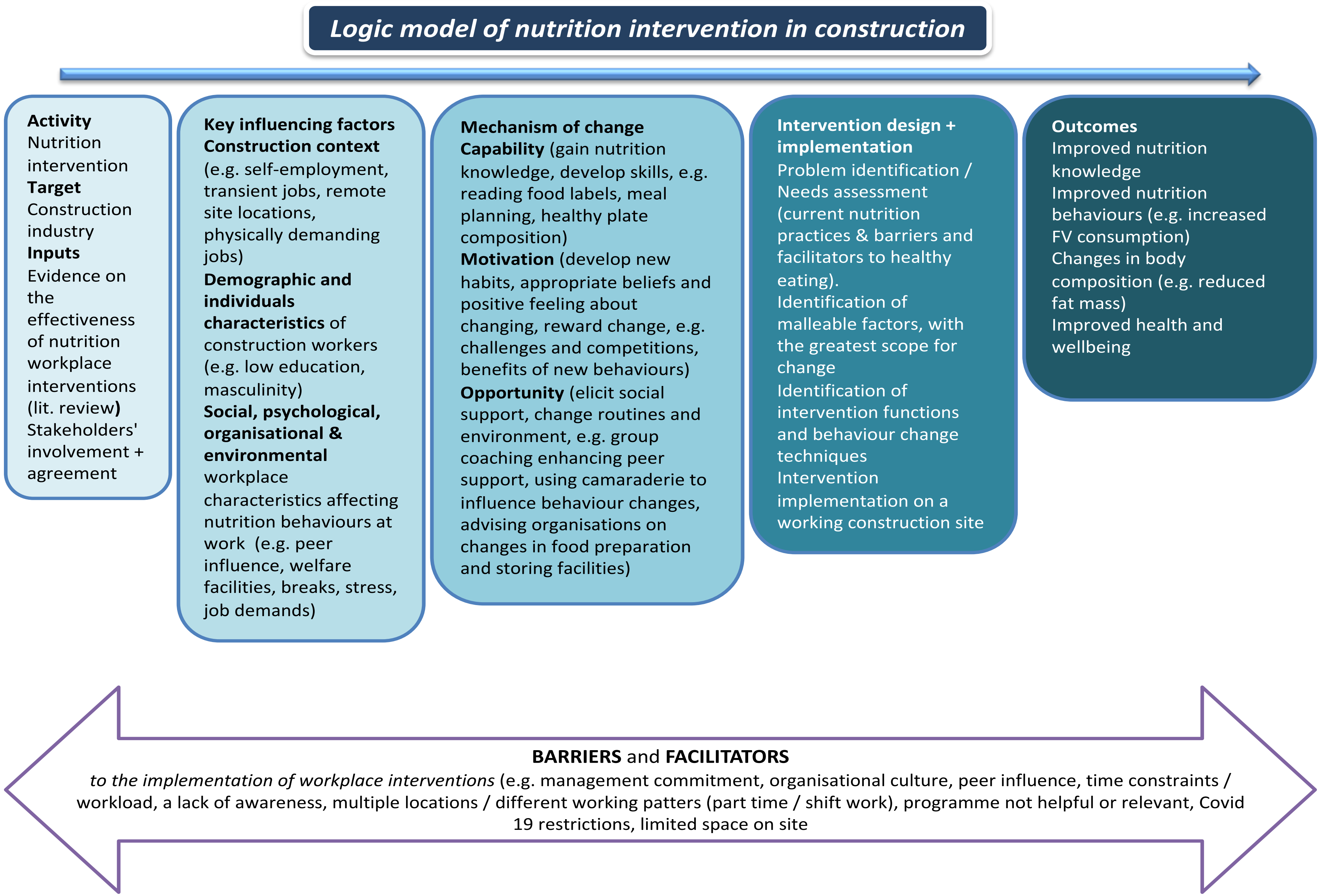

Figure 5.6. Logic model of a workplace nutrition intervention

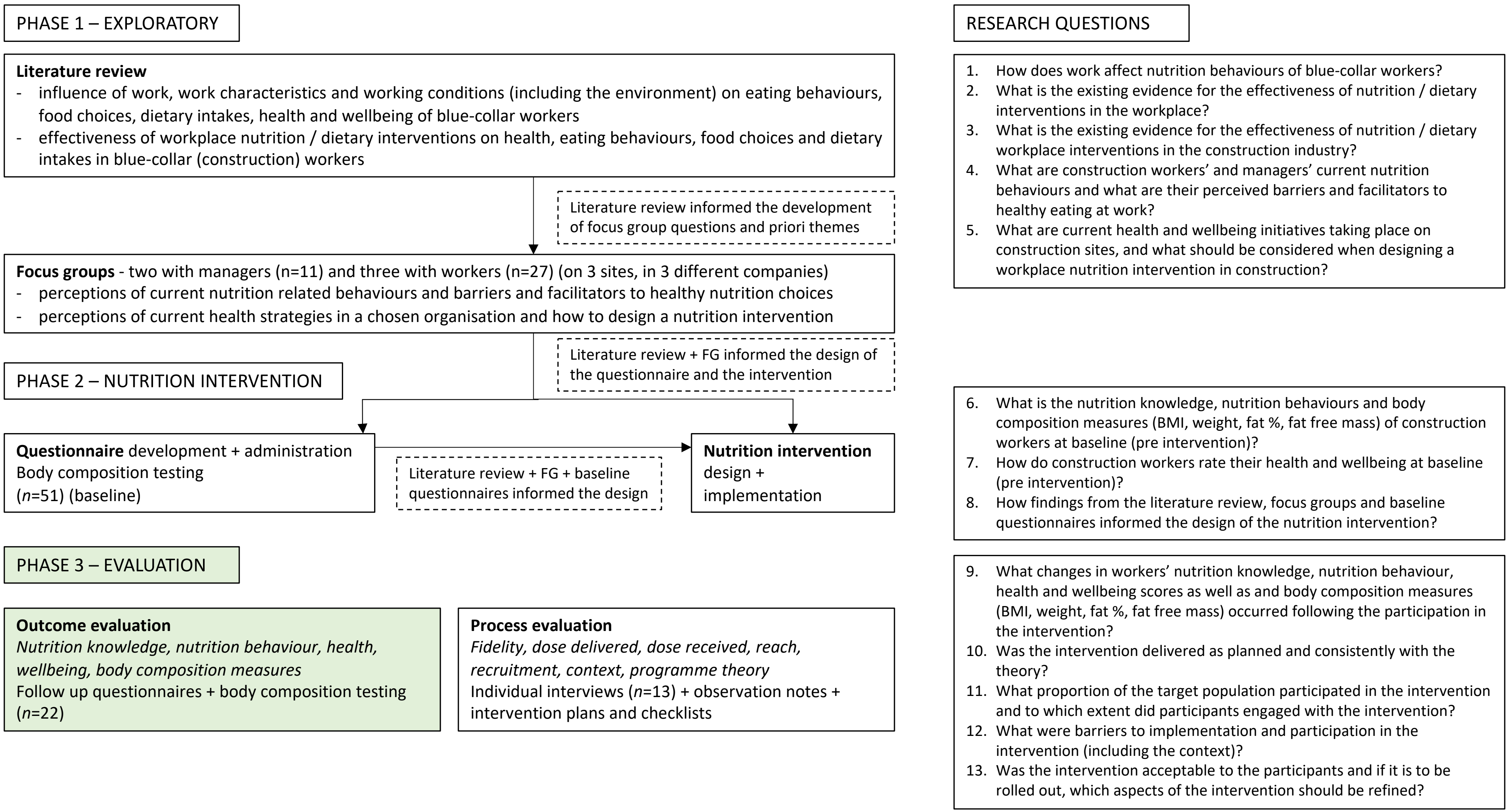

Figure 6.1. The Research Framework – Follow-up questionnaires

Chapter Six – Outcome evaluation – follow-up questionnaires

6.1. Introduction to follow-up questionnaires

Following the design of the nutrition intervention, this chapter focuses on the third phase of the study, the evaluation phase (see Figure 6.1) and provides results from the follow-up questionnaire and body composition testing (BCT). This chapter starts with a presentation of the aim and objectives, followed by the methods, including participants and sample size, questionnaire distribution and data analysis. Following this, the results from the follow-up questionnaire and body composition are presented. This chapter finishes with a summary of the main findings.

6.2. Aim and objectives of follow-up questionnaires

This chapter aims to identify the impact of the nutrition intervention on health, wellbeing, nutrition knowledge and behaviours, and body composition on construction workers. It was achieved by carrying out follow-up questionnaires (n=22) (post intervention) and analysing differences in pre and post results using descriptive and inferential statistics. In this chapter, the following research question is addressed:

9. What changes in workers' nutrition knowledge, nutrition behaviour, health and wellbeing scores as well as and body composition measures (BMI, weight, fat %, fat free mass) occurred following participation in the intervention?

6.3. Method – follow-up questionnaires

Detailed description of the questionnaire design was presented in chapter five. The same chapter also provided the rationale behind the questionnaire administration and using body composition measures. Therefore, this method section focuses on the participants and sample size, questionnaire distribution, and data analysis related to the follow-up cohort.

6.3.1. Participants and sample size

Of 51 participants who took part in the intervention, 22 completed it, i.e. took part in the interview and completed the follow-up questionnaire and follow-up BCT. Most of those who participated in the intervention were not working on site when the follow-up measures were taken in May 2021. It is the nature of the job that construction workers stay on one site for a limited time; a few weeks to months. However, the high dropout rate in this intervention was exacerbated by the four-month break in the intervention delivery (between January and April 2021), due to the Covid-19 lockdown (see details in chapter seven and section 1.5). This meant that by the time the intervention returned on site, some workers had already left it. Participants who completed the intervention included both workers and managers, who were either company employees or self-employed, and business owners of sub-contracted companies (referred to as sub-contractors).

6.3.2. Questionnaire distribution

Questionnaires were distributed in paper form, during the last day of the intervention (May 2021), after all activities were concluded. Participants were allowed time to fill in part 1 (self-administered), while part 2 was administered by the researcher. A separate room was used to collect the questionnaire answers. As with baseline questionnaires, numeric identifiers were applied to code the questionnaires to ensure confidentiality and anonymity. All hard copies were stored in a locked filing cabinet in the researcher's study room.

6.3.4. Data analysis

The next section presents the results of a follow-up questionnaire using descriptive and inferential statistics. Data is presented to compare the results from the same questionnaire and BCT conducted at the beginning of the intervention.

Inferential statistics were used to explore post intervention changes to nutrition knowledge, behaviour, health and wellbeing, and body composition. To enable this, scores were allocated to the nutrition knowledge questions, e.g.1 point for a correct answer, and a total score for nutrition knowledge was calculated (i.e. scale data). Where questions were asked about nutrition behaviours, scores were allocated to reflect the desirability of the nutrition behaviour. For example, a higher score was allocated to a higher frequency of vegetables consumption, as a more desired behaviour. Not all questions were scored. For example, questions around attitudes towards food did not allow the desirability of the behaviour to be established, therefore, these questions were analysed using descriptive statistics. Further details on the scoring of individual questions are available in Appendix 8.

Data was analysed using SPSS v. 26. Firstly, normality was assessed, as the normal distribution of the dependent variable scores is an underlying assumption for using parametric tests (Mishra et al., 2019). The Shapiro-Wilk test was undertaken, as well as the visual inspection of data from plots / graphs, due to the small sample size (n=22) (Mishra et al., 2019). The value of the Shapiro-Wilk test to measure the total knowledge score at baseline was found to be < 0.05 ($p= 0.024$), which indicated data significantly deviated from the normal distribution, although the value of the test to measure the total knowledge score at follow-up was considered normal (>0.05) at $p=0.096$. The same procedure was conducted for other measures (i.e. behaviour, health, wellbeing and body composition test scores). However, due to the inconsistent results of normality testing and, in some instances, data deviating from normal distribution, as well as the small sample size, a non-parametric test (the Wilcoxon single rank test) was chosen to be used. This test is designed for use with repeated measures, i.e. when participant scores, relating to the variables of interest are measured on two or more occasions (Verma & Abdel-Salam, 2019). In addition, effect sizes were calculated to assess the magnitude of the differences between results at baseline and follow-up. Whilst a *p* value indicates whether an effect exists, it does not reveal the size of the effect, therefore, both the substantive significance (effect size) and statistical significance (*p* value) are deemed essential results to report (Durlak, 2009; Sullivan & Feinn, 2012).

Finally, as part of the evaluation, individual interviews with intervention participants (n=13) were conducted. A detailed overview of the analysis methods and interview results are presented in chapter seven, however, where comments were related to the outcomes of the intervention (e.g. changes in nutrition habits individual reported during interviews), they are presented in this chapter, alongside the quantitative findings.

6.4. Results – follow-up questionnaires

This section presents the results of the questionnaire using descriptive and inferential statistics. Firstly, demographic data is provided, including participant and workplace characteristics, followed by an analysis of the health and wellbeing scores, nutrition knowledge, and nutrition and health behaviour questions, and BCT results.

6.4.1. Participants and workplace characteristics

Table 6.1. Participant characteristics (baseline and follow-up)

Category / sub-category	**N**	**%**	**N**	**%**
Month of joining intervention	***n = 51 (baseline)***		***n = 22 (follow-up)***	
Month 1	14	27.5	10	45.5
Month 2	6	11.8	1	4.5
Month 3	7	13.7	5	22.7
Month 4	11	21.6	3	13.6
Month 5	9	17.6	3	13.6
Month 6	4	7.8	0	0
Gender				
Male	47	92.2	20	90.9
Female	4	7.8	2	9.1
Ethnicity				
English / Welsh / Scottish / Northern Irish / British	25	49.0	14	63.6
Irish	5	9.8	0	0
Other White – Italian	1	2.0	1	4.5
Other White – Romanian	7	13.7	2	9.1
Other White – Bulgarian	1	2.0	0	0
Other White – Polish	2	3.9	1	4.5
Other White – Spanish	1	2.0	0	0
Other White – Georgian	1	2.0	0	0
Other White – Slovenian	1	2.0	1	4.5
Other White – Portuguese	3	5.9	1	4.5
White and Asian	1	2.0	1	4.5
Indian	1	2.0	0	0
African	0	2.0	1	4.5
Caribbean	1	2.0	0	0
Language				
English first language	34	66.7	16	72.7
English not first language	17	33.3	6	27.3
Age				
18-24	6	11.8	4	18.2
25-34	16	31.4	6	27.3
35-44	15	29.4	5	22.7
45-54	10	19.6	5	22.7
55-64	4	7.8	2	9.1
Job				
Managers	18	35.3	9	40.9
Operatives	32	62.7	12	54.5
Apprentice	1	2.0	1	4.5
Shift work				
Working shifts	8	15.7	2	9.1
Not working shifts	43	84.3	20	90.9
Employment / Contract type				
An employee	18	35.3	10	45.5
Self-employed or freelance	32	62.7	12	54.5
Business owner with employees (sub-contractor)	1	2.0	0	0

Category / sub-category	N	%	N	%
Education				
Secondary	8	15.7	2	9.1
Higher or secondary or further education (A-levels, BTEC, etc.)	9	17.6	4	18.2
College or university *	26	51.0	13	59.1
Post-graduate degree	5	9.8	3	13.6
Prefer not to say	3	5.9	0	0

***** Note that seven operatives from Romania, who took part in the intervention, selected 'college or university' as their selected education level. Romanian Diploma de bacalaureat is comparable to UK level 3 qualification, however, due to the name it could have been confused by Romanian workers with UK Bachelor, and therefore, a higher than expected number of individuals selecting college of university education.

Table 6.1 indicates that at follow-up 45.5% (n=10) of participants joined the nutrition intervention in the first month and 22.7% (n=5) in the fifth. Most of the participants who joined the intervention in months 2-4 were no longer working on the site in May 2021 when follow-up measures were taken. Similar to the baseline findings, at follow-up over 90% of participants were male, aged between 25-54 (72.7%). When compared with the baseline, at follow-up a higher percentage of participants were British (63.6% compared to 49%), followed by Europeans (27.1%, compared to 33.5%). This might be because most European participants at baseline were operatives, who left the site prior to the 6-month follow-up measures being taken. Overall, at follow up 72.7% (n=16) declared English as being their first language (66.7% at baseline). At follow-up 54.5% of participants were self-employed (62.7% at baseline), with 54% of participants being operatives (62.7% at baseline). Two respondents (9.1%) worked shifts (15.7% at baseline) and most of respondents (59%) declared a college or university education (51% at baseline).

Table 6.2. Participant workplace characteristics (context, at baseline and follow-up)

Living situation	**N**	**%**	**N**	**%**
	n = 51 (baseline)		***n = 22 (follow-up)***	
Living at home	44	77.2	19	73.1
Staying temporarily with friends and family	5	8.8	3	11.5
Staying in temporary accommodation (e.g. hotel, B&B, guest house) with food preparation and food storing facilities available (e.g., kitchen, fridge)	3	5.2	2	7.7
Staying in a rented flat or a house	5	8.8	2	7.7
Total (including double counting when more than one response selected)	**57**	**100**	**26**	**100**
Food outlets availability near workplace / site				
Good choice of food shops, take-aways, cafes	10	19.6	5	22.7
Limited choice of food shops, take-aways, cafes	35	68.6	17	77.3
No food shops or cafes in the areas	6	11.8	0	0
Food outlets availability near workplace / site				
Good choice of food shops, take-aways, cafes	29	56.9	14	63.6
Limited choice of food shops, take-aways, cafes	21	41.1	7	31.9
No food shops or cafes in the areas	1	2.0	1	4.5
Food-related welfare facilities available on site				
Canteen serving hot and cold food	7	4.5	2	2.5
Van / café / shop serving hot food	2	1.3	0	0
Van / café / shop serving cold food	2	1.3	0	0
Vending machine with snacks and drinks	15	9.7	18	22.5
Kitchen allowing for food preparation and storage (e.g. microwave, fridge, toaster)	26	16.9	17	21.3
Kitchen allowing for food preparation only	6	3.9	2	2.5
Kitchen allowing for food storing only	9	5.8	2	2.5
Water stations	32	20.8	17	21.2
Tea and coffee facilities	35	22.8	18	22.5
Only eating area (tables, chairs)	18	11.7	3	3.7
No facilities	2	1.3	1	1.3
Total (including double counting when more than one response selected)	**154**	**100**	**80**	**100**

Table 6.2 shows baseline and follow-up measures (n=51, and n-22 respectively) in respect of their workplace characteristics. For living situation and welfare facilities, participants could select multiple responses if applicable to their situation. At baseline and follow-up, most participants (77.2% and 73.1% respectively) lived at home while working on site, followed by 11.5% (8.8% at baseline) who lived temporarily with friends and family, 7.7% (8.8% at baseline) stayed in a rented flat or a house, and 7.7% (5.2% at baseline) staying in temporary accommodation with food preparation and storage facilities available. Some participants (n=4) selected multiple responses when answering the living situation question, as they lived at home but stayed in rented or temporary accommodation or with friends during the working week.

Similar to the baseline results (68.6%), at follow-up most respondents (77.3%) stated that there was a limited choice of food shops, take-aways, or cafes available near the site, while 63.6% declared a good choice of food shops, take-aways, cafes near the places where they lived (56.9% at baseline). Finally, regarding welfare facilities available on site, as with the baseline findings, the were varied responses. Tea and coffee facilities and vending machines with snacks and drinks were mentioned as available by 18 respondents (22.5%). With regards to the 'vending machine' option, this was an increase from 9.7% at baseline because the company introduced several vending machines across the site. The above responses were followed by 'kitchen allowing for food preparation and storage (e.g. microwave, fridge, toaster)' (n=17, 21.3% - at follow-up; n=26, 16.9% at baseline), and 'water stations' (n=17, 21.2% at follow-up; n=32, 20.8% at baseline) answers. At baseline, 18 respondents (11.7%) selected 'only eating area' option, whereas at follow-up this option was selected by 3 respondents (3.8%). This might relate to the changing restrictions on the use of premises and facilities on site due to Covid-19.

6.4.2. The health and wellbeing of construction workers

Health and wellbeing was assessed using: (i) the self-rated general health item and (ii) the ONS4 wellbeing questions. Baseline and follow-up results are presented in Table 6.3 below.

Table 6.3. Self-rated health at baseline and follow-up

Self-rated health	**N**	**%**	**N**	**%**	**Mean (baseline)**	**Mean (follow-up)**	**Wilcoxon single rank test**		**Effect size**
	n = 22 (baseline)		***n = 22 (follow-up)***				**z**	**p**	**r**
Excellent	0	0	1	4.5	0.05	0.27	2.236	<0.025*	0.1
Very good	1	4.5	5	22.7					
Good	17	77.3	13	59.1					
Fair	4	18.2	3	13.6					
Poor	0	0	0	0					

*Significant change ($p<0.05$) from baseline to follow-up

Table 6.3 shows changes in self-rated health at baseline and follow-up. To carry out the Wilcoxon single rank test the categories 'excellent' and 'very good' were pooled together (scored as 1), and similarly 'good', 'fair', 'poor' were combined (scored as 0). This has been previously performed in other studies (e.g. Jarczok et al., 2015; Kananen et al., 2021; Zajacova & Dowd, 2011). The Wilcoxon single rank test indicated a statistically significant increase in self-rated health scores following participation in the workplace intervention, z=2.236, n=22,

$p<0.025$, with a small effect size ($r=0.1$). Mean scores increased from 0.05 at baseline to 0.27 at follow-up.

Table 6.4. ONS4 Wellbeing (baseline and follow-up)

Wellbeing (4ONS)	**Mean**	**SD**	**Range**	**Min**	**Max**	**Mean**	**SD**	**Range**	**Min**	**Max**	**Wilcoxon single rank test**		**Effect size**
	n = 22 (baseline)					***n = 22 (follow-up)***					**z**	**p**	**z**
Life satisfaction	7.00	1.07	4	5	9	7.55	0.97	3	6	9	2.972	<0.003*	0.1
Worthwhile	7.50	1.41	4	5	9	7.73	1.55	5	5	10	1.318	<0.187	0.0
Happy yesterday	7.32	1.43	4	5	9	7.73	1.39	5	5	10	1.852	<0.064	0.0
Anxious yesterday	4.14	2.10	7	0	7	3.27	1.61	6	0	6	-1.533	<0.125	0.0

*Significant change (p<0.05) from baseline to follow-up

Table 6.4, shows a non-significant drop in the ’anxiety’ mean score from 4.14 at baseline to 3.27 at follow-up, and non-significant improvements in the three positive wellbeing questions at follow-up (‘life satisfaction’ 7 to 7.55, ‘worthwhile’ from 7.5 to 7.73 and ‘happy yesterday’ score from 7.32 to 7.73). The only statistically significant improvement was in ‘life satisfaction’ z=2.972, n=22, p<0.003, with a small effect size (r=0.1).

Figure 6.2 (below) compares the baseline and follow-up wellbeing scores with published national data from ONS for the period of March 2020 to April 2021. The ‘anxiety’ mean score at baseline was higher than ONS average ratings (4.41 – intervention baseline score vs. 3.31 ONS data), while at follow-up the ‘anxiety’ score was similar to the national average (3.27 – vs. 3.31 ONS data). When looking at the positive wellbeing scores; ‘life satisfaction’ was 7 at baseline and 7.55 at follow-up, which is higher that ONS average of 7.39. The ‘worthwhile’ score was 7.5 at baseline and 7.73 at follow-up, which is similar to the score reported by ONS - 7.71. Finally, the ‘happy’ question scored 7.32 at baseline, is similar to ONS score of 7.31. However, at follow-up, the ‘happy’ questions score was 7.73.

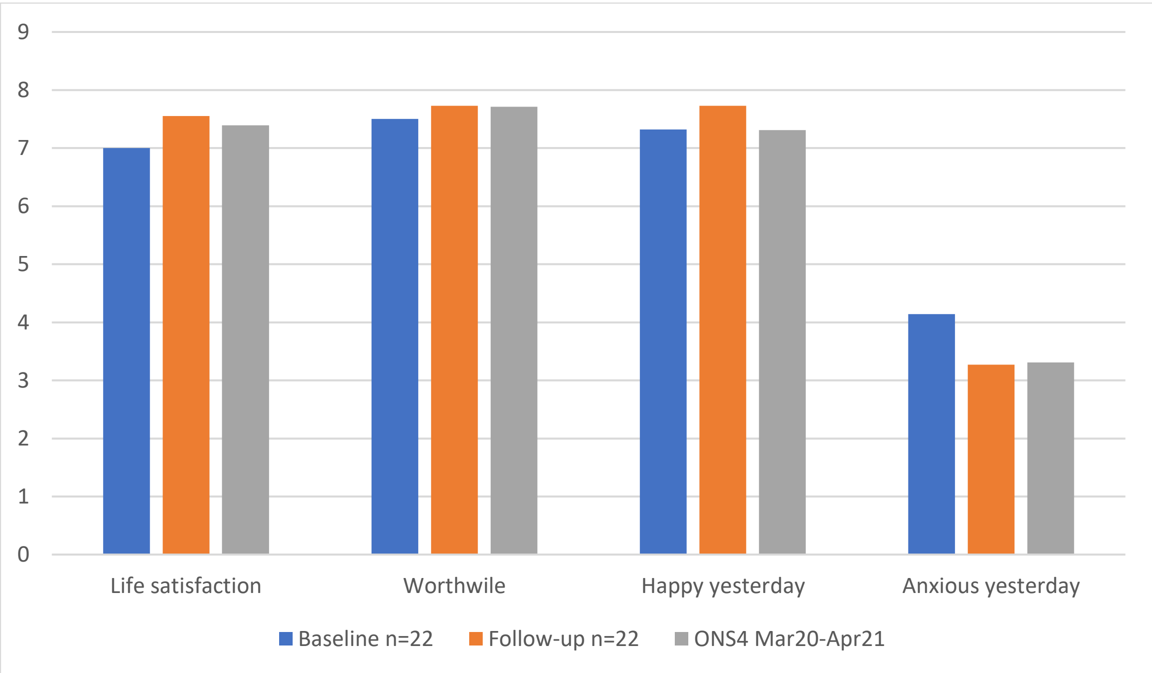

Figure 6.2. ONS4 Wellbeing – a comparison between the intervention baseline, follow=up and ONS published wellbeing scores

Comments with regards to changes in health and wellbeing, as well as health behaviours, were made by participants taking part in the individual interviews (n=13) conducted to evaluate the intervention (presented in chapter seven). Feeling mentally and physically better, having more energy, sleeping better (n=6) as well as taking up exercise (n=5) were commonly mentioned outcomes of the intervention.

6.4.3. Nutrition knowledge

In total, 10 questions were asked to assess participants' knowledge on nutrition, covering 4 main areas: official dietary recommendations (the EatWell Guide), the nutrient content in foods, the relationship between diet and health, choosing everyday foods and using information to make healthy dietary choices (e.g. food labelling). A summary of scored nutrition knowledge results from the baseline and follow-up questionnaires of the 22 participants who completed the intervention are presented in Table 6.5 below. The Wilcoxon single rank test was used to ascertain the significance of these differences. To enable this, each correct answer was scored as 1 and scores from each of the four sub-sections of the knowledge questionnaire were combined to generate a total knowledge score.

Table 6.5. Summary of score knowledge questions

Knowledge content covered in the questionnaire - sub-sections	Mean (baseline) *n = 22*	Mean (follow-up) *n = 22*	Max available score	Wilcoxon single rank test		Effect size
				z	p	r
Knowledge on official dietary recommendations (the EatWell Guide)	3.32	4.50	6	3.373	<0.001*	0.1
Knowledge on the nutrient content in foods	5.05	5.73	6	2.292	<0.022*	0.1
Knowledge on a relationship between diet and health	6.68	7.50	8	2.871	<0.004*	0.1
Knowledge on choosing everyday foods and using information to make healthy dietary choices (e.g. food labelling)	1.27	1.73	2	4.131	<0.001*	0.1
Total score on all knowledge questions	**16.32**	**19.45**	**22**	**3.899**	**<0.001***	**0.1**

*Significant change ($p<0.05$) from baseline to follow-up

As presented in Table 6.5, statistically significant increases in nutrition knowledge were found for all four sub-sections. Knowledge mean scores increased as follows: (i) official dietary recommendations (the EatWell Guide), significantly increased from 3.32 to 4.50, z=3.373, p<0.001, with a small effect size (r=0.1), (ii) nutrient content in foods significantly increased from 5.05 to 5.73, z=2.292, p<0.022, r=0.1, (iii) knowledge on the relationship between diet and health significantly increased from 6.68 to 7.50, – z=2.871, p<0.004, r=0.1, (iv) food labelling increased from 1.27 to 1.73, z=4.131, p<0.001, r=0.1 (small effect size). A statistically significant increase in total nutrition knowledge scores following the participation in the workplace intervention was found, with the mean score of 16.32 increasing to 19.45, z=3.899, n=22, p<0.001, with a small effect size (r=0.1).

Findings from the individual interviews highlighted that due to the learning received as a part of the intervention, some participants started to incorporate more protein foods in their diets, e.g., poached eggs added to soups, eggs on toast or lentils and seeds added to salads. Furthermore, interviewees mentioned learning about and tasting new food and drinks, such as coconut water, omelettes, kombucha, which now are a part of their diets.

6.4.4. Nutrition and health behaviours of construction workers

In total, 14 questions were asked to assess participants' nutrition and health behaviours, covering fruit and vegetable consumption, smoking and alcohol, information from food labels affecting food choices, eating behaviours at work, attitudes towards nutrition, meals frequency, drinks consumption and food groups composing a part of daily diet.

Table 6.6. Individual fruit and vegetable portion consumption

Vegetable (portions a day)	**N**	**%**	**Mean**	**N**	**%**	**Mean**	**Wilcoxon single rank test**		**Effect size**
	n = 22 (baseline)			***n = 22 (follow-up)***			**z**	**p**	**r**
0-1	7	31.8	1.09	0	0	1.41	2.111	<0.035*	0.1
2-3	7	31.8		14	63.6				
4-5	7	31.8		7	31.8				
6+	1	4.5		1	4.5				
Fruit (portions a day)									
0-1	12	54.5	0.55	11	50.0	0.55	0.000	<1	0.1
2-3	8	36.4		10	45.5				
4-5	2	9.1		1	4.5				
6+	0	0		0	0				
Fruit and vegetable combined (portions a day)									
≤ 2	5	22.7	1.64	0	0	1.95	1.427	<0.154	0.0
≤ 4	4	18.2		6	27.3				
≤ 6	8	36.4		11	50.0				
≤ 8	4	18.2		5	22.7				
≤ 10	1	4.5		0	0				
≥ 11	0	0		0	0				

*Significant change (p<0.05) from baseline to follow-up

Participants were asked to assess their daily intake of fruit and vegetables (in portions) and the results are presented in Table 6.6. The Wilcoxon single rank test showed a statistically significant increase in the consumption of vegetables, but not fruit, following the nutrition intervention (1.09 to 1.41, z=2.111, p<0.035), with a small effect size (r=0.1). While vegetable consumption increased, for fruit, the most frequently given responses at follow-up were '0-1' – 50% (n=11) or '2-3' – 45.5% (n=10) portions compared to at baseline '0-1' and '2-3' responses scored 54.5% (n=12) and 36.4% (n=8), respectively, these changes were not significant (p>0.05).

Considering combined fruit and vegetable consumption, the mean score increased from 1.64 to 1.95 following the intervention, however, the Wilcoxon single rank test showed this difference was not statistically significant.

Additional comments with regards to fruit and vegetable consumption were made by participants taking part in the individual interviews. Eating more vegetables and fruit was a frequently mentioned change to their diet (n=11), as well as participants declaring being more aware of benefits of different vegetable colours and therefore, adding a variety to their meals and shopping baskets (n=8).

Table 6.7. Smoking status and alcohol consumption

Smoking status	**N**	**%**	**N**	**%**
	n = 22 (baseline)		***n = 22 (follow-up)***	
Smoker	3	13.6	3	13.6
Non-smoker	19	86.6	19	86.4
Consuming alcohol				
Yes	21	95.5	21	95.5
No	1	4.5	1	4.5

Alcohol type (weekly consumption)	**Mean** ***n = 22 (baseline)***	**Mean** ***n = 22 (follow-up)***	**Wilcoxon single rank test**		**Effect size**
			z	**p**	**r**
Beer (pint)	4.86	4.23	-1.851	<0.064	0.0
Wine (glass 120ml)	2.95	2.05	-1.967	<0.049*	0.1
Liquor (1 drink or 1 shot)	1.32	1.23	-0.355	<0.723	0.0
Alcohol units per week	**20.64**	**17.50**	-1.503	<0.133	0.0

*Significant change (p<0.05) from baseline to follow-up

Table 6.7 shows no changes to smoking status and consuming alcohol following the intervention, with 13.6% (n=3) reporting smoking and 95.5% (n=21) reporting drinking alcohol. Overall, the mean scores for alcohol units and individual types of alcohol reduced, for beer and liquor this change was not significant, however, based on the Wilcoxon single rank test a statistically significant difference in wine consumption was noted (<0.049) with a small effect size (r=0.1).

Table 6.8. Traffic lights labels affecting food choices

Traffic lights labels affecting food choices	**N**	**%**	**Mean**	**N**	**%**	**Mean**	**Wilcoxon single rank test**		**Effect size**
	n = 22 (baseline)			***n = 22 (follow-up)***			**z**	**p**	**r**
Not at all	2	9.2		0	0				
Not very much	3	13.6		0	0				
A little	12	54.5	1.91	10	45.5	2.55	2.889	<0.004*	0.1
A lot	5	22.7		12	54.5				
Don't know	0	0		0	0				

*Significant change ($p<0.05$) from baseline to follow-up

Table 6.8 shows that there was a significant increase in respondents food choices being determined by the traffic light system following the workplace intervention. The mean score increased from 1.91 to 2.55, z=2.889, p<0.004, with a small effect size (r=0.1). Notably at baseline, only 5 participants reported using traffic light labels 'a lot', which had changed to 12 participants at follow-up.

Table 6.9. Nutrition information on labels affecting food choices

Information on individual nutritional items affecting food choices (e.g. fat, calories, sugar, protein content)	**N**	**%**	**N**	**%**
	n = 22 (baseline)		***n = 22 (follow-up)***	
Yes	19	86.4	22	100
No	3	13.6	0	0
What nutrition information on labels affects food choices **	**N**	**%**	**N**	**%**
	n = 20 (baseline)*		***n = 22 (follow-up)***	
Fat	10	50.0	13	59.1
Calories	14	70.0	14	63.6
Sugar	9	45.0	15	68.2
Salt	7	35.0	4	18.2
Saturated fat	5	25.0	8	36.4
Protein	7	35.0	11	50.0
Carbohydrates	3	15.0	9	40.9
Other	0	0	0	0
Don't know	2	10.0	0	0

* Missing responses – 2
** 'What nutrition information on labels affects food choices' was a multiple response question: 22 participants gave in total 57 responses at baseline and 74 responses at follow-up

Table 6.9 shows that at follow-up, all participants declared that the information about individual nutrients affected their food choices, compared to 86.4% (n=19 at baseline). Sugar (n=15), calories (n=14), fat (n=13) and protein (n=11) were the most frequent responses given at follow-up to a question on ‘nutrition information on labels affecting food choices’. Calories (n=14) and fat (n=10) were the most popular at baseline. ‘Protein’ was selected by 3 participants at baseline, however at follow-up it was selected by 9. Descriptive statistics were used to analyse the data on nutrition information on labels affecting food choices as it was not possible to determine more desirable answers and therefore, provide scores.

Additional comments from individual interviews, conducted to evaluate the intervention, highlighted that food labels were used by participants when shopping (n=8).

