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IN HEALTH, WELFARE AND POLICY

What evidence is there to support the impact of gardens on health outcomes?

A systematic scoping review of the evidence

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About SHUSU

The Sustainable Housing & Urban Studies Unit (SHUSU) is a dedicated multi-disciplinary research and consultancy unit providing a range of services relating to housing and urban management to public and private sector clients. The Unit brings together researchers drawn from a range of disciplines including: social policy, housing management, urban geography, environmental management, psychology, social care and social work.

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Foreword

Professor Alistair Griffiths (Director of Science and Collections – The Royal Horticultural Society)

We can all benefit from gardening, gardens and growing projects and it is now widely recognised that regular contact with plants, animals and the natural environment can improve our health and wellbeing. When we grow we positively re-engage and reconnect with our natural world. Half of the adult population in England report being involved in gardening, and it is an important activity throughout our lives. Gardens are therefore important to our nation's health due to the large numbers of people who engage with them.

This study reviews the scientific literature that exists, examining what evidence there is to support the impact of gardens on health outcomes. As a result, this study presents a compelling case for action by Government planning, health professionals and the NHS, local authority planners and policy specialists and by gardeners the horticultural industry and communities to create the circumstances in which greening the UK can thrive, for the benefit of everyone's health.

This report helps towards delivering the UK Health and Horticulture Charter and highlights that gardens are a necessary component for delivering healthy, sustainable and liveable places. I believe that there are very few, if any, other public health interventions that can achieve all of the social and health benefits highlighted in this report, and especially the impact on mental well-being and social interaction.

This work highlights that gardening, gardens and green space interventions urgently need to be considered as long-term investments, and they need to be integrated within national and local development strategies and frameworks (e.g. masterplans, social and housing regulations, transport policies, sustainability and biodiversity strategies). This requires continued political support within national and local government, and the general understanding that gardens, gardening and urban green spaces go way beyond environmental or ecological objectives but also deliver social and health benefits that increase the quality of life and wellbeing of all UK residents.

As a lifelong gardener and horticultural scientist I am really pleased that gardens are beginning to deserve the attention of health professionals, spatial planners and other policy makers. However, more action needs to be taken to turn this evidence into practice and more evidence is required to further maximise the health benefits of horticulture, gardens, gardening and greenspaces for the benefit of peoples health wherever they live.

Executive Summary

According to the World Health Organisation Global Health Observatory (2017), non-communicable diseases (NCD's) present a significant cause of death through cardiovascular disease, respiratory conditions and type 2 diabetes. The impact of NCDs on health and social care is estimated to outstrip service provision and the drive to promote health and well-being to tackle the key causes of NCD's is at the vanguard of UK, European and global health care policy. There is a need for health and social care commissioners to examine and commission new treatment interventions that can offer multipurpose interventions for people in the community with LTC and co-morbid conditions. It is claimed that nature based activities, such as therapeutic horticulture or gardening activity, can improve health and wellbeing for a range of people with long-term conditions. Nature Based Activities have been defined as 'an intervention with the aim to treat, hasten recovery, and/or rehabilitate patients with a disease or a condition of ill health, with the fundamental principle that the therapy involves plants, natural materials, and/or outdoor environment, without any therapeutic involvement of extra human mammals or other living creatures' (Annerstedt & Währborg 2011). This includes, amongst other activities, gardens as a nature based activity that encourages individuals to engage with, observe or access.

This review has located and described research evidence that has reported on the impact of gardens on physical, mental, health and well being. A systematic approach was used to scope the evidence base across a range of data bases and external sources. The review reports on the following:

- How gardens can improve physical, mental, health and wellbeing outcomes
- A 'map' of the literature in relation to the benefits for particular conditions, types of garden, and health outcomes
- The gaps in the literature in relation to particular conditions, garden types and health outcomes
- Gardens as an intervention within the social prescribing movement
- Infographics and a logic models, which capture the data in a simple way. These can be used to inform the future development of the RHS therapeutic garden and for organisations interested in green care or nature-based activities

This report has provided an overview of the evidence for gardens as an intervention that could promote health and wellbeing in a range of populations. This has significance for public health and health care as there is a precedence to explore alternative methods of service provision. The findings from this review report on the impact of gardens and gardening on four key areas: Mental Health, Dementia, Wellbeing, Specific Conditions using Physiological Outcome Measures and Nutrition. The review evidence indicated that nature based activities such as gardens (in the range of formats) can help social inclusion, self-esteem and perceived wellbeing. Although the methodologies and interventions varied, the evidence base overwhelming supported the use of gardens as an activity that could promote wellbeing. Moreover, these activities were reflected in the Bragg et al (2016) Green Framework which suggests that gardens positively impact on people through everyday life such as home gardening, health promotion through nature based activities such as digging and community gardening through to and green care that uses more structured approaches for people with defined needs.

1. Introduction



1.1 Background

According to the World Health Organisation Global Health Observatory (2017) non-communicable diseases (NCD's) represent a significant cause of death through cardiovascular disease, respiratory conditions and type 2 diabetes. Notwithstanding, the influence of mental ill-health also makes a substantial contribution to these figures with an estimated 14% of the cause of chronic disease attributed to mental disorders (Prince et al. 2006). These global statistics present a current trend in the increase of long-term conditions and it is estimated that deaths from type 2 diabetes will continue to rise and over 1 billion people globally will be affected by obesity by 2025 (World Obesity Federation 2017). The prevalence of a myriad of NCD's globally and across the UK present serious challenges to health and social care providers, predominantly due to the longevity of the disease and subsequent associated co-morbid conditions. Long Term Conditions (LTC) caused by cardiovascular diseases such as stroke, heart failure and pulmonary diseases now affect a large percentage of the total UK population. Moreover, mental health disorders affect 1 in 6 people (McManus et al. 2016) and are one of the main causes of disease burden globally (Vos et al. 2013). Furthermore, it is estimated by the Alzheimer's Society (2017) that Dementia will affect over 2 million people by 2052. Edwards et al. (2012) indicate that gardening is perceived to be a therapeutic activity can improve the lives of people living with dementia, and their carers.

The impact of NCDs on health and social care is estimated to outstrip service provision and the drive to promote health and well-being to tackle the key causes of NCD's is at the vanguard of UK, European and global health care policy. Many of the LTC's require complex interventions that are multipurpose necessitating multi-disciplinary and intra-agency responses. For many people, service provision for initial diagnosis and treatment of an LTC may initiate within an acute NHS care setting, however, once initial treatment is complete, the complex needs of patients are predominantly met and managed within a community context. As such, primary care services account for a large percentage of care provided to people with long-term conditions. However, the NHS is fiscally insecure and under constant pressure to provide services to an increasing aging population. Hence, there is a need for health and social care commissioners to examine and commission new treatment interventions that can offer multipurpose interventions for people in the community with LTC and co-morbid conditions.

1.2 Nature Based Activities

It is claimed that nature based activities such as therapeutic horticulture, or gardening activity can improve health and wellbeing for a range of people with long-term conditions. For example, nature-based activities can help to improve anxiety (Gonzalaz et al. 2011), general health (Wood et al. 2016), heart rate (Wichrowski 2005) & reduce social isolation (Howarth et al. 2016). Hence, interest in the relationship between nature and its positive benefits for humans has grown over the last 20 years (Gullone, 2000). In the UK, there has been an increased recognition about the effectiveness of nature-based therapies on people with mental health problems and other long terms conditions. Pretty (2005) argues that there are three reported levels of engagement with nature that demonstrate health benefits. These include 'viewing nature', 'being in the 'presence' of nature' and 'active participation with nature' (Pretty 2005). It is understood that gardening is aligned with active participation and hence, will affect larger benefits (Collins & O'Callaghan 2008). As such, Nature Based Activities have been defined as 'an intervention with the aim to treat, hasten recovery, and/or rehabilitate patients with a disease or a condition of ill health, with the fundamental principle that the therapy involves plants, natural materials, and/or outdoor environment, without any therapeutic involvement of extra human mammals or other living creatures' (Annerstedt & Währborg 2011). Examples include walking in the woods, gardening or forest schools. However, nature based activities have evolved to include structured therapeutic nature based programmes that promote health and well-being (Bragg et al. 2016). Over the past decade, there have been multiple reports (NERC 2016, Bragg and Leck, 2017) that illustrate the way in which nature based activities have grown and been defined. Moreover, the diversity of nature based activities has led to work to define the key characteristics to help develop frameworks to support evaluations of nature based activities.



1.3 Levels of Engagement with Nature



The levels of engagement are a significant attribute when defining levels of nature based activities and have influenced the way in which Green Care and Nature based interventions are described. For example, similar taxonomies have been used to delineate between 'Green Care' and 'Nature Based Activities', hence, the terms 'Green Care' and 'Nature based' interventions are often used interchangeably (Bragg et al. 2016). It is now acknowledged that nature based activities can provide 'Green Care' which is defined as a *'targeted therapeutic or treatment intervention which are specifically designed for people with a defined need and are delivered by trained/qualified practitioners'* (Bragg et al. 2016). For example, therapeutic horticulture is a popular approach used within Voluntary Sector Organisations (VSO's) and is defined as being "the use of plants as a therapeutic medium by a trained professional to achieve a clinically defined goal" (Kam & Siu, 2010, p. 80 In Cipriani). Moreover, Green Care is part of a 'spectrum of nature based activities' (Green Care Coalition 2017) that include everyday activities such as gardening, vistas and walking, to activities that promote health such as, food growing, community gardens through to Green Care. Haubenhofer et al. (2010) provide an overview of the different types of nature-based activities that are commonly used. Within this framework, health promotion, therapy and combinations are clearly delineated (see figure 1).