Table 6.10. Eating behaviour at work

	always *n = 22* *(baseline)*		**always** *n=22* *(follow-up)*		**often** *n=22* *(baseline)*		**often** *n=22* *(follow-up)*		**sometimes** *n=22* *(baseline)*		**sometimes** *n=22* *(follow-up)*		**seldom** *n=22* *(baseline)*		**seldom** *n=22* *(follow-up)*		**never** *n=22* *(baseline)*		**never** *n=22* *(follow-up)*	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	~~**N**~~	~~**%**~~	~~**N**~~	~~**%**~~	**N**	**%**	**N**	**%**	**N**	**%**
I bring food (breakfast / lunch) from home	7	31.8	6	27.3	7	31.8	9	40.9	1	4.5	4	18.2	4	18.2	2	9.1	3	13.6	1	4.5
I buy food in a local shop / take-away / cafe	0	0	0	0	5	22.7	3	13.6	8	36.4	6	27.3	7	31.8	12	54.5	2	9.1	1	4.5
I buy food from a canteen on site	0	0	0	0	1	4.5	0	0	2	9.1	2	9.1	6	27.3	6	27.3	13	59.1	14	63.6
I prepare food at work	1	4.5	1	4.5	1	4.5	0	0	4	18.2	6	27.3	4	18.2	8	36.4	12	54.5	7	31.8
I eat together with my colleagues when at work	1	4.5	1	4.5	4	18.2	3	13.6	7	31.8	8	36.4	3	13.6	7	31.8	7	31.8	3	13.6
I prepare / cook food with my colleagues when at work	0	0	0	0	0	0	0	0	1	4.5	1	4.5	1	4.5	2	9.1	20	90.9	19	86.4
I eat with my colleagues, managers and workers from other divisions	1	4.5	1	4.5	0	0	0	0	2	9.1	0	0	2	9.1	3	13.6	17	77.3	18	81.8
I share the food I bring from home with my colleagues	0	0	0	0	0	0	0	0	1	4.5	2	9.1	4	18.2	6	27.3	17	77.3	14	63.6
I shop, prepare food and eat with my colleagues, we live in the same accommodation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	100	22	100
I have difficulty eating and drinking during work, due to insufficient break time	1	4.5	1	4.5	6	27.3	4	18.2	4	18.2	8	36.4	2	9.1	2	9.1	9	40.9	7	31.8
I have difficulty eating and drinking during work, due to being busy at work	1	4.5	1	4.5	6	27.3	8	36.4	8	36.4	8	36.4	2	9.1	3	13.6	5	22.7	2	9.1
I cannot eat healthily due to limited options available around my work	1	4.5	1	4.5	7	31.8	8	36.4	5	22.7	6	27.3	5	22.7	4	18.2	4	18.2	3	13.6

Table 6.10 shows eating behaviours at work at baseline and after the intervention . Results were not statistically tested, therefore descriptive statistics were used to analyse the data, as it was not possible to determine desirability of answers and therefore, provide scores. The main changes following the intervention included:

- 68.2% (n=15) declared bringing food from home either ‘always’ or ‘often’ at follow-up, compared to 63.6% at baseline;
- 54.5% (n=12) reported that they ‘seldom’ buy food in a local shop or café. At baseline this behaviour was more frequent, with 31.8% (n=7) reporting it as ‘seldom’, 36.4% (n=8) ‘sometimes’ (27.3%, n=6 at follow-up) and 22.7% (n=5) as ‘often’ (13.6%, n=3 at follow-up);
- At baseline most participants did not prepare food at work, with 54.5% (n=12) responding ‘never’, although when follow-up measures were taken, ‘never’ was a less popular answer (31.8%, n=7);
- ‘Eating with colleagues’ behaviour was more frequent at follow-up, with 36.4% (n=8) selecting ‘sometimes’ and 31.8% (n=7) ‘seldom’ options. ‘Never’ was chosen by 13.6% (n=3) at follow-up and 31.8% (n=7) at baseline;
- At follow-up, having difficulty eating at work due to insufficient breaks was ‘sometimes’ considered an issue by 36.4% (n=8) (18.2%, n=4 at baseline), ‘often’ by 18.2% (n=4) (27.3%, n=6 at baseline) and ‘never’ by 31.8% (n=7) (40.9%, n=9 at baseline);
- When asked about difficulty eating due to busy schedules, 72.8% (n=16) answered ‘often’ or ‘sometimes’ (63.7%, n=14 at baseline). ‘Never’ was chosen by 22.7% (n=5) at baseline (at follow-up - 9.1% (n=2));
- Limited food outlet options around work affect respondents healthy eating ‘often’ (36.4%, n=8) compared to 31.8%, n=7 at baseline, and ‘sometimes’ 27.3%, n=6 compared to 22.7%, n=5 at baseline);

Table 6.11. Attitudes towards nutrition and general eating behaviour

	Strongly agree *n = 22* *(baseline)*		**Strongly agree** *n = 22* *(follow-up)*		**Agree** *n = 22* *(baseline)*		**Agree** *n = 22* *(follow-up)*		**Neither agree / disagree** *n = 22* *(baseline)*		**Neither agree / disagree** *n = 22* *(follow-up)*		**Disagree** *n = 22* *(baseline)*		**Disagree** *n = 22* *(follow-up)*		**Strongly disagree** *n = 22* *(baseline))*		**Strongly disagree** *n = 22* *(follow-up)*	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
My work affects my food choices at home	0	0	1	4.5	12	54.5	9	40.9	2	9.1	3	13.6	6	27.3	6	27.3	2	9.1	3	13.6
I am interested in health checks	6	27.3	11	50.0	14	63.6	11	50.0	2	9.1	0	0	0	0	0	0	0	0	0	0
I am interested in professional advice about healthy eating	4	18.2	12	54.5	14	63.6	10	45.5	3	13.6	0	0	1	4.5	0	0	0	0	0	0
I am not interested in healthy eating	0	0	0	0	2	9.1	1	4.5	1	4.5	0	0	3	13.6	7	31.8	16	72.7	14	63.6
I am confused about what is healthy or not	3	13.6	0	0	4	18.2	0	0	3	13.6	6	27.3	8	36.4	12	54.5	4	18.2	4	18.2
I plan my meals in advance	4	18.2	2	9.1	7	31.8	13	59.1	6	27.3	5	22.7	5	22.7	2	9.1	0	0	0	0
I have my routine when it comes to buying and preparing food	3	13.6	3	13.6	10	45.5	15	68.2	4	18.2	2	9.1	5	22.7	2	9.1	0	0	0	0
I have no motivation to eat healthily	0	0	0	0	3	13.6	0	0	2	9.1	8	36.4	11	50.0	7	31.8	6	27.3	7	31.8
I have no energy to eat healthily	0	0	0	0	4	18.2	2	9.1	3	13.6	6	27.3	11	50.0	10	45.5	4	18.2	4	18.2
I have no time to prepare food	0	0	0	0	7	31.8	9	40.9	5	22.7	6	27.3	9	40.9	6	27.3	1	4.5	1	4.5
My food choices affect my concentration during the day	1	4.5	3	13.6	12	54.5	13	59.1	5	22.7	3	13.6	3	13.6	2	9.1	1	4.5	1	4.5
I choose foods that give me energy during the day	1	4.5	5	22.7	12	54.5	11	50.0	8	36.4	5	22.7	0	0	1	4.5	1	4.5	0	0
Healthy eating is too expensive	1	4.5	1	4.5	4	18.2	3	13.6	6	27.3	6	27.3	9	40.9	11	50.0	2	9.1	1	4.5
Healthy food does not taste good	0	0	0	0	1	4.5	0	0	4	18.2	3	13.6	9	40.9	13	59.1	8	36.4	6	27.3

Table 6.11 shows attitudes towards nutrition and general eating behaviours at baseline and intervention follow-up. Descriptive statistics were used to analyse the data, as it was not possible to determine desirability of answers, score them and therefore, statistically test the differences. Main changes following the intervention included:

- Approximately a half (54.5%, n=12 at baseline and 45.4%, n=10 at follow-up) ‘agreed’ or’ strongly agreed’ that work affected their food choices at home, while fewer ‘disagreed’ or ‘strongly disagreed’ (36.4%, n=8 at baseline; 40.9%, n=9 at follow-up);
- An interest in health checks and getting professional advice on healthy eating increased, either ‘agree’ or ‘strongly agree’ options being selected by all 22 respondents (100%) to both questions at follow-up (90.9%, n=20 and 81.8%, n=18, respectively at baseline);
- ‘Confused about what is healthy or not’ statement received 72.7% (n=16) of combined ‘disagree’ and ‘strongly disagree’ responses, and nobody agreeing with the statement. At baseline answers were distributed between all five responses;
- At follow-up, participants reported more ‘meal planning’ behaviour, with 68.2% (n=15) either agreeing or strongly agreeing (50%, n=11 at baseline). In addition, findings from the individual interviews suggested that the intervention helped participants in planning their meals, where a handout on different vegetable colours was used to ensure meals were well balanced;
- ‘Routine when buying and preparing food’ question received more positive responses at follow-up (81.8%, n=18 said ‘agreed’ or ‘strongly agreed’), when compared with baseline (59.1%, n=13);
- Regarding ‘no motivation’ and ‘no energy’ to eat healthily, a high number of respondents ‘disagreed’ or ‘strongly disagreed’ with the statements (77.3%, n=17; 68.2%, n=15, respectively at baseline and 63.6%, n=14; 63.7%, n=14, respectively at follow-up);
- ‘No time to prepare food’ statement received 40.9% of ‘agree’ responses at follow-up (31.9% at baseline), and 31.8% of ‘disagree’ or ‘strongly disagree’ responses at follow-up (45.4% at baseline);
- At baseline, 13 participants (59%) ‘agreed’ or ‘strongly agreed’ that food choices affect their concentration, and 16 (72.7%) at follow-up. At baseline, over a half of respondents (59%, n=13) ‘agreed’ or ‘strongly agreed’ that they ‘chose food which gives energy’. At follow-up, it was higher at 72.7%, n=16;

Table 6.12. Frequencies of different meals consumed over the last month – higher scores reflect a more desired behaviour

	Mean *n=22 (baseline)*	**Mean** *n=22 (follow-up)*	**Wilcoxon single rank test**		**Effect size**
			z	**p**	**r**
Meals cooked using fresh or raw ingredients	4.50	4.95	1.768	<0.077	0.0
Meals cooked using pre-prepared ingredients	4.73	4.86	0.632	<0.527	0.0
Take-away meals or eat out	4.45	4.95	2.072	<0.038*	0.1
Ready meals	3.82	5.77	3.581	<0.001*	0.1
Salty snacks	4.18	4.77	1.893	<0.058	0.0
Sweet snacks	3.23	4.09	2.768	<0.006*	0.1

*Significant change ($p<0.05$) from baseline to follow-up

Table 6.12 shows the frequency of consumption of different meals. To conduct statistical analyses to assess the differences in frequency pre to post intervention, responses were scored. The higher score was assigned to a more desirable rather than more frequent behaviour. For example, a consumption of ready meals reported as ‘rarely or never’ was scored as 7, while ‘5+ a day’ was scored as 0. For a frequency of ‘cooking using mostly fresh or raw ingredients’, the highest score was assigned to the highest frequency response – ‘5+ a day’ as it was considered the most desired behaviour. Thus, a higher mean score would always reflect a more desired behaviour, and not necessary a more frequent behaviour (see Appendix 8 for further details on scoring). The Wilcoxon single rank test revealed a statistically significant reduction in ready meal consumption, with a mean of 3.82 increasing to 5.77, $z=3.581$, $p<0.001$, with a small effect size ($r=0.1$). There was also a significant change in the reduced consumption of take away meals or eating out ($p<0.038$), with a small effect size ($r=0.1$). For sweet snack consumption, the mean score increased from 3.23 to 4.09, $z=2.768$, $p<0.006$, with a small effect size ($r=0.1$), also suggesting a more desired behaviour following the intervention (i.e. a reduced consumption). In addition, qualitative findings from individual interviews also highlighted reduced consumption of sweet foods, like biscuits, chocolate, desserts as a result of the intervention. The differences in frequency of consumption of remaining meals, i.e. cooked using fresh or raw ingredients, cooked using pre-prepared ingredients and salty snacks, were not statistically significant ($p>0.05$).

Table 6.13. Drink consumption (daily)

Drink type (1 glass = 180-200ml = a third of pint (1/3 pint)	**Mean**	**Mean**	**Wilcoxon single rank test**		**Effect size**
	n=22 (baseline)	***n = 22 (follow-up)***	**z**	**p**	**r**
Water	4.91	6.14	1.957	<0.05	0.0
Juice	1.00	0.59	-1.930	<0.054	0.0
Smoothie	0.14	0.18	0.577	<0.564	0.0
Coffee	2.05	1.59	-2.126	<0.033*	0.1
Tea	1.50	1.05	-1.186	<0.236	0.0
Energy drink	0.32	0.18	-1.000	<0.317	0.0
Soft drink	0.73	0.64	-1.343	<0.179	0.0
Squash	0.41	0	-1.633	<0.102	0.0
Other (milk)	0.50	0.32	-0.707	<0.48	0.0
Other (coconut water)	0	0.55	2.226	<0.026*	0.1
Other (kombucha)	0	0.23	2.236	<0.025*	0.1

*Significant change ($p<0.05$) from baseline to follow-up

As presented in Table 6.13, the results from the Wilcoxon single rank test indicated a statistically significant increase in the consumption of coconut water and kombucha. For coconut water, the mean score increased from 0 to 0.55 ($z=2.226$, $p<0.026$, $r=0.1$), while for kombucha the mean score increased from 0 to 0.23 ($z=2.236$, $p<0.025$, $r=0.1$). Both drinks were newly declared in the category ‘other’ on the follow-up questionnaire, not mentioned at baseline, and introduced during the tasting sessions in the intervention. In addition, a significant reduction in coffee consumption was found ($p<0.033$), with a small effect size ($r=0.1$). Reducing coffee and energy drink consumption was also highlighted by participants of individual interviews as outcomes of the intervention. Changes in the consumption of the remaining drinks were not significantly different.

Table 6.14. Daily meal consumption

Meal type	0-1 day / week				2-3 days / week				4-5 days / week				6-7 days / week			
	n = 22 (baseline)		***n = 22 (follow-up)***		***n = 22 (baseline)***		***n = 22 (follow-up)***		***n = 22 (baseline)***		***n = 22 (follow-up)***		***n = 22 (baseline)***		***n = 22 (follow-up)***	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Breakfast	2	9.1	1	4.5	0	0	1	4.5	3	13.6	5	22.7	17	77.3	15	68.2
Mid-morning snack	11	50.0	12	54.5	2	9.1	4	18.2	6	27.3	5	22.7	3	13.6	1	4.5
Lunch	0	0	0	0	0	0	0	0	1	4.5	2	9.1	21	95.5	20	90.9
Mid-afternoon snack	14	63.6	13	59.1	3	13.6	5	22.7	2	9.1	3	13.6	3	13.6	1	4.5
Dinner	0	0	0	0	0	0	1	4.5	1	4.5	0	0	21	95.5	21	95.5

The responses relating to the frequency of meal consumption are summarised in Table 6.14. Differences in responses were not statistically tested, as it was not possible to determine the desirability of behaviours, therefore, descriptive statistics were used to analyse data. Main changes following the intervention included:

- Having breakfast on all, or almost all days of the week (6-7 days a week), was reported by most respondents (77.3%; n=17 at baseline and 68.2%; n=15 at follow-up);
- Both lunch and dinner were less frequently missed, with 95.5% of participants (n=21) at baseline and 90.9% (n=20) at follow-up declaring having lunch 6-7 days a week, and 95.5% (n=21) both at baseline and follow-up reporting having dinner 6-7 days a week;
- Most respondents reported that they did not snack, with similar results reported at baseline and follow-up for mid-morning and mid-afternoon snacks;

Table 6.15. Food groups composing a part of daily diet (as a part of the plate)

Food group	One third				One half				One sixth				One tenth				Mean **n=22** (baseline)	Mean **n=22** (follow-up)	Wilcoxon single rank test		Effect size
	n = 22 (baseline)		*n = 22 (follow-up)*		*n = 22 (baseline)*		*n = 22 (follow-up)*		*n = 22 (baseline)*		*n = 22 (follow-up)*		*n = 22 (baseline)*		*n = 22 (follow-up)*						
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**			**z**	**p**	**r**
Potatoes, bread, rice, pasta or other starchy carbohydrates	10	45.5	14	63.6	11	50.0	5	22.7	0	0	1	4.5	1	4.5	2	9.1	0.50	0.77	2.449	<0.014*	0.1
Fruit and vegetables	7	31.8	15	68.2	7	31.8	6	27.3	5	22.7	1	4.5	3	13.6	0	0	0.64	0.95	2.646	<0.008*	0.1

Highlighted responses are recommended intakes by EatWell Guide

*Significant change (p<0.05) from baseline to follow-up

Table 6.15 summarises answers provided by respondents on food groups composing part of their daily diet. As with the previous question, responses were scored. All responses which were in line with the recommended intake by EatWell Guide were scored as 1, however, other desired behaviours were also given a score of 1. For example, for fruit and vegetable consumption 'one-third' or more (i.e. 'one-half') was scored as 1 and considered as desirable behaviour, while responses less than EatWell Guide recommendations i.e. 'one-sixth' and 'one-tenth', were scored as 0. For starchy carbohydrates, a consumption of 'one-third' or less (i.e. 'one-sixth' and 'one-tenth') was considered as a desirable behaviour and scored as 1. 'One-half' with regards to starchy carbohydrate consumption was scored as 0 as this was considered excessive (for further details on scoring see Appendix 8). The Wilcoxon single rank test revealed a statistically significant reduction in starchy carbohydrate daily consumption, with the mean value increasing from 0.50 to 0.77 following the intervention z=2.449, p<0.014), with a small effect size (r=0.1). For fruit and vegetables forming a part of a plate, a statistically significant increase in consumption was found, with a mean value of 0.64 to 0.95 (z=2.646, p<0.008), with a small effect size (r=0.1).

6.4.5. Body composition testing results

Table 6.16. Body Composition Testing (BCT) results by gender – Weight, fat %, fat free mass (FFM) and visceral fat (VF), Body Mass Index (BMI)

BCT category	Mean baseline	Mean Follow-up	Wilcoxon single rank test		Effect size
			z	p	r
Weight (kg) *n*=22	86.83	83.55	-3.393	<0.001*	-0.1
Fat % *n=20* (males only)	23.15	21.48	-2.838	<0.005*	-0.1
FFM (kg) *n*=22	65.75	64.57	-1.429	0.153	0.0
VF *n*=22	8.05	7.14	-3.542	0.001*	-0.1
BMI *n*=22	27.10	26.11	-3.306	0.001*	-0.1

*Significant change (p<0.05) from baseline to follow-up

Table 6.16 summarises the results of BCT, conducted at baseline and post intervention with the use of a Tanita analyser, and includes measures of weight, fat percentage, fat free mass (FFM), visceral fat (VF) and body mass index (BMI). The results for fat percentage were presented for males only due to different recommended fat ranges for males and females (only

2 females took part in the intervention). The body fat and BMI classifications were previously discussed in section 5.4.9.

The Wilcoxon single rank test statistical analysis revealed a significant reduction in weight with mean scores reducing from 86.83(kg) to 83.55(kg), ($z=-3.393$, $n=22$, $p<0.001$), with a small effect size ($r=0.1$). A reduction in fat percentage in males was found with mean scores falling from 23.15 to 21.48 ($z=-2.838$, $n=20$, $p<0.005$), with a small effect size ($r=0.1$). In addition, analyses showed a statistically significant reduction in VF, mean values of 8.05 to 7.14, ($z=-3.542$, $n=22$, $p<0.001$) with a small effect size ($r=0.1$), and BMI (mean 27.1 to 26.1, $z=-3.306$, $n=22$, $p<0.001$) with a small effect size ($r=0.1$). Only changes in FFM were found to be statistically insignificant.

Weight-loss, reported through monthly weigh-in, or from clothing fitting more loosely, was also highlighted during the individual interviews conducted to evaluate the intervention (n=5).

Table 6.17. Mean comparison between age and metabolic age of participants

Category	**Mean**	**Mean**	**Wilcoxon single rank test**		**Effect size**
	n = 22 (baseline)	***n = 22 (follow-up)***	**z**	**p**	**r**
Age of participants	36.73	36.73	n/a	n/a	n/a
Metabolic age of participants	40.27	37.45	-3.087	<0.002*	-0.1

*Significant change ($p<0.05$) from baseline to follow-up

Table 6.17 compares the mean scores for biological and metabolic age. Metabolic age is calculated by the BCT analyser by comparing the Basal Metabolic Rate (BMR) (the number of calories a body burns at rest) to the average BMR of individual's chronological age group. Metabolic age, when higher than biological age, can be a sign that an individual needs to gain more muscle mass and lose fat mass.

The Wilcoxon single rank test found a statistically significant reduction in metabolic age from 40 to 37 following the intervention ($z=-3.087$, $n=22$, $p<0.002$), with a small effect size, $r=0.1$).

6.5. Summary of the main findings

1. 22 (out of 51) participants completed the intervention; most of those who joined in months 2-4 were no longer working on the site in May 2021, when follow-up measures were taken.

2. Statistically significant increases in self-rated health scores were found following the intervention. For wellbeing, at follow-up, scores from all 4 wellbeing questions ('life satisfaction', 'worthwhile', 'happy yesterday', and 'anxious yesterday') were close or more positive than ONS data for the same period; only the improvement in 'life satisfaction' was found to be statistically significant.
3. 10 questions were used to assess participants' knowledge on nutrition, covering 4 main areas: official dietary recommendations (the EatWell Guide), the nutrient content in foods, a relationship between diet and health, and choosing everyday foods and using information to make healthy dietary choices (e.g. food labelling). Results revealed statistically significant increases in nutrition knowledge in all four sub-sections.
4. Following the intervention, a statistically significant increase in the consumption of vegetables, but not fruit, was recorded. However, when looking at fruit and vegetables forming part of a plate of food, a statistically significant increase in consumption was found. Where starchy carbohydrates are concerned, a reduction in consumption was also statistically significant. In addition, a statistically significant change (i.e. reduction) in ready meals, sweet snack consumption, take away meals and eating out was found. The consumption of meals cooked using fresh or raw ingredients, pre-prepared ingredients and salty snacks were not significant different pre to post intervention.
5. Although a reduction in alcohol consumption showed a positive trend (mean weekly alcohol units consumed 17.5 at follow-up, compared to 20.64 at baseline), the only significant change was in respect of wine consumption. Looking at non-alcohol drinks, increases in the consumption of coconut water and kombucha (both introduced during the intervention) and a reduction in coffee consumption were found to be significant.
6. Other nutrition related behaviours which showed statistically significant changes following the intervention included an increase in using traffic lights labels, with sugar, calories, fat and protein content determining food choices the most.
7. Descriptive statistics showed some shifts in eating behaviours at work at follow-up with more participants preparing food at work, eating with colleagues (these were not statistically tested due to inability to establish more desired behaviours). However, the number of individuals bringing food from home and buying in a local canteen remained similar. In addition, some shifts in general eating behaviours and attitudes were found, with more planning meals and having a routine in buying and preparing food and choosing chose food giving energy. Fewer participants declared having no motivation

and no energy to eat healthily, while the number admitting that work affects their food choices, who reported being interested in health checks and professional advice around food, skipping meals or snacking remained similar.

8. A statistically significant reduction in weight, in fat percentage in males, VF and BMI was found.

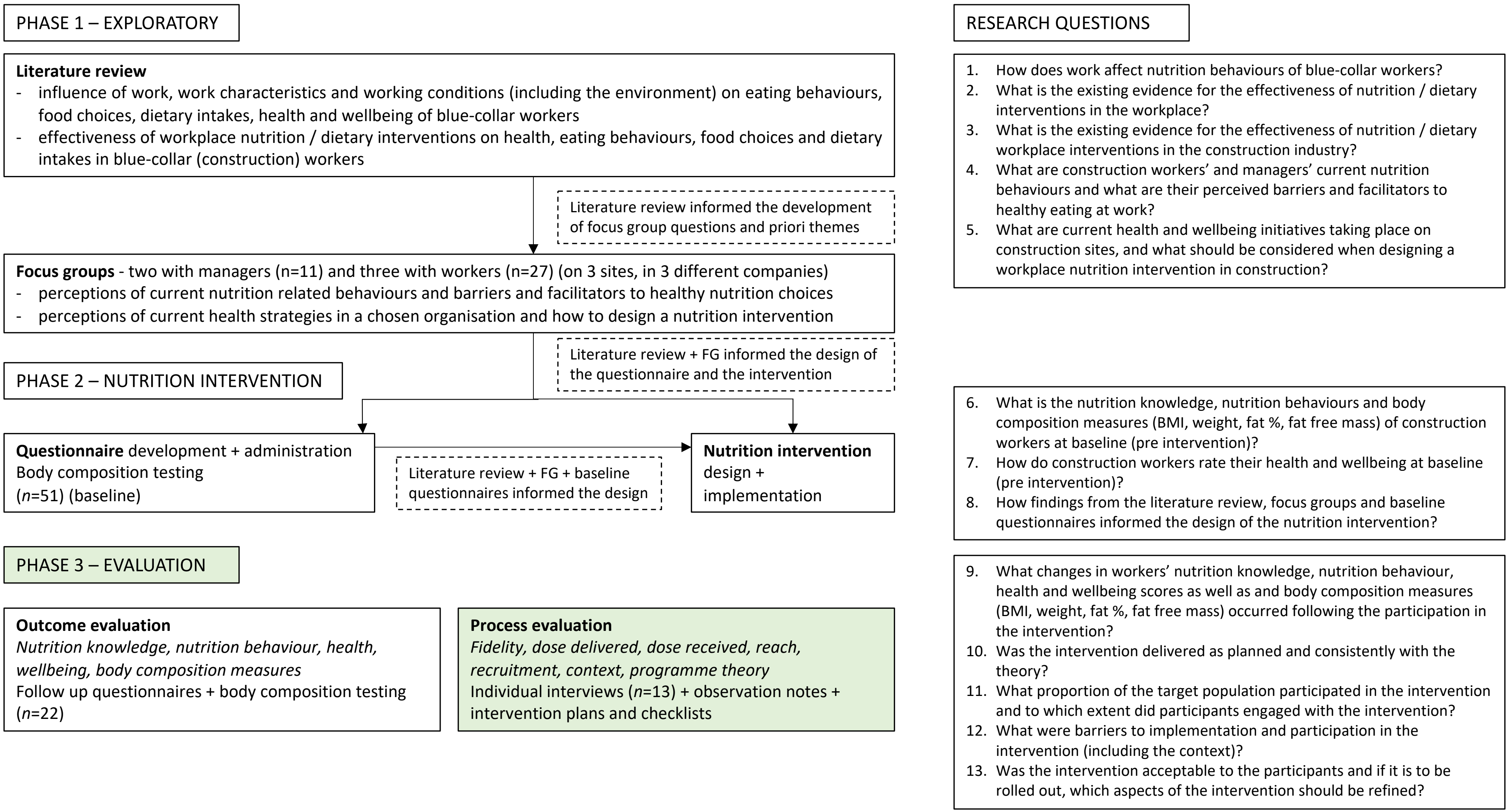

Figure 7.1. The Research Framework – Process evaluation

Chapter Seven – Process evaluation – individual interviews

7.1. Introduction to process evaluation

This chapter presents the findings from individual interviews with participants, conducted to evaluate the intervention. It begins with a presentation of aim and objectives, followed by the methods, which includes the rationale for conducting interviews, a brief discussion of using field notes, sampling, procedure and analysis. This is followed by the results and summary of the main findings.

7.2. Aim and objectives of process evaluation

This chapter aimed to identify the impact of the nutrition intervention by designing and carrying out a process evaluation at 9 month follow-up, using the results from individual interviews (n=13), field notes, the intervention plan and multiple checklists. In this chapter, the following research questions are addressed:

10. Was the intervention delivered as planned and consistently with the theory?
11. What proportion of the target population participated in the intervention and to what extent did participants engage with the intervention?
12. What were the barriers and facilitators to implementation and participation in the intervention (including the context)?
13. Was the intervention acceptable to the participants and if it is to be rolled out, which aspects of the intervention should be refined?

7.3. Methods – process evaluation

7.3.1. Evaluation framework

The evaluation of complex interventions is of continuous interest to practitioners, researchers, and policymakers (Skivington et al., 2021). This stems from the need to develop an evidence base for the effectiveness of public health interventions and an understanding that the more complex the intervention, the more challenging its evaluation (MRC, 2008). The need for evaluation is also driven by the ongoing debate on the most appropriate methods for evaluation, and the importance of knowing not only if an intervention works, but when, why, how and in what circumstances (Datta & Petticrew, 2013; Treweek, 2005). Evaluation is important to justify policy, programmes and funding, and inform future decisions and practice (Fynn et al., 2020).

Research looking at the evaluation of health interventions has been stimulated by the guidance published by the MRC on developing and evaluating complex interventions (2008), recently updated (Skivington et al., 2021), in response to the difficulties encountered by researchers trying to develop interventions and evaluate their impact. In particular, real-world, behaviour change programmes, such as nutrition interventions, are complex, and difficult to evaluate (Fynn et al., 2020). The complexity is due to the contextual factors affecting the intervention itself, such as the setting or target population, diverse evaluation priorities (e.g. different needs of the intervention stakeholders), and the challenges in selecting appropriate evaluation methods (Fynn et al., 2020; Moore et al., 2014).

The use of evaluation frameworks, offering systematic approaches to evaluation, have been suggested to mitigate some of the aforementioned challenges (Fynn et al., 2020). The MRC guidance called for definitive evaluation frameworks, which provide a combination of outcome and process evaluation to estimate effect, while developing a detailed understanding of implementation, causal mechanisms and the contextual factors which shape the outcomes (Craig et al., 2008; Skivington et al., 2021). Investigation into causal mechanisms offer an understanding into how more effective interventions may be developed, and how findings might be applied across different settings and population groups (Moore et al., 2014).

A recent study by Fynn et al. (2020), which provided a scoping review of evaluation frameworks used in real-world physical activity and dietary change programme evaluation, identified 71 frameworks within the field of public health, health promotion and behaviour change. The authors emphasised the importance of the framework to focus on key process evaluation components, such as causal mechanisms, implementation, context, reach and a logic model, to facilitate a better understanding amongst researchers as to whether and how an intervention works. The authors concluded the most comprehensive and detailed guidance on these components include the MRC Guidance on Process Evaluation of Complex Interventions (Figure 7.2) (Moore et al., 2015), followed by Center of Excellence for Training and Research Translation (Center TRT) Framework (Leeman et al., 2012), and the Physical Activity Evaluation Handbook (US Department of Health and Human Services, 2002).

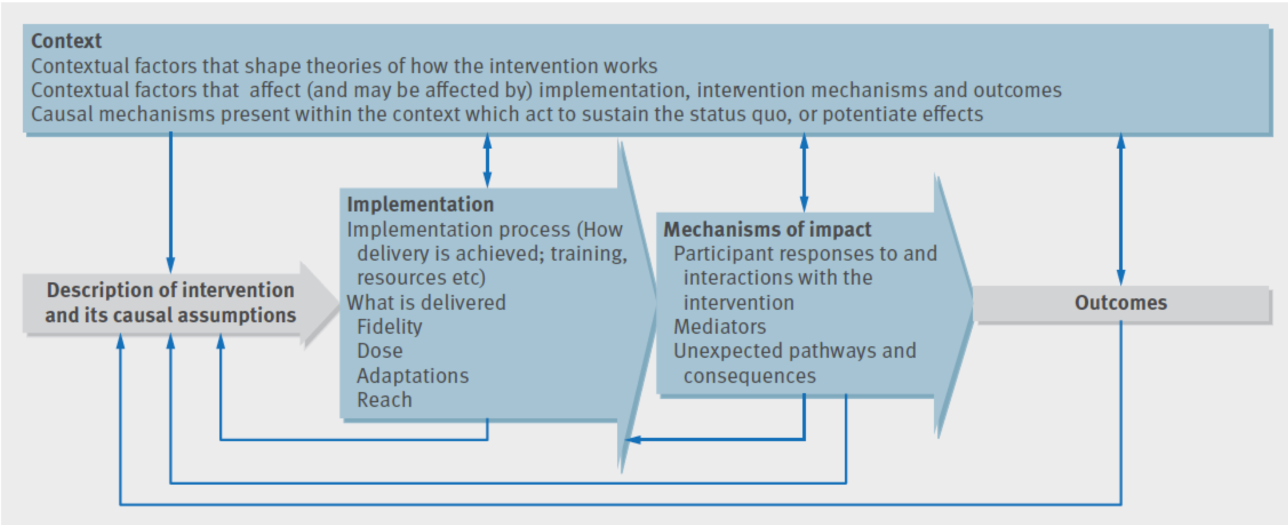

Figure 7.2. Key functions of process evaluation (Moore et al., 2015)

The MRC Guidance on Process Evaluation of Complex Interventions (Moore et al., 2015) suggests that when structuring a process evaluation, a number of frameworks and theories may be drawn upon to serve the functions set out in the guidance (Moore et al., 2015), proposing several different frameworks related to each aspect of the process evaluation, as outlined in Figure 7.3.

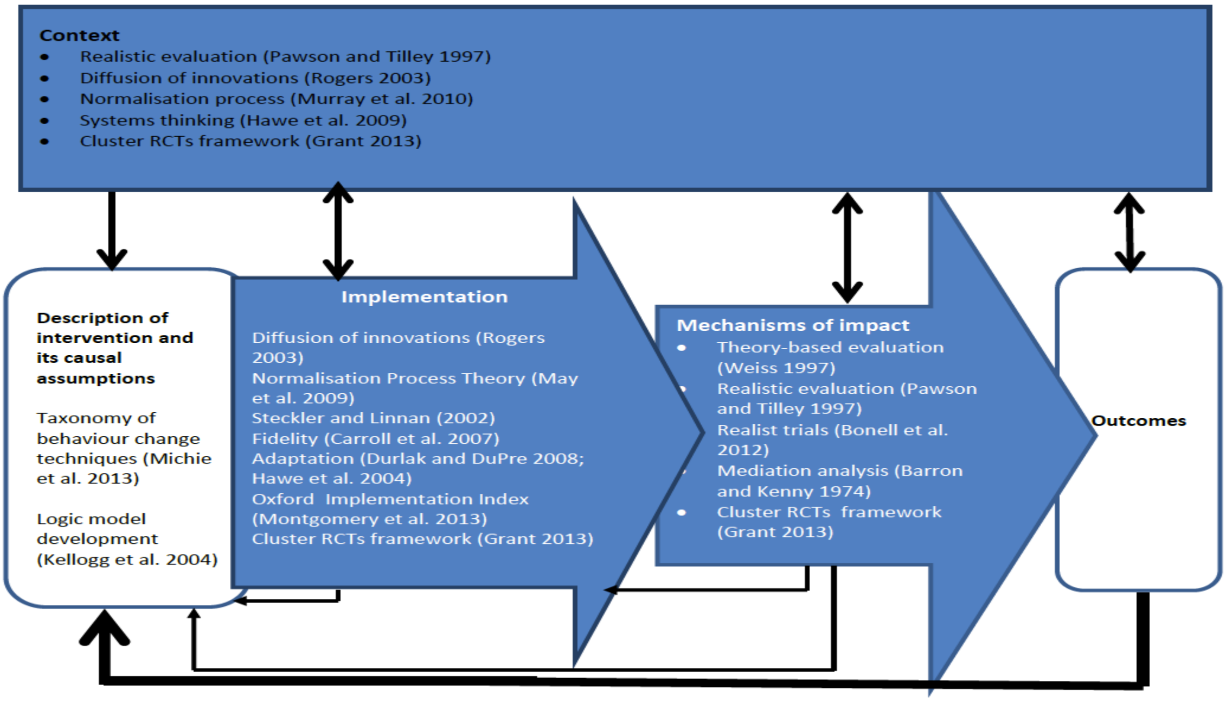

Figure 7.3. Examples of key frameworks for process evaluation and their relationship to each core function of process evaluation (Moore, et al., 2015)

The design of the evaluation in this study followed the guidance set by the functions in the MRC guidance (Moore et al., 2015) and was influenced by Steckler and Linnan's (2002) process evaluation framework (covering the implementation) and Pawson and Tilley's (1997) realistic evaluation for the aspects of context and mechanisms of impact. Both frameworks guided the evaluation components and methods of data collection, presented in Table 7.1. Steckler and Linnan (2002) identified six important process evaluation focus points: context (local factors that influence implementation), fidelity (the extent to which the intervention is delivered as conceived), dose delivered (the amount of intervention offered to participants), dose received (the extent of participant engagement in the intervention), reach and recruitment. As one of very few existing evaluation frameworks assessed in the previously mentioned scoping review by Fynn et al. (2020), Steckler and Linnan's (2002) approach provides detailed guidance on incorporating participatory evaluation methods. Within their framework, the authors define fidelity as the quality of delivery, highlighting the necessity to qualitatively capture 'the spirit' of what was delivered, not just the technical characteristics of delivery. However, in a realistic evaluation framework by Pawson and Tilley (1997), the configuration of 'context, mechanism and outcome' is a main structure used for analysis. This framework specifies that mechanisms generate outcomes, while some contextual factors might trigger or prevent mechanisms from being triggered. Therefore, the goal of the framework is to identify both the mechanism (how the change is achieved) and the contextual factors (conditions affecting the change mechanism) that can create differences in outcomes (Pawson & Tilley, 1997), thereby providing an understanding of what works, for whom, and in what circumstances (Moore et al., 2015).

Evaluation approaches place a varying level of importance on the use of theories within their frameworks, although the role of theory in evaluation was emphasised by the MRC guidance (Skivington et al., 2021). Understanding the causal assumption about how the intervention works, in order to scrutinise its plausibility, helps researchers decide on which aspects need to be further investigated, and build an evidence base informing both policy and practice (Moore et al., 2015; Skivington et al., 2021). Steckler and Linnan's framework (2002) focuses predominantly upon implementation, placing less emphasis on theory development (Moore et al., 2015). However, Steckler and Linnan (2002) argue that examining the fidelity and dose of what is implemented, and consideration of the intervention reach are essential in establishing the extent that outcomes are met, which is a valid test of intervention theory. On the other hand, a realistic evaluation approach focuses on testing and enhancing the programme theory while assessing whether and how the programme succeeds in the selected setting (Pawson & Tilley, 1997). The realistic approach assumes that a theory is an integral part of the intervention, and when the intervention is implemented, it is testing a theory about what might cause change.

When considering ‘context’, Steckler and Linnan's (2002) framework predominantly considers pre-existing conditions, which may facilitate or hinder implementation fidelity (Moore et al., 2015). However, realistic evaluation (Pawson & Tilley, 1997) considers contextual factors as impeding the outcomes of the intervention. This means that the same intervention can produce different outcomes in different contexts. Participants of the intervention have their own pre-existing beliefs, assumptions, and circumstances, which all affect their interaction with the intervention, and therefore, its outcomes (Moore et al., 2015).

Whether an intervention is going to work depends on how an individual (audience) responds to it (Moore et al., 2015). When looking at participants and their responses and interaction with the intervention, Steckler and Linnan (2002) discuss these in terms of ‘dose received’. However, the realist evaluation (Pawson & Tilley, 1997) advocates that participants do not just receive the intervention, but instead interact with it. Furthermore, Moore et al. (2015) emphasised that ‘dose’ might imply an application of only quantitative measures to assess ‘satisfaction’ or ‘acceptability’ of the intervention. However, ‘satisfaction’ should not be assessed by purely quantitative measures, but by examining its relationship to the mechanisms through which the intervention works (Moore et al., 2015).

With this considered, the MRC guidance (2008; 2021) suggests that the evaluation might need to include a mixture of qualitative and quantitative methods to assess its feasibility, e.g. to assess the response rates and to understand barriers and facilitators to participation. It has been emphasised that qualitative methods are essential components of health research, enabling understanding into the acceptability of the intervention, and its social consequences (Datta & Petticrew, 2013). Therefore, as a part of the evaluation process in this study, semi-structured, individual, face to face interviews were conducted with managers and workers on the construction site three months after the completion of the intervention. Table 7.1 (below) provides a summary of all evaluation components used in this study, together with methods of data collection.

Table 7.1. Evaluation plan using Steckler and Linnan's (2002) process evaluation and Pawson and Tilley's (1997) realistic evaluation frameworks

Evaluation component	Definition	Operationalisation	Method of data collection
Fidelity	The extent to which the intervention was delivered as planned; the quality of delivery	• The extent to which the intervention was delivered as planned, consistent with the intervention design plan • The extent to which the intervention was implemented consistent with the underlying theory	• Intervention design plan • Daily intervention checklists • Researcher's field notes and intervention daily reports • Logic model of the intervention
	Incl. barriers and facilitators to implementation	• Aspects of the implementation process that hindered the implementation of the intervention	• Individual interviews • Researcher's field notes and intervention daily reports
Dose delivered	Number of intended units of intervention that were delivered	• Number of intervention days that were delivered • Number of intervention components intended to be provided during the intervention days (e.g. BCT, educational component, coaching component); • The extent to which all the intended components of the intervention were provided to participants • The extent to which all the intended content was covered	• Intervention design plan • Intervention daily checklist containing components planned for each intervention day, content planned to be covered during each intervention day • Researcher's field notes and intervention daily reports
Dose received (exposure)	The extent to which participants used (engaged with) offered activities	• The extent to which participants were present at intervention days (the number of intervention days each participant attended)	• BCT data taken during each visit from every participant attending the intervention day, showing the number of participants during each intervention day and number of intervention days attended by every participant • Individual interviews • Follow-up results - questionnaires

Evaluation component	Definition	Operationalisation	Method of data collection
Dose received (satisfaction)	Participant satisfaction with the intervention	• The extent to which participants were satisfied with the intervention (in general, with the number of intervention days, activities and the duration of activities, content, materials provided, attained result regarding weight / fat loss and/or changes in dietary intakes / nutrition practices, recommendation of the intervention to a colleague) • Reasons for dropping out / not attending all intervention days • Qualitative exploration of how the intervention was experienced by participants	• Individual interviews • Positive comments post the intervention and an interest of the site in the commercial offering • Emails received after webinars • A Christmas gift for the researcher
Reach	Proportion of the target group that participated in the intervention	• Percentage of workers who participated in at least one intervention day (overall reach) • Percentage of workers who participated in the intervention on a monthly basis (monthly reach)	• Signed up slips and consent forms – taken from every participant during their first visit • BCT data taken during each intervention day from every participant attending • Data on the number of workers on site on the days of the intervention
	Incl. barriers and facilitators to participation	• Aspects that prevented participants from attending the intervention • Reasons why workers / managers did not participate / did not want to participate	• Individual interviews
Recruitment	Procedures used to approach and attract participants at individual and organisational level incl. barriers and facilitators to recruitment	• The extent to which planned and actual recruitment procedures were used to attract individuals and organisations to participate in the intervention	• Recruitment protocol (both organisational and individual) • Flowchart presenting communication with construction organisations inviting them to participate in the intervention • Researchers notes on actual recruitment procedures • Individual interviews

Evaluation component	Definition	Operationalisation	Method of data collection
Context	Aspects of the environment that may influence intervention implementation or outcomes; Conditions affecting the change mechanism	• The extent to which physical, social, organisational, political environment might have affected the implementation of the intervention or the intervention outcome and needed a corrective action • Pre-existing beliefs, assumptions, and circumstances, which all affect their interaction with the intervention, and therefore, its outcomes	• Individual interviews • Researcher's field notes and intervention daily reports • Covid risk assessment plan • Follow-up results – questionnaires

7.3.2. Individual interviews – method overview

Initially, focus groups were planned as a part of the evaluation process, however, due to the restrictions related to the Covid-19 pandemic, individual interviews were conducted instead. Although conducting interviews can be more time consuming (Saks & Allsop, 2019), the safety of both the participants and researcher while adhering to the Covid-19 guidelines was a priority. Individual interviews, both with stakeholders and participants, have previously been used successfully to evaluate workplace health promotion interventions in multiple settings, including in a government sponsored health education programme in Australia (Crane et al., 2019), nutrition work intervention in Ireland (Fitzgerald et al., 2016), environmental and educational nutrition programmes conducted at supermarkets and worksite cafeterias in the Netherlands (Steenhuis et al., 2004), an employer-led, free lunch initiative in Northern Ireland (Schliemann et al., 2019a), and two European nutrition and lifestyle interventions in construction (Tonnon et al., 2016; Viester et al., 2014).

Interviews are considered an effective evaluation tool to gain insights into the perspectives and experiences of participants, their knowledge, thoughts and expectations of the intervention (Patton, 2002). Moreover, they can be conducted after other results are analysed (e.g. quantitative questionnaires), to gain an understanding of unforeseen and novel findings (Saks & Allsop, 2019). Furthermore, it has been suggested that qualitative results might be more difficult to ignore by decision makers (e.g. employers) who disagree with findings, with the actual words of participants often conveying emotional and powerful messages, and hence perhaps harder to dismiss (Patton, 2002). Also, as construction is a busy, fast-paced environment, and workers are often difficult to reach and unwilling to take part in and contribute to workplace initiatives, interviews are considered useful tools in situations where the researcher might face challenges in obtaining information (Dempsey et al., 2016). Specifically semi-structured interviews, which were used in this study, are flexible, allowing any new, emerging information to be pursued during the interview, for example the researcher might be able to diverge from the interview guide to explore variations in respondents' answers and investigate a topic in greater details, which was not expected prior to the interview (Corbin & Morse, 2016; Saks & Allsop, 2019). In addition, the pace of a semi-structured interview can be adjusted throughout (Corbin & Morse, 2016), which is particularly useful in environments like construction, where not all individuals are English native speakers and have varying levels of education.

Nonetheless, it is important to recognise that interviews have some drawbacks. Not all participants may be willing and motivated to take part in the interviews, as these require a greater commitment in terms of energy than focus groups, especially as some workers might feel that they are not articulate enough to provide a researcher with rich responses (Saks & Allsop, 2019). However, the researcher was well known to participants, having worked on site delivering the nutrition intervention for six months. McGrath et al. (2018) and Fox (2009) assert that building rapport and establishing comfortable interaction in advance of the interview is crucial to ensure respondents feel relaxed, the interview appears more like a conversation, and therefore, respondents provide a rich and detailed account of their experience, beliefs and opinions. Looking more specifically at semi-structured interviews, it has been suggested that they require a lot of time to analyse (Saks & Allsop, 2019) and rely on the ability of the respondent to remember specific details about the intervention, their thoughts, behaviours and opinions (Esterberg, 2002). In addition, semi-structured interviews should not be used as a standalone method, as they can capture what people say, but not do (Saks & Allsop, 2019). Considering the above, the evaluation interviews were conducted three months after the intervention ended to ensure that participants could recall details of the nutrition programme. In addition, the evaluation data was enriched with field notes (discussed below) recorded by the researcher to enhance the rigour of the evaluation process (Esterberg, 2002).

7.3.3. Researcher's field notes

During the process of the intervention recruitment, implementation and evaluation, the researcher took notes, to record contextual information (Phillippi & Lauderdale, 2018; Ward et al., 2013). Field notes were taken after every meeting, site visits, intervention day, and immediately after the evaluation interviews were undertaken. These notes were read alongside the transcripts, to ensure the context was considered (Phillippi & Lauderdale, 2018; Ward et al., 2013). Field notes are useful for recording thoughts, feelings, and issues which might be important while analysing and evaluating data, and also to consider the overall setting of the research (Phillippi & Lauderdale, 2018). In this study, the following aspects were noted by the researcher: (i) comments from representatives of approached companies in relation to the organisational recruitment; (ii) comments from initial meetings; (iii) barriers and facilitators to the intervention implementation; (iv) events taking place during the intervention days; (v) observations of the site environment; (vi) changes in the intervention delivery, and (vii) comments from participants (see a field notes sample in Appendix 11).

7.3.4. Sample

Consistent with the realistic approach (Pawson & Tilley, 1997), a purposive sampling strategy was used in this evaluation. The researcher used knowledge of the intervention theory and intended outcomes to deliberately select participants who were able to provide information relevant to the research question, which allowed insight into what worked, for whom, how, and in what circumstances (Pawson & Tilley, 1997). To ensure that the analysis of collected data reflects the broad view of participants in the setting (Saks & Allsop, 2019). participants were selected to represent groups of managers, workers and included those who were both employed and self-employed. Participants who took part in the intervention were invited.

Participants were contacted directly by the researcher, using emails provided during the registration. An invitation, together with a consent form and information sheet, was sent, asking participants to get in touch with the researcher (by email) or a line manager. Information on the interview times and place was agreed with the managers on site and information was provided during a staff briefing, and consent forms were collected prior to the interviews commencing.

In total, 17 participants were approached to take part and 13 accepted. Those who declined were too busy on the particular day or no longer working on site. Although the size of the sample in this study was determined by availability of participants, a study of Guest et al.

(2006) analysing 60 interviews found the saturation of themes was reached by the 12th interview.

7.3.5. Interview guide

An interview guide, prepared prior to the interviews, included what to say to ensure the consistency across all interviews (Breen, 2006; Kitzinger & Barbour, 1999). Apart from the questions, it included: the welcome, an overview of the topic, and the reassurance of confidentiality (Breen, 2006; Ritchie et al., 2013) (see Appendix 9 for the individual interview guide). The interview questions were developed with the help of two experienced workplace health researchers, in line with the research aim and objectives, together with the evaluation framework used in this study. Questions covered the implementation of the intervention (e.g. experiences of those involved in the implementation), transferability of the intervention to other sites, motivation behind participation, both on personal and organisational levels, recruitment, suggested improvements, barriers and facilitators to the participation, and satisfaction. Questions asked during the interview were selected depending on who an interviewee was, as not all were relevant to all interviewees, e.g. questions around experiences in recruiting participants were directed at managers, who were engaged in the intervention implementation on site.

7.3.6. Procedure

Interviews (lasting between 30 to 50 minutes) took place in August 2021, in a small meeting room to allow a quiet and comfortable environment. They were recorded, with permission, using an encrypted digital recorder and transcribed verbatim by professional service providers, as it was considered the most time efficient. Participants were anonymised to ensure confidentiality.

At the beginning of interview, the researcher introduced themselves and the study, informed participants about confidentiality, the voluntary nature of the meeting, recording the session and the right to withdraw. Following this, predetermined open-ended questions were asked by the researcher.

7.3.7. Qualitative analysis of individual interviews

Interview data was analysed using Framework Analysis (FA) and followed the process of analysis consisting of 5 stages: familiarisation, identifying a thematic framework, indexing, charting, mapping and interpretation. Details on the method and stages involved in the data analysis were previously provided in chapter four.

7.4. Individual interviews: participant characteristics

In total, 13 participants (7 managers and 6 workers), took part in the interviews. Table 7.2 outlines participant characteristics, including, their role, employment status, gender, age, education, and the number of intervention events they took part in. All participants lived locally and stayed at home whilst working on a site.

Table 7.2. Individual interviews - participants characteristics

Role	Employment status	Gender	Age	Education	Number of visits
Manager 1	Employee	Male	35-44	Post-graduate degree	6
Manager 2	Employee	Male	25-34	Post-graduate degree	6
Manager 3	Employee	Male	18-24	College or university	2
Manager 4	Employee	Male	45-54	Post-graduate degree	4
Manager 5	Employee	Male	35-44	College or university	5
Manager 6	Employee	Male	18-24	College or university	5
Manager 7	Employee	Male	45-54	Higher or secondary or further education (A-levels, BTEC)	6
Worker 1	Self-employed	Male	25-34	College or university	4
Worker 2	Self-employed	Male	45-54	College or university	3
Worker 3	Self-employed	Male	18-24	Secondary	2
Worker 4	Self-employed	Female	45-54	College or university	5
Worker 5	Self-employed	Male	18-24	College or university	3
Worker 6	Self-employed	Male	55-64	College or university	6

7.5. Process evaluation results

Results included the findings from the intervention participant interviews (n=13), supplemented by data from field notes, a plan of the intervention, daily checklists, sign up slips, consent forms, BCT results, recruitment protocol, flowchart, and a logic model of the intervention. Process evaluation is discussed using the previously presented evaluation framework (see section 7.3.1. and Table 7.1), covering fidelity, dose delivered, dose received (exposure and satisfaction), reach, recruitment and context.

Analysis of the 13 individual interviews provided 14 themes. Themes were often relevant to different components of the evaluation framework, for example, the theme 'industry-related barriers' was applicable to the section on fidelity, dose delivered, reach and context. Table 7.3 shows the mapping of themes and their relevance to the different evaluation components.

Table 7.3. Themes arising from individual interviews reported in the evaluation

Theme number	T (theme) ST (sub-theme)	Theme / sub-theme	Evaluation section: where the theme is discussed	Evaluation section: where the theme is also applicable
1	**T**	**Covid-19 restrictions**	Fidelity – barriers and facilitators to implementation	Context Dose delivered
2	**T**	**Industry (context) - related barriers**	Fidelity – barriers and facilitators to implementation Reach (barriers to participation)	Reach (barriers and facilitators to participation) Context Fidelity - barriers and facilitators to implementation Dose received (satisfaction) (roll-out)
	ST	Limited space on site, stigma, a lack of trust in the company, time and permission to attend, self-employment status, roll out barriers – time, facilities, space, transient jobs		
3	**T**	**Personal barriers**	Reach (barriers to participation)	Dose received (satisfaction) – (languages) Context (low education)
	ST	Fear, ignorance, shyness, languages, low education, recent GP checks		
4	**T**	**Intervention support**	Reach (barriers to participation)	Dose received (participant engagement) (peer influence) Context (management, supply chain)
	ST	Management incl. mandatory character of the intervention, supply chain, peer influence		
5	**T**	**Intervention support**	Dose received (participant engagement)	Reach (barriers to participation)
	ST	Peer influence		
6	**T**	**Intervention design**	Dose received (participant engagement)	Context
	ST	Industry context and workforce demographics		
7	**T**	**Intervention components**	Dose received (participant engagement)	Context
	ST	Food demonstrations, body composition testing / competitiveness, reading food labels activities, coaching / goal-setting sessions, nutrition presentations		

Theme number	T (theme) ST (sub-theme)	Theme / sub-theme	Evaluation section: where the theme is discussed	Evaluation section: where the theme is also applicable
8	**T**	**Satisfaction**	Dose received (satisfaction)	
	ST	Potential roll-out	Dose received (satisfaction)	
9	**T**	**Improvement suggestions**		
	ST	Recipe cards, electronic handouts, graphs, open / awareness day, languages, environmental changes, frequency	Dose received (satisfaction)	Fidelity (Covid-19 restrictions, open / awareness day) Reach (languages)
10	**T**	**Organisational recruitment**		
	ST	Organisational motivation / a difficulty in gaining commitment from project site teams, industry (context) -related barriers	Recruitment	Context
11	**T**	**Individual recruitment**		
	ST	Peer influence / poster advertising / personal reasons	Recruitment	Dose received (participant engagement) Reach (barriers and facilitators to participation) (peer influence)
12	**T**	**Company leadership**	Context	
13	**T**	**Culture on site**	Context	
14	**T**	**Changing industry**	Context	

Due to the large number of themes and sub-themes, and the volume of information, only the key findings will be presented in this section. These start with fidelity, i.e. the extent to which the intervention was delivered as planned, and barriers and facilitators to implementation. This is followed by the dose delivered, i.e. an assessment of how much of the intervention was delivered. Then, a section on dose received is presented, which includes an evaluation of the extent to which participants engaged with the intervention and their satisfaction with it. This is followed by the evaluation of the intervention reach, which also includes the findings on barriers and facilitators to participation. Organisational and individual recruitment is the next section of this chapter, which covers both the recruitment procedures and barriers and facilitators to recruitment. Then, aspects of the environment that influenced intervention implementation are presented in the context section.

7.5.1. Fidelity, including barriers and facilitators to implementation

Measuring fidelity is important to understand whether the nutrition intervention was delivered as planned. Field notes, alongside researcher's checklists, the implementation plan and qualitative findings from interviews provided the data used to assess fidelity and evaluate barriers and facilitators to the intervention implementation.

The implementation plan (Table 7.4) shows an overview of the intervention and its delivery plan. If elements were not delivered or adjusted in relation to the original plan (see Chapter five, section 5.7), the element was marked as 'not delivered as planned'.

Table 7.4. The implementation plan – an overview of the intervention

Intervention structure criteria		**Delivered as planned**	**Not delivered as planned**
1	Intervention to be delivered on three construction sites		✓
2	Awareness day delivered prior to commencement of the intervention		✓
3	Intervention to be delivered face to face for 6 consecutive months		✓
4	Intervention to be delivered once a month	✓	
5	Each intervention day delivered on site for a whole day	✓	
6	Multiple sessions offered throughout the day	✓	
7	Each session length - 1.30min		✓
8	Sessions open to all working on site (including managers, supervisors, workers, sub-contractors)	✓	
9	Drop-in and pre-booked sessions offered	✓	
10	Session offered in multiple locations on site		✓
11	Each session consisting of different components using numerous behaviour change techniques and covering multiple intervention functions like education, training, modelling, incentivisation, persuasion, enablement, environmental structuring (based on COM-B model and the BCW)	✓	
12	Toolbox talks delivered to the whole workforce throughout the intervention to recruit more participants		✓
13	Assessment of physical environment (e.g. staff canteen, sitting area, resting area, kitchen, changing room etc.) provided on site to provide a company a report with suggested changes in the physical environment, which could be implemented as a part of the intervention to support healthy nutrition choices amongst the workforce		✓
14	Monthly promotion of the intervention included emails, posters, face to face conversations with workers and managers on site		✓

Of the 14 elements, 8 were not delivered as planned which indicates moderate fidelity. This rating was assigned in line with other studies that had used checklists. For example, 'high' (most or all intervention criteria are met), ‘moderate’ (intervention delivery varied from criteria), ‘low’ (most or all criteria were not met) ratings were used in a workplace weight management study (DeJoy et al., 2012), while a participative stress prevention study evaluated the fidelity as high when 9 out of 12, and 11 out of 14 checklists criteria were met (Arapovic-Johansson et al., 2020).

In addition to the implementation plan, daily fidelity checklists were completed, in line with recommendations provided by Walton et al. (2020), whose study focused on developing quality fidelity and engagement measures for complex health interventions. Six fidelity checklists were developed, one for each day of the intervention. Table 7.5 (below) presents a checklist for the first day of the intervention, with the remaining checklists available in Appendix 10. On each checklist, three response options were available: ‘done’, ‘done to some extent’, and ‘not done’. A ‘reason’ column was provided to add details on a lack, or modified implementation of an activity.

Table 7.5. Nutrition intervention day 1 checklist - 24th September 2020

Activity		**Done**	**To some extent**	**Not done**	**Reason (if not done or done to some extent)**
Initial activities	Explained what the nutrition programme was and what it would involve	✓			
	Asked if all participants received a participants information sheet. Asked if they had any follow-up questions. Collected signed consent forms and sign-up sheets	✓			
	Distributed baseline questionnaires and completed the second part of the questionnaire with participants (interviewer-administered). Collected questionnaires	✓			
Plan	Provided relevant resources for the topic of nutrition and energy (practical tips flyer, activity handout) and healthy snacks		✓		Time constraints on the day did not allow for an activity on nutrition and energy to be carried out
	Provided relevant resources explaining body composition measures	✓			
	Made at least one plan with the participant (including where, when and how they would start making changes in their diet to eat for more sustained energy during the day)		✓		Time constraints on the day did not allow for a detailed discussion with participants on their plans

Activity		Done	To some extent	Not done	Reason (if not done or done to some extent)
	Encouraged the participant to think about what might help and what might get in the way of carrying out their plan(s)	✓			
	Encouraged the participant to think of ways to overcome problems	✓			
	Helped the participant to set their first nutrition goals	✓			
	Recorded plan(s) on the goal-setting sheet		✓		Although all participants were asked to record their goals and plans on sheets, due to social distancing it was not possible for the researcher to verify that and discuss plans with individuals
Do	Conducted a presentation on nutrition and energy explaining how fluctuations in blood sugar affect our energy during the day	✓			
	Facilitate discussion on current nutritional habits and how they affect energy	✓			
	Distributed ‘energy handout’ and explained how to use it			✓	Time constraints on the day did not allow for an activity to be carried out
	Asked participants to use the ‘energy handout’ to draw an energy chart helping them to understand their energy patterns during the day (e.g. energy dips)			✓	Time constraints on the day did not allow for an activity to be carried out
	Distributed healthy snacks to individuals explaining their nutritional value, how they can be used to support energy, places they can be purchased, and cost. Asked for feedback on snacks	✓			
	Conducted a quiz on nutrition value of different foods	✓			
	Conducted body composition testing (recorded measures and explained results to individuals)	✓			
Support	Gave positive feedback	✓			
	Gave the opportunity to ask any questions or clarify any issues	✓			
	Provided contact details and explained methods of support	✓			
Next step	Set a time and date for next session	✓			

Activity	Done	To some extent	Not done	Reason (if not done or done to some extent)
Total	16	3	2	

Based on the analysis of the fidelity checklists, most of the elements planned for the intervention days were delivered, with some requiring modifications or being partly delivered. Overall, 129 activities were planned over the course of 6 intervention days; 103 of which were delivered as planned, 21 were delivered to some extent, and 5 were not delivered at all. Amongst planned activities that did not take place were an activity on nutrition and energy, a meal planning activity, and a presentation on different types of diets. Some of the activities that were partly delivered included goal-setting sessions, stay active, discussions and coaching on nutrition habits, and some presentations and food demonstrations. Covid-19 restrictions, limited space on site and time constraints were the main barriers to the implementation (all discussed in the next section of this chapter).

This intervention was developed in line with the COM-B model and the BCW (see section 5.7. nutrition intervention design). Activities were designed to maximise capability to regulate own behaviour (gain knowledge and understanding, develop skills), maximise opportunity to support self-regulation (elicit social support, change routines and environment) and increase motivation to engage in the desired behaviour (develop new habits, develop appropriate beliefs and positive feeling about changing, reward change) (Michie, Atkins, et al., 2014). Furthermore, the design included 7 intervention functions, which are broad categories by which the intervention can change the behaviour (education, training, persuasion, incentivisation, enablement, modelling, and environmental restructuring) and 31 behaviour change techniques (see Table 5.31). Activities used in the delivery of the intervention often used different behaviour change techniques and covered more than one function. For example, a food demonstration activity used at least two behaviour change techniques: (i) ‘demonstration of the behaviour’ (covering a function of modelling) and (ii) ‘instruction on how to perform the behaviour’ (covering training function). The delivery of the intervention used all planned COM-B components, intervention functions and behaviour change techniques, therefore, the theory was used as planned. However, the way the physical environment was assessed, required some modifications by the researcher due to Covid-19 (see Table 7.4). This may have weakened the company response, and therefore the opportunity for participants to support self-regulation of new, healthy behaviours. For example, as a part of the environmental assessment, the researcher planned to assess all eating areas, canteens, resting areas etc. to provide a company with suggested improvements on how to make environmental changes to better support healthy choices amongst the workforce. However, due to Covid-19, not all areas were accessible to the researcher, and the assessment only covered part of the site, and so the response from the company (e.g. new microwaves) were introduced in the main cabin, but the researcher could not be sure if this was rolled out to other parts of the site. As a result, a part of the workforce might not have benefited from environmental modifications, which could have provided them with an opportunity to improve nutrition behaviours.

7.5.1.1. Barriers and facilitators to implementation: interviews and field note analysis

As a part of the evaluation, barriers and facilitators to the implementation of the nutrition intervention were analysed. Data was drawn from interviews, researcher's field notes and intervention checklists. Two major barriers were recognised: Covid-19 restrictions and industry-related barriers, which included limited space on site (see Table 7.3).

Covid-19 was the major barrier to implementation. After establishing contacts and building relationships with construction companies, three organisations committed to the intervention in late 2019 / early 2020, with focus groups taking place on three sites with three different construction companies between January 2020 and March 2020. However, visits and data collection were suspended until July 2020, due to the first national lockdown introduced in late March 2020.

Between July and September 2020, some lockdown restrictions were lifted, e.g., most hospitality businesses were permitted to reopen, new health and safety guidance on operating businesses 'Covid securely' was published (Brown & Kirk-Wade, 2021), and gatherings of up to thirty people were legally permitted, although the Government was still recommending people avoid gatherings with more than six people (Brown & Kirk-Wade, 2021). However, none of the construction organisations that had initially made a commitment to take part in the intervention wished to continue. The main reasons provided were: (i) increased job demands and delays in the schedule due to the site being closed for months, (ii) managers who originally committed to supporting the implementation of the intervention were not available on site (either furloughed or moved to a different position or a project due to changing demands), and

(iii) one company facing financial problems due to the lockdown, resulting in the health intervention no longer being a priority.

Following refusal from all three companies, the researcher established contact with a different construction company, who expressed an interest in taking part in the intervention. The company was identified through the researcher's personal network of commercial contacts. The researcher conducted the first visit on site in August 2020, followed by an awareness raising day with construction workers (10^{th} September 2020) and the intervention commenced on site in late September 2020.

Some Covid restrictions were reimposed between September and October 2020 and a second national lockdown took place in November 2020, with a tiered system (locations being placed in tiers 1-4, with different level of restrictions) introduced in December 2020 (Brown & Kirk-Wade, 2021). As a result, the intervention design was amended to follow government and company regulations and ensure protection for the researcher and intervention participants. Table 7.6 shows the changes in the design of the intervention, due to Covid restrictions.

Table 7.6. Changes in the design of the nutrition intervention due to Covid restrictions

Design component	**Planned**	**Delivered**
Awareness day (a toolbox talk)	An awareness day to take place on site, with a researcher talking to the workforce, explain the intervention, inviting participants to take part, offering food tasting and nutrition handouts	A toolbox talk was delivered on site to the workforce (outside) explaining the intervention and inviting attendance. There was no equipment available to display slides and the site noise could have impacted the talk. Due to restrictions of movement on site (see details below in this table), an awareness raising day on site was not agreed to.
Group sessions	Presentations to be delivered in groups of 10 -12. Toolbox talks to be delivered to the whole workforce every two months (to engage new participants)	Restrictions on gatherings and social distancing meant that presentations were delivered to a maximum group of 6 people in a larger meeting room or 4 in a smaller room. This restricted the number of individuals who could attend, and the length of each session. Toolbox talks delivered to the whole workforce were not agreed to.
Length of sessions	Presentations to last approximately 45 minutes, with coaching, practical activities and body composition testing sessions lasting 45 minutes (1h 30min in total)	Due to the limited number of participants who could attend sessions at the same time, the length was limited to a maximum of an hour for each participant.
Delivery in multiple location	The intervention to be delivered in multiple places on site (e.g., meeting rooms in the office, a canteen, a sitting area, stalls on site)	Due to restrictions, i.e. one-way systems to ensure social distancing, staggered breaks, and increased cleaning regimes, it was not possible to deliver the intervention in multiple locations. Activities were mainly delivered in meeting rooms and twice in a canteen.
Physical environment assessment and consultation	The intervention to include an assessment of physical environment (e.g. staff canteen, sitting area, resting area, kitchen, changing room etc.) provided on site. The assessment findings to be included in a report provided to the company with suggested changes in the physical environment, which could be implemented to support healthy nutrition choices amongst the workforce	Not all the site facilities were assessed due to Covid-related restrictions in movement. Offices, staff canteen, changing rooms, kitchen facilities, toilets (all in the main cabin) were assessed, however, the researcher could not access any of the on-site facilities in other cabins and resting places for the workforce on site.

The third national lockdown was enforced on 6th January 2021 and lasted until March 2021, with restrictions on gatherings and the 'stay at home' rule re-established. This meant that the face-to-face intervention was suspended between January and April 2021. During this time, the site operated with limited capacity, and no external visitors were allowed. To keep the workforce engaged, presentations were delivered online as webinars, using Microsoft Teams, while BCT was still offered on site and delivered by one of the managers working on site, who was provided with instructions on how to operate the machine. Details on all components delivered during the lockdown can be seen in Table 7.7.

Table 7.7. Nutrition intervention components delivered during the third national lockdown (Jan – Apr 2021)

	Component	**Delivery**	**Additional notes**
1	Presentations	Presentations on nutrition delivered twice (January 2021 and March 2021) on Microsoft Teams	Online presentations (webinars) were attended mainly by office staff working on site. Webinars were recorded, with a link to recordings distributed to the workforce by email. Presentation slides, handouts, recipes etc. were also included in the follow-up emails. Seven emails were received following the first webinar, and four following the second webinar expressing gratitude for delivering the presentation and positive feedback on the content and delivery.
2	Body composition testing	Delivered monthly on site by one of the managers working on site	A BCT machine was delivered on site with instructions on how to conduct tests. Instructions included a machine manual, warning signs and a video recorded by the researchers on how to operate the machines and conduct the tests, which was sent by email to the manager, who conducted body composition testing. Testing was conducted on a monthly basis between Jan and April 21. Participants were asked to keep their test results (print outs) and share them with a researcher during the next post-lockdown visit.
3	Food tasting	Snacks and drinks distributed by a member of the team	Snacks and drinks were delivered on site (sent by a delivery company) and distributed amongst the workforce by one the managers.
5	Coaching	An email was sent to all intervention participants offering one to one online coaching sessions.	Nobody got in touch with the researcher and no coaching sessions were organised.
6	Education / motivation emails	‘Touch base’ emails were sent to all participants reminding them about simple nutrition habits, inviting to get in touch, reminding that the intervention will return on site post lockdown and motivating them to keep up the great work they had been doing with regards to changing nutrition practices.	Four emails were received in response to the ‘touch base’ emails thanking the researcher for the information.

During the interviews, participants (n=10) discussed Covid-19 as a barrier to implementation. Interviewees appreciated that some activities were still provided online and that they could continue with BCT on site, although they highlighted that face-to-face delivery was preferred, as it was more engaging and impactful. Also, it was highlighted that multiple daily online meetings lead to exhaustion, with individuals often turning their cameras off and disengaging.

> *"The time when we were in lockdown was hard as we could not see you and I know the machine was here but it was not the same" (Worker 6)*

> *"Sometimes we do online sessions ... and people lose interest… they're doing something else …I promise you after the sessions, we will talk about it in the office, or the sub-contractors will be talking about that was really informative" (Manager 4)*

In addition, participants (n=2) said the break in the intervention negatively affected their nutrition habits and weight. Nonetheless, one worker (who only attended 50% of sessions) explained that although he put on weight during the lockdown, the intervention gave him knowledge and confidence to lose it again.

> *"If I want to lose weight, I know how to do it" (Worker 2)*

It was highlighted (n=4) that Covid-19 restrictions affected the engagement with and completion of the intervention, as some workers moved to different projects. The intervention gained the highest engagement in December 2020 (see 'Reach' section in this chapter), however, following the lockdown, time was insufficient to rebuild the 'momentum' lost during the break.

> *"Once we came four months later, most of the guys from December were not available here anymore" (Worker 5)*

Nonetheless, while Covid-19 restrictions meant a limited number of individuals attending the intervention at once (max 6 people), this was recognised as positively influencing the participants' attention, engagement and learning.

"Having less people, being face-to-face definitely helped in paying attention and gaining from the session, actually registering what you were saying to then use in everyday life" (Worker 3)

The limited space on site was an industry-related implementation barrier (also see the 'Reach' section) as recorded in the researcher's field notes. The site had two meeting rooms (big – for 6 people and small – for 4), however, due to a high number of daily meetings (often unplanned and unexpected), the intervention often had to compete for space. On three occasions the intervention had to move from a big to a small room during the day, which altered the schedule of planned sessions and the attendance. In addition, the smaller room was not equipped with a screen, meaning Power Point slides were shared from a laptop screen, possibly impacting the quality of presentations and the learning.

7.5.2. Dose delivered

This component was used to assess how much of the intervention was delivered and was defined as intervention days delivered, intervention components delivered, and the intervention content covered.

Taken together, the planned intervention composed of 6 days (6 visits on site). All six days were delivered on site (100%), although there was a 4 month break due to Covid-19 lockdowns. Each day of the intervention consisted of 6 components: 36 components in total. These included: a presentation (e.g. a talk on the composition of a healthy plate), a food demonstration and tasting session, a coaching session (e.g. goal-setting), a quiz, a challenge, or a competition, and BCT. Table 7.8 presents the extent to which intervention components were delivered, both by day of the intervention and component type.

Table 7.8. Intervention components delivered by day and type of activity

Component		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Components delivered (by type)	The extent to which components were delivered (by type)
1	Presentation	✓	✓	✓	✓	✓		5/6	83%
2	Practical activity			✓	✓	✓	✓	4/6	67%
3	Food demonstration and tasting	✓	✓	✓	✓	✓	✓	6/6	100%
4	Coaching session	✓	✓	✓	✓	✓	✓	6/6	100%
5	Quiz, a challenge or a competition	✓	✓	✓	✓	✓	✓	6/6	100%
6	Body composition testing (BCT)	✓	✓	✓	✓	✓	✓	6/6	100%
Components delivered (daily)		5/6	5/6	6/6	6/6	6/6	5/6		
Components delivered (total)		**33 (out of 36)**							
The extent to which components were delivered (daily)		83%	83%	100%	100%	100%	83%		
The extent to which components were delivered (total)		**92%**							

In total, 33 of 36 components (92%) were delivered, an average of 5.5 per day. Components in days 3, 4 and 5 were fully delivered (100%), while in days 1, 2 and 6, only 83% were delivered. When looking at the dose delivered by component type, practical activities were delivered least (67%), presentations next (83%), while the remaining activities were fully delivered (100%) (i.e. food tasting, coaching, quizzes and challenges, and body composition testing (BCT)). Although, due to a different design of the intervention it is difficult to make a direct comparison with other studies, in the intervention ‘Health under Construction’, on average 4.9 out of 6 components were consistently delivered (Tonnon et al., 2016).