More recently, Bragg et al (2016) built on Haubenhofer et al.'s framework and further differentiated the types of green activity to illustrate what constituted 'Green Care' as opposed to everyday activities (see figure 2).

Overview Sectors of Green Care

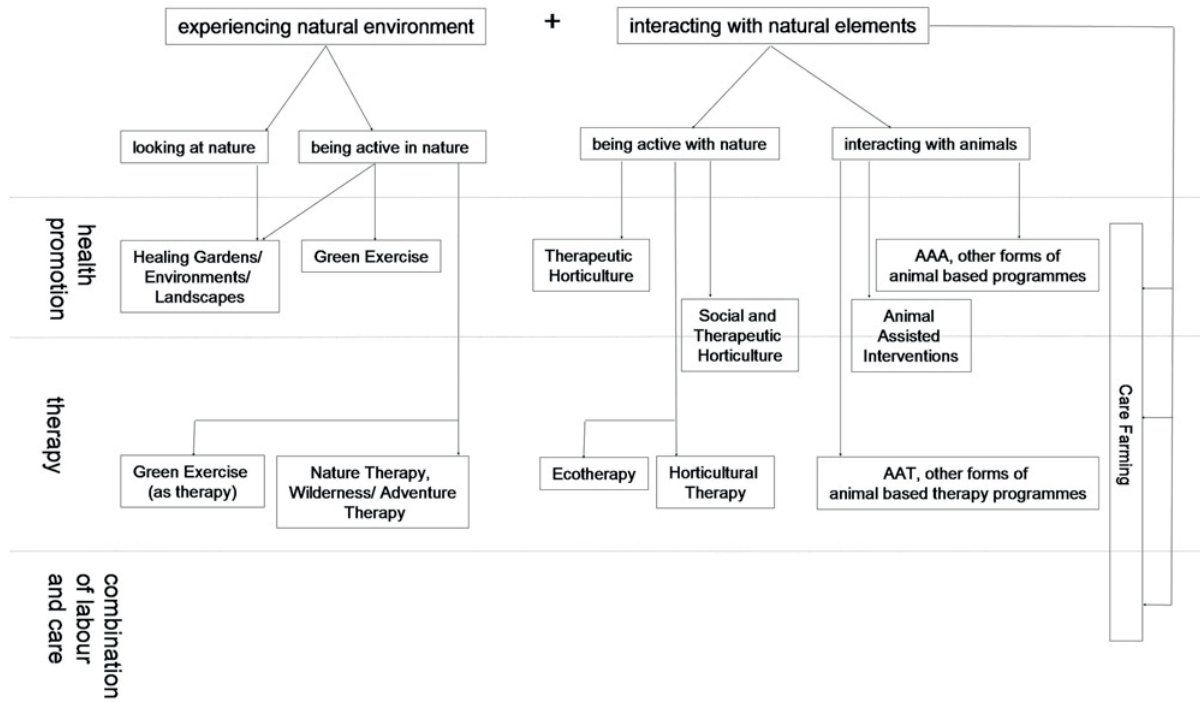


Figure 1 - Sectors of Green Care (Haubenhofer et al. 2010)

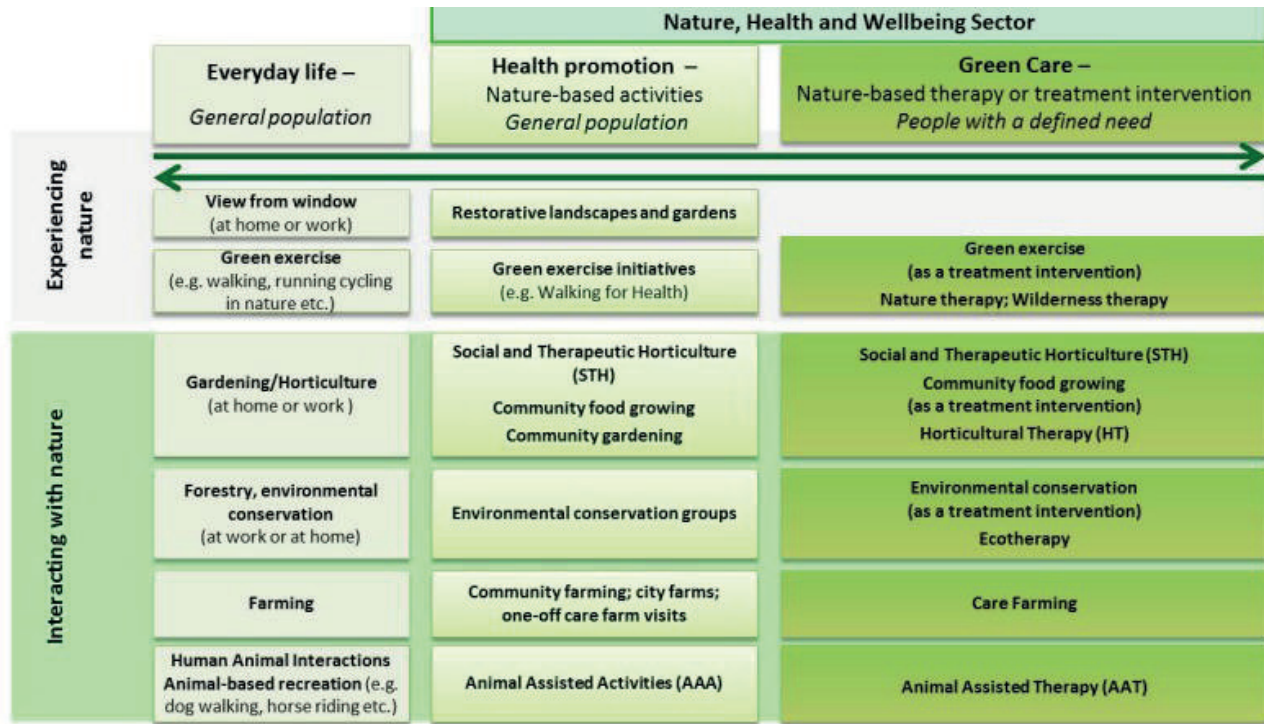


Figure 2 - Green Care v Everyday Activities Used with permission from Rachel Bragg

This model has been further developed to make explicit the way in which populations could move in and around the different types of activities. The later version (see figure 3) uses 'Green Circles' to highlight the fluidity of

movement between the different types of nature based activities and these are predicated on the severity (i.e. less acute/more acute) of the individuals need.

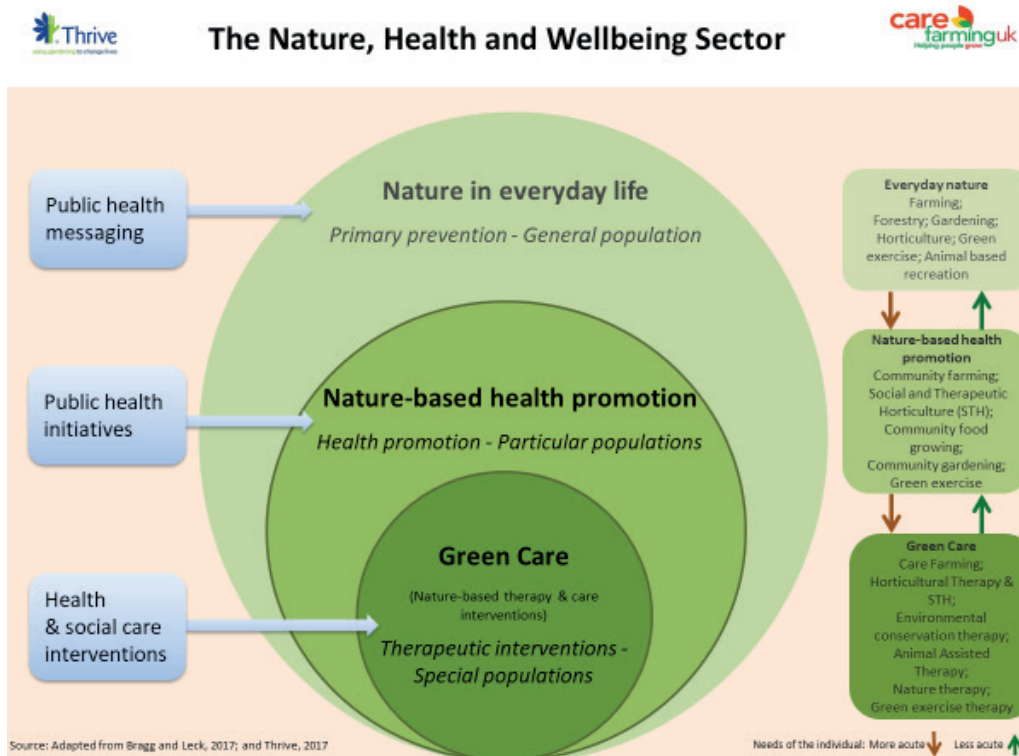


Figure 3 - Composition of the Nature Health and wellbeing sector (2017)

Hence, it is suggested that there may be some overlap between the different stratum of activities which enable people with LTC’s to access a range of nature-based interventions. In this report, approaches from both green care and nature based activities have been included in this report to enable the full range of approaches to be included.

1.4 Social Prescribing

The move towards the referral of people for these alternative approaches is predicated on a ‘social prescribing’ framework which is an innovative approach that encourages partnership working between primary, secondary and third sector services (South et al. 2008). Social prescribing is a way of linking patients in primary care with sources of support within the community to

help improve their health and well-being. (Bickerdale et al. 2017). This includes, but is not exclusive to therapeutic horticulture and arts based approaches. The York Centre for Reviews and Dissemination (2015) advise that social prescribing can link patients in primary care with sources of support in the community and help reduce health inequalities (York CRD, 2015). Whilst social prescribing continues to grow, it is reported that just over 40% have been evaluated (Thomson et al. 2015). Interestingly, most of the evaluations to date have been qualitative and a smaller number have used quantitative methods with validated clinical scales (Thomson et al. 2015). In a recent meta-analysis, Soga et al. (2017) have produced the first meta-analysis of the impact of gardening and gardens on a range of physical and mental health outcomes.



1.5 Measuring Impact

As previously noted, the concept of Green Care resides within a spectrum of nature-based activities which can be provided contemporaneously to patients with LTCs. However, there is a disparity between the use of qualitative, non-experimental as opposed to quantitative experimental methods to evaluate the impact of nature based activities as a result of diverse nature-based interventions and as a because of difficulties in capturing outcomes of such interventions which may be classed as complex due to having several interacting components (MRC 2006). Put simply, an outcome is an effect of a process (Fairfield and Long, 1997) but health outcomes have been defined as an “*attributable effect of an intervention or its lack on a previous health state*” (Department of Health, 1994) or more recently an indicator or measure of a patient’s condition or progress’ (Annerstedt & Währborg 2011).

The outcomes (or impact) of a nature-based intervention may be achieved over a long time, or may be difficult to separate from other variables or aspects of the intervention, which presents significant challenges to researchers who wish to capture outcomes accurately or objectively. This has been referred to as an issue with the length and complexity of a causal chain and is common in the evaluation of public health interventions that are more difficult to standardise than many clinical interventions. For example if someone became involved in gardening or even a structured gardening programme and subsequently improved their fitness (measured by a reduced heart rate) – how can researchers be sure that the improved fitness was due to the gardening rather than a change in diet or an increase in other exercise, and how long would it take before someone could expect to see a meaningful improvement in fitness and how can the researchers be sure that the gardening programme one participant undertook was the same as another (one may like digging and the other prefer planting)? If someone reported less stress due to visiting a garden regularly how can we be sure that the stress reduction is due to the garden rather than any social interaction that may take place in order to get them to the garden or because they have perhaps retired and have more time to visit gardens?

There is increasing interest in developing studies to tackle these issues. Validated tools used capture subjective and objective outcomes using self-reported measures, observed behaviours, physiological changes plus a range of impact measures on service provision, health intervention and health promotion outcomes exist. There has been a recent surge in the development of validated ‘nature scales’ such as ‘Five Ways to Wellbeing’, ‘Connections to Nature Scale’, ‘Nature Relations Scales’ and ‘Connections to Nature Index’. More recently, there has been work to develop national indicators that capture and measure the impact of nature on specific

outcomes through the development of the MENE survey. However, unless the issue of attribution mentioned above is not addressed in individual studies, the evidence may only demonstrate that nature-based interventions contribute to improved health outcomes rather than demonstrate an actual improvement in health.

The diversity of outcomes, lacked of defined intervention parameters and complex needs of people with LTC’s has resulted in a plethora of evidence for social prescribers to use, but the evidence is fragmented and to date there has been limited synthesis on a clearly defined intervention. Soga et al. (2017) have provided the first steps towards this though their meta-analysis of gardens and gardening. Whilst this meta-analysis is the first to combine outcomes to determine overall effect of gardening it has included horticultural therapy alongside daily gardening as key interventions, both of which potentially fall within context of ‘daily activities’, ‘health promotion’ and ‘green care’. This clearly highlights the challenges associated with capturing outcomes of complex ‘interventions’, which make meta-analysis problematic. Hence, it is important the range of interventions used in studies are fully recognised, described and the outcomes used to capture impact are aligned. However, there is a wealth of evidence available in different sources, using different definitions and of varying quality. Systematic scoping reviews use a degree of rigour and objectivity to provide a means of examining available evidence and are appropriate to:

- 1 “Examine the extent, range and nature of research activity and provide a way of mapping fields of study.
- 2 Determine the value of undertaking a full systematic review
- 3 Summarise and disseminate research findings
- 4 Identify research gaps in the existing literature” (Arksey and O’Malley 2005)

Given the increasing interest in the use of green space and therapeutic horticulture (for example by organisations such as Public Health England, DEFRA, the RHS and Natural Health England) it is timely to draw together this fragmented evidence to provide a map of what is available and illustrate the potential contribution of gardens to health. This systematic scoping review will draw together the literature in this area to produce a map of the evidence of the impact of gardens on health outcomes. It will be illustrated with infographics and a logic model that can be used to inform social prescribers and other organisations interested in using Green Care or nature based activities to provide an evidence base for their work in relation to health or identify where further research is needed to underpin their activities. Logic models are graphic tools that can be used in programme planning and evaluation to demonstrate the relationships between the resources and activities used and expected benefits (Midlands and Lancashire Commissioning Support Unit nd). They were developed by the Kellogg

Foundation but are increasingly being used in the public sector to illustrate impact. The evidence located as part of this report will be used to develop a series of Logic models to highlight the contribution of gardening on health outcomes.

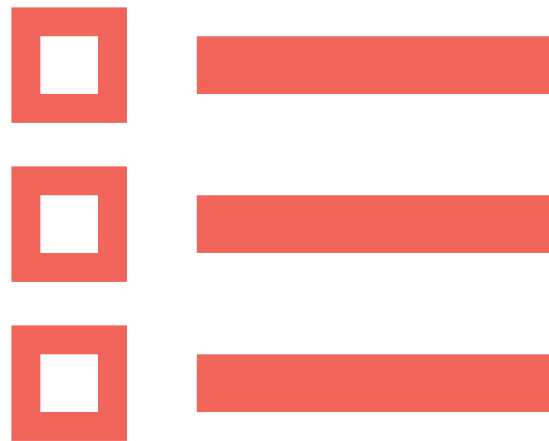
1.6 Aims and objectives

This project reports on a systematic scoping review of the literature to identify the evidence base on the physical, mental, health and well being of gardens. In particular, it seeks to:

- improve the understanding of the physical, mental, health and wellbeing benefits of gardens
- provide a map of the literature in relation to the benefits for particular conditions , types of garden, and health outcomes
- identify gaps in the literature in relation to particular conditions, garden types and health outcomes
- to provide contextualised located evidence about health and wellbeing outcomes within social prescribing.
- produce infographics and a logic model that can be used to inform the RHS development of the therapeutic garden at RHS Bridgewater and other organisations interested in green care or nature-based activities



2. Methods



2.1 Systematic scoping review of the literature

Systematic scoping reviews provide a broad map of the field of interest, and a degree of rigour (due to the extensive searching and filtering process). However they do not examine the results or critically appraise each included study in detail (unlike a traditional systematic review). This review follows the framework described by Arksey and O'Malley (2005) that has been used to map the evidence of other complex interventions in health care. The remainder of the report including this methods section is set out according to the Arksey and O'Malley (2005) framework which comprises 5 steps of identifying the question, the relevant studies, selecting the studies, charting the data and collating, summarising and reporting the results.

2.2 Stage 1: Identifying the research question

The research question was agreed by the research team following a series of scoping searches and a discussion of the definition of a garden.

The agreed question was: *What evidence is there on the physical, mental, health and well-being benefits of gardens?*

This enabled an inclusive approach to be taken to identify studies that demonstrate the effectiveness, value and impact of all types of gardens. The definition of a garden was taken from Buck (2016).

The definition of gardens and gardening differs widely in terms of scale, function and activity. Gardens are often thought of as intimate private spaces attached to private households but they can also be large private or formal gardens open to the public, or part of hospitals, care homes or hospices. Gardens can be cultivated for flowers or growing food, used as spaces for exercise, relaxation, solace and recovery, as places to play, meet and volunteer, and as one part of wider environmental, planning or sustainability policies. In short, gardens have many and varied functions – some individual, some community, some directed and some indirect or incidental.

Use of this definition enables inclusion of a wide range of spaces and projects such as those based on allotments and community projects such as Incredible Edible, "Social and Therapeutic Horticulture (STH), Horticultural Therapy (HT) and food growing as an intervention. STH is using gardening and plants to help individuals develop well-being and this can be done through spending time in gardens, participating in gardening activities or doing something more active such as growing food (Mind 2013). HT has been used as a more formal therapy or as an add-on to therapy for many

years and there has been a steady rise since the 1980s in the numbers of garden projects in the UK that offer both STH, HT (Hine et al. 2008) and more recently food growing as a treatment intervention.