The content, which was intended to be covered in the intervention, was developed in line with findings from the literature review, analysis of focus groups and baseline questionnaires, as well as the EatWell Guide. Table 7.9 presents an estimate of the extent to which the planned content was covered. This was based on the intervention daily checklists (presented in the 'Fidelity' section) and estimates from the researcher's field notes.

Table 7.9. Content covered during the intervention

Content (topics) covered		**The extent to which the content was covered**			
		0-25%	**25-50%**	**50-75%**	**75-100%**
1	Alcohol				✓
2	Body composition				✓
3	Breakfast at work			✓	✓
4	Christmas meals				✓
5	Colourful vegetables and fruit			✓	
7	Diets – different types		✓		
8	Exercise, fitness and staying active			✓	
9	Food cravings				✓
10	Healthy plate composition				✓
11	Healthy snacks				✓
12	Lunch at work			✓	
13	Meal planning		✓		
14	Nutrition and optimal weight and body composition				✓
15	Nutrition and energy		✓		✓
16	Nutrition and immunity			✓	
17	Nutrition and mental wellbeing				✓
18	Reading food labels				✓
19	Shopping lists				✓
20	Ingredients swaps				✓

As indicated in Table 7.9, most of the planned content was delivered. Content on meal planning, nutrition, and energy, as well as different types of diet was only delivered 25-50% of the time, which was the lowest, while information on nutrition and immunity, staying active, colourful fruit and vegetables as well as breakfast and lunch at work ideas, were delivered between 50-75% of the time, with the remining content delivered 75-100% of the time. It is worth mentioning that content was delivered using different activities, and some aspects were easier to deliver in full than others. For example, how to swap ingredients was delivered in the form of a handout and a short coaching session, while the content on nutrition and energy was delivered as a presentation, followed by a practical activity, a handout, and a food demonstration.

7.5.3. Dose received (exposure)

Dose received was assessed by the extent to which participants used and engaged with offered activities. The number of intervention days each participant attended, as well as findings from the interviews were also used in this evaluation section.

Overall, 51 participants took part in the intervention, although only 22 completed it (i.e. filled out the follow-up questionnaire). Table 7.10 presents a summary of dose received, i.e. the extent to which participants were present during the intervention days.

Table 7.10. Dose received – a summary of the extent to which participants were present during the intervention days (number of intervention days attended)

Number of visits	**Number of participants**	**Number of visits**	**Number of participants**
All intervention participants (*n*=51)		Participants who completed the intervention (*n*=22)	
6	4	6	4
5	6	5	6
4	2	4	2
3	6	3	5
2	12	2	5
1	11	1	0
Total number of participations	**125**	**Total number of participations**	**87**
Average attendance per participant (the number of intervention days each participant attended)	**2.45**	**Average attendance per participant** (the number of intervention days each participant attended)	**3.95**
Dose received	**40.8%**	**Dose received**	**65.8%**

In total, 51 participants attended the intervention 125 times, over a period of 6 months, giving an average attendance of 2.45 day per person (the average number of intervention days each participant attended), meaning on average participants received 40.8% of the intervention. When considering only those who completed the intervention, 22 participants attended the intervention 87 times, with an average attendance of 3.95 intervention days per participant, making the average dose received 65.8%. In comparison, in the ‘Health under Construction’ study, the average number of attended sessions per participant was 3.5 (out of a possible 7), i.e. dose received of 50% (Tonnon et al., 2016).

7.5.3.1. Participant engagement: interview and field note analysis

Individual interviews with participants allowed for an exploration into the engagement with the intervention. Based on the analysis, three main themes were identified: (i) intervention design, (ii) intervention components and (iii) the intervention support, which focused on peer influence (see Table 7.3).

Interviewed participants discussed the design of the intervention incorporating the context of construction industry and workforce demographic characteristics. Small group interaction, comfortable for those who were shy, less confident, or less educated (n=6) enhanced the engagement with the intervention. In addition, onsite delivery, not requiring additional travel (n=4) and flexibility of delivery, using both pre-booked slots and drop-in sessions available throughout the day and adjusting the time of sessions to help participants meet the work demands (n=7) were all considered as factors improving the engagement.

> *"You brought it to them so they didn't have to go anywhere for it which would have been the big barrier" (Manager 5)*

> *"You get more engagement with a smaller group, because people are a little bit less nervous of talking in smaller group. You know, the bigger the group, that's where you will get people who will go into their shell a little bit" (Worker 4)*

However, opinions were divided regarding the use of pre-booked sessions in health interventions. Pre-booked sessions were highlighted as preventing most of the busy workforce from attending past health checks, however, others said that pre-booked sessions allowed them to plan the day. Appreciation for pre-booked sessions was evident amongst managers rather than workers, which might be due to managers having more organised schedules.

> *"Flexibility really helped. Once we had a nurse who did health checks but you had to pre-book and stick to it. and 80% of us did not attend because some major thing happened on a day" (Worker 2)*

Other factors discussed to support the engagement included the frequency (i.e. once a month) and length of sessions (i.e. 1 hour) (n=10). Participants discussed that a monthly break between site visits was long enough to make dietary changes or lose weight, but not long enough to lose interest. Additionally, hourly sessions were praised for keeping people engaged and being "*easily excusable*" from work.

> *"If you come more often I would probably not change in terms of my numbers so maybe I won't even come to see you not to be disappointed" (Worker 4)*

Fun, relaxed atmosphere, interaction, using games, challenges and quizzes were mentioned as supporting engagement, where participants felt at ease and the intervention appeared to provide a nice change to an otherwise pressurised environment (n=8).

> *"It was quite a relaxing kind of hour in the day when, you know, it's quite a pressurised daily, with constant change, it's quite an unstable industry really" (Manager 2)*

The intervention facilitator was also praised (n=7) for being enthusiastic, approachable, knowledgeable, delivering scientific concepts in an accessible way and building relationships with workers who might find coming into the office and listening to a presentation "*daunting*". The researcher's ability to control the audience was also highlighted.

> *"You were able to control the room and the target audience which sometimes can be a bit negative" (Manager 3)*

Nutrition education and advice was considered relatable and relevant to the construction workforce (e.g. low education) and the environment (e.g. busy schedules) (n=5). Simple, easy to implement changes, such as freezing ginger and turmeric shots, ensuring a protein rich breakfast, switching to low sugar fruit, and eating a rainbow of vegetables were not considered "*lifechanging*", but provided "*a bigger picture"*. Food demonstrations and tasting sessions were praised for being easy to make, requiring limited ingredients and being the most impactful, which seemed especially suitable for those with low education or language barriers (n=10). This was applauded by both managers and workers who declared their education as 'college or university'.

"For example, blood sugar levels and what you have in the morning and, I can actually take the scenario that you were talking about picture it happening in my life, or my morning" (Manager 6)

"I am not academic … that's why I work in construction I guess [laugh]…. and I really understood all you said. When I go to GP, I don't get half he says to me" (Worker 1)

Food tasting sessions also exposed participants to new foods and drinks that they would not usually even consider buying, due to a fear of not tasting nice. Participants declared stated that they had been regularly buying some of the products (e.g. ginger shots, kombucha, kefir and coconut water) sampled during the intervention (n=5). However, this was mentioned by managers and not workers, which might be linked with a higher education or income.

BCT was a component discussed by all participants, who commented that monthly weigh-ins supported engagement, made them aware of their current health, allowed them to track progress and was often commented as "*eye-opening*", "*shocking*", but equally "*useful*". Furthermore, doing BCT was regarded as fun, as is created "*an awful lot of rivalry, in a good way"* (n=11). Participants declared comparing their results, competing on the lowest metabolic age or the highest muscle mass, which further encouraged them to do extra gym sessions or reduce unhealthy food to "*beat*" others, or in fear of poor results on the next weigh-in. BCT results were a source of jokes on site, with comments about people not working as hard as they claim since their body fat remained unchanged.

"It's a good bit of banter but at the same time makes everyone think about it, so I think that's a very good thing" (Manager 1)

"Someone brought donuts, and like, oh no, we can't have any donuts, I'm not having a donut because I've got to go on the machine tomorrow" (Manager 3)

Two managers, both decisions makers, said they would advocate for similar machines to be available on all sites.

Other components recognised as improving engagement were practical activities on reading food labels (n=6), coaching and goal setting (n=4), and nutrition presentations with handouts (n=5). The skill of reading food labels was regarded as helping participants to reduce alcohol (e.g. due to the high sugar content in wine), choose healthier products when shopping (e.g. natural yoghurt and fruit instead of fruit yoghurt, dark instead of milk chocolate), understand portion sizes (e.g. crisps) and how food manufacturers "*fabricate*" and "*manipulate*" information to make food seem healthier.

> *"What I did enjoy was how you read the ingredients to what you eat and the colour coding and how the sellers of the food fabricate it to make it actually seem better" (Worker 5)*

Coaching sessions were appreciated for "*guiding rather than telling"* and learning from others, while presentations and handouts were valued for being easy to understand and enabling them to review information later.

> *"I liked the group sessions when we were all chatting. You could learn from others" (Worker 6)*

Finally, peer influence was recognised as improving engagement (n=10), with workers encouraging each other to attend, which created a "*snowball effect*". Some participants discussed how seeing others attending and enjoying the intervention gave them confidence to participate as well, while others mentioned feeling peer pressured to get involved, i.e. not wanting to be left out. Peer-pressure was highlighted by workers who attended a maximum of 3 days, suggesting they took some time and persuasion to get involved and that if the intervention had strict signup dates, then these participants may have been left out.

> *"I'm not going to say peer pressure, it was probably more to do with the team involved, and I'd have felt … not right, not to get involved" (Worker 2)*

However, peer influence was also recognised by managers, discussing their observations from the site that groups of workers always spend time together and would only attend the intervention *"if their mates were going"*.

"A lot of the plumbers came down and they were raving about it upstairs saying, oh I've got me measured and I know all these sort of things and they were sort of telling their friends" (Manager 5)

7.5.4. Dose received (satisfaction)

Participant satisfaction was evaluated predominantly through interviews, followed by researcher's field notes, and emails from intervention participants. Two major themes arose from the discussions: (i) a satisfaction with the intervention, with a sub-theme of a potential roll out, and (ii) improvement suggestions (see Table 7.3).

Overall, all participants said they were happy with the intervention, would recommend it to others and if offered, would be willing to attend again. Participants commented that the intervention was *"useful", "enjoyable", "well presented", "easy", "fun", "engaging", "informative, "eye-opening", "interesting", and "practical".* Three managers mentioned that *"better than expected"* feedback was received from sub-contractors, a client, and the workforce.

Satisfaction was also demonstrated beyond the interviews, through emails, which the researcher received from seven participants following the first webinar delivered during lockdown, and four following the second. In all instances, emails were sent to express positive feedback on the content and the delivery and satisfaction with the presentation. In addition, the researcher received a Christmas gift from site workers (a bottle of champagne) as a token of appreciation.

Satisfaction with the intervention was also demonstrated through a discussion about a potential roll out. Managers expressed a desire for the intervention to be rolled out to other projects and sites (n=6) as they appreciated an impact it had on the workforce, and also on culture change on site. The intervention prompted new health and wellbeing initiatives, helped to "*bring health into focus*" in a similar way to safety, and supported breaking stigma amongst the workforce on taking care of and an interest in own health.

"I know that a fair few of us, like me and [name], I suppose, are the two key ones, would be definitely looking to do something similar, with yourself … on the next project we're looking at doing" (Manger 2)

"Hopefully it has helped in breaking a bit of stigma as well, on the mental health side. It's okay to go and weigh yourself and find out and actually take an interest in your own body" (Manager 5)

Following the evaluation, the researcher received confirmation that a company was looking into rolling it out on a large, three year prison build project in late 2022.

Whilst satisfaction with the intervention was evident, participants offered suggestions for improvement, which formed another major theme in this evaluation (see Table 7.3). These included introducing recipe cards for main meals (not only breakfast and lunch), translating handouts and presentations into multiple languages, conducting an awareness day allowing workers to sample the intervention and using other spaces on site, like a canteen, an eating area, or a tent / a stall on site (areas of high traffic) to deliver some of the activities, as most of workers did not feel comfortable coming into an office. This was previously explored during focus groups and was a part of the planned intervention but was not possible due to Covid-19 restrictions (see 'Fidelity' section). In addition, a suggestion for physical environmental changes, in the form of vending machines with healthy foods and snacks was offered by one manager.

7.5.5. Reach

Reach was defined as a proportion of a target group that participated in the intervention. Sign-up sheets, consent forms, body composition testing data collected on a monthly basis and data from the company on the number of workers on site were used to calculate it. In addition, this section used findings from individual interviews and researcher's field notes to evaluate barriers and facilitates to the intervention participation.

In total, 51 participants took part in the intervention between September 2020 and May 2021. During this time, the number of people working on site ranged from 76 (in December 2020) to 177 (in April 2021), with a monthly average of 104. Therefore, the overall reach of the intervention was 49% (i.e. the percentage of workers who participated in at least one intervention day). However, the design of the intervention allowed participants to join at anytime, therefore, monthly reach was also calculated, and the results are presented in Table 7.11.

Table 7.11. Reach of nutrition intervention – overall and monthly

Month	Number of workers on site	New participants signing up	Returning participants	Total attendance on the day	Total signed up to that moment	**Monthly reach (%)**
1. September 2020	82	14	n/a	14	14	**17**
2. October 2020	80	6	12	18	20	**23**
3. November 2020	101	7	15	22	27	**22**
4. December 2020	76	11	18	29	38	**38**
5. April 2021	177	9	10	19	47	**11**
6. May 2021	106	4	19	23	51	**22**
Average	**104**			**21**		**20**

The monthly intervention reach varied from 11% (in April 2021) to 38% (in December 2020), with an average of 20%. Total daily attendance was lowest (n=14) in the first month (September 2020), and highest (n=29) in December 2020, which was month four. The average daily intervention attendance was 21 participants.

Our findings are similar to those of others, for example Lier et al. (2019) in a cross-company study looking at determinants of participation found the average rate of 15.37%, while Bevan & Cooper (2021) suggested that the average participation is between 20-30%. In construction, 20% of invited workers participated in the 'Health under Construction' study (Groeneveld et al., 2009).

7.5.5.1. Barriers and facilitators to participation -– qualitative analysis from individual intervention and field notes

During the interviews, participants were asked about barriers and facilitators to intervention participation. Because all respondents who took part in the interviews also participated in the intervention, questions explored potential, rather than actual, reasons. Key themes that arose in this respect were: personal barriers (e.g. fear, ignorance, language, or GP checks) and those that related to the context of working in the industry (e.g. stigma, a lack of trust in the company, time and permission to attend and a self-employment status). Within the context of working in the industry, barriers and facilitators to potential rollout were also discussed. The final theme arising from the interviews was on intervention support ('mandatory' character of the intervention), supply chain (sub-contractors) and peer influence) (see Table 7.3).

In relation to individual barriers, low levels of education and language were mentioned as potential reasons for non-participation (n=6), as a large proportion of workers come from Eastern Europe and had poor English. Low education level meant that *'forcing'* attendance to engage with this group was suggested by managers (see also 'mandatory' character of the intervention).

> *"The less academic ones, to get them involved, we've almost got to force them into doing it and then they might see a benefit from it" (Manager 7)*

Fear, ignorance, and shyness were very commonly discussed personal barriers to participation (n=11). Workplace delivery meant that some might have felt shy, embarrassed, and resistant to discuss their health (or diet or weight) in front of co-workers. This comment was provided by a female worker, who might have found sharing experiences amongst male colleagues difficult.

> *"... a bit possibly embarrassing to be going through it in front of your peers and people you work with, you know…" (Worker 4)*

In addition, a fear of knowing the truth about one's health or recent GP health checks were highlighted as reasons for non-attendance amongst older participants, and in the case of younger workers, ignorance was mentioned.

> *"Some people know on site they're not going to be that healthy, they don't want to hear the news, it's sort of like blissful ignorance" (Manager 6)*

> *"So some of them had health checks, so the older" (Manager 4)*

The second theme related to the context of working in the industry was stigma around health, diet, nutrition (n=6), and a perception of builders *"going to the café"* and *"eating bacon rolls"*. Also, workers still consider a site visit from a nurse or other health professional as *"trouble",* with health check results potentially keeping them away from the job. In addition, a lack of trust in the company's genuine interest in workers' health was mentioned, with health interventions perceived as potentially a way to "*tick a box*".

> *"This is construction, here you can't be sick, you don't talk about your problems, you know… it doesn't look good for lads to talk about salad and stuff" (Worker 3)*

> *"We're just going to be told we're not eating well enough, we should drink more, should do more exercise…" (Manager 5)*

Finally, time (busy schedules, deadlines, unexpected tasks), permission to attend from supervisors, and a self-employed status, so being on 'price work' were recognised barriers to participation (n=10). A mature worker, who attended all 6 sessions, recognised that benefits outweigh the money lost when attendings the intervention.

> *"We are all self-employed so we will be losing money but in the end it all depends how much you take care of yourself and your health. I think we can all sacrifice some money to do it, it is only once a month so not a bit ask. If you are to go to GP you will be losing time too, even more probably" (Worker 6)*

During the interviews, participants also discussed potential barriers and facilitators to the intervention roll out, i.e., aspects that could prevent and encourage participation on different sites. While the theme of 'a potential roll-out' was discussed in the 'satisfaction' section of this chapter, findings relating to the barriers and facilitators to roll out are analysed below, with regards to it potentially limiting or improving the reach of future interventions.

Limited space on sites (especially in central London) (n=4), facilities on site and the availability of canteens, which could provide the right environment for the intervention and use staff working there (n=4), as well the transient character of jobs (n=5) and previously discussed time pressures on construction sites (n=5), were context-related issues mentioned in relation to a roll out.

"If they've got their own canteens, it would probably be an easier thing to do, because you could hold it in a canteen, and you can have the canteen people that are making food and, uh, and do your demonstrations there and then" (Manager 2)

"If the project views under a bit of pressure and needing to work additional hours, they are less likely to entertain an intervention like this" (Manager 1)

A different attitude was presented by one of the managers, who highlighted that time is an excuse that *"gets used constantly for everything",* calling it *"the best excuse for everything in construction".* This was one of the managers who supported the intervention from the onset.

Another theme that arose from the interviews was around the support for the intervention. Three sub-themes of management (including 'mandatory' characters of the intervention), supply chain (sub-contractors) and peer influence were raised (see Table 7.3).

Management support was considered essential for intervention roll out (n=11), however, it was suggested that different sites (even within the same company) had varied levels of interest and commitment to workforce health and wellbeing. Some participants highlighted that the project leaders' attitude towards health, being collaborative and looking after the teams, as well as their personal interest in fitness or nutrition might be essential factors in obtaining the right support for the intervention roll out. The age of managers was mentioned, with younger managers more willing to embrace health initiatives.

"I think if you just rocked up tomorrow or Monday, on the rest of the 11 jobs, I think you'd probably find it would be harder to get engaged and the levels we did, in comparison" (Manager 5)

"We kind of have it with sustainability, health and safety, the older generation have done it for 30 years like that so why do they have to change it" (Manager 1)

Additionally, 'selling' the health intervention to company directors was discussed. If the intervention is supported by executive leaders, the site management teams and others on site (e.g., sub-contractors) "*will have no choice*" but to take part it, making the intervention "*mandatory".* However, one worker highlighted that the cost of workers staying away from their jobs for the time of the intervention would need to be covered by the company. The idea of a compulsory health intervention was further discussed in relation to including it in the project /work schedule from the onset. This would allow all of those on site (managers, supervisors, suppliers, workers) to be aware that the intervention was an integral part of the project and eradicate multiple context related barriers. The idea was compared to compulsory safety trainings.

> *"This could somehow be written within the work schedule, that once a month on this day there is this half hour that every single worker has to be allowed this half an hour. If they come or not, then that's their personal choice, but then it removes this uncertainty of will my supervisor allow me or not, or it's the time or it's busy" (Worker 1)*

Support from suppliers (sub-contractors) was also discussed, with a need for them to be informed and often persuaded about the benefits of the intervention and that a collaboration with them is essential to the intervention engagement (n=4). However, some issues were highlighted: (i) companies often work simultaneously on multiple projects, resulting in their workforce being spread across different sites, which can make the coordination of an intervention challenging, (ii) on a large project, engagement with all sub-contracting companies might not be possible due to their high numbers and a short work duration.

Lastly, peer influence was discussed (n=5). Suggestions on early identification and communication with "*champions*", who could serve as role-models and advocates for the intervention were provided. It was suggested that official health peer supporters (e.g. Wellbeing Champions), similar to those dedicated to safety, should be available on every project.

> *"It kind of needs on-site a person who will take some form of championship for that site…. Because there is no real person who is such devoted by default… about health" (Worker 2)*

7.5.6. Recruitment

This section evaluates the procedures used to approach and attract participants, both at an organisational and individual level, and includes barriers and facilitators to recruitment. The recruitment protocol, interviews and researcher's notes provided the data analysed in this section.

7.5.6.1. Organisational recruitment: barriers and facilitators

The recruitment of construction organisations to take part in the research project started in August 2019. Through industry contacts of the advisor on the PhD, two construction companies were approached ('H' and 'W'). While both companies expressed initial interest and requested more information, neither agreed to take part (see details Figure 7.4).

Following that, research was conducted to identify the biggest construction companies, which advertised health and wellbeing initiatives they were involved in (e.g. through websites, press releases, case studies). Four companies and their relevant health and wellbeing contacts (e.g. Head of Health and Wellbeing, Occupational Health Director) were identified and approached. Although all four companies initially expressed a desire to partake, only two businesses identified suitable sites, gained commitment from the site project teams, and eventually, took part in the focus groups (site 'A' and 'B') (see details Figure 7.4). Having ensured the commitment from two organisations, the researcher used a private network of industry contacts and succeeded in attracting an interest of one more construction company, which following exploratory calls and a site visit, also participated in focus groups (site 'C').

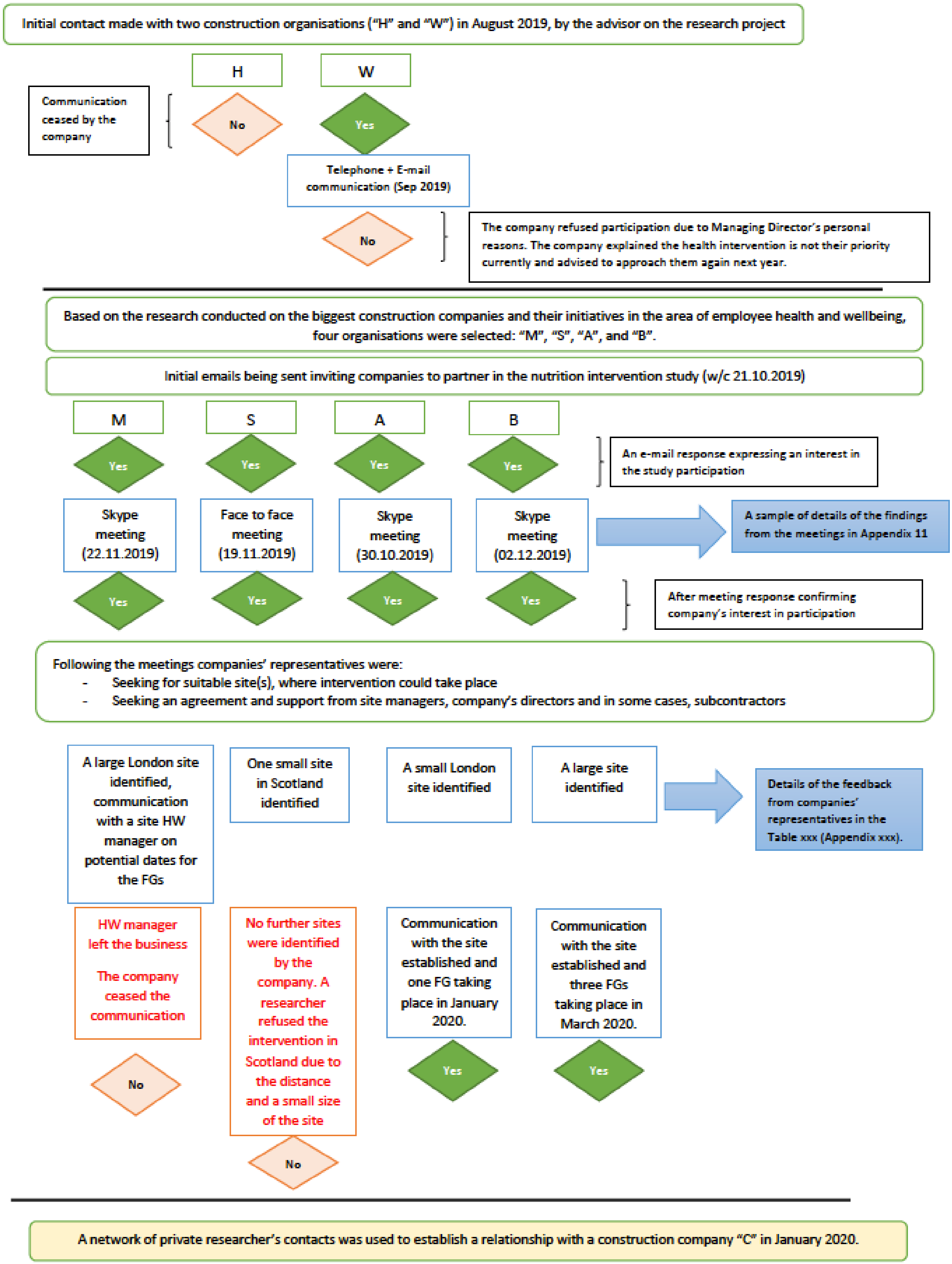

Figure 7.4. Flowchart on establishing relationship with construction companies (and site) leading to the participation in focus groups

As previously explained (see ‘Fidelity’ section), none of the organisations that took part in the focus groups, wished to continue with the intervention following Covid-19 lockdowns. Therefore, the researcher approached a different site, using a private contact to a construction company’s client (site ‘I’). After an initial communication and a site visit, the company decided to take part in the intervention, which commenced in September 2020.

During interviews, participants discussed organisational motivation to take part in the intervention (n=5), and reasons included: an intervention being considered beneficial for the workforce and their health (n=4) and adding value to the business (n=2). One participant reported that because the initial contact was made through a client, this provided additional motivation to implement the intervention. This was one of the main decision makers on the site, whose agreement was crucial for the intervention to take place.

> *“It wasn't like we went out to market to find it. It was more the other way around” (Manager 3)*

7.5.6.2. Barriers and facilitators to organisational recruitment

A theme related to organisational recruitment was identified and is discussed in this section, focusing on difficulty in gaining commitment from project site teams and the context of the industry (e.g. temporary character of sites, sub-contractors, character of site).

Firstly, although senior leaders in health and wellbeing were initially approached, they struggled to gain commitment from the project site teams. All companies were large construction management businesses, running dozens of sites across the UK (see details Figure 7.4). This suggests that not having a site leader willing to participate in the health and wellbeing intervention and show their commitment to supporting the workforce health, was a significant barrier to organisational recruitment. Also, individuals approached as representatives of the companies (i.e. Head of Health and Wellbeing, Wellbeing Directors, Health Leads, Occupational Health Directors) did not have the authority to insist on the health intervention implementation on individual sites. Instead, companies’ representatives were seeking agreement and support from the site management teams. For example, during the initial communication, the company ‘T’ discussed nutrition being a part of the health and wellbeing company strategy, and that the business was looking into commercial offering on diet-related programmes. However, the representative (i.e. Head of Health and Wellbeing) managed to secure the commitment from only one site, with 12 workers. In London alone, the company runs nearly 30 sites (see Figure 7.4 and Appendix 11 for details).

In the context of the above discussion, it is important to mention that the site which eventually took part in the nutrition intervention ('I') was approached from the project management team level, rather than company's senior health and wellbeing representative. During the process where site managers gained the company approval for the intervention to take place, the research team was not asked for any additional communication to be established with the company senior leaders. This suggests that in order to recruit construction companies, it might be more effective to approach individual sites and their project management team, rather than company's health and wellbeing senior leaders.

Additionally, recruitment barriers, which were mentioned by companies' representatives included the character of a site, for example, rail, sewage tunnels or airport sites, which would require special permission (and often a safety training) to access, which might be difficult and time consuming. Furthermore, the length of the intervention and relationships with supply chain (sub-contractors) were emphasised. Most of the projects were shorter than 6 months, therefore, not suitable for the intervention and in many instances, sites were dominated by sub-contracting companies, where agreement would be required for the intervention to take place. Furthermore, companies felt that with multiple sub-contractors, it might be challenging to impose workers' participation in the intervention. Finally, the size of the construction companies posed a barrier to organisational recruitment, with one company describing themselves as a *"bureaucratic monster",* with any interventions requiring multiple signoffs (see Appendix 11 for details).

7.5.6.3. Individual participant' recruitment (including barriers and facilitators)

Individual participants were approached and invited to take part in the intervention using several methods: (i) a toolbox talk was delivered on site to the workforce explaining the intervention and inviting the attendance, (ii) the organisation was asked to email the workforce information about the intervention, (iii) posters about the nutrition intervention were displayed in the premises (in the canteen, a kitchen, on notice boards, in rest area, in changing rooms and toilets) inviting employees to sign up to the programme, (iv) through managers, supervisors and other workers on site, who spoke about the intervention and encouraged their peers to take part.

Results from interviewees allowed a theme related to individual recruitment to be established, which covered peer recommendations, poster advertising, and personal motivation. Peer recommendation was the most common way of recruitment, with participants, both managers and workers (n=10), highlighting that they learnt about the intervention from others on site. A name of a manager, who offered the support in bringing the intervention on site, was mentioned the most frequently.

> *"[name] did send an email, I think, or put flyers up that said to everyone there was … Magda is coming, the health and nutritionist, do you want to sign yourself up for an hour in your diary in the day?" (Worker 3)*

However, the site manager involved in the implementation, stated that they had a "*scattergun approach*" to the recruitment, trying to encourage high attendance (which "*seemed like a win*"), but instead, should focus on workers who have "*a longevity on a project*", so are expected to work on site for longer.

Following that, poster advertising (n=3) was discussed as a recruitment method, with some participants commenting that the intervention was well advertised, and posters clearly stated the offering, while others suggesting more should be displayed on site.

Finally, all participants discussed their personal reasons for joining the intervention, and these included personal interest in nutrition and health (n=7), the desire to lose weight or get in shape (n=5), poor health related to work in construction (n=2), not feeling well, being tired or lethargic (n=2) and the intervention being free (n=1).

> *"Because I didn't feel well. That was my main motivator. You know, as I said, there were days where I felt really lethargic. And, you know, like towards the end of the week I was absolutely knackered …" (Worker 2)*

7.5.7. Context, as a barrier / facilitator

Context was considered in relation to the aspects of the environment (social, physical, organisational) that influenced the implementation of the intervention or the outcomes; conditions that potentially affected the change mechanisms. Most of themes related to the context of the construction industry were previously discussed in different sections of this evaluation (see Table 7.3). However, three new, not previously mentioned themes, form the discussion in this section: company leadership, the health and safety culture on the site and a changing industry.

Participants discussed that while company senior leaders ("*head office level")* might be supportive towards individual sites running health and wellbeing initiatives, such as a nutrition intervention, there was no real drive from senior leaders, and it is at the discretion of site teams to implement health and wellbeing solutions (n=8). This might lead to individual sites not understanding and following the overachieving health and wellbeing strategy of the company, lacking time and financial resources for health initiatives, as well as knowledge and support from health and wellbeing professionals needed to effectively implement interventions, which can support the workforce.

> *"I genuinely believe, and it's a negative on [company name], that it's on us to do it and if we didn't do it, no one would ask the question… nothing is done, it's all words" (Manager 7)*

The health and safety culture on the site was discussed, with the site management being recognised as proactive and caring when it comes down to the health, wellbeing and safety of the workforce (n=11). The site had been at the top of the Health and Safety League for nearly a year, gained a 'Considerate Constructors' accreditation and had been the best performing project in the region for the last 7 months. Young age of the leads on sites (i.e. 32, 33, 43), who try to work differently and change the way the construction industry is perceived, was considered as a potential reason for the success.

> *"So since January 2021, up till July of this year we've been top out of the 12 projects. And on July they actually decided to start it into the whole of the UK. And crazy to say we actually topped the whole of the UK out of 84 jobs" (Manager 1)*

Additionally, participants highlighted other interventions that were taking place on the site (n=6), including mental health initiatives, charity events donating food to foodbanks, a multilingual library, health check-ups, and a Christmas dinner for everybody on site. Furthermore, the site participated previously in a research project on the subject of 'modern slavery', and was planning on supporting research focusing on healthy performance. Finally, the site workforce was asked to set their own personal health and wellbeing objectives during annual progress review meetings.

Lastly, a changing industry was discussed by the interview participants (n=3), who reported a slowly growing awareness of the importance of the workforce health and wellbeing. Over the years, construction has developed a strong safety culture, and now *"health now needs to catch up".* Furthermore, the Covid-19 pandemic "*changed the mentality of the industry"* and imposed more flexibility and work-life balance to be offered to the workforce and a new generation of leaders is expected to bring positive changes.

> *"There's still an awful lot of gorillas and grizzly bears still in the industry and they are getting weeded out for retirement … the transition of younger people that have had a different upbringing in the industry, will be a lot more receptive to the wider issues" (Manager 3)*

7.6. Summary of the main findings from the process evaluation

1. The intervention had moderate fidelity. Modifications to the intervention plan included: a number of sites taking part, recruitment procedures, promotion methods, the length of the intervention, mode of delivery, activities delivered during the intervention days, length of sessions, and the extend of physical environment assessment. Changes made to the original intervention plan were due to Covid-19 restrictions, time constraints and a limited space on site.

2. A break in the intervention delivery (4 months), due to Covid-19, negatively affected intervention completion rates and outcomes.

3. Approximately 92% of planned intervention components were delivered, with practical activities (67%) and presentations (83%) delivered least. When looking at the planned content, the least delivered was content on meal planning, nutrition and energy, as well as different types of diet.

4. In total, 51 participants took part in the intervention; the average attendance was 2.45 day per person, dose received 41%. Of 51, 22 completed it, with the average attendance amongst those who completed it at 3.95 day per person, giving a dose received of 66%.

5. Incorporation of the context of the industry and workforce characteristics (e.g. flexible delivery considering busy schedules, monthly frequency, relatable and relevant nutrition education, practicality of advice, using small groups, fun, relaxed atmosphere, welcoming facilitator, non-judgmental approach, using masculine characteristics in BCT, peer influence) in the intervention design supported the engagement.

6. Overall satisfaction with the intervention, which prompted new health and wellbeing initiatives, was reported to challenge stigma around men's health and helped the site management team to focus on health in a similar way to safety.

7. Following the intervention, there is an initial commitment from the company to roll out the intervention to a large site in late 2022.

8. Two major improvement suggestions were included: using a different space than an office on site to deliver an intervention and translating posters and presentations to multiple languages.

9. Overall, the intervention reached 49% of the workforce, however, the monthly average reach was 20%.

10. Fear, ignorance, shyness, language barriers and recent health checks recognised as personal barriers to participation, while stigma around health, permission to attend and self-employed status were documented as main barriers to participation related to the context of the construction industry.

11. Integration of efforts between senior leaders (executives), site management, peer supporters and sub-contractors is essential in supporting health and wellbeing of the workforce and offering interventions on site.

12. Difficulties in organisational recruitment, despite widespread marketing efforts, promoting companies as being committed to the workforce health and wellbeing were encountered. Approaching individual sites, rather than companies' senior health and wellbeing representatives might be a more effective way of recruiting construction companies to take part in health and wellbeing interventions.

13. Peers and managers recommendations ('snowball effect') were considered the most effective way to recruit participants and promote the intervention.

14. There was a lack of health and wellbeing initiatives driven from the company senior leaders (executives). Sites are left on their own to decide if they want to support health and wellbeing of the workforce, and how to plan and implement interventions, but a lack of experience and knowledge on how to do it successfully might be a barrier.

15. The culture on site as well as personality, attitude, commitment (and potentially age) of site management teams determined health and wellbeing initiatives offered to the workforce.