2.3 Stage 2: Identifying relevant studies

A comprehensive and iterative approach to the literature searches for evidence was taken to ensure that the range of perspectives relating to gardens was captured. This included sources from health, sociology, psychology and the environment. The research team developed a protocol at the outset that was agreed and modified throughout the search and filtering process to ensure the project remained manageable and faithful to the initial research question and definitions. Focusing on health outcomes and the definition of gardens outlined above facilitated this process.

2.3.1 Literature searches

An experienced health information specialist conducted the literature searches after discussions with the project team and in line with the agreed protocol. A time frame of 1990 onwards was set to capture evidence from the last 25 years. Searches were undertaken in April 2017.

2.3.2 Resources searched

A full list of resources searched can be found in Appendix 1. In brief resources searched included 15 electronic databases and 6 key journals capturing health, social, psychological and environmental perspectives, grey literature sources and websites (including Google Scholar).

2.3.3 Search terms

The search was wide and sensitive in order to encompass the wide range of potential types of gardens that could be located within green space or nature type of activities. The search therefore encompassed a range of thesaurus and free text terms to describe the different types of gardens, and potentially wide range of health outcomes. Following a brainstorm within the project team and scoping searches, terms to capture the most likely health conditions that could benefit from gardens were included in the search.

2.3.4 Process of searching

The search followed the agreed protocol and results of the searches were stored on Endnote web reference management software to enable sharing across the project team. The Endnote group function was used to enable the team to track references throughout the systematic review process and notes were added to each record to justify inclusion and exclusion decisions made. Any queries were discussed between the information specialist and the project team. Search strategies were recorded, together with details of the date the search was undertaken and the number of results obtained and

issues arising during the searching in order to provide a complete history of the search process and provide transparency of the review process. Dropbox was used to facilitate data sharing and version control.

2.4 Stage 3: Study selection

The inclusion and exclusion criteria were initially set out in the protocol by the project team following scoping searches. As the screening process continued the criteria were refined through project team discussions then applied to all search results in Endnote. The final inclusion and exclusion criteria are listed in Table 1.

Table 1 - Inclusion & Exclusion Criteria

Include
Studies that meet the Bucks (2016) definition of gardens
Evidence of measurable outcome on health or well being (e.g. physical or mental health or physiological or quality of life/wellbeing, improved nutrition)
All evidence (including experimental or observational evaluation studies with controlled or uncontrolled prospective design or controlled retrospective design, return on investment analysis, correlation studies, qualitative, mixed methods, reviews)
Studies in English, post 1990
Exclude
Any other 'green spaces' such as forests, parks
Interventions that include gardens or gardening as part of a wider package of nature based activities and the effects cannot be separated
Papers that evaluate the access to green care or the access to green spaces
Papers that do not provide clear health outcome measures or evidence about health outcomes
Studies regarding living near or moving towards a green space
Biological indicators of soil health and plants
Descriptions of interventions/services with no evaluation component or measurable outcomes that relate to health
Studies which only include process type outcomes such as user satisfaction numbers of visitors etc
Studies in languages other than English
These, dissertations, book chapters, conference abstracts and posters
Papers published before 1990
Papers where full text could not be located

2.4.1 Outcomes considered

Any measurable outcome on health or well-being was considered. This included physical or mental health or physiological or quality of life/wellbeing, improved nutrition

2.4.2 Screening/Sifting of studies

All records were uploaded on to the Endnote database. Each record was screened independently on the basis of title by 2 out of 3 members of the project team (AB, MHa, Mho). Abstract screening was conducted by 1 member of a team of 3 (AB, MHa, Mho) and then full text screening was conducted by 1 member of a team of 3 (AB, MHa, Mho). Random checks on abstract and full text screening were conducted by a fourth member of the team (MM). Any discrepancies were resolved through double-checking and discussion. Figure 4 explains how the located studies passed through the searching and sifting process.

2.5 Stage 4: Charting the data

Data was extracted into a series of evidence tables by one member of the project team (MM) following project team discussions regarding the column headings and data to be extracted. This included details on the types of health conditions, the outcomes achieved and the type of intervention or green space.

2.6 Stage 5: Collating, summarising and reporting the results.

The evidence tables were used to organise and synthesise the data to produce the findings in the following section. The results were synthesised to address the aims of the review, ie: provide a map of the literature in relation to the benefits for particular conditions, types of garden, and health outcomes and identify the gaps in the literature for these areas. Evidence was located for a small number of health conditions namely dementia, mental health and obesity, although there were a number of studies that focused on general health benefits rather than examine a particular condition. Evidence was found for a range of different types of gardens such as allotments or botanical gardens or gardening interventions such as therapeutic horticulture. Studies of note (due to their design, sample size or focus) are highlighted and propositions relating to the evidence are summarised.

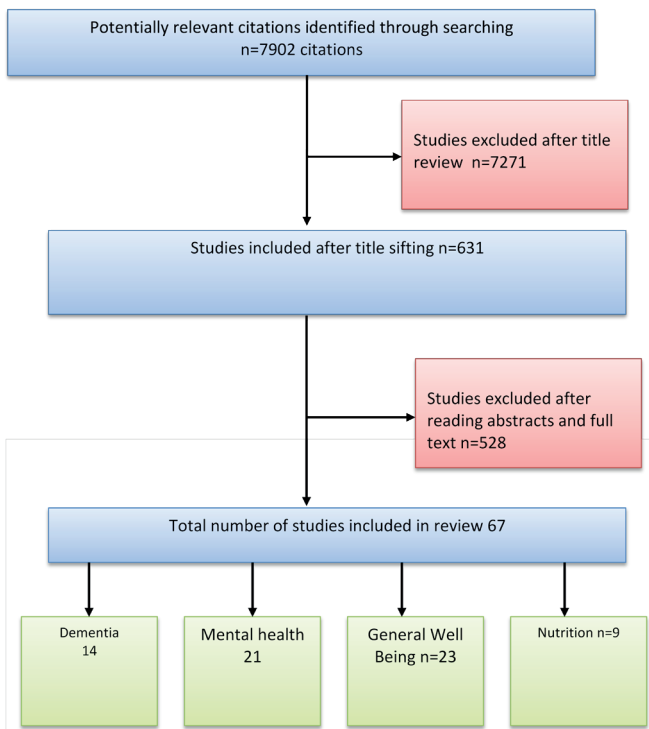


Figure 4 - Sifting & Sorting Process

3. Findings



The following findings present papers that have been included in the review that report on the impact of gardens on four key areas: Mental Health, Dementia, Wellbeing, Specific Conditions using Physiological Outcome Measures and Nutrition.

3.1 Papers that Reported on Mental Health and Gardening



3.1.1 Overview

Mental health is a core contemporary focus, with central Government, local authorities and other organisations exploring ways to tackle this often invisible condition (NHS, 2017). In terms of academia, research into the topic is multidisciplinary, with studies exploring the condition in the armed forces to horticultural therapy (St Clair et al., 2017). The latter has seen a surge in activity, with studies exploring the role of productive and non-productive spaces on those with mental health conditions. The therapeutic nature of gardening has influenced health professionals and other academics to explore the potential of community gardens, urban farms, allotments and other spaces to address issues in this field. There were 21 studies focusing on mental health and gardening located within this review. In terms of study design, the majority of these were mixed methods (6), with 3 exclusively qualitative, 4 were systematic reviews, 4 desktop based, 3 RCTs and 6 longitudinal studies.

3.1.2 Studies of Note

- Fieldhouse (2003) focuses explicitly on allotment gardening, a traditional form of growing in the UK. This is the only study of its kind to focus on such a space and, since they are used so widely, one could argue that it is a study of note. The age range used was broad and involved participants in their 20s – 60s, enabling the reader to understand what allotments mean to each age group. Whilst only using a small sample size (N=9), the qualitative and in-depth nature of the study

revealed how important these spaces are in tackling mental health issues. The allotment impacted on quality of life, enabled increased physical and social activities, and provided the participants with a general resurgence in personal lifestyles. The social element was focussed on most here, with other areas being mentioned at times alongside; the former is often the focus in allotment research and it was no surprise to see Fieldhouse mention it so much here.

- Detweller et al. (2015) explores the effect of horticultural therapies on veterans in the USA. This study uses a larger sample size (n=49) and focuses on a group who are frequently in the media due to mental health issues from recent conflicts. The study is the largest and first to look at the role of horticultural therapy on veterans, with a non-horticultural therapy group included for comparison. Primary data was collected from a complex group of users who were facing a range of issues: substance misuse, alcohol dependency, depression and other symptoms linked to PTSD. A positive impact was recorded on the group involved in the horticultural therapy, although the result was not statistically significant. More research was recommended to critically explore the idea that horticultural therapy can make a major impact on those suffering from similar conditions.

3.1.3 Propositions

There was a wide array of evidence to show how gardening activity can have a major positive impact on those affected by complex mental health issues. The studies focused on a broad group of individuals, perhaps due to the condition in question and its ability to affect a wide range of actors. Studies generally agreed that gardening can enable better social interactions between users, improve physical activity and general quality of life. The former was a dominant theme, with multiple papers arguing how the social benefits were significant, allowing individuals to share information and make connections which otherwise would have been difficult.

3.1.4 Within mental health gardens contribute to:

Increased Social Skills

- Bragg and Atkins (2016: 26) note how 'food growing can contribute to improved social interaction and community cohesion, reduce stress and associated depression'.
- Adevi et al. (2013: 234) explains that the participants 'described situations in the garden when trust was built and how they were comforted through this informal socialisation, besides the therapeutic activities'.
- Annerstedt and Wahrborg (2011: 381) reveal that 'one observational study of wilderness therapy, family work, and counselling reported significant improvements in several aspects – family function, adolescent behaviour, mental health, school success, and social relationship at 2 and 12 months follow-up'.
- Cipriani et al. (2017: 48) argue that '[horticultural therapy] can have a potential impact on client factors and performance skills such as specific mental functions (e.g., cognitive, attention, emotional) and process skills'.

Better Quality of Life

- Detweller et al. (2015: 105) explain that 'a sense of freedom may improve the residents' quality of life. Having the option of leaving the indoor residential area for a well-designed garden may be useful in reducing agitation and negative behaviors towards other residents and staff.'
- McCaffery and Lier (2016: 182) mention 'personal growth initiative, and quality of life, many comments from participants demonstrated the benefits of this [gardening] program.'

A Reduction in Depression, Anxiety or Stress

- Kam et al. (2010: 83) explain how 'participants expressed that the programme had emotional benefits such as the release of work stress, enjoyment in natural environment. Social benefits suggested include improvement of social skills, extension of social network, a sense of being respected.'

Areas for further research

- 1 Whilst there is a wide range of methods used in the studies reviewed, many were at a pilot stage and brief in nature. Further research is required over a greater time and with larger sample sizes to explore the impact in a more in-depth way.
- 2 Although featured in the 'studies of note' section, there was little on the potential of horticultural therapies with veteran groups. Indeed, the study was the first to explore this user group; with veterans heavily featured in the media, further research could explore this user group in more detail.
- 3 Almost half the studies reviewed were through secondary data analysis, more work is needed to collect primary data on the role of gardening as a tool for tackling issues with mental health.

3.2 Papers that Reported on Impact of Gardening on Dementia



3.2.1 Overview

Dementia is defined as 'a set of symptoms that may include memory loss and difficulties with thinking, problem-solving or language' (The Alzheimer's Society, 2017). The area has seen a surge in research in recent years, with studies aiming to explore tools for better quality of life to tackling its root cause. Linked to this topic is multidisciplinary research, bringing together not just health researchers, but geographers, planners, architects and other actors; many focusing on the design of spaces and measures which can enable those with the disease to lead fruitful lives. Within the literature base there is a wide range of studies that focus on gardening and dementia; exploring care home gardens to community gardens and other interventions.

There were 14 studies located which explored the impact of gardening on dementia. Of these studies, 4 were mixed methods in nature, 1 a case study approach, 1 observational study, 1 systematic review, 3 repeated measures designs, 1 RCT and 1 purely qualitative study. For obvious reasons, the majority of these studies focused explicitly on those over 80, with two exploring a younger age set of around 56 and upwards. The papers focused on multiple outcomes, with behaviour a consistent theme.

3.2.2 Studies of Note

- Jarott et al. (2002) noted how there was no significant change between those taking part in horticultural activity and those who did not take it up. The 10-week programme was linked to an adult day service scheme and involved attendees planting and cooking. A small sample of 11 was included for the study, with observations starting 30 minutes before and 30 minutes after the activity had taken place. An adapted Dementia Care Mapping Scale was used to evaluate affect. The author noted that the affect between those taking part and those who did not was only minimal. For instance, the average level of affect for horticultural activities ranged from 1.7-2.4 and for the non-horticultural activities ranged from 1.5-2.5. Despite this, the author still argues that horticultural activity is still better value than traditional dementia care methods.
- Hewitt et al. (2013) are the only group to focus on early onset dementia, with the other 13 papers focussing more on later life. Although a pilot study, the paper revealed the impact of a structured gardening programme on attendees aged between 43 and 65. The length of the study was also somewhat unique in that feedback was obtained from 6 and 12 months alongside more immediate data collection. The paper revealed how gardening helped to enable independence, a feeling of value and reduced anxiety. These benefits are despite cognitive function declining over the evaluation period. Ultimately the study suggests that a guided activity gardening programme can help to 'maintain or improve wellbeing in the presence of cognitive deterioration' (Hewitt et al., 2013: 1).

3.2.3 Propositions

There are a range of benefits from dementia sufferers who partake in gardening activities. The dominant benefit is behaviour change, impacting on depression and a general state of mind of those taking part in gardening. It was also evident that physical activity increased, quality of life was increased and there were wider benefits; for example, carers/family members in one study also benefited from the activities in that it reduced their stress levels and enabled better management of the patients (Edwards et al., 2012).

3.2.4 For patients with dementia, gardens contribute to

Positive Behaviour Change

- Hewitt et al. (2012: 356) noted that 'the benefits include improved mental state (including reduced depression), reduced behavioural problems and improved quality of life.'
- Edwards et al. (2002: 505) explained that 'All 10 residents reduced their agitation levels after the garden and atrium were built, seven of the 10 also reduced their depression scores and eight of the 10 increased their quality of life scores.'
- Murphy et al. (2010: 105) shows that 'visiting the wander garden helped lower agitation levels in all the dementia patients.'

Increased Physical Activity

- Hewitt et al. (2012: 359) revealed that carers felt that a core benefit of gardening was 'safe physical activity and knowing a loved one was being looked after.'
- Stem and Konno (2009: 276) 'Engaging in some physical activities (i.e. gardening, walking) appears to be more beneficial than other activities.'

Better Quality of Life

- Raske (2010: 348) explains that 'the findings suggest that the garden had a positive impact on resident quality of life, especially in terms of meaningful daily activities, enjoyment of daily life, relationships with others, and functioning as independently as one would like.'
- Whear et al. (2014: 701) in a review of studies explained that 'Staff and family members (and some residents) reported that the residents' interaction with the garden seemed to improve their well-being and, in some cases, also improved their interactions with visitors and staff.'
- Edwards et al. (2002: 505) showed how 'staff, family members and resident interviews elicited consistently positive feedback concerning the new environment, including observations that it had improved the quality of life for residents as well as decreasing staff and visitor stress levels.'
- Masuya et al. (2014: 103) declare that 'The results of this study indicate the effectiveness of the horticultural activities program to improve short-term vitality and cognitive function of elderly people with dementia.'

Areas for further research

- 1 Arguably, whilst there is a wealth of evidence relating to the impact of gardens on people living with Dementia, a large percentage of research is predicated on subjective proxy responses. This is largely due to the inability of people with end stage Dementia to consent to participate in research.
- 2 Subsequently, there are limited studies that include people at the end stages of dementia, and research has instead relied on garnering subjective responses from carers. Similar challenges exist within the context of severe and enduring mental health, where, despite the obvious potential of nature based activities on wellbeing, the sample population in studies are derived from proxy responses or those who are able to consent.
- 3 Hence, the predilection of research that have included the carers voice has influenced the evidence base.
- 4 Future research should, where possible, include people with later onset dementia and if possible utilise tools that can best assess behavioural or cognitive change.

3.3 Papers that Reported on Impact of Gardening on General Wellbeing



3.3.1 Overview

Stable wellbeing is defined as being when *individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge* (Dodge et al. 2012). Hence, the concept of wellbeing is complex and multifaceted. Consequently, there are a myriad of validated tools that can be used to evaluate, measure and observe the state of wellbeing in an individual. The influence of such complexity on the evidence base has resulted in the lack of a common methodology with which to measure the

impact of gardening on wellbeing. Moreover, there was a distinct lack of experimental or quasi-experimental methodologies used, and out of a total of 23 studies that measured well-being, there was only 1 RCT. The predominant research approach located was pre-test post-test designs that were reported in 4 papers. A total of three papers used a survey and 4 used qualitative approaches. Two papers used mixed methods and the other papers used a range of methodologies from comparative approaches, quasi-experimental, secondary data analysis, longitudinal, cross-overs and cohort. There were two systematic reviews, four literature reviews and one meta-analysis.

The gardens/ garden types and gardening interventions that were measured, varied and were poorly defined. These ranged from private gardens through to community gardens, allotments and botanical gardens. Most garden interventions included structured activities, such as digging, planting, weeding, sowing, and some captured self-reported perceived benefits of accessing or using a garden space.

Outcomes measured were broad and included general wellbeing outcome measures through to physiological outcomes. Papers reported a range of outcomes, one paper reported just the BMI as an outcome, whereas Ohly et al. (2016) reported on 14 outcomes.

The lack of a defined intervention led to a plethora of outcomes being measured which has resulted in heterogeneous studies proving future extrapolation difficult.