Chapter Eight – Discussion and conclusions

8.1. Introduction to discussion

This study was carried out in three phases. Firstly, the exploratory phase comprised a literature review exploring the influence of work on nutrition behaviours, health and wellbeing of blue-collar workers and the effectiveness of workplace nutrition interventions. This phase also included conducting focus groups to explore perceptions of nutrition behaviours, barriers and facilitators to healthy nutrition choices, current health strategies in the chosen organisations and views on what the nutrition intervention to be developed, should include. The second phase used a questionnaire, developed in line with the findings from the first phase, to explore nutrition knowledge, behaviours, health and wellbeing scores and weight-related measures amongst construction workers at baseline. This phase also sought to design an intervention to be delivered on a working construction site. The third, and last phase, was an outcome and process evaluation. This phase looked at changes following the intervention and sought to identify if the intervention was delivered as planned, what worked well, what did not and in what context, the barriers and facilitators to implementation and participation, and whether they intervention was acceptable to the target population.

As the results from each stage of the research have been presented in their respective chapters, this chapter aims to provide a discussion of the main findings from each stage before conclusions are outlined.

8.2. Discussion of the main findings from the study

8.2.1. Discussion of the focus group results

The aim of focus groups was to explore the perceptions of construction workers and managers on their current nutrition related practice, and barriers and facilitators to healthy dietary choices in the workplace. The focus groups were also used to explore how to design a nutrition intervention for the workers that took account of their needs, characteristics, and the context of the industry. This section examines the main findings from focus groups in relation to the literature and discusses the implications for the nutrition intervention design.

The findings from this study are consistent with, and further expand on, the limited body of evidence on nutrition practices amongst construction workers. Workers reported high intakes of processed, high calorie and high sugar foods as previously reported (Men’s Health Forum (MHF), 2009) as well as high intakes of caffeinated drinks and low fruit and vegetable consumption, which are new findings of this study. In previous research, workers described food as a release from work stress, a form of ‘escape’ (Devine et al., 2009), often leading to the consumption of energy-dense comfort foods (Nobrega et al., 2016), although in this study, eating to sustain energy to fulfill physically demanding jobs was the primary motivation behind this consumption pattern. A relationship between energy, nutrition and safety at work has previously been established, suggesting that accidents might be at least partly attributed to an unhealthy diet resulting in feeling weak, indisposition or hypoglycaemia (Bates & Schneider, 2008; Meliá & Becerril, 2009). This indicates that, as suggested by Steyn et al's. (2009) systematic review, a workplace intervention should target the needs of workers and therefore, provide education on the relationship between diet, energy and concentration. However, it is worth noting that educational approaches, alone or in combination with multi-component interventions or environmental modifications, have previously shown moderate, but consistent effectiveness on dietary behaviour changes in systematic reviews (Ni Mhurchu et al., 2010; Maes et al., 2012; Geaney et al., 2013).

Findings from this study and that of others showed that work-related factors, including job demands, break times and physical environments impact the nutrition choices of blue collar workers (Loudoun & Townsend, 2017) by restricting access to food outlets (Mazzola et al., 2017; Nea et al., 2017), provision of insufficient welfare, food preparation and storage facilities (Nobrega et al., 2016; Okoro et al., 2017), limited time and personal resources to buy, prepare or even plan food (Devine et al., 2003; Thomas et al., 2016). Given the vital role of the workplace environment in assisting workers to adopt and lead healthier lifestyles, environmental changes to facilitate healthy diets have been recognised as elements which can supplement education components of interventions (Meng et al., 2017). A systematic review by Allan et al. (2017) highlighted that environmental changes can supplement and provide advantages over individually targeted interventions, as they work via automatic or non-conscious processes. However, Schliemann & Woodside (2019), in a systematic review of 21 systematic reviews, found that research on environmental changes is often carried out in workplace canteens, therefore, evidence is limited to interventions conducted in bigger organisations. In construction, including the sites that took part in this study, there is limited space, and the majority of sites are temporary, operating only for weeks or months (Burki, 2018; Oswald & Turner, 2017), which restricts the practicality and cost-effectiveness of implementing catering solutions. While some large sites offer canteens, workers usually stay in one place for a limited time and are not guaranteed to move to a location with similar facilities (Eaves et al., 2016; Sherratt, 2018). In this study, although one of the sites was large, it did not offer canteen facilities, therefore, workers, in the interest of their health, need to be offered interventions focusing on their capabilities and motivation to make healthier food choices regardless of environmental constraints. Additionally, simply providing more nutritious foods might be insufficient in facilitating behaviour change, as the food choice must be preceded by an intention to change (e.g. behaviour change and educational activities) (Almeida et al., 2014; Thomas et al., 2016).

The findings from this study and that of others (Eaves et al., 2016; Nea et al., 2017) show that amongst a construction workforce, there is a growing interest in health and in receiving feedback and advice from health professionals. Workers were also found to be motivated to learn how to plan meals and establish healthy habits and routines, which should encourage employers to invest in on site health initiatives. However, to support the engagement, improve the effectiveness, and ensure that interventions are not a lost opportunity, both findings from this study and the literature indicate that those responsible for the intervention design need to consider the convenience of locations and flexible modes of delivery (Brown et al., 2018; Demou et al., 2018), and to enable the intervention to be accessed by all workers (including sub-contractors and part-time workers). In addition, interventions should be mindful of social connections, as food choices are often made to gain and solidify social identity (Mazzola et al., 2017), and individuals can be peer-pressured into healthy or unhealthy behaviours (Okoro et al., 2017). Multiple studies (Kilpatrick et al., 2017; Payne et al., 2018; Smith et al., 2017), including a systematic review of Demou et al. (2018), found the importance of using peer support and group based activities in workplace health interventions. In construction, this approach could provide support in integrating workers and managers working on site, and reduce, ethnic and occupational groups divisions (found in this study), with the latter also previously reported in the literature (Naweed et al., 2017; Wandel & Roos, 2005). In addition, sharing experiences, colleagues motivating each other, the introduction of champions, and a ‘no judgment’ approach (especially in ‘macho cultures’) have been found to lead to a higher engagement and better intervention results (Demou et al., 2018; Kilpatrick et al., 2017; Payne et al., 2018). The ‘no judgment’ approach is an interesting finding, in light of the previously mentioned peer-pressure, and the results of this study. Findings from the exploratory focus groups showed that some workers felt hassled and judged when using kitchen facilities and pressured to consume sweet and unhealthy foods, highlighting the importance of addressing the organisational culture to improve the health of workers.

In construction, issues of poor mental health have become a top priority (Burki, 2018), and therefore, it is unsurprising that this study found mental health initiatives, including the Mental Health First Aider (MHFA) being frequently implemented. However, in the exploratory focus groups in this study participants criticised this initiative for not providing them with confidence in aiders’ competency or trust in the confidentiality of the scheme and suggested having mental health support provided by a third-party company. Although these types of initiatives have been widely used in the construction industry, including in ‘All Safe Minds’ or ‘Mates in Mind’ campaigns (Janusonyte et al., 2019), the effectiveness of MHFA has been mainly evaluated in white-collar industries, with the exception of one study commissioned by the Institution of Occupational Safety and Health (IOSH) (Narayanasamy et al., 2018). Results showed that while some of the expectations of MHFA training were achieved, for example increased understanding of mental health issues or conversations about mental health, positive changes could not be confidently attributed to MHFA. These findings were in line with results published by the HSE, which included reviewing evidence from 22 studies on the effectiveness of MHFA. Results suggested that an MHFA training initiative can raise awareness of mental illnesses, although no evidence was found that the introduction of MHFA in the workplace improved the management of ill-health (Bell et al., 2018). Both studies agreed that the evidence of MHFA improving the organisational outcomes (e.g. stress or anxiety-related sickness absence) is anecdotal and that the content of MHFA training should be tailored to the industry specific challenges and men’s mental health (Bell et al., 2018; Narayanasamy et al., 2018).

The importance of tailoring workplace interventions to the needs of the target population was highlighted in findings from this study. Although sport and exercise initiatives on construction sites are frequently offered and can be effective, as highlighted in two reviews (Carmichael et al., 2014; Steyn et al., 2009), job demands and time pressures limit the opportunity for workers to take part. Furthermore, the present study showed that some workers do not partake as these initiatives require overly high levels of fitness and are not designed for everybody. In this research, other initiatives were also found to be provided for selected parts of the workforce.

For example, on one site fresh fruit was only available in the main cabin, meaning that just managers benefitted from it, with site workers not even aware of this opportunity, while a 'Cycle to Work' scheme was only available to those employed by the company, even though 80% of people working on site were self-employed. This carries the potential to exacerbate occupational health divisions, which have been previously found by others in the blue-collar workplaces (Naweed et al., 2017; Wandel & Roos, 2005).

Earlier research highlighted that subcontractors should not only be allowed access to health interventions on site, but also be included in their planning and developing (i.e. participatory approach) (Carmichael et al., 2014; Loudoun & Townsend, 2017). However, the literature does not offer practical advice on how this could be achieved, particularly given the presence of many sub-contractors on big construction sites and the short duration of contracts as found in this study. Difficulties in engaging with sub-contractors extend to issues around the communication and promotion of the workplace interventions. Previous studies have advocated using multiple avenues to advertise workplace interventions, including email, staff intranet, and posters in the canteen, to effectively engage the workforce and increase participation (Smith et al., 2017). However, whilst these techniques were adopted in this study, it became apparent that sub-contractors do not receive any direct communication from the main company, with the majority of messages being passed on verbally, through supervisors. This highlights the value of using poster and leaflets over other forms of communication, particularly on sites with large numbers of sub-contractors.

When looking at the intervention delivery, issues around accessibility of the intervention to everybody on site, the convenience of scheduling and location proximity came out strongly in the study results and findings from the literature. For example, a systematic review looking at workplace health interventions in shift workers found location convenience (proximity to the workplace) a key feature in determining intervention success (Demou et al., 2018), while an Australian study, using cross-sectional data from 3228 surveyed employees, found that workplace interventions often use a city-centric or a head-office location, which creates a participation barrier (Kilpatrick et al., 2017). Additionally, the present study found the visibility and accessibility of the intervention important, suggesting activities need to take place in a common, visible area (e.g. staff canteen or a parking area), where everybody can see it and feel invited, and not just in office spaces or board rooms, as workers "*don't like to be called into the office*".

Managers and co-workers can have an influence on the effectiveness of health and wellbeing interventions, with managers either offering health promotion opportunities and encouraging participation, or limiting options, by not allowing time off (Brown et al., 2018; Demou et al., 2018; Payne et al., 2018; Pescud et al., 2015; Quintiliani et al., 2008). These studies also showed that managers are more likely to buy into the health intervention if they think the programme can improve morale, health and reduce injury risk, highlighting the importance of employer education about the benefits of the intervention (Brown et al., 2018; Pescud et al., 2015). In the present study, some workers reported that their managers were either reluctant for them to attend or unaware of their participation, whilst others stated that they were encouraged to take part in health and wellbeing initiatives. This, however, apart from management attitudes towards health and wellbeing, seemed to depend on time pressures on site, with the small site, often closed due to the weather conditions, being the most accommodating in respect of health and wellbeing interventions.

This study explored nutrition practices amongst construction workers and managers, enabling differences between the two groups to be identified. These included an interest in on-site health checks expressed by workers rather than managers. This may well be because employment conditions for managers usually include employee assistance programmes, health insurance, and occupational health services, while workers are frequently self-employed (41% of the construction workforce (HSE, 2018)), with limited access to occupational health services (Burki, 2018; Stocks et al., 2011). Occupational divisions were also found in respect of lunch eating practices, distinct wellbeing initiatives, and in the variety and state of facilities between the cabins of managers and workers, particularly on the large site; a finding not previously reported in the literature. Lastly, some of the comments made by managers related to the eating practices of workers, showing that they were aware of struggles, barriers and poor eating practices amongst the workforce.

8.2.2. Discussion of the baseline questionnaire and body composition results

The aim of conducting baseline questionnaires was to assess pre intervention health, wellbeing, nutrition knowledge and behaviours as well as the body composition of construction workers. This section discusses the main results from the baseline questionnaires and body composition testing (BCT) (conducted on the intervention site) in relation to the existing literature, how they compared to the findings from the exploratory focus groups and the implications of the findings for the design of a nutrition intervention in construction.

Covid-19 impacted on the design and delivery of the intervention as the pandemic caused construction sites to temporary close, led to restrictions on external visitors and social distancing on sites. As a result, all three sites (2 temporary and 1 permanent, A, B, C, see section 4.4, Table 4.2) that took part in the exploratory phase of this research (focus groups) declined to take part in the intervention phase, as they did not consider the intervention to be a priority due to the increased job demands, personnel changes or financial difficulties caused by Covid-19. Therefore, the baseline questionnaire and subsequently the intervention were delivered on a different site to the exploratory focus group sites, which was a temporary (opened for approximately 2 years), medium sized site, with an average of 100 workers, in West London, based on the campus of a large corporation.

The importance of addressing the context of construction and focusing on the needs of individual workplaces and employees have been previously discussed in this study and by others (Carmichael et al., 2014; Hanna & Markham, 2019; Lassen et al., 2018; Viester et al., 2012) to ensure the intervention is relevant, appropriate and effective. Therefore, as the baseline questionnaires were conducted on a different construction site to the focus groups, and six months later, it is important to explore the differences in findings, which demonstrate that even within the same industry and country, the practices and behaviours of construction workers might vary. For example, the exploratory focus groups and previous studies (Devine et al., 2003; Nea et al., 2017; Pridgeon & Whitehead, 2013; Wandel & Roos, 2005) indicated that construction workers skip meals due to busy schedules and work pressures, however, the baseline questionnaire findings of this study indicated that breakfast was the only meal participants sometimes skipped, with 63% reporting having it regularly. Similarly, snacking was reported in the focus groups and other studies (Bonnell et al., 2017; Hemiö et al., 2015; Wirth et al., 2014), but the questionnaire results found 60% declaring snacking on 0-1 days a week. There also seemed to be differences in the type and the number of reported drinks. There was no previous discussion in the literature on coffee and tea intake, but participants in the focus groups reported that some individuals have more than 6 cups of coffee a day to sustain energy required for work, however, when baseline questionnaires were conducted, the mean score for coffee was around 2 cups, and 1.2 cups for tea. Similarly, workers who filled in the questionnaires did not seem to be drinking sweet and energy drinks in excess (mean - 0.9 and

0.4 glass, respectively). However, the literature (Bonnell et al., 2017; Hemiö et al., 2015; Naweed et al., 2017) and 2 focus groups reported a high intake. Finally, socialising at meals and food preparation at work were discussed in the focus groups, but were not confirmed by the questionnaire results, with 57% declaring they never prepare food at work. These differences might be due to the intervention taking place during a pandemic, which restricted socialising and movement on site as well as different make up of participants on the focus group and intervention site, or could be due to different data collection methods.

Site location, availability of food outlets and the proportion of workforce living locally provides important contextual characteristics to be considered when designing an intervention. Results from the baseline questionnaire, carried out at the intervention construction site indicated that nearly 70% of respondents reported a limited choice of food outlets, take-aways and cafes. This had also been reported in the exploratory focus groups and previously discussed in the literature (French et al., 2007; Mazzola et al., 2017; Nea et al., 2017; Pridgeon & Whitehead, 2013; Wandel & Roos, 2005). One of the reasons for this was that sites often cover large areas, and the distance to food outlets as well as security checks undertaken at every entry to the site, make accessing external food outlets challenging. In the temporary intervention site, 77% of respondents lived at home, which was different to the makeup of participants from the exploratory focus groups from the two temporary sites, which comprised more workers who travelled to work, rather than living locally. This might be partly due to changes in the industry and more construction businesses employing locally (Workers of England Union, 2022), which is also sometimes written in the contracts of construction companies bidding for building work (Macfarlane, 2000).

In the UK in 2020, it was estimated that the proportion of the construction workforce represented by non-UK born workers was 13.4%, although regional variations were evident, with half of workers in London being born outside the UK (Construction Industry Training Board, 2021). It is not uncommon for migrant workers to be underrepresented in health promotion interventions, as they might be lacking an interest or a confidence to take part, especially if language is a barrier (Burki, 2018; Stocks et al., 2011). However, in this study, 49% of those taking part in the intervention were British, indicating that the other half were non-British and nearly 67% declared English being their first language, suggesting the intervention sample was similar to the target population.

The baseline questionnaires completed on the intervention site found lower wellbeing and higher anxiety scores amongst construction workers when compared with published ONS results from the same period (ONS, 2021). This is of concern given findings from the recently published Chartered Institute of Building (CIOB) report, which showed that 26% of construction workers considered taking their own lives in 2019, while 97% reported stress related to work factors, e.g. intense workloads, financial problems and poor work-life balance (Rees-Evans, 2020). In addition, Mates in Mind charity (2021) suggested construction workers are hard to reach and reluctant to talk about their health due to continuing stigma, which worsens their health and wellbeing even further. A recent report commissioned by the charity found that 42% of respondents considered quitting construction, while 34% turned to drinking alcohol in response to low mood experienced due to work pressures (Bevan et al., 2022). At the same time, only 18% sought GP help, and 13% received therapy (Bevan et al., 2022).

Excessive alcohol consumption has previously been reported as a big concern in the construction industry, with potentially harmful implications to health, social behaviours, and safety in the workplace (Oswald & Turner, 2017). The Considerate Construction Scheme (CCS) (2016) survey reported that 59% of construction workers agreed that the industry had a drug and alcohol issue, 35% noticed their colleagues under the influence of drugs and alcohol, and 25% agreed that drugs or alcohol affected them at work through tiredness. In this study, the baseline intervention questionnaire indicated that 96% of respondents reported drinking alcohol with a mean score of 29 units of alcohol per week; 15 units higher than the recommended intake, and 8 units higher than the average weekly consumption in England of the demographic group with the highest recorded intake - men aged between 65-74 (i.e. 20.9 units) (Statista, 2019). The differences in the alcohol consumption between construction workers and similar demographic groups might be due to the workplace culture and social norms, which also influence alcohol consumption behaviours, and specifically in the construction industry where masculine norms may foster a climate of alcohol accessibility and acceptance (Roche et al., 2020) and where men are less likely to seek help for health issues as well as demonstrating more stoicism in the face of ill-health or pain (Hanna et al., 2020; Mahalik et al., 2007). Therefore, workplace interventions, next to information provision and education on alcohol, need to address the wider context of the construction culture, use peer support (Roche et al., 2020) and rules around engaging men in health promotion (Carroll et al., 2014; Lefkowich et al., 2017; MHF, 2018).

A mismatch between nutrition knowledge and behaviour amongst construction workers has been previously recognised by other authors (Du Plessis et al., 2013; Okoro et al., 2015a), who suggested that while some workers might know the basics about healthy eating, this is not reflected in their eating behaviour, given the influence of other factors, such as economic constraints and personal preferences (Okoro et al., 2015a). In this study, the nutrition questionnaire was designed to explore whether knowledge translated into behaviour. The results showed that this was not always the case. For example, even though 49% of respondents knew that potatoes, rice, pasta, and other starchy carbohydrates should make up a third of a daily intake, only 27% reported following this recommendation, with nearly 60% declaring that starchy carbohydrates accounted for half of their intake. Similarly, although over 76% knew the recommended daily portions of fruit and vegetables (i.e. 5 or more), over 50% consumed 4 portions or less a day. The issues around fruit and vegetables consumption were also previously highlighted, with focus group participants reporting that the two main barriers to their consumption were the perception that they did not provide sustainable energy, and the difficultly in preparation given their temporary accommodation, and hence a lack of kitchen facilities. In addition, other studies have reported that a higher income was associated with increased fruit and vegetable consumption (Nagler et al., 2013). This supports an agreement amongst studies that interventions increasing nutrition knowledge alone might not be effective in changing behaviours, and should be combined with behavioural approaches, like coaching, to explore barriers to behaviour change, and therefore, maximise chances for better outcomes (Maes et al., 2012; Rachmah et al., 2022). This is supported by the assumption of the COM-B model, which was used in the design of this intervention, stating that a successful behaviour change requires transformation in one or more of the interacting components: capability (e.g. knowledge), opportunity (e.g. access to food outlets, social support) and motivation to perform a new behaviour (Atkins & Michie, 2013).

The ability to use food labels can be an important skill for construction workers, who often move between sites, cannot rely on one source of food provision, and therefore, need to be able to navigate nutrition information on labels to look for healthier options. However, neither knowledge nor behaviours around reading food labels have been previously explored by studies conducted in construction. In this study, 59% reported that traffic lights labels affected their food choices ‘a little’ or ‘a lot’, and using information on individual nutrients on labels (e.g. protein, fat, carbohydrates) was declared by 78%, and while the meaning of the colour red on labels was understood by over 86% of respondents, only 31% knew the rules around the order of ingredients. This finding is unsurprising considering the results of a survey carried out from 2003 to 2017 in Britain, which estimated that 53% of adults find it difficult to understand food labelling (Statista, 2022b). However, the desire to learn more about using labels was highlighted in the exploratory focus groups, with participants suggesting this should form a component of the intervention. The importance of reading and understanding food labels was also demonstrated by a review published by the Food Standard Agency, which highlighted that 80% of purchased food items are pre-packed (Osman & Jenkins, 2021). Education on food labels has previously shown some promising results. For example, a systematic review looking at the effects of education on understanding and using nutrition labels, highlighted that it may improve diet (Moore et al., 2018), while a meta-analysis exploring effects of using food labels on dietary behaviours found decreased intake intakes of energy by 6.6%, total fat by 10.6%, and other unhealthy dietary options by 13.0%, while increasing vegetable consumption by 13.5% (Shangguan et al., 2019). This suggests incorporating training on how to read food labels as a part of the nutrition intervention might be effective in improving nutrition behaviours.

A high consumption of processed food, ready-meals, take-aways and eating out has previously been reported by literature (Escoto et al., 2010; Nea et al., 2017; Nobrega et al., 2016; Oswald & Turner, 2017; Zagorsky & Smith, 2017). In this study, the focus group findings were confirmed by the baseline questionnaires, which showed that 76% of participants have take-away meals or eat out at least once a week, and 78% eat a ready-meal at least once a week. This is higher than data from the Food Standard Agency, which reported that 53% eat out and 52% order a take-away once per week or more (Osman & Jenkins, 2021). Previous studies have found that men do not see an issue with a high consumption of ready-meals and a lack of cooking skills was identified as a strong predictor of (Van Der Horst et al., 2011), while time and convenience have been found to be the main driver of a high ready-meal consumption (Ahlgren et al., 2005). Therefore, workplace interventions need to consider the above as barriers to healthy eating, for example, by offering simple recipes and food demonstrations of meals, which are quick and easy to make.

The above discussion points highlight the importance of targeting the intervention to the needs of specific industries and individual workplaces (Carmichael et al., 2014; Du Plessis et al., 2013; Holtermann et al., 2010; Smith et al., 2017), and that a lack of exploration of the context and nutrition behaviours of workers on individual sites might provide a missed opportunity in addressing their needs. In addition, the above shows that addressing a context and multiple behaviours might be an effective way to ensure the relevance of the intervention to the individuals and potentially, encourage the engagement (Hutchinson & Wilson, 2012).

8.2.3. Discussion of the follow-up questionnaire results (outcomes evaluation)

This study aimed to identify the impact of the 6-month nutrition intervention on health, wellbeing, nutrition knowledge and behaviour and body composition measures of construction workers. Results from the questionnaires (n=22) and body composition testing (BCT), pre and post the intervention, were explored. This section examines the main results from the outcome evaluation in relation to other literature and discusses the implications of the findings for future health interventions in construction.

The intervention was delivered on a medium size (having on average 100 workers) construction site in West London. Although it was a temporary site, opened for approximately 2 years, most of workers lived locally and lived at home (approximately 77%). The intervention lasted 6 months, although the Covid-19 restrictions caused a 4-month break in the delivery. In total, 51 participants took part in the intervention and 22 completed it. Although it is the nature of the job that construction workers stay on one site for a limited time, a few weeks to months for example, the high dropout rate in this intervention was exacerbated by the break in the intervention delivery, as most of the workers who originally participated were no longer working on site when the intervention resumed post-lockdown.

The intervention was designed using findings from the literature review, focus groups and baseline questionnaires to ensure its relevance to the target population (i.e. construction workers). It applied the COM-B model and BCW therefore, the process of the intervention design was categorised in three stages, over eight steps. Due to the participatory character of the intervention and differences in nutrition behaviours found between the literature, focus groups and baseline questionnaires, the step of selecting one specific behaviour to focus the intervention on was considered unfeasible in this study. Therefore, the intervention addressed multiple nutrition behaviours, for example, an excessive consumption of high fat, high sugar, processed and convenient meals, skipping meals, snacking, an excessive soft and energy drinks and tea and coffee consumption and others. The intervention used seven intervention functions (education, persuasion, incentivisation, training, environmental restructuring, modelling, enablement) and multiple behaviour change techniques (e.g. problem solving, goal-setting, feedback on behaviour), selected on their likelihood to bring behaviour change. To optimise the delivery of selected behaviour change techniques, each intervention day consisted of six components (i.e. a presentation, a practical activity, food demonstration or tasting, coaching, a quiz or a challenge and BCT, all delivered during each intervention day), with a number of accompanying resources which were developed to support delivery.

In addition to focusing on multiple nutrition behaviours, the intervention used BCT, included monthly weigh-ins and addressed excessive weight, due to higher obesity levels found amongst blue collars and men (French et al., 2007; Queiroz Bortolozo at al., 2016). In the UK almost 7 out of 10 men are overweight or obese (67.2%) (PHE, 2017). In construction, apart from individual health risks, the problem of overweight and obesity has implications for safety at work (HSE, 2016), as obese workers are more likely to encounter difficulties when performing work tasks (HSE, 2016) and to experience injuries (Gu et al., 2016).

Overall, the intervention positively impacted the nutrition knowledge of participants, with statistically significant differences in knowledge scores noted in all four subsections: (i) official dietary recommendations (the EatWell Guide), (ii) nutrient content in foods, (iii) a relationship between diet and health, and (iv) food labelling. This is an important finding in the light of previous research into levels of nutrition knowledge amongst construction workers, which suggested they have little understanding of particular foods, are not aware of their personal intakes (Kenny et al., 2021; MHF, 2009; Viester et al., 2012) nor the benefits of a good diet (Kenny et al., 2021). Furthermore, it has been suggested that educational programmes to increase awareness of the health benefits of a balanced diet and healthy lifestyle, and to elicit behaviour change, should be a part of workplace health promotion in construction (Kenny et al., 2021). Although there are no other studies in construction that have assessed nutrition knowledge following a workplace intervention, a study of this nature of manufacturing workers' in Ireland also showed statistically significant results (Geaney et al., 2016). Additionally, a recent systematic review looking at effectiveness of nutrition interventions in workplace settings reported positive outcomes of increased nutrition knowledge and changing behaviours (Rachmah et al., 2022). An appropriate design, with the consideration of the specific needs of workplaces, together with a participatory approach and the use of a theoretical framework (all used in this research), were suggested as important factors contributing to the success of the interventions increasing nutrition knowledge (Geaney et al., 2016; Rachmah et al., 2022; Robroek et al., 2021).

In relation to changes in nutrition behaviours, the intervention found statistically positive effects on daily consumed vegetable portions, reduced wine intake, increased use of traffic light food labels, reduced ready meals and take-away meal consumption and eating out, reduced sweet snacks, some drinks (i.e. reduced coffee, increased coconut water and kombucha), as well as reduced starchy carbohydrates and increased fruit and vegetables comprising part of a daily diet. However, no significant effects were found for daily fruit portions, vegetables and fruit combined, units of alcohol, beer and liquor consumption, meals cooked fresh or raw ingredients and pre-prepared ingredients, salty snacks and some drinks (i.e. water, juice, tea, energy and soft drinks). Other studies in construction, and amongst blue-collar workers (e.g. Fitzgerald et al., 2019; Groeneveld et al., 2011; Viester et al., 2018), used a number of different measures to assess nutrition behaviour, and therefore it is difficult to make a direct comparison between the findings. Where possible, however, similarities and differences between results will be made in this section.

Changes in fruit and vegetable consumption are a useful way to measure the effectiveness of nutrition interventions aimed at changing behaviours amongst construction workers. For example, the 'Health under Construction' study in Netherlands found increased intake of fruits at 6 months (from 10.1 to 11.8 pieces a week), although not sustained at 12 months (Groeneveld et al., 2011), while a 3-month intervention in North America reported a 11% increase in a number of workers consuming at least five portions of fruits and vegetables a day) (Hunt et al., 2010). A study in the USA also measured consumed portions of fruit and vegetables amongst construction workers and found a one portion increase in the intervention group (from 5 to 6 portions at 6 month) (Sorensen et al., 2007). Viester et al. (2018) in 'VIP in Construction' study found no significant differences in fruit and vegetable consumption following the intervention. In this study, statistically significant changes were reported in daily portions of consumed vegetables, but not fruit after the intervention. This might be due to the benefits of vegetable consumption being discussed in many components of the intervention, including presentations on their benefits, coaching sessions, and a 'vegetable challenge', asking participants to record weekly consumed vegetables according to their colour. A previous systematic review showed that nutrition education and a multi-component design (Geaney et al., 2013) as well as a behavioural component, like coaching (Panchbhaya et al., 2022) had a positive effect on dietary behaviour, in particular regarding increased fruit and vegetable consumption. However, changes in vegetable consumption in this study were rather modest, which previous studies had also shown, and might be due to the low income of construction workers, with a higher income being linked to an increased consumption (Hunt et al., 2010; Nagler et al., 2013).

Sweet drink consumption and snacking were common behaviours addressed in previous construction studies, with mixed results. Viester et al. (2018) evaluated the effectiveness of 'VIP in Construction' intervention on a number of consumed beverages (including alcohol), snacks and fruit and vegetables, and statistical significance was only found for the reduction in sweet beverages (i.e. soft and energy drinks, fruit juice and sweetened tea and coffee). The authors explained that decreased differences between an intervention and a control group could have been the result of contamination of the control group, as changed dietary behaviours of workers might have affected other peers (Viester et al., 2018). A different study amongst blue-collar workers also found a significant decrease in sugary drink consumption following the intervention (Sorensen et al., 2010). However, in the present study, although soft, energy drinks and juice consumption showed a positive trend, significant changes were only reported for reduced coffee and increased coconut water and kombucha intakes. Both latter drinks were introduced as a part of the tasting sessions during the intervention. Although the effects of this intervention on sugary drinks are not as promising as that of others, the baseline results for this behaviour were low in comparison with the previous literature. For example, the mean of daily sugary drink consumption at baseline was 6.4 glasses in a study of Viester et al. (2018), while in this research the combined mean consumption of all drinks containing sugar was 2.6 glasses. In addition, authors of other studies found significant beneficial effects of the health and nutrition interventions on reducing snacks (Groeneveld et al., 2011; Sorensen et al., 2010), which in the case of Groeneveld et al. (2011) was sustained at 12 month follow-up. This study showed a significant reduction in the consumption of sweet, but not in salty snacks, which was recognised as a favourable outcome of the intervention during the interviews conducted as a part of the evaluation. Overall, results from the focus groups conducted as a part of this study (see chapter four), as well as previous research (Nea et al., 2017), found snacking to be a popular behaviour in blue collars, especially in the absence of other food options. In addition, the way snacks are labelled was recognised as an important indicator of the purchasing decision (Martinez, 2020), suggesting that construction companies need to evaluate options in vending machines suppliers, to ensure snacks and drinks are healthy, and not only labelled as healthy, as workers are keen and capable of improving behaviours around snacking and sweet drink / coffee consumption.

There are multiple nutrition behaviours and strategies which can lead to weight loss and previous studies often attribute positive outcomes to body weight to significant changes in nutrition behaviours targeted during the workplace interventions. For example, Viester et al., (2018) commented that positive changes in reduced consumption of sweet beverages, which often contribute to a high daily calorie intake, could have led to the effects on weight outcomes. However, while positive changes in weight related outcomes in this study (discussed in the next section) took place, the intervention showed no effect on sweet beverage consumption. Similarly, Groeneveld et al., (2011) explained weight loss effects by changes in snack consumption following the intervention, with participants realising that decreasing snack consumption had a direct effect on losing body weight. Results from this study showed a significant reduction in consumption of sweet (but not salty) snacks, however, this is likely to be only one contributory factor in weight reduction. For example, a significant reduction in the consumption of ready meals, take-away meals and eating out was also found, indicating an overall decrease in calorie intake, and subsequent weight loss. Reducing intake of these energy dense foods, and eating fewer 'away from home meals' have been shown to be beneficially associated with weight loss in previous studies (Koutras et al., 2021; Soini et al., 2016).

Significant differences in knowledge on food labels as well as in behaviour, i.e. using traffic light food labels, were found in this study potentially indicating some of the weight loss mechanisms. Following the intervention, all participants (n=22) either reported using traffic light food labels 'a little' or 'a lot' (n=17 at the baseline), which potentially affected other positive changes in nutrition behaviours (e.g. reduced consumption of ready meals) as well as health outcomes (e.g. weight loss). A systematic review looking at the effects of an educational intervention using food labels suggested that education optimising comprehension and use of labels can shape dietary choices, improve health behaviours and purchasing decisions (Moore et al., 2018). This is an important finding considering the transient nature of construction work and varying food provision on different sites, meaning that workers should be equipped with the knowledge on reading food labels and making healthy choices regardless of site location. However, other studies did not explore knowledge or behaviours around food labels, and often postulated for the incorporation of environmental changes as an integral part of the nutrition workplace interventions (Groeneveld et al., 2011; Hulls et al., 2022; Lassen et al., 2011), including modifications of food provided in staff canteens (Allan et al., 2017; Geaney et al., 2016; Lassen et al., 2011). While the latter seems to be a feasible solution, it is potentially so only in the case of permanent workplaces. Importantly, only one of the 4 sites that participated in the study (3 in focus groups and 1 in the intervention) was permanent, and it was a small logistic site with 12-14 workers, where a canteen solution would have been not economically viable.

After the intervention period, significant changes in nutrition knowledge and some of the changes in nutrition behaviours appeared to translate in changes in body weight (-3.3kg, $p<0.001$), BMI (-1 BMI, $p<0.001$) and other body composition measures taken post-intervention. These are greater weight reductions compared to other studies in construction, for example, Groeneveld et al., (2010) found -2kg differences in body weight at 6 and 12 months, while an intervention of Viester et al., (2018) resulted in weight loss at 6 months (-1.06kg, -0.32 BMI), but results were not significant at 12 – month follow-up. Similar, modest results were found in a systematic review (Anderson et al., 2009) and a meta-analysis (Verweij et al., 2011), which reported an average weight loss of 1.2kg and 0.47 BMI. Nonetheless, results from this study showed higher weight reduction trends, similar to those presented in a meta-analysis of Power et al. (2014) (-3.95kg) on workplace interventions targeting diet and physical activity in healthcare professionals. However, the small sample size in this current study and pre-post design limits the confidence which can be placed on our results.

For the best weight-related outcomes, a systematic review indicates that education needs to be combined with behavioural interventions, coaching or counselling (Anderson et al., 2009; Cabrera et al., 2021; Panchbhaya et al., 2022), which was the case both in this study and two previously discussed interventions in construction (Groeneveld et al., 2010; Viester et al., 2018). In this study, 6 face to face sessions took place with the average attendance of nearly 4 sessions per participant, while the intensity of the 'VIP in Construction' was lower (Viester et al., 2018). Participants were offered 2 to 4 coaching sessions (depending on participants' stages of change) and the mean number of attended coaching sessions in this group was only 2.2 (out of 4) (Viester et al., 2014). In comparison, 'Health under Construction' was more intensive, with participants having three 45- to 60-min face to face and four 15- to 30-min telephone contacts during the intervention (Groeneveld et al., 2010). Although more intensive approaches have been found to be more effective in weight loss programmes (Franz et al., 2015; Gotthelf et al., 2018; Webb & Wadden, 2017), higher intensity interventions are often more expensive and require greater time commitment, a flexible delivery, in an unstructured way, at convenient times, to increase chances for the intervention success (Brown et al., 2018; Demou et al., 2018; Smith et al., 2017). Apart from the intensity of the intervention, individual interviews conducted as a part of the process evaluation (discussed in chapter seven) in this study showed that the use of the body composition machine provided an additional motivation to lose weight, by creating rivalry which led to ‘banter’ amongst participants. This adds to the literature suggesting that using camaraderie between men can lead to relationships being characterised by humour and teasing, as well as drawing on competitiveness, which in turn can support promotion of healthy behaviours (Du Plessis et al., 2013; Hanna et al., 2020; Oliffe et al., 2017).