3.3.2 Studies of note

- Hawkins et al. (2011) cross sectional study was undertaken due to the lack of knowledge about the specific components of the activity that may construe particular health benefits. Hawkins et al. (2011) compared people physiological, social and psychometric attributes between allotment owners, people with home gardens and those who attended indoor exercise groups. The range of sample characteristics was selected so that they could be compared with gardening engagement activities- and not just merely being 'present' in a green space (Pretty 2004)– A total of 94 individual participants completed physiological measures and psychometric scales of self-rated health, perceived stress, physical activity level, and perceived social support. Physiological measures included BMI, blood pressure, lung function (spirometry). Psychological measures were subjective and self-reported through questionnaires of perceived social support and psychometric measures such as perceived stress scale, social provisions scale, IPAQ-S, & the SF-36v2. The detailed description of the study design enhances the potential for replication. Controlling for the effects of gender and socioeconomic status did not alter the results and the research reported that allotment gardeners reported significantly less perceived stress than participants of indoor exercise classes ($P < 0.05$) hence they advocate that the benefits of allotment gardening activity as a health-promoting behaviour in later life.

- Kohlleppe et al. (2002) surveyed 312 people who visited 3 different botanical gardens. The validated survey used a range of outcomes measures to capture the mood of the participants, for example, a modified version of the Centre for Epidemiological Depression Scale, the Stressful Life Event Inventory and the Rosenberg Self-Esteem Scale. The survey was completed on exit and measured stress subjectively by asking 'How stressed are you now?' and "how stressed were you before you came the garden". No baseline data was undertaken, although regression analysis was undertaken on the responses from the validated tools used to assess stress and mood. This paper identified that visiting the botanical garden can reduce stress. This paper is of note because it is an example of how a lack of baseline data – particularly relevant physiological data can undermine the trustworthiness of results. The variability within the garden was not considered and there was no account or observation of any confounders that may have influenced the stress reduction.
- Korpela et al. (2017) "A marginal positive association over time was seen between the use of a yard/garden and happiness. A potential strategy to enhance employee vitality over time is free time physical activity in natural surroundings."
- Hawkins et al. (2015) "Gardening may have significant physical and psychosocial benefits for older adults."
- Kim et al. (2010). "Horticultural occupational therapy has the potential to be used as an occupational therapy programme for stroke patients with hemiplegia."
- Ohly et al. (2016). "There is limited quantitative evidence for the impacts of school gardens. Qualitative evidence suggests that participants of gardening programmes may experience or perceive a range of health/wellbeing outcomes".

3.3.3 Propositions

Gardens contribute to a range of health and wellbeing outcomes through using structured approaches that embed nature based activities. These include reduced stress & anxiety, reduced depression, improved physical activity, reduced social isolation and improved individual ad/or community wellbeing.

3.3.4 Gardens contribute to a range of general health and well-being outcomes including:

Reduced anxiety/stress

- Hawkins et al. (2011) "Gardening could be an effective health promoting outdoor activity for older people."
- Kollleppe et al. (2002) "Results found limited support for an association between perceived nature exposure and employee well-being over time. Frequent physical activity in natural surroundings during free time predicted greater vitality. A marginal positive association over time was seen between the use of a yard/garden and happiness. A potential strategy to enhance employee vitality over time is free time physical activity in natural surroundings."

Reduced depression

- Leng et al. (2016) "Daily gardening for pleasure was associated with reduced mortality for Taiwanese >50 years old with mobility limitations but without depression."
- Masuya et al. (2014) " Taking part in horticultural activities reduced depression and increased life satisfaction in elderly residents of nursing homes."

Improved physical activity

- Blair et al. (2013) ". Trends were noted toward an increase in total carotenoids and a decrease in total serum Vitamin D. The findings support the feasibility and acceptability of a mentored gardening intervention."

Reduced Social Isolation

- Harris et al. (2014) "Community gardens can play a role in building relationships and facilitating integration into society."
- Hartwig & Mason (2016) "Gardens may serve as a meaningful health promotion intervention for refugees and immigrants adjusting to the complexity of their new lives in the U.S. and coping with past traumas."
- Middling et al. (2011) "One of the qualitative themes identified related to health and well-being. Some participants report a positive impact of gardening on improving physical and mental health and increased socialisation."
- Sempik et al. (2014) "STH was effective in promoting social interaction among vulnerable and isolated groups."

Individual &/or Community Wellbeing

- Dunnett et al. (2000) "For many gardening was very therapeutic, maintaining garden features in the memory of their beloved ones. The opportunity to meet neighbours was reported as a benefit by 23%. Gardens have a considerable influence on perceptions of individual human well-being".
- Heliker et al. (2001) "Gardening had psychological and spiritual benefits at an affordable cost."
- Kingsley et al. (2009) "positive impact of a community garden on health and wellbeing, including a sanctuary where people could come together and escape daily pressures, a sense of worth and involvement, spiritual, fitness and nutritional benefits. Community gardening offers many health and wellbeing benefits to members."
- Lanier et al. (2015) "Study findings support community gardens as a strategy to create sustainable positive change in the community by building social capital and fostering community health through collaboration."
- Leaver & Wiseman (2016) "Four themes emerged: time and wellbeing, embodied wellbeing, being part of a gardening community and pondering the creator. Garden visiting can enhance the wellbeing of both individuals and communities."

Areas for further research

- 1 There is a significant lack of studies that have used robust experimental approaches, further research that uses experimental approaches is required to demonstrate both clinical and cost effectiveness.
- 2 There is a lack of evidence about the impact of gardens on physical conditions such as Type 2 diabetes, obesity and heart disease. Research that focus on specific conditions is required to support policy decision-making and social prescribing.
- 3 Natural experiments need to be used to determine the extent to which gardens can positively influence health and well-being.
- 4 More triangulated approaches that focus on similar outcomes measures are needed to fully explicate the impact of gardens on health and well-being.

3.4 Studies that Captured impact of Gardening on Specific Conditions using Physiological Outcome Measures



3.4.1 Overview

Similar to the papers that measured wellbeing, a range of methodologies were used to capture physiological outcomes. These included two pre-test/post-tests, one literature review, one cross-sectional study, one longitudinal study, one scoping review, one systematic review and one feasibility study. Whilst the majority of papers explicated the impact of gardens on well-being, there were only 9 papers which focused on a specific physiological condition. For example, Austins et al.' (2006) exploration of a community based garden which included participants with lung disease. Other papers, such as Blair et al. (2013) evaluated vegetable gardening on child and adult survivors of cancer using pre-test post-test design. There were few studies that focused specifically on long-term conditions generally, probably due to the comorbid nature of longer term conditions and the challenges isolating effect of gardens on one health outcome. However, Leng et al.'s (2016) longitudinal study explored the impact of gardening (defined as growing flowers, gardening or cultivating potted plants for pleasure) on a range of physiological outcomes such as diabetes, hypertension, lung and kidney disease. This is one of the few papers to use a range of physiological outcome measures. Matsunaga et al., (2011) used a cross sectional design with cross over to evaluate the impact of a hospital rooftop garden on heart rate variability for older women, Whilst the conclusions suggest that elderly women entered a 'physiologically relaxed state' in the garden, detail about the methods used were not included in the paper. Secondary data that captured physical functioning ability was included in a scoping review by Nicklett et al. (2016) in which biometric indicators were the predominant outcome measure to determine the impact of planned garden activities. Equally, Ohly et al.'s (2016) systematic review of school gardens included both qualitative and quantitative data and captured (amongst other physiological health indicators) urinalysis, total fat, BMI and systolic/diastolic blood pressure outcomes.

3.4.2 Studies of Note

- Leng et al. (2016) one of the few that have explored impact of gardening on mortality by explicating co-morbidities such as stroke, cancers, diabetes, hypertension and heart disease. This paper did not focus on one condition but extracted data relating to a range of conditions, depression and mobility. The intervention was gardening defined as growing flowers, gardening, or cultivating potted plants for pleasure. "Findings suggest that daily home gardening had a positive impact being associated with a high survival rate (hazard ratio: 0.82; 95% CI 0.71–0.94). Later comorbidities, mobility limitations and depression lowered the protective effect of daily gardening at baseline (HR: 0.87; CI: 0.73–1.02). Daily gardening appeared to be significantly beneficial for survival (HR: 0.64; CI: 0.48–0.87) for those with mobility limitations, but without depression at baseline after adjusting for time-dependent comorbidities, mobility limitations, and depression. The protection of gardening was weakened by chronic or relapsed depression."

- Ohly et al. (2016) systematic review of mixed methods about a school gardening intervention using a total of 14 separate biometric outcomes coupled with qualitative data. This review concluded that there is limited quantitative evidence about the impact of school gardens, but qualitative evidence induced a possible impact on perceived health and wellbeing. This review highlights the need for triangulation and synthesis of data alongside the generation of more robust experimental studies.
- Rodiek (2002) pre-test/post-test design to explicate the impact of gardens on mood, anxiety and salivary cortisol. The findings suggest that there is an association between nature and the health outcomes measured.