There are multiple nutrition behaviours and strategies that have been found to lead to improved health and weight loss (Koutras et al., 2021; Kruger et al., 2006), although no single best way, hence the literature on nutrition approaches assert they should be individualised (Kim, 2021). This further suggests that selecting and focusing on one nutrition behaviour when a workplace intervention is being designed may be ineffective. This is because positive health outcomes (e.g. weight loss) might be the result of changes in varying behaviours (e.g. reduced snacking, reduced energy-dense food consumption, reduced sweet beverages), often specific to individuals or groups. Furthermore, although the workplace environment, both physical and social, has a crucial role in building and maintaining healthy behaviours, workers need to be equipped with knowledge on how to make better choices, which, as this study indicates, might lead to improved nutrition behaviours and therefore, health outcomes.

8.2.4. Discussion of the individual interviews (process evaluation)

The aim of the process evaluation was to explore the implementation process of the intervention, to examine its impact and the influences of contextual factors on the implementation process and participants’ experiences of taking part. This section examines the main results from the process evaluation in relation to the literature and discusses the implications of the findings for future health interventions in construction.

The process evaluation was carried out at 9 month follow-up and used the results from individual interviews (n=13), field notes, the intervention plan and multiple checklists. The interviews were conducted on the same West London site as the questionnaires were distributed and the nutrition intervention took place. Interview participants included both managers (n=7) and workers (n=6).

Contextual factors played a role in the intervention implementation, with Covid-19 impacting the design and delivery of the intervention, discussed in the previous section (see 8.2.3). As stated earlier, three companies withdrew their commitment to take part in the intervention, due to the financial difficulties caused by Covid-19. Financial challenges were also reported by ONS (2021), stating that the value of new construction work experienced a record 16.3% fall in 2020 to £99,651 million after the record high of £119,087 million in 2019 due to Covid-19. At the same time total employment in construction fell by about 3% in 2020, especially among self-employed workers, with a reported decrease of 11%. However, the number of registered construction companies grew by 2% (ONS, 2021). Notwithstanding this, maintaining visible leadership onsite, engagement with the workforce, providing good health management practices (Balmforth et al., 2021; Denny-Smith et al., 2021; International Labour Organisation, 2021) and prioritising employee wellbeing and safety over productivity (Balmforth et al., 2021) are key management responsibilities, particularly given the impact of Covid-19 on both physical and mental health of the construction workforce (Pamidimukkala & Kermanshachi, 2021).

Previous health interventions in construction (Fuller et al., 2022; Groeneveld et al., 2009; Tonnon et al., 2016; Viester et al., 2014) also found external, contextual factors impacting the implementation. Key factors have included work pressures, job insecurity, high staff turnover and supply chain issues, happening as a result of economic crisis. These affected the interest, recruitment, and participation in the nutrition interventions. Authors suggested that these challenges can lead to both employees and employers being less willing to invest time and effort into health and wellbeing interventions, and instead, prioritise core job tasks (Tonnon et al., 2016). The current situation is the UK can be characterised by rising living costs, depressed activity in the construction industry (The Chartered Institute of Procurement & Supply, 2022), mounting job demands and organisations having to operate leaner structures and revised budgets (including money available to the workforce health and wellbeing). This can potentially result in deprioritising workforce health and wellbeing and might risk the roll out of the nutrition intervention discussed in this evaluation, as well as future similar offerings.

Evaluation of the intervention reach took place to gain insights into levels of and issues around participation. All those working on site (including managers, workers, self-employed, employees) were invited to take part and overall, 49% of the workforce attended at least one intervention day, with a monthly reach (i.e. the percentage of workers who participated in the intervention on an average month) estimated at 20%. This is in line with other studies in construction, including 'Health under Construction' (Groeneveld et al., 2009), where 20% of the eligible workforce attended the intervention and a 'VIP in Construction', which achieved participation rates of 31% (Viester et al., 2014). Results from a systematic review showed that the participation in workplace health promotion interventions ranges from 10% to 64%, but is usually less than 50% (Robroek et al., 2009), with participation amongst men and blue-collar workers being usually lower (Robroek et al., 2021). However, a different study looking at the evaluation of the 'Health under Construction' intervention scaled up to national level, indicated an intervention reach of only 2.4% across workers on all sites (Tonnon et al., 2016). The authors asserted that the low reach could have been related to the design of the study (i.e. a large-scale implementation was difficult to control) or the recruitment strategy used (i.e. using only occupational health professional referrals) (Tonnon et al., 2016). Viester et al. (2014) suggested that higher participation rates in workplace interventions are achieved when input from workers is used (i.e. participatory approaches). In addition, smaller workplaces were shown to have higher participation in health interventions (Robroek et al., 2009). These are important findings in the context of future interventions as they need to consider that reaching the workforce and implementing the intervention on larger construction sites might be more challenging, therefore, using a participatory approach and multiple recruitment strategies should be considered for a higher reach.

It has been previously suggested that participants engaging in workplace health promotion programmes are those who already have a healthy lifestyle and therefore, are more motivated and interested in partaking (Kilpatrick et al., 2017; Smith et al., 2017) with the lowest participation rates amongst those individuals who struggle the most with poor health and would benefit from support (Viester et al., 2014). In this study, interviewed participants (n= 13) explained that often their personal interest provided the motivation to attend the intervention, however, a desire to lose weight, feeling tired or having poor health were also reported. A different study in construction used BMI data from health screening and compared it to national levels of obesity to assess if the intervention reached those individuals who would benefit the most (i.e. those who struggle with poor health or excessive weight) (Viester et al., 2014). Looking at BCT data collected during this study, 27 of 51 participants had a BMI classified as overweight (a BMI of 25 kg/m^2 to 29.9 kg/m^2) and further 9 as obese (a BMI of 30 kg/m^2 and above), making a total of 70% of participants. This is in line with national data, which shows that in England, 64.2% of adults are either overweight or obese (68.2% of men) (NHS Digital, 2019), suggesting the sample of participants who took part in the intervention might reflect national trends and include those struggling with excessive weight.

Men, especially those from lower socioeconomic groups, are often considered as hard to reach and to engage in health promotion, yet these groups are usually at the highest risk of adverse health outcomes (Lefkowich et al., 2017). Men are also less likely to seek help for health issues and often demonstrate stoicism in the face of ill-health or pain (Hanna et al., 2020; Mahalik et al., 2007). In macho cultures, such as construction workplaces, men might be socialised to embrace unhealthy practices, like excessive drinking, in an effort to prove their masculinity rather than engage in health and wellbeing initiatives, and therefore, they are often deprioritised within health promotion (Lefkowich et al., 2017). However, men report that their lack of engagement is often due to a lack of trust in health providers, not being cared for or listened to and not finding male-friendly workplace initiatives (Carroll et al., 2014; Lefkowich et al., 2017; Robertson et al., 2018), which was also found in the exploratory focus groups in this study when current interventions, like MHFA initiative, were discussed. Therefore, workplace interventions in male-dominated industries should incorporate a gender specific lens (Carroll et al., 2014; Hanna et al., 2020; Lefkowich et al., 2017; Robertson et al., 2018). For example, prevent framing the intervention directly as one focusing on health or diet, create safe spaces, a fun and relaxed environment for men to have health conversations, use humour or supportive silence, foster collaboration, team spirit, peer-support and camaraderie (also through competition and banter), and also have opportunities for more spontaneous conversations and design interventions with men's problem-solving strengths in mind (Carroll et al., 2014; Lefkowich et al., 2017; MHF, 2018; Robertson et al., 2018). In addition, men should be allowed flexibility to attend, without feeling embarrassed, to maintain a sense of self-control and autonomy (Lefkowich et al., 2017; MHF, 2018). Furthermore, health promotion opportunities should use safe, private, trusted spaces and practical and usable knowledge needs to form part of the offering, to allow men a clear sense of purpose and tangible benefit of the intervention (Lefkowich et al., 2017; MHF, 2018). In this study, participants commended the intervention for being delivered in a fun, relaxed atmosphere as well as for allowing flexible attendance, with both pre-booked and drop-in slots offered and adjusting the time of sessions to help participants meet their work demands. The latter affected the dose delivered as some of the sessions had to be shortened and not all the planned content was delivered. However, flexible delivery was also reported in 'Health under Construction', and although it reduced dose delivered, authors emphasised that it was important to adjust the delivery protocol to meet the needs of participants (Tonnon et al., 2016). In addition, respondents from the present study discussed how the use of the BCT machine created rivalry and banter amongst the team, which aided their motivation to improve nutrition behaviours, and therefore, weight related outcomes during the monthly weigh-in. Furthermore, participants found the nutrition education relatable, and food demonstrations simple, and therefore these were deemed impactful. This was potentially achieved due to an opportunity for workers to inform the design through the participatory nature of the intervention (e.g. the use of focus groups). Finally, peer influence improved engagement, with workers encouraging each other to attend, which created a ‘snowball effect’.

Construction has a well-established safety culture, but often at the expense of health (Tyers & Hicks, 2012), with many companies still being resistant to invest in the health and wellbeing of workers (Sherratt, 2018). Furthermore, short-term projects, transient jobs, multi-level supply chains and the prevalence of sub-contracting makes the implementation of health interventions challenging (Fuller et al., 2022; Hanna & Markham, 2019), as each individual company has their own set of policies and it is unclear as to who is responsible for the health and wellbeing of workers (Hanna & Markham, 2019). This was visible in the results of this study, where there seemed to be a misalignment between the health and wellbeing strategy at head office, compared to sites. The process evaluation found that the health and wellbeing lead of large construction organisations struggled to gain commitment from the site management team to implement an intervention, while site managers discussed a lack of any health and wellbeing offering and support coming from the head office. In future interventions, this might be partly mitigated by including health and wellbeing interventions in every construction project schedule, providing training to managers on the importance of supporting workforce health. This might be especially driven by larger companies, those with greater health and wellbeing budgets and leading the changes in the industry (Hanna & Markham, 2019).

Nonetheless, there is a growing interest in building a culture of health, although the complexity of cultures makes them resilient and resistant to change, which seems to be an even bigger challenge in construction industry (Hanna & Markham, 2019). For example, in this study, the industry was referred to as being “*like no other*” and having *“an awful lot of gorillas and grizzly bears”*, while different authors described it as “*how it was and quite fixed”* (Hanna & Markham, 2019, p.150) and structured to be the *“inevitable detriment of construction worker health”* (Sherratt, 2018, p.3). In this regard, a culture of health, with genuine company support, employee - employer trust and workers' health being a high priority, has been found to be essential in the implementation of successful workplace health interventions amongst blue-collars (Fuller et al., 2022; Kilpatrick et al., 2017; Kuoppala et al., 2008; Nea et al., 2017; Payne et al., 2018). As the need for a healthy workforce has become more relevant, especially for companies which undertake high value contracts, for prestigious clients (Hanna & Markham, 2019), one of the ways of improving the healthy culture and introducing workforce health and wellbeing is through clients (Bell et al., 2015; Hanna & Markham, 2019). Their demands to focus on health and wellbeing of workers might form a part of the tendering process and be a big motivator for companies (Bell et al., 2015; Hanna & Markham, 2019). In the present study, and following the failure to re-engage the three companies that took part in the focus groups post-lockdown, the site that eventually agreed to partake in the intervention was approached through a researcher's private contact, from a client company. This was highlighted by one of the managers during the evaluation interviews, who acknowledged that the site management team was interested and committed to supporting the health and wellbeing of the workforce, and was always looking for ways to show their commitment to improving the wellbeing of workers. Nonetheless, the manager recognised that being approached and offered the opportunity to participate in the study by the client provided an additional motivation to commit to the nutrition intervention. Nonetheless, the risk of client driven agendas is that the focus on health and wellbeing will not be genuine, but rather form a bureaucratic exercise (Hanna & Markham, 2019).

Other factors which were suggested to improve the implementation of similar interventions in the future include a cooperation with stakeholders (i.e. sub-contractors) and a mandatory character to the intervention. Participants taking part in the evaluation interviews asserted that the intervention should be written in the project schedule, to prevent supervisors and sub-contracting companies using time pressures as an excuse for not allowing workers to attend. Other studies found cooperation with other stakeholder groups, such as cafeteria staff and unions, important in supporting the implementation of health interventions. For example, cafeteria managers can decide for or against the provision of healthy foods (Lassen et al., 2006) which could contribute to the mandatory character of the intervention, limiting workers' food choices unless they want to sources food from elsewhere, however this would only be feasible in sites with canteens. However, Union reps often act as ambassadors for health interventions, provide communication structures and infrastructure necessary for a programme delivery and are considered to be a trusted source of information (Barbeau et al., 2005; Hunt et al., 2010; Lassen et al., 2006, 2011; Sorensen et al., 2007).

Lastly, management and organisational support are important factors determining the success of health interventions. In the present study, the role of the management team on site was larger than anticipated. Starting from gaining the initial commitment to running the intervention, through the communication, promotion, recruitment, taking part, and encouraging workers to attend, managers and supervisors played a vital role in the implementation and their support was excellent. The name of one manager, who supported the delivery of the intervention on site, was mentioned the most frequently when recruitment was discussed. Importantly, the management team on the site was young, proactive, caring and understood the need to support workers' health and wellbeing, which, as found from the interviews, might not be the case on different sites. Other studies also found managers' support essential for intervention success, and their advocacy for workers' health and wellbeing was determined by their understanding of the intervention benefits, including enhanced morale, improved health and reduced injury risk (Brown et al., 2018; Demou et al., 2018; Fuller et al., 2022; Payne et al., 2018; Pescud et al., 2015; Quintiliani et al., 2008). However, a study by Viester et al. (2014) highlighted that the types of support that managers often need to provide during health interventions, such as facilitating the arrangement of coaching sessions with workers, might increase their own workload and time pressures. A recently published 'Health and Wellbeing Manager Competencies Framework', in the rail industry, emphasised a shift in managers' roles, from technical leadership to people management, including supporting workforce health and wellbeing (e.g. through the implementation of health initiatives, spotting behavioural changes, having wellbeing conversations, making work adjustments) (Waters & Smith, 2022). However, it has been highlighted that managers often lack skills, competencies, and time to support their workforce (Waters & Smith, 2022) or are unclear about their obligations in health promotion (Pescud et al., 2015; Smith et al., 2017), and it is essential that companies review managers' workloads and provide them with adequate training to develop competencies to meet the health needs of their employees (Waters & Smith, 2022). This might at least partly explain difficulties in recruiting sites in the present study, as site managers might be lacking competencies and resources to support the nutrition intervention.

8.3. Conclusions

The findings from each stage of the research have been presented in their respective chapters, with discussions of those findings presented in the previous section (8.2.1-8.2.4). This section begins with a presentation of the main strengths and limitations of the study. Then, the contributions of the thesis are summarised, before recommendations are proposed, and the section closes with a conclusion.

8.3.1. Strengths and limitations of the study

This study used both self-reported outcomes and objective weight-related measures to support and validate these outcomes, which is a strength of this study. Weight loss was not the major objective of the intervention and participation was not limited to overweight or obese individuals, therefore, not all improvements in nutrition behaviours might have translated into weight changes. Although the intervention focused on changing nutrition-related behaviours, some of the education and coaching provided were around general health behaviours, including exercise, however, changes in physical activity, which might have also led to the weight loss, were not measured, which is a limitation of the study.

This study used a non-randomised, pre – post design, which is a limitation of the study. However, following the guidelines outlined in the TREND statement for reporting the results of studies using non-randomised designs, we have described the use of behavioural theory in the intervention design, provided information about the intervention, and described the research design.

This study focused on a specific occupational group: blue-collar workers in the construction industry. As there were not rigorous exclusion criteria to partake in the nutrition intervention, apart from occupation, and the intervention was carried out on a working construction site, under ‘real life’ circumstances, it is expected that the intervention design and implementation process could be transferable outside the research settings, which is a strength of this study.

The sample used in the intervention stage of this study was low (51 participated) and the dropout rate was high (22 competed), which was a limitation of the study as it made it difficult to draw conclusions regarding the effectiveness of the intervention. The latter was an effect of

Covid-19 and associated lockdowns, which influenced the intervention completion rates. As previously highlighted, the intervention was conducted under 'real life' conditions, therefore, future researchers might expect encountering some of these issues and consider ways to mitigate them. Moreover, the size of the sample was determined by the site size, which is also a strength of the study, as the intervention was implemented on a medium size site, which has not been previously done in European studies.

This study used a participatory approach which is a strength of this research. The intervention was tailored not only to the needs of the industry, but to a specific workplace and workers. However, the limitation was that the questionnaire used in this study was not validated, although it included some validated measures, e.g., 4 ONS questions. Nonetheless, good practice guidelines were followed when it was designed, and the newly designed questionnaire addressed the nutrition behaviours of workers and the context of working in construction.

The intervention in this study lasted only 6 months and did not include any additional follow-up periods, which is a limitation. Although changes in nutrition behaviours and weight-related outcomes in this study are important, the short duration of the study meant it was not possible to determine whether changes were sustainable.

8.3.2. Contributions

The main contribution of this thesis is the development of a study design for nutrition interventions in the construction industry, as evidenced by the literature review and findings from the empirical research. The literature review considered how work, work environment and work characteristics affect the nutrition behaviours of blue-collar workers as well as effectiveness of workplace nutrition interventions. In addition, it explored barriers and facilitators to workplace intervention design and implementation. These findings contributed to the developments of focus group questions, *a priori* themes, and questionnaires, as well as the design of the intervention.

Focus groups with construction workers and managers, partly supported the existing knowledge with regards to nutrition practices and barriers and facilitators to better nutrition choices in the workplace. However, behaviours not previously found in the literature were reported including excessive tea and coffee consumption and low fruit and vegetable intake, meal preparation at work, planning and preparing meals as well as bringing foods from home. New evidence was also found which showed that while feedback provided by professionals, as well as established healthy habits and routines, can support positive nutrition behaviours of construction workers, facilities on site and health interventions differed between managers and workers as well as between employees and self-employed, limiting food choices and health support opportunities. These findings were published in the peer-reviewed International Health Promotion journal (Wronska et al., 2022).

In addition, this study used a participatory approach to engage the workforce. This provided insights on how an intervention should be designed to motivate (break barriers) workers to participate and which aspects of the intervention were most appealing to participants. Although previous studies explored barriers and facilitators to the design and implementation of workplace interventions, findings from the focus groups contributed to the limited evidence available for blue collar and specifically construction workers. Focus group participants spoke about health and wellbeing initiatives on the sites, such as MHFA, and their views on the content needed in future interventions, including nutrition topics of interest. These have not been previously explored by other studies. Furthermore, findings from focus groups contributed to the literature by exploring issues around the implementation of intervention (e.g. continuity of the intervention and facilities improvement), including ways to increase participation (e.g. ensuring practicality, flexibility and nutrition recommendations), the accessibility of the intervention (e.g. time, location), promotion, and management and co-workers' support, in the construction industry context.

Findings from the focus groups were used to develop the questionnaire used to collect baseline and follow-up measures during the nutrition intervention. This study contributed to the literature in terms of designing a questionnaire for the construction industry, which can be further tested and developed. Measures included nutrition knowledge, behaviours, health, wellbeing and weight-related measures (both objective and subjective measures), which were different to those reported in other construction studies.

The questionnaires, along with the intervention were implemented on a different site than the exploratory focus groups. The results highlighted some of the differences in nutrition practices between sites, for example in reported snacking practices, skipping meals, or bringing food from home. This supported the literature showing the importance of designing an intervention based on gaining a detailed understanding of the industry but also characteristics of individual employees (e.g. demographic and socioeconomic characteristics) and the workplace. Results from this study also stressed that even on similar construction sites, within the same country, nutrition practices might differ and that work settings have unique characteristics; therefore, it is necessary to examine the worksite and employee populations before developing health promotion interventions.

Another contribution of this study was a presentation of the design process using the COM-B and BCW and insights gathered from the literature review, focus groups and baseline questionnaires. This study showed how the participatory element of the intervention led to required changes in the BCW design process and how the workplace settings posed research challenges when designing the health interventions (e.g. programme length, frequency, attendance during working hours). This study demonstrated how an intervention could be designed to tackle some of these issues, including work schedules, project-based work or temporary workforce. This could be valuable to the construction industry, particularly small to medium sized organisations.

This study explored nutrition knowledge among construction workers and used educational components in the design of the intervention (previous interventions focused mainly on individual components like motivational interviewing, coaching). Furthermore, it showed that increasing nutrition knowledge could have been a potential mechanism which led to positive changes in nutrition behaviours and other measures, like weight loss.

Finally, this study used an evaluation framework, which included both qualitative and quantitative measures and offered both outcomes and process evaluation contributing to the literature on the effectiveness of nutrition interventions in construction, as well as recommendations on best practice to be considered in the design and implementation of interventions in construction. The findings offered novel suggestions on the design of the interventions, including considering the option of making them mandatory, the importance of engaging multiple stakeholder groups, using competitiveness and other masculine characteristics, and incorporation of the context of the industry and workforce characteristics.

In summary, although this study is based on UK construction workers, it is internationally relevant, adding to the small evidence-base focusing on understanding nutrition practices amongst blue collar workers. This is of particular importance given the paucity of studies conducted amongst workers from this group, the research gap in respect of effective interventions targeting low socioeconomic workforce and the high ill-health and injury costs associated with the industry. Our findings provide important insights into what should be considered when designing effective nutrition interventions to improve health and wellbeing, particularly of construction workers in low socioeconomic positions. It is the first study conducted in the UK, on a medium size site. Future researchers might anticipate encountering some of these issues highlighted in previous sections of this chapter and consider ways to mitigate them in future interventions. This in turn may lead to a more effective design and delivery of interventions and hence potentially yield better results, in terms of the outcomes of the intervention, the engagement, reach, satisfaction.

8.3.3. Recommendations for future research and practice

- Future research should focus on the implementation of health and wellbeing interventions in different types and sizes of construction sites, and in different geographical locations. Researchers need to explore the effectiveness of similar interventions on large construction projects, where onsite food provision is available, which can allow implementation and testing of the effectiveness of environmental changes. Equally, it should be of interest to explore the feasibility of similar interventions with small companies, which often act as sub-contractors for large businesses. These organisations might lack both financial and human resources to support health and wellbeing of the workers and therefore this may require creativity in designing interventions.

- Further research is needed to better understand the possible benefits of lifestyle interventions, where studies incorporate measures around physical activity in construction and include controlled conditions.

- Further research is needed, over longer follow-up periods, to explore the most effective ways to sustain initial weight loss in construction.

- Economic evaluation should form part of future studies in order to provide practitioners with evidence supporting their business cases to obtain organisation commitment to invest into workforce health and wellbeing.

Recommendations for practice

- Practitioners designing and implementing workplace health and wellbeing interventions should consider existing evidence and best practice guidance. The checklist below, which has been designed from the findings of this study, offers recommendations for practitioners on what to consider when designing future health and wellbeing interventions in construction.

Table 8.1. Elements to consider in the intervention design and implementation

	Elements to consider in the intervention design and implementation	**Check**
1	Consider industry context, workers' demographic and socio-economic characteristics and individual workplace circumstances	
2	Use a participatory approach and the use of theory in the intervention design	
3	Use masculinity in the intervention design, e.g. competitiveness, banter, problem solving, empowerment strategies	
4	Include education and feedback provided by professionals	
5	Ensure employer buy-in and leadership support	
6	Ensure support and commitment from site managers in the implementation	
7	Engage with peer supporters serving as communication channels, support providers, and role models	
8	Engage with clients and sub-contractors for integration of efforts	
9	Consider multiple components (e.g. education, coaching, environment changes) and ensure the content of the health and wellbeing programmes is tailored to the needs and demographics of construction workforce	
10	Ensure recruitment and promotion involves multiple methods and channels, tailored to the workforce needs, demographics and work status (e.g. consideration of the self-employed)	
11	Ensure a flexible delivery, convenient location, time, length and frequency of the intervention	

8.3.4. Conclusions

Despite limitations of the study design (i.e. pre – post design), as well as Covid-19 affecting the design and implementation of the intervention (resulting in a small sample size) (see

Appendix 12), this study outlined the process of designing a construction industry tailored nutrition intervention, which at 6 month follow-up showed some promising results. In addition, results from this study indicate the importance of using a participatory approach in the intervention design and ensuring that not only the context of the industry is considered, but also the individual workplaces. Practitioners and researchers wishing to further explore workplace interventions in construction should consider the findings from this study, including the barriers to the design, implementation, and engagement, and to explore ways to mitigate these in future work. Finally, the findings from this study suggest that there is a need to support the health and wellbeing of construction workers, and regardless of context related barriers to the implementation, workplace interventions taking place on 'real-life' working construction sites, even during Covid-19 pandemic, are possible and can bring positive changes, not only in individual outcomes but in supporting the culture of health.

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Appendices

Appendix 1 - Ethical approval and amendment notification forms

Approval was gained for Research Ethics Committee of the University of Salford (HSR1819-124) on 10th September 2019

University of Salford
MANCHESTER

Research, Enterprise and Engagement
Ethical Approval Panel

Doctoral & Research Support
Research and Knowledge Exchange,
Room 827, Maxwell Building,
University of Salford,
Manchester
M5 4WT

T +44(0)161 295 2280

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10 September 2019

Dear Magdalena,

RE: ETHICS APPLICATION–HSR1819-124 – A study to design and evaluate a participatory workplace nutrition intervention to improve the health and wellbeing of blue-collar (construction) workers.

Based on the information that you have provided, I am pleased to inform you that application HSR1819-124 has been approved.

If there are any changes to the project and/or its methodology, then please inform the Panel as soon as possible by contacting Health-ResearchEthics@salford.ac.uk

Yours sincerely,

Professor Andrew Clark

Amendment notification form 1

University of Salford MANCHESTER

Amendment Notification Form

Title of Project:		
A study to design and evaluate a participatory workplace nutrition intervention to improve the health and wellbeing of blue-collar (construction) workers.		
Name of Lead Applicant:	**School:**	
Magdalena Daria Wronska	Health & Society	
Are you the original Principal Investigator (PI) for this study?		Yes
If you have selected 'NO', please explain why you are applying for the amendment:		
Date original approval obtained:	**Reference No:**	**Externally funded project?**
10/09/2019	HSR1819-124	No
Please outline the proposed changes to the project. *NB. If the changes require any amendments to the PIS, Consent Form(s) or recruitment material, then please submit these with this form highlighting where the changes have been made:*		

The project consists of a nutritional intervention in the construction industry. Due to the participatory nature of the intervention, findings from the first phase (focus group) informed and determined the next phases (including the design of the intervention), therefore, this amendment covers the changes to the project after the first exploratory phase (focus groups) took place.

Consent for intervention participants

The researcher will provide information sheets (see Appendix 1) to the organisation for them to e-mail to employees. All participants will be advised that if they would like to take part in the nutrition intervention, they can contact the researcher directly by e-mail, or advise their line manager (who will have copies of information sheets / consent forms) that they are happy to take part in the intervention. Additionally, the researcher will be available on site to deliver a 'toolbox talk' (defined below) inviting employees to take part in the study (the researcher will have copies of information sheets / consent form). A 'Toolbox talk' is defined by Health and Safety Executive (2019) as a short presentation to the workforce, during the morning staff briefing, lasting usually between 5 and 15 minutes, on a single aspect of health and safety). After that, information on nutrition programme time and place will be provided during a staff briefing, within the next few days, to those interested in taking part. In all cases, participants will have the information sheet at least 24 hours prior to the nutrition intervention start day. No home addresses or participant identifying data will be gathered or provided to the research team. Once contacted, the researcher will arrange to pick up the consent form on the morning of the day when the nutrition intervention is about to start.

Questionnaire design

A questionnaire has been chosen in this study to assess baseline health, wellbeing and eating behaviours, together with the nutrition knowledge of construction workers in a chosen organisation. The questionnaire will subsequently be used to evaluate the impact of the nutritional intervention on these outcomes post intervention.

University of Salford MANCHESTER

As no suitable questionnaire was found (brief, simple, relevant to eating habits, health and wellbeing concerns of blue-collar workers, including those working in construction), one was developed for the purpose of this study. An extensive literature review and five focus groups (two with managers and three with workers) were conducted in order to establish current nutritional practices amongst workers and to learn about their eating behaviours. Furthermore, barriers and facilitators to healthy eating choices were also explored. Based on the findings from the above, a final questionnaire was developed, with a self-administered section on nutrition (part 1) and an interviewer administered section (part 2). Part 1 consisted of 18 nutrition-related items, and 31 questions in total, additionally including health and wellbeing measures, alongside demographic questions. Part 2 consisted of 10 nutrition-related questions. Nutrition questions in both part 1 and 2 were based on the findings from the literature review, the focus groups (n = 5), best practice in designing questionnaires, as well as the Eatwell Guide ("The Eatwell Guide - NHS," 2020).

The nutrition education part of the questionnaire consists of 10 multiple-choice questions, and has been designed to cover a spectrum of nutrition knowledge content, including: 1. awareness of the official dietary recommendations (Q1, Q3-5 Part 1), 2. knowledge on the nutrient content in foods (Q2, Q6 Part 1), 3. choosing everyday foods and using information to make healthy dietary choices (practical food choices – food labelling) (Q9-10 Part 1), 4. knowledge on a relationship between diet and health (Q7-8). The above specified subsections were used in line with recommendations provided by Parmenter & Wardle (1999) when developing General Nutrition Knowledge Questionnaire (GNKQ). The authors specified that in order to maximise content validity, the above aspects of nutrition knowledge should be covered by the questionnaire (Parmenter & Wardle, 1999, 2000; Trakman et al., 2017). Furthermore, information from the EatWell Guide, available to the general public through the NHS website ("The Eatwell Guide - NHS," 2020), was used to design individual knowledge questions in all four subsections. The knowledge tested was based on information provided by the Guide but focused primarily on the areas of nutrition knowledge known from the literature review and focus groups to be relevant to construction workers (e.g. Q8 Part 1 focused on general link between poor nutrition and health, while Q7 Part 1 focused on obesity, both identified in the literature review and focus groups theme 1).

The next section of the questionnaire, asking about food intake and eating behaviours amongst construction workers, was developed based on the questions in the knowledge section, findings from the literature review and focus groups, with a consideration of best practice guidelines on questionnaire development. Firstly, all knowledge questions were mirrored in the behaviour section to identify if nutrition knowledge is translated into food choices and eating behaviours amongst construction workers (e.g. Q3 Part 1 asks about recommended water intake, which was mirrored in Q4 Part 2 by asking about daily intake of drinks). Next, all questions designed at this point were mapped against themes identified by the literature review and focus groups to identify any themes that were not yet covered, and finally, additional questions covering the remaining themes were developed with a consideration of best practice guidelines in questionnaire development.

The next stage in the development of the questionnaire considered the selection of measures to assess the health and wellbeing of the study participants prior and post the intervention.

The single-item, self-rated health measure was chosen for the purpose of this research, as a simple, brief tool, offering a broad-ranging assessment of health (relevant to the aim and objectives of this study) (McDowell, 2009). Furthermore, the measure makes fewer demands on respondents and researchers (Bowling, 2005b) and has also been significantly and independently associated with use of health services, changes in functional status, rates of recovery from episodes of ill health (Bowling, 2017) and mortality, as supported by the findings from a systematic review (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006). A single item question *'In general how is your health? Would you say your health is…' asks* respondents to rate their health as 'excellent', 'very good', 'good', 'fair' and 'poor' (Bowling, 2017; McDowell, 2009). Although the self-rating of the question is often criticised as being subjective, Bowling (2017) suggests that the subjectivity is its strength, as it reflects personal health evaluation.

The Office for National Statistics (ONS) approach to measuring subjective wellbeing has been selected for the purpose of this research. It provides a balanced assessment of wellbeing by taking into account different ways to measure wellbeing (affect, eudaimonic and evaluative) (Tinkler & Hicks, 2011). ONS has adapted this measure following previously mentioned recommendations that Dolan, Layard, & Metcalfe (2011) made to ONS as well as from a framework that is being considered by the OECD (Hicks et al., 2013; OECD, 2013; Tinkler & Hicks, 2011). Furthermore, the ONS measure consists of four questions only, which when tested in the Integrated Household Survey (HIS) only took 30 seconds to complete (ONS, 2011, as cited by OECD, 2013), indicating that measures were not difficult to understand. Additionally, an advantage of using ONS questions is that measures of subjective well-being – such as overall life satisfaction – are considered to be relatively easy to answer (OECD, 2013), which has also supported by the ONS cognitive testing, suggesting that respondents do not generally find subjective questions difficult or upsetting to answer and the inclusion of such questions does not negatively impact the response rates to subsequent questions or to the survey as a whole (ONS, 2012, as cited by OECD, 2013). Furthermore, measures of subjective well-being generally have low non-response rates (Rässler & Riphahn, 2006), implying that respondents do not find these types of questions difficult to understand or answer. Conclusively, the four ONS questions featured are as follows:

• Overall, how satisfied are you with your life nowadays? (experience)
• Overall, how happy did you feel yesterday? (positive affect)
• Overall, how anxious did you feel yesterday? (negative affect)
• Overall, to what extent do you feel the things you do in your life are worthwhile? (eudemonic)
All questions use a 0 – 10 scale.

The last section of the questionnaire included 'about you' (demographic) questions (age, gender, education level, occupation, living situation). These were adapted from the UK Census and were included at the end since it has been suggested that demographic questions at the beginning can be seen as probing and therefore off-putting (Parmenter & Wardle, 2000; Trakman et al., 2017).
The final questionnaire (31 questions in part 1 and 10 questions in part 2) consists of 4 sections: nutrition questions, health question, wellbeing questions and about you (demographic) (see Table 1 for details).

Table 1: A summary of questionnaire development

Component	**Nutrition**	**Health**	**Wellbeing**	**About you (demographic)**
Measure	Newly developed based on the literature review, focus group findings, Eatwell Guide	Single-item, self-rated health measure	ONS4	Adapted from UK Census
Questions number	1-18 Part 1 1-10 Part 2	19 Part 1	20-23 Part 1	24-31 Part 1

Body composition testing

As a part of the intervention the body composition testing will be conducted and measures of weight, Body Mass Index (BMI), fat mass (FM), and a fat-free mass (FFM) will be taken using Tanita SC-331S Body Composition Analyser (which uses a method of bioimpedance analysis (BIA)) .

BIA has been a popular method of measuring body fat (BF) mass, mainly due to its practicality (Barbosa-Silva & Barros, 2005; Duren et al., 2008; Huber, 2019; Ward, 2019). BIA technology transmits a small, single- or multi-frequency electrical current through a body of an individual via electrodes or metal contacts (Huber, 2019). Muscle (lean tissue) contains more water in comparison with adipose (fat) tissue and bone, therefore, muscle is a better electricity conductor. On the other hand, fat, as an insulator, does not conduct a current well, offering resistance and impedance to the current. Impedance is analysed and calculated by a BIA machine and produces estimates of total body water (TBW), BF percentage, and lean body mass (or FFM) (Duren et al., 2008; Huber, 2019).

The reliability of BIA for the estimation of body composition (FM and FFM) and the ability of the technology to repeat the same results in a space of time, has been investigated (Chula de Castro, Lima, & Silva, 2018; Talma et al., 2013). A systematic review found no method reproducibility, due to considerable variability in methodology (e.g. time intervals between tests ranging from 90 seconds to five weeks), however, differences in BF percentage were relatively low, ranging between 0.9% and 1.61% (Talma et al., 2013). However, a more recent meta-analysis found almost perfect reproducibility for BF percentage, with other components (FM and FFM) being inconclusive due to insufficient number of studies (Chula de Castro et al., 2018). It has been suggested that the almost perfect reproducibility is due to simplicity of equipment handling and therefore, little influence from the machine handler, which then reduces the errors when measures are repeated (Chula de Castro et al., 2018). The authors concluded that BIA is a low-cost, easy technique, which can be helpful for health professionals and is *"an applicable research tool in studies that investigate body composition changes at different times"* (Chula de Castro et al., 2018, p.15).