3.4.3 Propositions

The evidence base that demonstrates the impact of access to and engagement with gardens on physical health is less well established. There is a dearth of evidence that has specifically evaluated the impact of gardens on physical health outcomes. However, evidence located in this review indicates that gardens can promote physical activity, improve daily activities for people with cancer, can help to prevent obesity and can have important health benefits for people with lung disease.

3.4.4 Gardens contribute to:

Reduced Obesity:

- Schalkwijk et al., (2017) "Associations were found between environmental variables at ages 3 years and 5 years with children being overweight and obese at 7 years old. Limits on access to outdoor space are associated with future childhood overweight/obesity, moderated by parental education level."
- Zick et al. (2013) "Community gardeners had significantly lower BMIs (-1.84 for women and -2.36 for men) than neighbours not in the programme. Significantly lower BMIs for women community gardeners were noted compared with their sisters (-1.88) and men community gardeners compared with their brothers (-1.33). Community gardeners had lower odds of being overweight/obese than their neighbours. No statistically significant difference in BMI or odds of being overweight/obese were observed amongst gardeners and their spouses. Health benefits of community gardening may extend beyond an increase of fruit and vegetables. Community gardens may be a valuable neighbourhood feature that promotes health."

Health Benefits for Cancer Patients

- Blair et al. (2013) sample size (N= 12) paired adult and child cancer survivors with Master Gardeners. "Fruit and vegetable intake by ≥ 1 serving(s)/day in 40% of survivors. Physical activity increased by ≥ 30 minutes/week in 60% of survivors". The findings support the feasibility and acceptability of a mentored gardening intervention.

Health Benefits for Lung Disease Patients

- Austin et al. (2016) included 1 participant with lung disease "Results report a general trend towards lower, improved scores for most Dartmouth COOP Functional Health Assessment Charts at the post-test (physical fitness, feelings, change in health, overall health, social support, social activities, quality of life). Gardening has important health benefits.

Rehabilitation of Stroke Patients

- Kim et al. (2010) "Horticultural occupational therapy has the potential to be used as an occupational therapy programme for stroke patients with hemiplegia."

Improved Heart Rates

- Matsunaga et al., 2011: "A positive impact was seen on heart rate variability with the rooftop forest group recording a consistently higher parasympathetic indicator (HF) (range: 4.0–4.3, mean: 4.1) at every minute, except at 1 to 2 minutes, than those of the control (range: 3.5–3.7, mean: 3.6). Differences were significant. Elderly women requiring care entered a physiologically relaxed state in a hospital rooftop forest.

Areas for Further research in Relation to Impact of Gardens on Physiological Outcomes

- 1 As per wellbeing studies, there is a lack of robust RCT's that fully explicate the impact of gardens on long term conditions – future natural experiments or RCTs triangulated with other methods will help capture full range of physiological outcomes.
- 2 To date, there is only one systematic review (Soga et al. 2017) of the effectiveness of gardens on health and wellbeing, but this lacks focus on physiological outcomes. Future research should triangulate secondary data sets and where appropriate, focus on impact of gardens on single long-term conditions.
- 3 Baseline data capture of physical conditions was poor in most studies, and there is a need to ensure that medical histories are recorded as a baseline to control confounders to demonstrate both causality and correlation.

3.5 Gardening Impact on Nutritional Intake



3.5.1 Overview

It is acknowledged that obesity has become a major national and global public health problem (HCIC 2016). Obesity influences the development of co-morbid conditions such as type 2 diabetes and coronary heart disease and as such is considered to be the fourth largest risk factor contributing to deaths (HCIC 2016). In the UK, “58% of women and 65% of men were overweight or obese & obesity prevalence has increased from 15% in 1993 to 26% in 2014” (HCIC 2016). This dramatic increase is also reflected in 1 in 5 primary school aged children, predominantly from the most deprived areas. It is recognised that obesity and subsequent co-morbid long-term conditions can be prevented through good diet and physical activity, both of which are often promoted through gardening programmes such as the RHS School Gardens programme (Christian et al. 2014). Gardens can offer one method to promote exercise and improve nutritional intake. Surprisingly, there were only 7 studies that focused on nutrition as an outcome. Out of these one was an RCT, two used mixed methods, one was a pre-test/post-test, two were meta-analyses and one was a feasibility study. The evidence presents a mixed message about the effect of gardens on diet and nutritional intake. This maybe as a result of the way in which the outcomes were captured, for example, see studies of note below.

3.5.2 Studies of Note

- Blair et al. (2013) report on a feasibility study to evaluate a vegetable gardening intervention for cancer survivors and paired 12 adults who had survived cancer with Master Gardeners. This is one of the few studies that have included a population post cancer. The key outcomes captured were effects on fruit and vegetable intake, physical activity, quality-of-life, and physical function. Participants were followed up over a 3-year period. A range of physiological measures were taken, but nutritional intake was assessed using the NIH Eating at Americas Table Fruit & Vegetable Screener. The findings indicate that 40% of survivors increased their fruit and vegetable intake by ≥ 1 serving(s)/day. Moreover, all six adult survivors and three out of four parent caregivers achieved two out of three of the health behaviour/function goals (increase of ≥ 1 fruit and vegetable servings/day, an increase of ≥ 30 minutes/day of physical activity, and improvement in three out of four of the physical function measures). The authors note key limitations to be small sample size and lack of a control group, which is typical of other papers that have explored the impact of gardening on a range of conditions and populations. The authors conclude that a “*mentored gardening intervention among cancer survivors represents a novel and holistic strategy to improve physical function, fruit and vegetable consumption, and physical activity in cancer survivors. Randomized controlled trials are needed to evaluate efficacy and durability of vegetable gardening interventions*”.
- Christian et al. (2014) used an RCT to measure the impact that an RHS School Gardening programme had compared with a teacher led school gardening programme. A total of 26 schools across London were included, from which 10 were randomly allocated to receive the RHS intervention, and 16 the teacher -led intervention. Data were collected using a 24-hour food diary (CADET) at baseline and follow-up dietary intake. Questionnaires were used to measure children’s knowledge of, and attitudes towards, fruit and vegetables and to assess the intervention implementation. The findings indicated that there was no statistically significant difference between groups in terms of improvement in gardening level hence, school gardening alone cannot improve children’s fruit and vegetable intake. The findings do suggest that combined interventions from schools and family support could help improve nutritional knowledge and consumption. The authors note that this lack of differentiation between groups is likely to have influenced the primary outcome and that there is a *need for more sophisticated and accurate tools to evaluate diet in children*. There is a need to include parents in future studies that measure the impact of school gardening programmes on nutritional intake.

3.5.3 Propositions

- Gardening can contribute to improvements in nutritional intake through active participation in education about nutrition during gardening activities. However, 3 studies (Olhy & Christian et al. & Robinson-O’Brien) did not show any significant difference in nutritional intake for school based gardens. This was predominantly based on confounders such as the style of education and the methodological approach.

3.5.4 Gardens contribute to:

Improved Nutritional intake

- Blair et al. (2013) found that engagement with vegetable gardening programme improved the fruit and vegetable intake by ≥ 1 serving(s)/day in 40% of cancer survivors.
- Hartwig & Mason (2016) "An increase in vegetable intake was reported by 78% of people who used the Church garden/individual or family plots."
- Massett et al. (2012) "A positive impact of home gardens was found on increased consumption of fruit and vegetables. No evidence of impact was found on iron intake in children. Some evidence of impact was found on improved intake of vitamin A among children <5 years (Mean difference 2.4 $\mu\text{g}/\text{dL}$, 95%CI 1.67-3.16)".
- Ohly et al. (2016) "There is limited quantitative evidence for the impacts of school gardens. Qualitative evidence suggests that participants of gardening programmes may experience or perceive a range of health/wellbeing outcomes."
- Robinson-O'Brien (2009) "garden-based nutrition intervention programs may have the potential to promote increased fruit and vegetable intake among youth but highlight the limited quality of the included studies".

Education about Nutrition

- Christian et al. (2014) "There is little evidence that school gardening alone can improve children's fruit and vegetable intake, but when gardening was implemented at the highest intensities the findings suggest it could improve children's fruit and vegetable intake by a portion per day".
- Langelloto & Gupta (2012) "Gardening has a greater impact on vegetable consumption than other nutrition education programs."

Areas for further research

- 1 Robust methodologies that account for the confounders associated with teaching style.
- 2 More quasi-experimental longitudinal studies to evaluate long term impact of garden programmes on behaviours change and sustainable change in adults and children
- 3 Need to ensure parental involvement in the promotion of nutritional intake is accounted for and observed in future RCT's. This also includes a need for more accurate and sophisticated tools to evaluate diet in children (Christian et al. 2014).



4. Key Methodological Features



This scoping review identified that a range of methods have been used to determine the impact of gardens and gardening on health and well-being. This diversity reflects the heterogeneous interventions used to evaluate complex situations and interventions. To date, no single methodology is recommended as a standard approach and it is potentially unrealistic to prescribe such a framework as it could straightjacket innovative approaches. However, there is a prerequisite for evidence based interventions that demonstrate effectiveness both in terms of costs and health/wellbeing benefits, and there is a need to understand what methods work, for which interventions and for what populations to support the social prescribing movement. Hence, this review has located common methods and proposes a potential template that can be refined and adapted for future evaluations of gardens and/or nature based activities on health and wellbeing.