Low cost and practicality are only some of the advantages of BIA, with the technology offering non-invasive, safe, low maintenance, quick, portable and requiring limited operator expertise and training body composition results (Barbosa-Silva & Barros, 2005; Jaffrin, 2009; Kelly & Metcalfe, 2012; Ward, 2019). Measures are conducted in the participant is standing in an upright position, the results are available immediately, and measurements can be repeated as often as desired (Buchholz, Bartok, & Schoeller, 2004; Dehghan & Merchant, 2008; Jaffrin, 2009). However, it is also important to recognise the limitations of BIA method. Firstly, bioimpedance technology is an indirect method as the machine does not measure body composition, but resistance when exposed to an electric current and then uses algorithms to translate this information (Ward, 2019). As the measured resistance is then transformed into a prediction of total body water (TBW) by an algorithm (Ward, 2019), other BIA parameters are largely dependent on the individual's hydration status (Walter-Kroker, Kroker, Mattiucci-Guehlke, & Glaab, 2011). Some assumptions have been made in the process of developing these equations and therefore the following performance limitations need to be accepted: the body shape, the relationship between trunk and leg lengths, the hydration level (fat-free mass (FFM) is calculated by assuming a hydration fraction for FFM, typically 0.73) and the fat fraction, which is commonly determined by subtraction of predicted FFM from measured body weight (Barbosa-Silva & Barros, 2005; Ward, 2019). Despite the limitations, BIA is considered an acceptable method for measuring body composition (FM and FFM) in healthy individuals, with no fluid imbalance or body shape abnormalities (Barbosa-Silva & Barros, 2005; Kelly & Metcalfe, 2012). In addition, coupled with its ease of use, and less invasive nature makes it suitable for assessment of body composition amongst construction workers in this study. Furthermore, BIA technology has been suggested adequate for monitoring changes in an individual's body composition over time, rather than to conduct a single measurement (Buchholz et al., 2004), which is in line with the objectives of this study looking at the changes in selected measures pre and post intervention. Furthermore, reflecting on the limitations of both measures (BMI and BF), and in order to obtain the most comprehensive and complete picture of one's health (within a limits of this study), both BMI and body composition measures will be taken as a part of the intervention.

Tanita SC-331S, which will be used in this study, is a foot to foot bioimpedance analyser. The machine retrieves weight automatically, while requires additional data to be manually inserted, including gender, age, height. Participants will complete 6 measurements (once a month), all conducted in the workplace (on a construction site). All measurements will be made in the morning, after a staff briefing, and before the physical work commences. Participants will be instructed not to exercise (including fast walking or going up stairs) or consume caffeine for 12 hours prior to the test, and to avoid alcohol intake for 24 hours prior to their appointments. Prior to the first measurement, participants will be given a written protocol to read, which also explains the process of taking measurements (see below Table 2). Prior to the measurement participants will be pointed to the warning signs and asked about contraindications to conducting the test. All measurements will be recorded on measurement logs. Date, time, and the person completing the measurement will be noted. Menstrual cycles, if applicable, will be annotated. A table below provides recommendations on the measurement protocol using bioimpedance analysis monitor (Tanita SC-331S), which will be available to participants, and it based on existing body composition testing guidelines (Cornell Univeristy Recreational Services, 2018; Khalil, Mohktar, & Ibrahim, 2014; National Institute for Health Research (NIHR), 2019).

Table 2: Recommendations on the measurement protocol using bioimpedance analysis monitor (Tanita SC-331S).

Measurement considerations / conditions	**Application in the measurement protocol in the study**
Calibration	Measurements will be conducted to the manufacturer's recommendations and calibration will be regularly completed (a self-test is provided in the device).
Maintenance	A visual inspection of the following will be conducted weekly: • The display for any damage or contamination • All cables, cords, and connector ends for damage or contamination • All safety-related labeling for legibility • All accessories for wear or damage
Cleaning	The machine will be cleaned using a detergent wipe after every test. A person operating the machine will be asked to use a hand sanitizer after every test.
Food consumption	Participants to be advised to abstain from eating a meal at least 2 to 3 hours before the test.
Drink consumption	Participants to be advised to drink enough fluids (6-8 glasses of water) over the 24-hour period preceding the test to ensure normal hydration at the time of the test. Participants to be advised to abstain from drinking large amounts of fluid at least 2 to 3 hours before the test. Participants to be advised to refrain from consuming caffeine (tea, coffee and energy drinks) within 12 hours of the test.
Alcohol	Participants to be advised to refrain from consuming alcohol within 24 hours of the test.
Exercise	Participants to be advised to avoid vigorous activity 8 hours before testing (due to the physical nature of the construction jobs, body composition testing will be conducted in the morning, after a staff briefing, before work commences).

Bladder voided	Participants to be asked to empty bladder (urinate) at least 30 minutes prior to testing.
Other devices	Participants will be asked not to use transmitting devices, such as mobile phones, while the test is performed.
Data required to conduct the test	Height - Participants will be asked about their height (in cm, rounded-up or -down to the nearest whole number). If a participant knows their height in feet / inches only, a person taking a test will have a tool allowing the conversion of feet / inches into centimeters. Age - Participants will be asked about their age.
Timing	The measurement will be performed once a month, at the same time of the day (in the morning, after a staff briefing).
Location	The measurement to be conducted in a stable location (the same room). The device to be used on a stable and level surface on a firm flooring, not on a thick carpet.
Temperature	The measurement to be taken in the ambient temperature. After transportation, the machine to stand for at least 2 hours before using.
Position	The measurement to be performed standing. Participants will be asked to ensure their full feet touching metal plates (where the electrodes are). Hands and legs to be slightly separated from the body.
Footwear	Participants to be prepared to be barefoot. Shoes, socks, tights have to be removed prior to taking the measurement.
Skin	Participants to be asked to thoroughly wipe (using alcohol wipes) their feet before the test. Further explanation will be provided that moist or covered with body lotion skin, can affect the results. Participants will be asked to ensure the soles of feet are free of excess dirt, as this may block the mild electric current.
Contraindications	Participants will be asked not to take part in the test if they have any skin lesions on their feet (warning sign will be displayed and a person taking a test will be verbally checking with every participant prior to taking a test). No measurements will be carried out if participant has electrical device such as pacemaker or cochlear implant (warning sign will be displayed and a person taking a test will be verbally checking with every participant prior to taking a test).
Further explanation	Participants will be informed that the methods used for body composition can just provide an estimate and that body fat percentage estimates are influenced by a change in water content in the body throughout the day (consistency in testing conditions are important for tracking changes).

Nutrition intervention design

The nutritional intervention will run for 6 months, with final measures and evaluation taking place in month 6. The project will be delivered by the researcher.
The nutrition intervention design has been based on the findings from the literature review as well as focus group findings. The intervention will include the following:

1. Educational talks (up to 10 employees) on different topics, e.g. healthy plate, reading nutrition labels, energy during the day and food, planning meals when on the go, staying healthy when eating out etc.
2. Food demonstrations (short sessions showing practical ideas on the preparation of easy meals in a cost-effective way, which can be made at home or at work with ingredients available in local shops. These will include: breakfast porridge, chia seeds pudding, smoothie, salad, a wrap, hummus, energy balls. Food allergy signs will be displaced, and food hygiene rules will be followed (researcher has been awarded a Food Hygiene Certificate).

3. Coaching – individual or small groups (these session in small groups of 2-4 employees will contain goal setting and review, health feedback, looking into individual dietary habits, food diary review, recipe ideas)
4. Body composition testing (to be conducted every month to track the changes and progress overtime), including test and a short individual feedback on results
5. Environment – suggestions will be provided to the management of the company, in a form of a short report, about suggested environmental changes which could be implemented to support the nutrition habits and therefore, health and wellbeing of employees. These might include a purchase of an additional kettle or a fridge, looking into external food supplier on site (e.g. a van).

Please say whether the proposed changes present any new ethical issues or changes to ethical issues that were identified in the original ethics review, and provide details of how these will be addressed:

Due to the Covid-19 pandemic, guidelines provided by HSE and WHO were reviewed and below is a bullet point summary of key areas which will be considered when conducting the study:

1. Talks / individual and in small groups coaching (up to 10 people for talks):
   - To ensure the areas, surfaces (e.g. desk and tables) and objects (e.g. keyboards) are wiped with disinfectant regularly
   - To ensure face masks are available
   - To ensure hand sanitizers and paper tissue are available
   - To put sanitizing hand rub dispensers and paper tissues in prominent places around the training room to ensure workers use it prior to attending a coaching session / a talk
   - To encourage regular handwashing or use of an alcohol rub by all participants at the meeting or event
   - To ensure the trainer (a researcher) washes their hands and uses hand sanitizers prior to every session and regularly throughout the day
   - Coaching session / talks to be scaled down to a maximum number of 10 people (depending on the size of the room it might be less)
   - To advise participants in advance that if they have any symptoms or feel unwell, they should not attend
   - To provide information orally, on COVID-19 and the measures that a researcher is taking to make this event safe for participants
   - To ask participants to cover their face with the bend of their elbow or a tissue if they cough or sneeze
   - To supply tissues and closed bins for disposal
   - To arrange seats allowing a 2-meter social distance
   - To open windows and doors whenever possible to make sure the venue is well ventilated

2. Food demonstrations. Although Food Standard agency (FDA) states that it is very unlikely that coronavirus is transmitted through food, as good hygiene practice when handling food should be emphasised:
   - To wash hands often with soap and water for at least 20 seconds when handling food (before and after handling food, and especially after being in a public place, blowing their nose, coughing, or sneezing)
   - To wash hands when in the kitchen or preparation area, before preparing food, after touching raw food, after handling food waste or emptying a bin, after cleaning, after blowing nose, after touching phones, light switches, door handles etc.
   - To ensure objects and surfaces are frequently cleaned and disinfected using standard cleaning products

- To ensure a person handling food wears an aprons or other clean clothing as appropriate
- To ensure a person handling food keep hair tied back and wear a suitable head covering, e.g. hat or hair net, does not wear watches or jewellery (except a wedding band), does not touch their face and hair, smoke, spit, sneeze, eat or chew gum
- To ensure the distance between participants of at least 2 meters (arrange tables and chairs appropriately in staff canteen / welfare unit)
- To ensure notices promoting hand hygiene and social distancing are placed visibly in these areas
- To ensure face masks are available
- To ensure hand sanitizers and paper tissue are available
- To ensure food storing facilities (e.g. cupboards and fridges in the canteen / welfare units are clean
- To ensure food is purchased and transported in original, manufacture's packages
- To ensure masks, gloves and aprons are available for a person handing food – these to be double-bagged, then stored securely for 72 hours then thrown away in the regular rubbish after food demonstration and cleaning is finished

WHO - https://www.who.int/docs/default-source/coronaviruse/advice-for-workplace-clean-19-03-2020.pdf

HSE - https://www.hse.gov.uk/

Amendment Approved:	**YES**	***Date of Approval:***	**14/07/2020**

Chair's Signature:

Once completed you should submit this form and any additional documentation to the relevant Ethics Panel that reviewed the original proposal:

School of Health & Society	Health-ResearchEthics@Salford.ac.uk
School of Health Sciences	
School of Built Environment	S&T-ResearchEthics@salford.ac.uk
School of Environment & Life Sciences	
School of Computing Science and Engineering	
Salford Business School	SBS-ResearchEthics@salford.ac.uk
School of Arts & Media	A&M-ResearchEthics@salford.ac.uk

Amendment entification form 2

University of Salford MANCHESTER

Amendment Notification Form

Title of Project:		
A study to design and evaluate a participatory workplace nutrition intervention to improve the health and wellbeing of blue-collar (construction) workers.		
Name of Lead Applicant:	**School:**	
Magdalena Daria Wronska	Health & Society	
Are you the original Principal Investigator (PI) for this study?		Yes
If you have selected 'NO', please explain why you are applying for the amendment:		
Date original approval obtained:	**Reference No:**	**Externally funded project?**
10/09/2019	HSR1819-124	No

Please outline the proposed changes to the project. *NB. If the changes require any amendments to the PIS, Consent Form(s) or recruitment material, then please submit these with this form highlighting where the changes have been made:*

This amendment notification form is regarding a change in the data collection method intended to be used in the evaluation stage of the study. Initially, focus groups were planned as a part of the evaluation process, however, due to the restrictions related to Covid19 pandemic (e.g. social distancing and a number of individuals being permitted in one room at one time), the decision was made to conduct individual interviews instead. Although conducting individual interviews, rather than focus groups can be more time consuming (Saks and Allsop, 2019), the safety of both the participants and researcher while adhering to the Covid19 guidelines was a priority.

Individual interviews, both with stakeholders and participants, have previously been successfully used as a tool to evaluate workplace health promotion interventions in multiple settings, including in a government sponsored health education programme in Australia (Crane *et al.*, 2019), nutrition work intervention in Ireland (Fitzgerald *et al.*, 2016), environmental and educational nutrition programmes conducted at supermarkets and worksite cafeterias in the Netherlands (Steenhuis *et al.*, 2004), an employer-led, free lunch initiative in Northern Ireland (Schliemann *et al.*, 2019), and two European nutrition and lifestyle interventions in construction (Tonnon *et al.*, 2016; Viester *et al.*, 2014).

The following documents were update and included with this amendment notification form:

1. Research-Ethics-Application-Form updated 04 08 2021 (changes in the application form highlighted in yellow)
2. Ethics-Appendices update 04 08 2021, including new appendices related to interviews:

    16. Participant Information Sheet – EVALUATION
    17. Consent Form - EVALUATION

Version 3.0 – Nov 2018

18. Interview guide – intervention participants (EVALUATION)

19. Interview guide – decision-makers in the company and those involved in the implementation of the intervention (EVALUATION)

20. Participant Interview Invitation E-mail (EVALUATION)

Please say whether the proposed changes present any new ethical issues or changes to ethical issues that were identified in the original ethics review, and provide details of how these will be addressed:

The interviews will relate to questions about the nutrition intervention, which took place on site (see Appendix 18, 19 for topic guide). It is not anticipated that any of the questions will cause upset or anxiety, however, if this did happen, the interview would be suspended, and the respondent would be given time to decide whether or not to continue with the session. The respondent would be referred to their organisation's occupational health provider, or to their GP for further support, if necessary.

Amendment Approved:	**YES**	***Date of Approval:***	**13/08/2021**

Chair's Signature:

Once completed you should submit this form and any additional documentation to ethics@salford.ac.uk

Appendix 2 – Interview guide - Focus group questions

1. **Can you tell me about your food choices and eating habits when you are at work, so what, when, where and how you eat?**
   (What influences what you drink and eat at work? (e.g. health concerns, other people, availability, time, breaks))
2. **Can you tell me what kind of things make it easier for you to eat healthily when you are at work?**
3. **Can you tell me what kind of things make it harder for you to eat healthily at work?**
4. **Can you tell me about any health or wellbeing programmes / initiatives programmes in your workplace?**
   (Are there any aspects of those current health or wellbeing programmes / initiatives that you feel could be improved for construction workers, if so, what would these changes look like?)
5. **If we are able to put some things in place to help people to make better food choices at work what kinds of things would you like to see?**
   (If we are to implement nutritional programme at your workplace, what do you think would work best? If we are to run a nutrition programme within the workplace, what do you think this programme should include? How could these/could these be put in place practically? How do you think we could encourage you and your colleagues to participate and make positive nutritional changes during this programme?)

Appendix 3 - COM-B model of nutrition practices amongst UK construction workers (a summary of focus group themes)

COM-B component	**Sub-themes previously found in the literature**	**Sub-themes previously found in the literature AND identified in focus groups in this study**	**NEW sub-themes identified in focus groups in this study, not previously found in the literature**
Behaviour	1. Unhealthy behaviours including excessive alcohol consumption 2. Skipping meals 3. Snacking 4. Soft drinks and energy drinks consumption 5. Water intake 6. Convenient foods 7. Socialising at meals 8. Eating behaviour outside work	1. Unhealthy behaviours including excessive alcohol consumption 2. Skipping meals 3. Snacking 4. Soft drinks and energy drinks consumption 5. Water intake 6. Convenient foods 7. Socialising at meals 8. Eating behaviour outside work	1. Tea and coffee consumption 2. Fruit and vegetable intake 3. Food preparation at work 4. Meal planning and preparation 5. Bringing food from home
Capability	9. Nutrition knowledge 10. Personal resources	9. Nutrition knowledge 10. Personal resources	
Motivation	11. Energy – importance of sustaining energy during the working day 12. Obesity and other health problems 13. Safety, accidents and food choices 14. Taste and appetite	11. Energy – importance of sustaining energy during the working day 12. Obesity and other health problems	6. Habits and routines 7. Feedback and advice from professionals
Opportunity	15. Social identity, peer pressure, peer-support 16. Occupational groups divisions (eating practices) 17. Living conditions when working on site 18. Welfare facilities on site 19. Job demands 20. Breaks – insufficient time to eat 21. Site location affecting food choices 22. Cost of healthy foods 23. A growing interest in health and changes in the industry 24. On-site canteens (positive and negative effects) 25. Shift work	13. Social identity, peer pressure, peer-support 14. Occupational groups divisions (eating practices) 15. Living conditions when working on site 16. Welfare facilities on site 17. Job demands 18. Breaks – insufficient time to eat 19. Site location affecting food choices 20. Cost of healthy foods 21. A growing interest in health and changes in the industry	8. Occupational groups divisions (facilities and health promotion opportunities)

Appendix 4 - Questionnaire mapping

1. **Knowledge – behaviour questions – mapping**

SAD- self- administered questionnaire
IAQ – interviewer-administered questionnaire

Knowledge question	Behaviour questions
Q1 SAD	Q2, Q3 IAQ
Q2 SAD	Q1 IAQ
Q3 SAD	Q4 IAQ
Q4 SAD	Q4 IAQ
Q5 SAD	Q7 IAQ
Q6 SAD	Q8 IAQ
Q7 SAD	Q1, 2, 3, 4, 7 IAQ
Q8 SAD	N/A
Q9 SAD	Q11, 12 SAD
Q10 SAD	Q11, 12 SAD

2. **Themes – knowledge, behaviour, context questions mapping**

Literature review and focus groups findings

Focus groups finings only

Literature review findings only

SAQ – self-administered questionnaire

IAQ – interviewer-administered questionnaire

	Themes	Question number (knowledge / behaviour / context / about you)	Nutrition guidelines used (Eat Well Guide - EWG)
1	Obesity and other health related problems	Knowledge Q7, Q8 SAD	
2	Unhealthy behaviours	Knowledge Q8 SAD Behaviour Q5 IAQ About you Q31 SAD	EWG
3	Energy – importance of sustaining good energy throughout the day	Behaviour Q14 SAD	
4	Nutrition knowledge / education	Knowledge Q1-10 SAD Behaviour Q14 SAD	EWG
5	Interest in health / changes in the industry	Behaviour Q14 SAD	
6	Convenient foods (including take – away, ready meals, eating out), quick, easy, practical	Behaviour Q1 IAQ	

7	Snacking	Behaviour Q1, Q6 IAQ	
8	Soft drinks and energy drinks	Knowledge Q4 SAD Behaviour Q4 IAQ	EWG
9	Water intake	Knowledge Q3 SAD Behaviour Q4 IAQ	EWG
10	Eating behaviour outside work	Behaviour Q14 SAD Behaviour Q1 IAQ Behaviour Q6 IAQ	
11	Skipping meals	Behaviour Q6 IAQ	
12	Socialising at meals / building relationships	Behaviour Q13 SAD	
13	Social identity / peer- pressure and / or peer support	Behaviour Q13 SAD	
14	Occupational groups divisions (eating practices)	Behaviour Q13 SAD	
15	Breaks (insufficient time to eat)	Behaviour Q13 SAD	
16	Living conditions when working on site (no access to good quality food, food preparation facilities)	Context Q15 SAD Context Q17 SAD	
17	Welfare facilities on site	Context Q18 SAD	
18	Site location affecting food choices	Context Q16 SAD	
19	Job demands, the “nature” of the industry	Behaviour Q13 SAD	
20	Personal resources – choice, motivation and willpower	Behaviour Q14 SAD	
21	Cost of food, including healthy foods	Behaviour Q14 SAD	
1	Fruit and vegetables intake	Knowledge Q1 SAD Behaviour Q2, Q3 IAQ	EWG
2	Tea and coffee consumption	Behaviour Q4 IAQ	
3	Brining food from home / packed breakfast / lunch	Behaviour Q13 SAD Behaviour Q1 IAQ	
4	Meal planning and preparation	Behaviour Q13, Q14 SAD	
5	Habits and routines	Behaviour Q14 SAD	
6	Food preparation at work	Behaviour Q13 SAD Behaviour Q1 IAQ	
7	Feedback and advice from professionals / Health checks	Behaviour Q14 SAD	
8	Occupational groups divisions (facilities)	Behaviour Q13 SAD	
1	Safety, accidents and food choices	Behaviour Q14 SAD	
2	On site canteen (positive and negative effect)	Context Q18 SAD	
3	Shift work	About you Q28 SAD	
4	Taste and appetite	Behaviour Q14 SAD	

Appendix 5 – Questionnaire – Part 1 (self-administered)

<u>Knowledge</u>

1.**How many portions of fruit and vegetables (combined) do you think health experts would recommend eating every day?** (Please tick one answer only)

- 1-2
- 3-4
- 5+
- Not sure

2.Foods high in fat, salt and sugar like chocolate, cakes: (Please tick one answer only)

- are not needed in our diet
- should not make up more than a quarter of your plate
- are high in fibre
- not sure

3.How many glasses of water do you think you should drink every day? (Please tick one answer only)

1 glass = 180-200ml = a third of pint (1/3 pint)

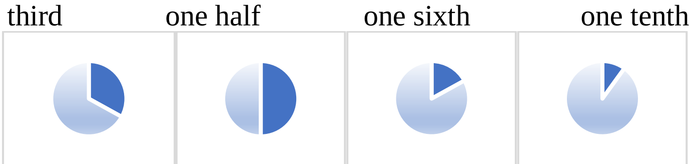
- 1 glass
- 2-3 glasses
- 4-5 glasses
- 6-8 glasses
- As much as you can
- Not sure

4. Daily consumption of juices and smoothies should be limited to: (Please tick one answer only)

- 1 glass (=1/3 pint)
- 2-3 glasses (=2/3 pint – 1 pint)
- A large bottle
- There is no recommended limit
- Not sure

5.What part of your daily diet should be composed of the following food groups?
(Please tick one answer only for each food group)

	one third	one half	one sixth	one tenth



• potatoes, bread, rice, pasta or other starchy carbohydrates	☐	☐	☐	☐
• fruits and vegetables	☐	☐	☐	☐

6.Which foods are rich sources of the following nutrients? (Please tick one answer only for each food)

	Starchy carbohydrates	Fats	Protein
• Potatoes	☐	☐	☐
• Rice	☐	☐	☐
• Eggs	☐	☐	☐
• Beans	☐	☐	☐
• Avocados	☐	☐	☐
• Olive oil	☐	☐	☐

7. What do you think are the main causes of obesity? (please tick as many boxes as apply)

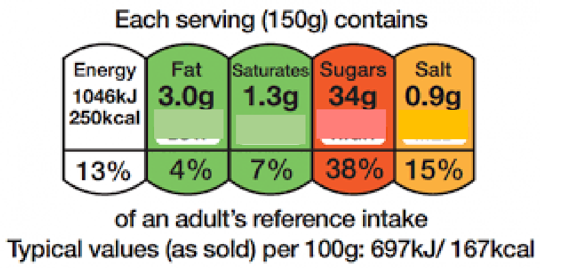
- Eating large portion sizes
- Eating lots of fast food / take-away food
- Drinking sugary drinks
- Eating more than 5 portions of fruit and vegetables a day

8. Poor diet might contribute to the development of: (please tick as many boxes as apply)

- Obesity
- Type 2 diabetes
- Cardiovascular disease
- Digestive problems like constipation, diarrhea or heartburn

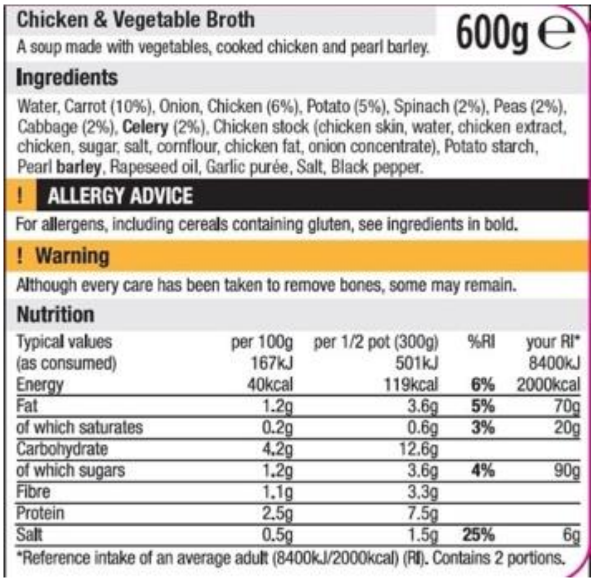
9. Traffic lights are often used on nutrition labelling, what would red mean for the sugar content of a food? (Please tick one answer only)

- Low sugar
- Medium sugar
- High in sugar
- Not sure



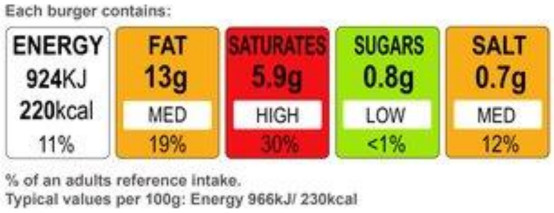
10. Ingredients on the food labels are always listed in:
(Please tick one answer only)

- Alphabetical order
- Randomly
- In ascending order (from least to greatest)
- In descending order (from greatest to least)
- Not sure



Behaviour

11. Do you use food labels like the one below when choosing foods? (Please tick one answer only)



- Not at all
- Not very much
- A little
- A lot
- Don’t know

12. Which items of nutritional information influence your food choice the most? (please tick as many boxes as apply)

- Fat
- Calories
- Sugar
- Salt
- Saturated fat
- Protein
- Carbohydrates
- Other (specify) ……..
- None
- Don't know

13. Which of the following best describes your eating behaviour at work? (please tick one box for each statement)

	always	often	sometimes	seldom	never
I bring food (breakfast / lunch) from home					
I buy food in a local shop / take-away / cafe					
I buy food from a canteen on site					
I prepare food at work					
I eat together with my colleagues when at work					
I prepare / cook food with my colleagues when at work					
I eat with my colleagues, managers and workers from other divisions					
I share the food I bring from home with my colleagues					
I shop, prepare food and eat with my colleagues, we live in the same accommodation					
I have difficulty eating and drinking during work, due to insufficient break time					
I have difficulty eating and drinking during work, due to being busy at work					

I cannot eat healthily due to limited options available around my work					

14. Which of the following best describes your attitude to nutrition and your eating behaviour in general? please tick one box for each statement which best represents your response)

	Strongly agree	agree	Neither agree / disagree	disagree	Strongly disagree
My work affects my food choices at home					
I am interested in health checks					
I am interested in professional advice about healthy eating					
I am not interested in healthy eating					
I am confused about what is healthy or not					
I plan my meals in advance					
I have my routine when it comes to buying and preparing food					
I have no motivation to eat healthily					
I have no energy to eat healthily					
I have no time to prepare food					
My food choices affect my concentration during the day					
I choose foods that give me energy during the day					
Healthy eating is too expensive					
Healthy food does not taste good					

Context questions

15. Which of the following best describes your living situation when you work on site? (please tick as many boxes as apply)

- living at home
- staying temporarily with friends and family
- staying in temporary accommodation (e.g. hotel, B&B, guest house) with food preparation and food storing facilities available (e.g., kitchen, fridge)
- staying in temporary accommodation (e.g. hotel, B&B, guest house) with NO food preparation or food storing facilities available
- staying in temporary accommodation (e.g. hotel, B&B, guest house) with a restaurant, a bar of a cafe
- staying in a rented flat or a house

16. Which of the following best describes the availability of food outlets on the construction site you work? (Please tick one answer only)

- There is a good choice of food shops, take-aways, cafes in the area
- There is limited choice of food shops, take-aways, cafes in the area
- There are no food shops or cafes in the areas. It is a very remote site.

17. Which of the following best describes the availability of food outlets around where your accommodation is (Please tick one answer only)

- There is a good choice of food shops, take-aways, cafes in the area
- There is limited choice of food shops, take-aways, cafes in the area
- There are no food shops or cafes in the areas. It is a very remote site.

18. Which of the following best describes welfare facilities provided on site? (please tick as many boxes as apply)

- Canteen serving hot and cold food
- Van / café / shop serving hot food
- Van / café / shop serving cold food
- Vending machine with snacks and drinks
- Kitchen allowing for food preparation and storage (e.g. microwave, fridge, toaster)
- Kitchen allowing for food preparation only
- Kitchen allowing for food storing only
- Water stations
- Tea and coffee facilities
- Only eating area (tables, chairs)
- No facilities

Health questions

19. In general, would you say that your health is (Please circle one answer only)

excellent very good good fair poor

Wellbeing questions

20. Overall, how satisfied are you with your life nowadays?
Where 0 is 'extremely dissatisfied' and 10 is 'extremely satisfied'. (Please circle one answer only)

Extremely dissatisfied 0 1 2 3 4 5 6 7 8 9 10 Extremely satisfied

21. Overall, to what extent do you feel that the things you do in your life are worthwhile?
Where 0 is 'not at all worthwhile' and 10 is 'extremely worthwhile'. (Please circle one answer only)

Not at all worthwhile 0 1 2 3 4 5 6 7 8 9 10 Extremely worthwhile

22. Overall, how happy did you feel yesterday?
Where 0 is 'extremely unhappy' and 10 is 'extremely happy'. (Please circle one answer only)

Extremely unhappy 0 1 2 3 4 5 6 7 8 9 10 Extremely happy

23. Overall, how anxious did you feel yesterday?
Where 0 is 'not at all anxious' and 10 is 'extremely anxious'. (Please circle one answer only)

Not at all anxious 0 1 2 3 4 5 6 7 8 9 10 Extremely anxious

About you

24.What is your gender? (please tick only one answer)

- Male
- Female
- Other ………………

25.What is your ethnic group? (Please tick only one answer)

White • English / Welsh / Scottish / Northern Irish / British • Irish • Gypsy or Irish Traveller • Any other White background, write in ………………………….
Mixed / multiple ethnic groups • White and Black Caribbean • White and Black African • White and Asian • Any other Mixed / multiple ethnic background, write in ………………………….
Asian / Asian British • Indian • Pakistani • Bangladeshi • Chinese • Any other Asian background, write in ………………………….
Black / African / Caribbean / Black British • African • Caribbean • Any other Black / African / Caribbean background, write in ………………………….
Other ethnic group • Arab • Any other ethnic group, write in …………………

26. How old are you? (Please tick only one answer)

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64

27. What is your job? …………………………

28. Do you work shifts?

- Yes
- No

29. In your job, are you: (Please tick only one answer)

- an employee?
- self-employed or freelance?
- business owner with employees?

30. What is the highest level of school you attended? (Please tick only one answer)

- None
- Primary
- Secondary
- Higher or secondary or further education (A-levels, BTEC, etc.)
- College or university
- Post-graduate degree
- Prefer not to say

31. Are you a smoker? (please tick only one answer)

- Yes
- No

Appendix 6 – Questionnaire – Part 2 (interviewer-administered)

<u>Behaviour</u>

1. For every question tick the answer indicating how often on average you had the following meals during the <u>past month</u> (please tick one answer only for each meal)

In the last month, on average…	Rarely or never	1-3 per month	Once a Week	2-3 times a Week	4-6 times a Week	1-2 times a Day	3-4 times a Day	5+ a Day
How often did you eat a meal cooked using mostly **fresh or raw** ingredients?								

Please give examples of two meals cooked with fresh or raw ingredients that you eat regularly.

……………………………………………………………………………………………………
……………………………………………

……………………………………………………………………………………………………
……………………………………………

In the last month, on average…	Rarely or never	1-3 per month	Once a Week	2-3 times a Week	4-6 times a Week	1-2 times a Day	3-4 times a Day	5+ a Day
How often did you eat a meal cooked using some **pre-prepared** ingredients? (e.g. sauces in jars, pizza bases etc.)								

Please give examples of two meals cooked with pre-prepared ingredients that you eat regularly.

……………………………………………………………………………………………………
……………………………………………

……………………………………………………………………………………………………
……………………………………………

In the last month, on average…	Rarely or never	1-3 per month	Once a Week	2-3 times a Week	4-6 times a Week	1-2 times a Day	3-4 times a Day	5+ a Day
How often did you **eat out or have a take- away meal**? (e.g. burgers, pizza, chicken or chips from restaurants, cafes, or local take-away places)								

Please give examples of two take-away meals / meals that you eat out regularly.

……………………………………………………………………………………………………
……………………………………………

……………………………………………………………………………………………………
……………………………………………

In the last month, on average…	Rarely or never	1-3 per month	Once a Week	2-3 times a Week	4-6 times a Week	1-2 times a Day	3-4 times a Day	5+ a Day
How often did you eat a **ready meal**? (a pre-packaged, fresh or frozen meal, sometimes in its own packaging)								

Please give examples of two ready meals you eat regularly.

……………………………………………………………………………………………………
……………………………………………

……………………………………………………………………………………………………
……………………………………………

In the last month, on average…	Rarely or never	1-3 per month	Once a Week	2-3 times a Week	4-6 times a Week	1-2 times a Day	3-4 times a Day	5+ a Day
How often did you **eat potato crisps or other salty snacks such as tortilla chips or corn chips?**								

In the last month, on average…	Rarely or never	1-3 per month	Once a Week	2-3 times a Week	4-6 times a Week	1-2 times a Day	3-4 times a Day	5+ a Day
How often did you **eat biscuits, cakes, donuts, muesli bars, chocolate, confectionary bars?**								

2. On average, how many portions of vegetables do you eat per day? (do not include potatoes, juices or smoothies) (examples include: 3 heaped tablespoons of carrots, a side salad, 2 spears of broccoli). (Please tick one answer only)

0-1	2-3	4-5	6+

3. On average, how many portions of fruit do you eat per day? (do not include juices or smoothies) (examples include a handful of grapes, an orange, a glass of fruit juice, a handful of dried fruits). (Please tick one answer only)

0-1	2-3	4-5	6+

4. On average, how many glasses of each do you drink every day? (please fill in all spaces that are applicable)

1 glass = 180-200ml = a third of pint (1/3 pint)

Water__
Juice___
Smoothie ______
Coffee_
Tea ____
Energy drinks__
Soft drinks (e.g. cola, lemonade)_______.
Others, please specify __

5. On average, how many of the following drinks containing alcohol do you have in a typical week? (please fill in all spaces that are applicable)

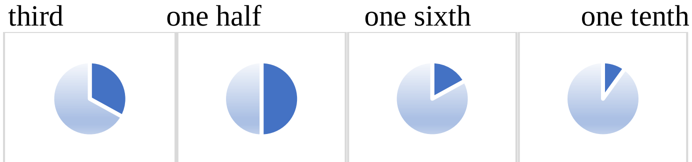
- Beer (1 pint)_________
- Wine (1 medium size glass = 120ml) __________
- Liquor, e.g. whiskey, gin, vodka (1 drink or 1 shot)_________
- I don't drink alcohol

6. In a typical week, how often do you eat the following meals? (Please tick one answer only for each meal)

	0-1 days / week	2-3 days / week	4-5 days / week	6-7 days / week
Breakfast				
Mid-morning snack				
Lunch				
Mid-afternoon snack				
Dinner				

7. In a typical day, what part of your daily diet is composed of the following food groups? (Please tick one answer only for each food group)

one third one half one sixth one tenth



- potatoes, bread, rice, pasta or

other starchy carbohydrates	☐	☐	☐	☐
• fruits and vegetables	☐	☐	☐	☐

8. What are the main sources of protein, fats and carbohydrates in your everyday diet? (Please give 2-3 examples each if applicable)

Protein …………………

Fats …………………

Carbohydrates ………………..

9. What would you normally have for breakfast on a working day?

………

………

10. What would you normally have for lunch on a working day?

………

………

Appendix 7 Recommendations on the measurement using bioimpedance analysis monitor (Tanita SC-331S) and a body composition testing protocol

Measurement considerations / conditions	**Application in the measurement protocol in the study**
Calibration	Measurements will be conducted to the manufacturer’s recommendations and calibration will be regularly completed (a self-test is provided in the device).
Maintenance	A visual inspection of the following will be conducted weekly: • The display for any damage or contamination • All cables, cords, and connector ends for damage or contamination • All safety-related labeling for legibility • All accessories for wear or damage
Cleaning	The machine will be cleaned using a detergent wipe after every test. A person operating the machine will be asked to use a hand sanitizer after every test.
Food consumption	Participants to be advised to abstain from eating a meal at least 2 to 3 hours before the test.
Drink consumption	Participants to be advised to drink enough fluids (6-8 glasses of water) over the 24-hour period preceding the test to ensure normal hydration at the time of the test. Participants to be advised to abstain from drinking large amounts of fluid at least 2 to 3 hours before the test. Participants to be advised to refrain from consuming caffeine (tea, coffee and energy drinks) within 12 hours of the test.
Alcohol	Participants to be advised to refrain from consuming alcohol within 24 hours of the test.
Exercise	Participants to be advised to avoid vigorous activity 8 hours before testing (due to the physical nature of the construction jobs, body composition testing will be conducted in the morning, after a staff briefing, before work commences).
Bladder voided	Participants to be asked to empty bladder (urinate) at least 30 minutes prior to testing.
Other devices	Participants will be asked not to use transmitting devices, such as mobile phones, while the test is performed.
Data required to conduct the test	Height - Participants will be asked about their height (in cm, rounded-up or -down to the nearest whole number). If a participant knows their height in feet / inches only, a person taking a test will have a tool allowing the conversion of feet / inches into centimeters. Age - Participants will be asked about their age.
Timing	The measurement will be performed once a month, at the same time of the day (in the morning, after a staff briefing).
Location	The measurement to be conducted in a stable location (the same room). The device to be used on a stable and level surface on a firm flooring, not on a thick carpet.
Temperature	The measurement to be taken in the ambient temperature. After transportation, the machine to stand for at least 2 hours before using.
Position	The measurement to be performed standing. Participants will be asked to ensure their full feet touching metal plates (where the electrodes are). Hands and legs to be slightly separated from the body.

Footwear	Participants to be prepared to be barefoot. Shoes, socks, tights have to be removed prior to taking the measurement.
Skin	Participants to be asked to thoroughly wipe (using alcohol wipes) their feet before the test. Further explanation will be provided that moist or covered with body lotion skin, can affect the results. Participants will be asked to ensure the soles of feet are free of excess dirt, as this may block the mild electric current.
Contradictions	Participants will be asked not to take part in the test if they have any skin lesions on their feet (warning sign will be displayed (Appendix 12) and a person taking a test will be verbally checking with every participant prior to taking a test). No measurements will be carried out if participant has electrical device such as pacemaker or cochlear implant (warning sign will be displayed and a person taking a test will be verbally checking with every participant prior to taking a test).
Further explanation	Participants will be informed that the methods used for body composition can just provide an estimate and that body fat percentage estimates are influenced by a change in water content in the body throughout the day (consistency in testing conditions are important for tracking changes).

Body composition testing – PROTOCOL

Dear Participant,

Thank you for your interest in taking part in the nutrition intervention at your workplace. As a part of the intervention, we will be conducting a body composition testing using Tanita machine, model Tanita SC-331S.

About a body composition testing

Body composition testing is a non-invasive method using a bioimpedance analysis (BIA). It is a valuable tool for measuring your body composition—the measurement of body fat in relation to lean body mass. It is an important part of any comprehensive health and nutrition assessment. A normal balance of body fat to lean body mass is associated with good health and longevity. Excess fat in relation to lean body mass, a condition known as altered body composition, can greatly increase your risk of cardiovascular disease, diabetes, and more. BCT serves to measure your progress as you work to improve your health. Improving your body composition measurement, or maintaining a healthy measurement, can help keep your body functioning properly for healthy ageing and reduced risk of illness.

How does BCT machine (Tanita) work and how the measurement will be taken?

BCT machine (as in the picture on the right-hand side) is more sophisticated than your bathroom scale, but just as painless-and almost as quick. BCT is a simple procedure, which will be performed at your workplace in a matter of minutes. You will be asked to remove your shoes and socks, heavy clothing and equipment and step on the scales (looking your bathroom scales) (as in the picture below). You will be asked about your age and height. The analyser will calculate your tissue and fluid compartments using an invisible electrical current passed through the metal pads you will be standing on. Lean tissue, which is over 70% water, is a good conductor of electrical current. Fatty tissue, which is low in water, is not. Thus, the resistance to the flow of electrical current measured by the analyser can be used to calculate the body composition. After the measurement, you will receive your results (showing your weight, body mass index, fat mass and fat free mass). After the test, you will take part in a short one to one session with a person taking the measurement, who will explain your results and suggest ways to improve them in future. You will also have a chance to further discus your results during the coaching sessions.

What to do to ensure the most precise results?

BCT machine readings depend on your hydration levels, and that is why sometimes there might be some discrepancies in the results (e.g. when you had a lot of coffee or alcohol the day before). In order to ensure that your readings are as accurate as possible, we will ask you to follow the guidelines below:

1. Do not eat at least 2 to 3 hours before the test.
2. Drink enough fluids (6-8 glasses of water) during the day before the test to ensure normal hydration at the time of the test.
3. Do not drink large amounts of fluid at least 2 to 3 hours before the test.
4. Do not drink caffeinated drinks (e.g. coffee, tea, energy drinks) for 12 hours before the test.
5. Do not drink alcohol 24 hours before the test.
6. Avoid rigorous exercise 8 hours before testing.
7. Make sure that you empty bladder (urinate) at least 30 minutes before the test.
8. Do not use transmitting devices, such as mobile phones, while the test is performed.
9. You will need to be barefoot. Be prepared to remove your shoes, socks and tights while taking the test.

10. You will be asked to wipe (using alcohol wipes) your feet before the test. Moist or covered with body lotion skin can affect the results. It is also to ensure that the soles of feet are free of dirt, as this may block the mild electric current.

WARNING!

You will **NOT** be able to take part in the testing if:

1. You have any **skin lesions** on your feet
2. You have an implanted **electrical device** such as **pacemaker** or **cochlear implant**
3. You are **pregnant**

However, please do not worry if you are not able or do not wish to take part in the body composition testing. You will still be able to take part in the educational and coaching sessions, as well as in food demonstrations.

If you have any queries at all, please get in touch at name@edu.salford.ac.uk. I am looking forward to meeting you soon.

Best wishes,

[researcher's name]

Appendix 8 – Questionnaire scoring

Questionnaire scoring – nutrition knowledge questions

Nutrition knowledge content covered	Questionnaire (part) and question number	Question	Answers	Scoring
Awareness of the official dietary recommendations - the EatWell Guide	1	Recommended daily portions of fruit and vegetables	1-2	0
			3-4	0
			5+	1
			Not sure	0
	2	Knowledge on foods high in fat, salt and sugar	are not needed in our diet	1
			should not make up more than a quarter of your plate	0
			are high in fibre	0
			not sure	0
	3	Recommended daily water intake	1 glass	0
			2-3 glasses	0
			4-5 glasses	0
			6-8 glasses	1
			As much as you can	0
			Not sure	0
	4	Recommended daily juice and smoothie consumption	1 glass (=1/3 pint)	1
			2-3 glasses (=2/3 pint – 1 pint)	0
			A large bottle	0
			There is no recommended limit	0
			Not sure	0
	5	Recommended part of a diet composed of potatoes, bread, rice, pasta or other starchy carbohydrates	One-third	1
			One-half	0
			One-sixth	0
			One-tenth	0
	6	Recommended part of a diet composed of fruits and vegetables	One-third	1
			One-half	0
			One-sixth	0
			One-tenth	0
Knowledge on the nutrient content in foods		Nutrient content in food - potatoes	Starchy carbohydrates	1
			Fat	0
			Protein	0
		Nutrient content in food - rice	Starchy carbohydrates	1
			Fat	0
			Protein	0
		Nutrient content in food - eggs	Starchy carbohydrates	0
			Fat	1
			Protein	1
		Nutrient content in food - beans	Starchy carbohydrates	1
			Fat	0
			Protein	1

		Nutrient content in food - avocado	Starchy carbohydrates	0
			Fat	1
			Protein	0
		Nutrient content in food - olive oil	Starchy carbohydrates	0
			Fat	1
			Protein	0
knowledge on a relationship between diet and health		Obesity causes	Eating large portion sizes	1
			Eating lots of fast food / take-away food	1
			Drinking sugary drinks	1
			Eating more than 5 portions of fruit and vegetables a day	1 (if answer not selected)
		Poor health outcomes	Obesity	1
			Type 2 diabetes	1
			Cardiovascular disease	1
			Digestive problems like constipation, diarrhea or heartburn	1
choosing everyday foods and using information to make healthy dietary choices (e.g. food labels)		Traffic light system food label – meaning of red colour	Low sugar	0
			Medium sugar	0
			High in sugar	1
			Not sure	0
		Order of ingredients on the food label	Alphabetical order	0
			Randomly	0
			In ascending order (from least to greatest)	0
			In descending order (from greatest to least)	1
			Not sure	0

Total (max): 22

Questionnaire scoring – nutrition behaviour questions, health, wellbeing, body composition

Content covered	**Questionnaire (part) and question number**	**Question**	**Answers**	**Scoring**
Health and wellbeing		Self-rated health	Excellent	1
			Very good	1
			Good	0
			Fair	0
			Poor	0
		Wellbeing question - 4ONS	Life satisfaction 0-10	Mean score
			Worthwhile 0-10	Mean score
			Happy yesterday 0-10	Mean score
			Anxious yesterday 0-10	Mean score
Nutrition behaviour – using labels		Using food labels when choosing foods?	Not at all	0
			Not very much	1
			A little	2
			A lot	3
			Don't know	0
Nutrition behaviour – frequencies		In the last month, on average… How often did you eat a meal cooked using mostly fresh or raw ingredients?	Rarely or never	0
			1-3 per month	1
			Once a week	2
			2-3 times a week	3
			4-6 timed a week	4
			1-2 times a day	5
			3-4 times a day	6
			5+ a day	7
		In the last month, on average… How often did you eat a meal cooked using some pre-prepared ingredients? (e.g. sauces in jars, pizza bases etc.)	Rarely or never	7
			1-3 per month	6
			Once a week	5
			2-3 times a week	4
			4-6 timed a week	3
			1-2 times a day	2
			3-4 times a day	1
			5+ a day	0
		In the last month, on average… How often did you eat out or have a take- away meal? (e.g. burgers, pizza, chicken or chips from restaurants, cafes, or local take-away places)	Rarely or never	7
			1-3 per month	6
			Once a week	5
			2-3 times a week	4
			4-6 timed a week	3
			1-2 times a day	2
			3-4 times a day	1
			5+ a day	0
		In the last month, on average… How often did you eat a ready meal? (a pre-packaged, fresh or frozen meal, sometimes in its own packaging)	Rarely or never	7
			1-3 per month	6
			Once a week	5
			2-3 times a week	4
			4-6 timed a week	3
			1-2 times a day	2
			3-4 times a day	1

<table>
<tr><td rowspan="17"></td><td></td><td></td><td>5+ a day</td><td>0</td></tr>
<tr><td rowspan="8"></td><td rowspan="8">In the last month, on average… How often did you eat potato crisps or other salty snacks such as tortilla chips or corn chips?</td><td>Rarely or never</td><td>7</td></tr>
<tr><td>1-3 per month</td><td>6</td></tr>
<tr><td>Once a week</td><td>5</td></tr>
<tr><td>2-3 times a week</td><td>4</td></tr>
<tr><td>4-6 timed a week</td><td>3</td></tr>
<tr><td>1-2 times a day</td><td>2</td></tr>
<tr><td>3-4 times a day</td><td>1</td></tr>
<tr><td>5+ a day</td><td>0</td></tr>
<tr><td rowspan="8"></td><td rowspan="8">In the last month, on average… How often did you eat biscuits, cakes, donuts, muesli bars, chocolate, confectionary bars?</td><td>Rarely or never</td><td>7</td></tr>
<tr><td>1-3 per month</td><td>6</td></tr>
<tr><td>Once a week</td><td>5</td></tr>
<tr><td>2-3 times a week</td><td>4</td></tr>
<tr><td>4-6 timed a week</td><td>3</td></tr>
<tr><td>1-2 times a day</td><td>2</td></tr>
<tr><td>3-4 times a day</td><td>1</td></tr>
<tr><td>5+ a day</td><td>0</td></tr>
<tr><td rowspan="8">Nutrition behaviour – fruit and vegetable consumption</td><td rowspan="4"></td><td rowspan="4">On average, how many portions of vegetables do you eat per day?</td><td>0-1</td><td>0</td></tr>
<tr><td>2-3</td><td>1</td></tr>
<tr><td>4-5</td><td>2</td></tr>
<tr><td>6+</td><td>3</td></tr>
<tr><td rowspan="4"></td><td rowspan="4">On average, how many portions of fruit do you eat per day?</td><td>0-1</td><td>0</td></tr>
<tr><td>2-3</td><td>1</td></tr>
<tr><td>4-5</td><td>2</td></tr>
<tr><td>6+</td><td>3</td></tr>
<tr><td rowspan="2">Nutrition behaviour - drinks consumption (incl. alcohol)</td><td></td><td>On average, how many glasses of each do you drink every day?</td><td></td><td>Mean score (glasses)</td></tr>
<tr><td></td><td>On average, how many of the following drinks containing alcohol do you have in a typical week?</td><td></td><td>Mean score (drinks, alcohol units)</td></tr>
<tr><td rowspan="8">Nutrition behaviour – food groups composing a part of daily diet (as a part of the plate)</td><td rowspan="4"></td><td rowspan="4">In a typical day, what part of your daily diet is composed of the following food groups?
• potatoes, bread, rice, pasta or other starchy carbohydrates</td><td>One-third</td><td>1</td></tr>
<tr><td>One half</td><td>0</td></tr>
<tr><td>One sixth</td><td>1</td></tr>
<tr><td>One tenth</td><td>1</td></tr>
<tr><td rowspan="4"></td><td rowspan="4">In a typical day, what part of your daily diet is composed of the following food groups?
• Fruit and vegetables</td><td>One-third</td><td>1</td></tr>
<tr><td>One half</td><td>1</td></tr>
<tr><td>One sixth</td><td>0</td></tr>
<tr><td>One tenth</td><td>0</td></tr>
<tr><td rowspan="6">Body composition</td><td rowspan="6">n/a</td><td colspan="2">Weight (kg) (all participants)</td><td>Mean score</td></tr>
<tr><td colspan="2">Fat % (males only)</td><td>Mean score</td></tr>
<tr><td colspan="2">FFM (kg)</td><td>Mean score</td></tr>
<tr><td colspan="2">VF (all participants)</td><td>Mean score</td></tr>
<tr><td colspan="2">BMI (all participants)</td><td>Mean score</td></tr>
<tr><td colspan="2">Age of participants vs metabolic age (all participants)</td><td>Mean score</td></tr>
</table>

Appendix 9 - Individual interviews guide

Interview guide – intervention participants (EVALUATION)

Conducting the interviews (to be read out at the beginning)

Firstly, I'd like to thank you for coming to this interview; I really value your input into our study, in which we will evaluate the nutrition intervention that took place on your site and explore how to design future nutrition interventions to improve the health and wellbeing of construction workers. My name is [researcher's name] and I will be the interviewer today. I am conducting this study as a part of my PhD, which I am undertaking at the University of Salford, and my job is to ask you some questions about your participation in the nutrition intervention.

Your thoughts on the nutrition intervention that took place on site are valuable to us because you took part in the intervention, and we are here to learn from you and your experiences. Just to remind you that this interview is strictly voluntary, and that we are going to tape the discussion, just so that we don't miss anything important and so we can go back and revisit the information if we need to.

I also wanted to remind you that if you wish to withdraw during or after the interview, you can do it within 1 month of the interview, by getting in touch with me using details provided to you on Participant Information Sheet. All the information and data collected from you, to date, will still be used, but your name will be removed from all the study files. Due to the nature of the interview, once the interview has been completed, data cannot be withdrawn, as it is not possible to "forget" what has been said in the interview.

The interview will last no longer than an hour, and we'd like to stress that we want to keep the sessions confidential so we ask that you not use names or anything directly identifying when you talk about your personal experiences.

DO YOU HAVE ANY QUESTIONS SO FAR?

If you're happy to move on, we'll begin:

1. **Can you tell me about taking part in the intervention?**

   Prompt: What did you learn? What did you achieve? How did you benefit? What difference did it make to you? How did you hear about it? How many times did you attend? Which sessions? What encouraged you to take part?

2. **Can you tell me about how the company (and managers and supervisors) have been about you taking part in the intervention?**

   Prompt: If being supportive, allowing time to attend, encourage participation

3. **What were the things that helped the intervention to work well?**

   Prompt: What did you like? (e.g., talks, food demonstrations, body composition testing, meal planning, small challenges)

4. **What were the things that made the intervention difficult?**

   Prompt: What did you like? What didn't you like about the intervention? Did you find any aspects of the intervention particularly challenging? (e.g. time to attend, permission from supervisors, difficulty of information provided, following the recommendations, difficulty in breaking old habits, filling out questionnaires)

5. **How was the intervention received on site?**

   Prompt: Were you recommended to attend by somebody else? Would you recommend attending to your colleagues? Would you take part again?

6. **Have you got any suggestions for how the intervention could be improved in future?**

At the end of the questioning:

I think we've come to the end of our questions. Let me be the first to say thank you for your honest opinions – you were tremendously helpful.

Again, thank you very much for your participation today. We really appreciate your help.

Interview guide – decision-makers in the company and those involved in the implementation of the intervention (EVALUATION)

Conducting the interviews (to be read out at the beginning)

Firstly, I'd like to thank you for coming to this interview; I really value your input into our study, in which we will evaluate the nutrition intervention that took place on your site and explore how to design future nutrition interventions to improve the health and wellbeing of construction workers. My name is [researcher's name] and I will be the interviewer today. I am conducting this study as a part of my PhD, which I am undertaking at the University of Salford, and my job is to ask you some questions about your role in the implementation of the nutrition intervention on site.

Your thoughts on the nutrition intervention that took place on site are valuable to us because you helped us in the implementation of the intervention, and also took part in the intervention, and we are here to learn from you and your experiences. Just to remind you that this interview is strictly voluntary, and that we are going to tape the discussion, just so that we don't miss anything important and so we can go back and revisit the information if we need to.

I also wanted to remind you that if you wish to withdraw during or after the interview, you can do it within 1 month of the interview, by getting in touch with me using details provided to you on Participant Information Sheet. All the information and data collected from you, to date, will still be used, but your name will be removed from all the study files. Due to the nature of the interview, once the interview has been completed, data cannot be withdrawn, as it is not possible to "forget" what has been said in the interview.

The interview will last no longer than an hour, and we'd like to stress that we want to keep the sessions confidential so we ask that you not use names or anything directly identifying when you talk about your personal experiences.

DO YOU HAVE ANY QUESTIONS SO FAR?
If you're happy to move on, we'll begin:

1. **Can you tell me about your company taking part in the nutrition intervention?**

   Prompt: Why did your company take part in the intervention? What did the company hope to achieve? Did the company have any concerns about taking part in the intervention? What were the barriers and facilitators to the intervention being adopted by the company?

2. **Can you tell me about your experiences of the nutrition intervention as a person engaged in the implementation process? (not just a participant)**

   Prompt**:** What went well? What didn't go so well? (time, interference in on-site daily wok, occupying a meeting room, recruitment, engagement) What could be done differently if it was delivered again? What were the benefits from the intervention to the company and workers? What did the intervention achieve? Do you think that the intervention was appropriate for construction workers? Why yes? Why not? Were there any other issues, not directly related to the intervention, that you might have impacted on the implementation of the intervention? (e.g., audits, Covid, schedule changes).

3. **Based on your experiences of working on other sites, how transferrable to other sites do you think the intervention is?**

   Prompt: Do you think there would be interest / support for health and wellbeing interventions? What are potential barriers (size, time, management support, environment)?

4. **You had a very important role in encouraging the participation in the intervention. Can you tell me a little about your experiences in recruiting participants?**

   Prompt: What were the facilitators/challenges? Were posters / signup sheets useful? Why people didn't want to attend / continue with the intervention?

5. **Do you have any ideas for what else could have been done to increase the participation?**

6. **Can you tell me about any comments/questions that you have noted/been asked about the intervention?**

   Prompt: from other sites? Workers on site? Managers? Directors? Clients / contractors?

At the end of the questioning:

I think we've come to the end of our questions. Let me be the first to say thank you for your honest opinions – you were tremendously helpful.

Again, thank you very much for your participation today. We really appreciate your help.

Appendix 10 Nutrition intervention daily checklists

Table 1: Nutrition intervention day 1 checklist

Nutrition in construction – intervention checklist – Day 1 - 24th September 2020					
Activity		**Done**	**To some extent**	**Not done**	**Reason (if not done or done to some extent)**
Initial activities	Explained what the nutrition programme was and what it would involve	✓			
	Asked if all participants received a participants information sheet. Asked if they had any follow up questions. Collected signed consent forms and sign-up sheets	✓			
	Distributed baseline questionnaires and completed the second part of the questionnaire with participants (interviewer-administered). Collected questionnaires	✓			
Plan	Provided relevant resources for the topic of nutrition and energy (practical tips flyer, activity handout) and healthy snacks		✓		Time constraints on the day did not allow for an activity on nutrition and energy to be carried out
	Provided relevant resources explaining body composition measures	✓			
	Made at least one plan with the participant (including where, when and how they would start making changes in their diet to eat for more sustained energy during the day)		✓		Time constraints on the day did not allow for a detailed discussion with participants on their plans
	Encouraged the participant to think about what might help and what might get in the way of carrying out their plan(s)	✓			
	Encouraged the participant to think of ways to overcome problems	✓			
	Helped the participant to set their first nutrition goals	✓			
	Recorded plan(s) on the goal-setting sheet		✓		Although all participants were asked to record their goals and plans on sheets, due to social distancing it was not possible for the researcher to verify that and discuss plans with individuals
Do	Conducted a presentation on nutrition and energy explaining how fluctuations in blood sugar affect our energy during the day	✓			
	Facilitate discussion on current nutritional habits and how they affect energy	✓			

	Distributed ‘energy handout’ and explained how to use it			✓	Time constraints on the day did not allow for an activity to be carried out
	Asked participants to use the ‘energy handout’ to draw an energy chart helping them to understand their energy patterns during the day (e.g. energy dips)			✓	Time constraints on the day did not allow for an activity to be carried out
	Distributed healthy snacks to individuals explaining their nutritional value, how they can be used to support energy, places they can be purchased, and cost. Asked for feedback on snacks	✓			
	Conducted a quiz on nutrition value of different foods	✓			
	Conducted body composition testing (recorded measures and explained results to individuals)	✓			
Support	Gave positive feedback	✓			
	Gave the opportunity to ask any questions or clarify any issues	✓			
	Provided contact details and explained methods of support	✓			
Next step	Set a time and date for next session	✓			
Total		16	3	2	

Table 2: Nutrition intervention day 2 checklist

Nutrition in construction – intervention checklist – Day 2 – 22nd October 2020					
Activity		**Done**	**To some extent**	**Not done**	**Reason (if not done or done to some extent)**
Initial activities (for new participants only)	Explained what the nutrition programme was and what it would involve. Asked if all participants received a participants information sheet. Asked if they have any follow up questions. Collected signed consent forms and sign-up sheets. Distributed baseline questionnaires and completed with participants the second part of the questionnaire (interviewer-administered)	✓			
Review	Asked participant about his/her progress since the last session		✓		Some participants came late to the session (due to work commitments) and did not have a chance to participate in this part of the session
	Discussed what helped and what got in the way of participant’s progress		✓		As above
	If problems were identified, discussed ways to overcome them		✓		As above
	Discussed and changed nutrition plans / goals if needed		✓		As above

Plan	Provided relevant resources on breakfast ideas and meal planning (activity handout) (practical tips flyer)		✓		Time constraints on the day did not allow for meal planning activity to be carried out
	Provided relevant resources explaining body composition measures	✓			
	Helped the participant to set their follow up nutrition goals (including helping participants to make plans, encourage them to think about what might help and what might get in the way of their plan and ways to overcome it)	✓			
	Recorded updated plan(s) on the goal-setting sheet	✓			
Do	Conducted a food demonstration showing participants how to prepare four simple breakfast recipes with a use of equipment available on site (e.g. microwaves, toasters, kettles) (e.g. oats with chia seeds and fruit, scrambled eggs with pitta bread and hummus, scrambled eggs and beans on toast)		✓		Demonstrations were planned to be provided during two breaks on site to ensure the highest attendance. Due to Covid restrictions workers on site had staggered breaks. Therefore, it was not possible to conduct a new demonstration whenever a group of workers came to the canteen for a break.
	Conducted a tasing session of prepared food and asked for feedback, facilitated discussion on using recipes in future		✓		As above
	Explained nutrition values of ingredients which were used in food demonstration, health benefits, their cost, and places to purchase	✓			
	Facilitated discussion on current nutrition practices and habits around breakfast	✓			
	Conducted a presentation on tips around meal planning	✓			
	Set a challenge / a competition on the most new meals incorporated in the week	✓			
	Distributed meal composition and planning handout and explained how to use it			✓	Time constraints on the day did not allow for this activity to be carried out
	Conducted meal planning activity – incorporate new meals to your weekly plan			✓	Time constraints on the day did not allow for this activity to be carried out
	Conducted body composition testing (recorded measures and explained results to individuals)	✓			
Support	Gave positive feedback	✓			
	Gave the opportunity to ask any questions or clarify any issues	✓			
	Provided contact details and explained methods of support	✓			

Next step	Set a time and date for next session	✓			
Total		13	7	2	

Table 3: Nutrition intervention day 3 checklist

Nutrition in construction – intervention checklist – Day 3 – 19th November 2020					
Activity		**Done**	**To some extent**	**Not done**	**Reason (if not done or done to some extent)**
Initial activities (for new participants only)	Explained what the nutrition programme was and what it would involve. Asked if all participants received a participants information sheet. Asked if they have any follow up questions. Collected signed consent forms and sign-up sheets. Distributed baseline questionnaires and completed with participants the second part of the questionnaire (interviewer-administered)	✓			
Review	Asked participant about his/her progress since the last session	✓			
	Discussed what helped and what got in the way of participant's progress	✓			
	If problems were identified, discussed ways to overcome them	✓			
	Discussed and changed nutrition plans / goals if needed	✓			
	Provided feedback on the challenge / competition on the most new meals incorporated in the week. Announced winners	✓			
Plan	Provided relevant resources on the topic of nutrition and immunity, a healthy plate (activity handout), the importance of vegetables and fruit consumption (practical tips flyer)	✓			
	Provided relevant resources explaining body composition measures	✓			
	Helped the participant to set their follow up nutrition goals (including helping participants to make plans, encourage them to think about what might help and what might get in the way of their plan and ways to overcome it)	✓			
	Recorded updated plan(s) on the goal-setting sheet	✓			
Do	Conducted a presentation on nutrition and immunity and the importance of eating a rainbow of fruit and vegetables		✓		The intervention was moved to a small meeting room, which did not have a large screen. The presentation was conducted, but the slides were displayed on a laptop screen only.

	Conducted a food demonstration showing participants how to prepare smoothies (e.g. kale, spinach smoothie, almond butter and watercress smoothie) and shots (e.g. ginger and apple, turmeric, lemon and ginger)	✓			
	Conducted a tasing session of prepared drinks and asked for feedback, facilitated discussion on using recipes in future	✓			
	Explained nutrition values of ingredients which were used in food demonstration, health benefits, their cost, and places to purchase	✓			
	Facilitated discussion on current nutrition practices and habits around drinks (e.g. smoothies, juices, energy drinks, soft drinks), and a fruit and vegetables consumption		✓		The intervention was moved to a smaller room, which limited the time allocated for group sessions. Time constraints did not allow for this discussion to be carried out in full.
	Set fruit and vegetable challenge, asked participants to note every piece of fruit or vegetable they consumed in a week, using a table with different column colours	✓			
	Distributed healthy plate activity handout and explained how to use it	✓			
	Conducted healthy plate activity – is my plate healthy and how to compose a healthy plate	✓			
	Conducted body composition testing (recorded measures and explained results to individuals)	✓			
Support	Gave positive feedback	✓			
	Gave the opportunity to ask any questions or clarify any issues	✓			
	Provided contact details and explained methods of support	✓			
Next step	Set a time and date for next session	✓			
Total		21	2	0	

Table 4: Nutrition intervention day 4 checklist

Nutrition in construction – intervention checklist – Day 4 – 17th December 2020					
Activity		**Done**	**To some extent**	**Not done**	**Reason (if not done or done to some extent)**
Initial activities (for new participants only)	Explained what the nutrition programme was and what it would involve. Asked if all participants received a participants information sheet. Asked if they have any follow up questions. Collected signed consent forms and sign-up sheets. Distributed baseline	✓			

	questionnaires and completed with participants the second part of the questionnaire (interviewer-administered)				
Review	Asked participant about his/her progress since the last session		✓		Due to a large number of new participants singing up, it was not possible to review progress with everybody
	Discussed what helped and what got in the way of participant's progress		✓		As above
	If problems were identified, discussed ways to overcome them		✓		As above
	Discussed and changed nutrition plans / goals if needed		✓		As above
	Provided feedback on the fruit and vegetables challenge. Announced winners	✓			
Plan	Provided relevant resources on reading food labels (practical tips flyer), shopping lists and ingredients swaps (activity handouts)	✓			
	Provided relevant resources explaining body composition measures	✓			
	Helped the participant to set their follow up nutrition goals (including helping participants to make plans, encourage them to think about what might help and what might get in the way of their plan and ways to overcome it)	✓			
	Recorded updated plan(s) on the goal-setting sheet	✓			
Do	Conducted a food demonstration showing participants how to prepare simple and healthy Christmas meals and drinks (e.g. avocado and cocoa pudding, non-alcoholic mulled wine, low sugar almond cake)	✓			
	Conducted a tasing session of prepared food and asked for feedback, facilitated discussion on using recipes in future	✓			
	Explained nutrition values of ingredients which were used in food demonstration, health benefits, their cost, and places to purchase	✓			
	Conducted a presentation on how to read food labels	✓			
	Conducted a quiz on reading food labels	✓			
	Facilitated discussion on current practices around doing shopping, selecting food and ingredients as well as reading food labels while buying food	✓			
	Distributed 'shopping lists and ingredients swap' activity handout and explained how to use it	✓			
	Conducted 'shopping lists and ingredients swap' activity	✓			

	Conducted body composition testing (recorded measures and explained results to individuals)	✓			
Support	Gave positive feedback	✓			
	Gave the opportunity to ask any questions or clarify any issues	✓			
	Provided contact details and explained methods of support	✓			
Next step	Set a time and date for next session	✓			
Total		19	4	0	

Table 5: Nutrition intervention day 5 checklist

Nutrition in construction – intervention checklist – Day 5 – 27th April 2021					
Activity		**Done**	**To some extent**	**Not done**	**Reason (if not done or done to some extent)**
Initial activities (for new participants only)	Explained what the nutrition programme was and what it would involve. Asked if all participants received a participants information sheet. Asked if they have any follow up questions. Collected signed consent forms and sign-up sheets. Distributed baseline questionnaires and completed with participants the second part of the questionnaire (interviewer-administered)	✓			
Review	Asked participant about his/her progress since the last session		✓		This was partly delivered due to the fact that the intervention was suspended for 4 months and most of participants did not have their goal-setting sheets, did not remember their goals or expressed a desire to 'start fresh'.
	Discussed what helped and what got in the way of participant's progress		✓		As above
	If problems were identified, discussed ways to overcome them		✓		As above
	Discussed and changed nutrition plans / goals if needed		✓		As above
Plan	Provided relevant resources nutrition for optimal weight (practical tips flyer), staying active (activity handout)	✓			
	Provided relevant resources explaining body composition measures	✓			
	Helped the participant to set their follow up nutrition goals (including helping participants to make plans, encourage them to think about what might help and what might get in the way of their plan and ways to overcome it)	✓			

	Recorded updated plan(s) on the goal-setting sheet	✓			
Do	Distributed healthy snacks to individuals explaining their nutritional value, how they can be used to support optimal loss and staying active, places they can be purchased, and cost. Asked for feedback on snacks	✓			
	Conducted a presentation on nutrition for optimal weight and improved fitness performance (including information on benefits of reducing alcohol consumption)	✓			
	Facilitated discussion on current practices around exercise, alcohol consumption and eating for the optimal weight	✓			
	Distributed 'stay active' activity handout and explained how to use it	✓			
	Conducted 'stay active' activity (it included a plank challenge, sit to stand test, push up challenge)		✓		This activity was restricted due to the size of the room and the clothing and equipment that some of the workers carried, which limited their movement.
	Set a plank challenge	✓			
	Conducted a quiz on alcohol and calories	✓			
	Conducted body composition testing (recorded measures and explained results to individuals)	✓			
Support	Gave positive feedback	✓			
	Gave the opportunity to ask any questions or clarify any issues	✓			
	Provided contact details and explained methods of support	✓			
Next step	Set a time and date for next session	✓			
Total		16	5	0	

Table 6: Nutrition intervention day 6 checklist

Nutrition in construction – intervention checklist – Day 6 – 27th May 2021					
Activity		**Done**	**To some extent**	**Not done**	**Reason (if not done or done to some extent)**
Review	Asked participant about his/her progress since the last session	✓			
	Discussed what helped and what got in the way of participant's progress	✓			
	If problems were identified, discussed ways to overcome them	✓			
	Discussed and changed nutrition plans / goals if needed	✓			
	Provided feedback on the plank challenge. Announced winners	✓			

Plan	Provided relevant resources on food and mood (activity handout), different diets (practical tips flyer)	✓			
	Provided relevant resources explaining body composition measures	✓			
	Helped the participant to set their nutrition goals going forward (including helping participants to make plans, encourage them to think about what might help and what might get in the way of their plan and ways to overcome it)	✓			
	Recorded updated plan(s) on the goal-setting sheet	✓			
Do	Distributed goodie bags with healthy snacks and drinks to individuals explaining their nutritional value, how they can be used to support energy, places they can be purchased, and cost. Asked for feedback on snacks	✓			
	Conducted a presentation on different types of diet			✓	The intervention was moved to a smaller room, which limited the time allocated for each group, and therefore, presentation did not take place.
	Conducted a quiz on different types of diet	✓			
	Facilitated discussion on nutrition and how food affects mood, cravings, wellbeing	✓			
	Distributed 'food and mood' activity handout and explained how to use it	✓			
	Conducted 'food and mood' activity	✓			
	Conducted body composition testing (recorded measures and explained results to individuals)	✓			
Support	Gave positive feedback	✓			
	Gave the opportunity to ask any questions or clarify any issues	✓			
Closing	Distributed follow-up questionnaires and completed the second part of the questionnaire with participants (interviewer-administered). Collected questionnaires	✓			
Total		18	0	1	

Appendix 11 – Field notes – sample

Company X
General findings
- Company X expressed their interest taking part in the intervention - London Euston identified as one of the potential sites
Characteristics of the company and workforce
- Multiple operational units and sites across the country (each site with 300 workers on average) - Sites differ in types of construction workers employed and construction work taking place (e.g. within x there are residential building construction sites, sewage construction sites, rail track construction sites etc.) - Some sites have canteens serving workers - All x canteens are run by external suppliers
Health, wellbeing, nutrition issues
- x is aware that poor nutrition is a problem in the industry and in the company, e.g. fried breakfast, high consumption of energy drinks, large portions have been identified by the company
Current initiatives (including nutrition – related)
- Nutrition has been on the agenda for some time but occupational health department struggles to find a way to deal with unhealthy food related behaviours and has no idea how to tackle the problem (some attempts to introduce better food labelling systems have been introduced but they did not go far) - Some sites introduced potion control in their canteens (not all of them); in other canteens employees eat as much as they want - Some canteens started to introduce labelling system (however it has been noticed that workers feel overwhelmed by the amount of information and ignore the information)
Potential barriers
- **The length of the intervention** (employees rarely stay on one site for a duration of 6 months); depending on the site and project workers might stay on the site for a duration of 1 day to few months - **Limited number of sites meeting the criteria** of the study **-** due to the above some of x's sites have been excluded during the initial meeting (they will be closing in the next few months or the type of work being conducted on the site means it is not going to exist for 6 months) - **Supply chain and subcontracting -** within x units and sites multiple other companies are operating, therefore, workers on the site are a combination of x employees and employees of other companies (x management has limited influence over health and wellbeing strategies of their subcontractors and their employees and might struggle to impose participation in the intervention) - **The size of sites -** most of the sites are very large – over 300 employees, which posts a question of opening the intervention to everybody - **The location of sites -** sites are all over the country, which means it might be very difficult and costly to travel - **Union representatives** – during the initial meeting x mentioned that getting a sample of union representatives in order to run focus groups might not be possible
Post meetings feedback
- Only one potential site identified so far which has expressed an interest in the participation, however, due to the location (remote location in Scotland) it might not be logistically possible to deliver the intervention there - The Scotland site has currently only 4 employees with plans to expand to 30 in January (not confirmed)

Appendix 12 – Changes in the research due to Covid-19

Research element	Intended	Adjusted due to covid
Number of sites taking part in the intervention	Three sites (small, medium and large) (the same sites as in the exploratory focus groups)	One site (medium) (different to exploratory focus groups)
Sample size	Estimated at 100	51 took part, 22 completed
Length of the intervention	6 months	6 months (plus 4 months break due to Covid-19 lockdown)
Intervention timeframe	June – November 2020	September 2020 – May 2021