4.1 Methods, Populations and Outcomes:

The most frequently used methodology was the Pre-test post-test (n=13). This popularity may be due to the ability of this design to measure change arising from experimental conditions (Dimiter et al. 2003). Pre-test designs provide an opportunity to reduce confounders by controlling threats to internal and external validity.

Hence, a range of pre-test post-test designs used mixed approaches to control and reduce bias. As a research design, they provide a good opportunity to test out nature based activities in a range of contexts and populations and provide an evidence base that is based on a quasi-experimental approach – therefore more likely to be replicable and applicable to clinical health care practice. Interestingly, there were 10 systematic reviews located as part of this review. Systematic reviews have long been considered to be the ‘gold standard’ evidence that is used to support NICE guidance and clinical commissioning, however their value is dependent on the quality of the studies located to include in them. The systematic reviews included over 35 validated outcome measures and a range of biometric outcomes. These heterogeneous outcomes have resulted in a paucity of meta-analyses that potentially have explicated the effect of gardens on health and wellbeing. The range of garden types (interventions) has been influenced by the complexities of the populations who access them. Typical interventions included ‘allotment gardening’, ‘Community gardens’, ‘Horticultural Therapy’ or ‘Therapeutic Horticulture’. When the term ‘gardens or gardening was used’, many studies characterised this by defining the activities undertaken within the garden such as planting seeds, potting on, taking cuttings, pricking out, sweeping and maintaining the garden, using and cleaning tools, and other similar tasks.

These methodological challenges may have influenced the range of research designs located in this review and could account for why there have been a high number of papers that have used mixed methods within standard designs. However, the types of evidence used to support health care commissioning are predicated on a typology of evidence that considers experimental studies, such as RCT's as high quality (Sackett et al. 1996). As such, RCT's have influenced systematic reviews and ultimately NHS policy and practice through the development of evidence based national guidelines (see for example NHS National Service Frameworks Typologies of Evidence). In this review, only four RCTs were located, which could be as a result of the complex interventions and challenges associated with minimising bias and controlling for confounders. An example of one RCT by Christian et al. (2014) highlights the challenges conducting an RCT when the key intervention was educational (School 'v' RHS school garden programme). In this study, the method of education and person delivering the programme presented confounders that could have influenced the results – to the extent that the effectiveness of the actual intervention – i.e. the content of the programme, may have been overlooked. The lack of RCT evidence indicates the challenges associated with undertaking robust and meaningful evaluations on the impact of gardens, and explains the myriad of research designs as a result.

Whilst experimental studies can help determine effectiveness of nature-based interventions, there is also a need to understand how these types of interventions can support individuals and communities to develop resilience. A large percentage of people with mental health are socially isolated, and equally, older people may suffer from social exclusion. The review evidence indicated that nature-based activities such as gardens (in the range of formats) can help social inclusion, self-esteem and perceived wellbeing. Understanding the

Table 2 - Emergent Methodological Framework

Framework	Description
Methodological Approach	Quasi experimental - longitudinal
Methods	Pre-test/post test
Triangulation	Mixed methods within the quasi experimental design a. Subjective accounts using qualitative enquiry b. Larger scale survey
Type of Garden/Activity	Everyday life - just accessing green spaces, walking etc, home gardening, view from window or work...outcomes and methods used Health promotion that use nature based activities - digging, Social and therapeutic horticulture, community gardens...outcomes and methods used Green care: for a population with a defined need (other conditions for example, depression etc) where nature based activities are used as an intervention (therapy) and provided by professionals groups...outcomes and methods used (NECR 2017)
Population	Should be clearly defined in terms of age, mental, educational and physical ability , condition (where appropriate) , wellbeing.
Outcome measures	Determined by population that capture that range of outcomes, for example: Physiological, functional, sociological, economic, psychological, emotional, behavioural

subjective effects of gardens present significant health and wellbeing outcomes that may not be captured using experimental or quasi-experimental approaches. Therefore, qualitative methodologies provide in-depth evidence about social isolation (as one example) that can be contextualised and transferred to similar settings. Whilst the option to extrapolate findings from qualitative research maybe limited, there is none the less a value placed on subjective findings for commissioners as they can help steer future research and when triangulated or synthesised with other data, can provide a holistic perspective of the impact of gardens on a range of populations.

4.2 Towards an Emergent Methodology

The lack of experimental studies is inevitable given the heterogeneous nature of the intervention, populations who access these and the subsequent outcomes used to measure impact. Realistically, future proofing methodologies as a standard approach may not be a viable option, and research that evaluates the impact of gardens on health and wellbeing should consider robust mixed methods that describe such variabilities and clearly define both the garden type and population to ensure that findings are meaningful for commissioners, social prescribers and VSO's. Typically, methods used included are detailed in table 2.

Triangulating approaches using mixed methods within a quasi-experimental approach provides a realistic methodology that could provide a holistic perspective of the impact of gardens on health and wellbeing across a range of populations. Arguably, the population being evaluated should direct the outcome measures used. In all cases, validated tools should be used to enhance the validity of the findings and ensure a robust approach.

4.3 Methods Logic Model:

This review has located and included evidence relating to the impact of gardens on health and wellbeing; in doing so, the diversity of methodologies has been highlighted as both a strength in terms of its ability to support a range of populations, but also its limitations resulting in no standard outcome or methods. Using 'Logic models' can help illustrate the key attributes of gardens and as such, maybe a useful tool to guide providers and commissioner's decision making. This review has developed three logic models that illustrate the evidence for 'General Wellbeing', 'Mental health' and 'Dementia'.

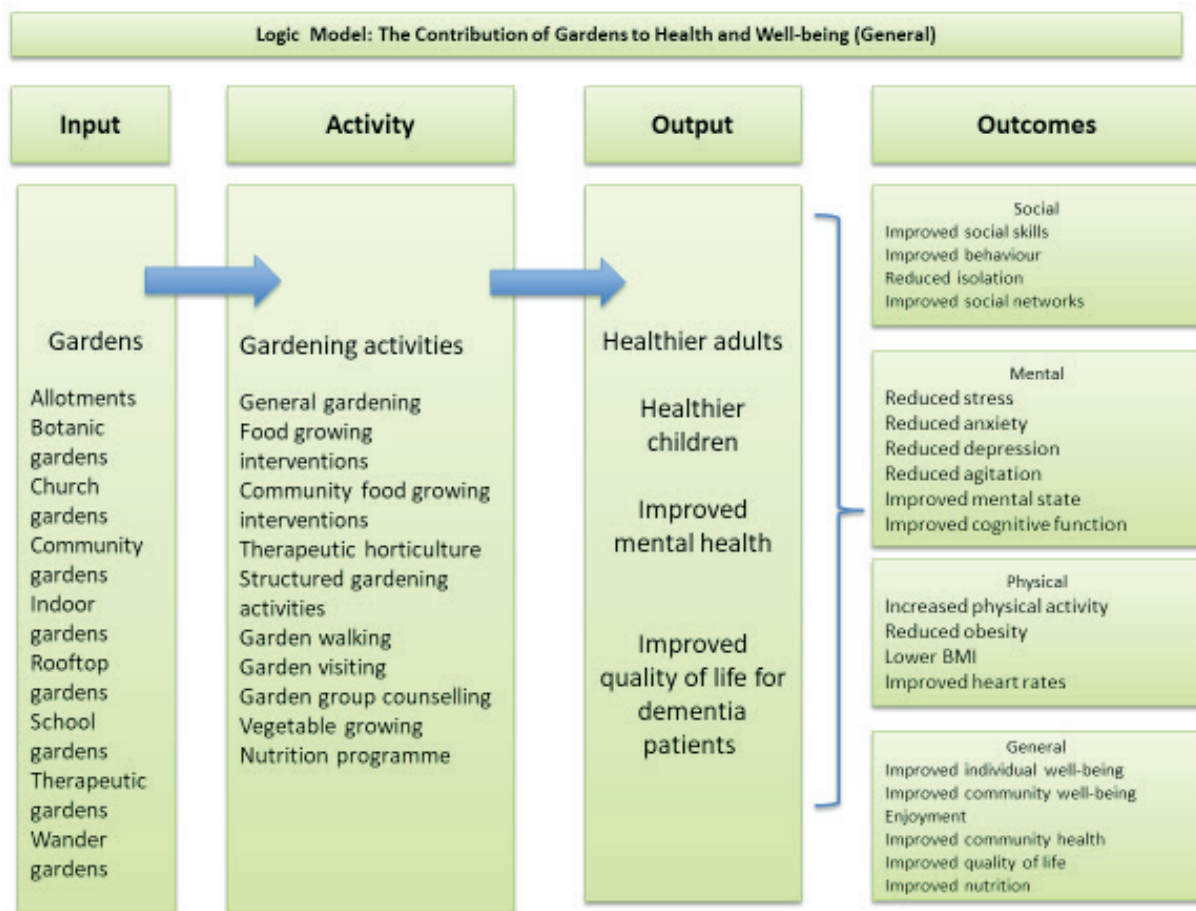


Figure 5 - Logic Model 1: Contribution of Gardens to Health & Wellbeing (general)

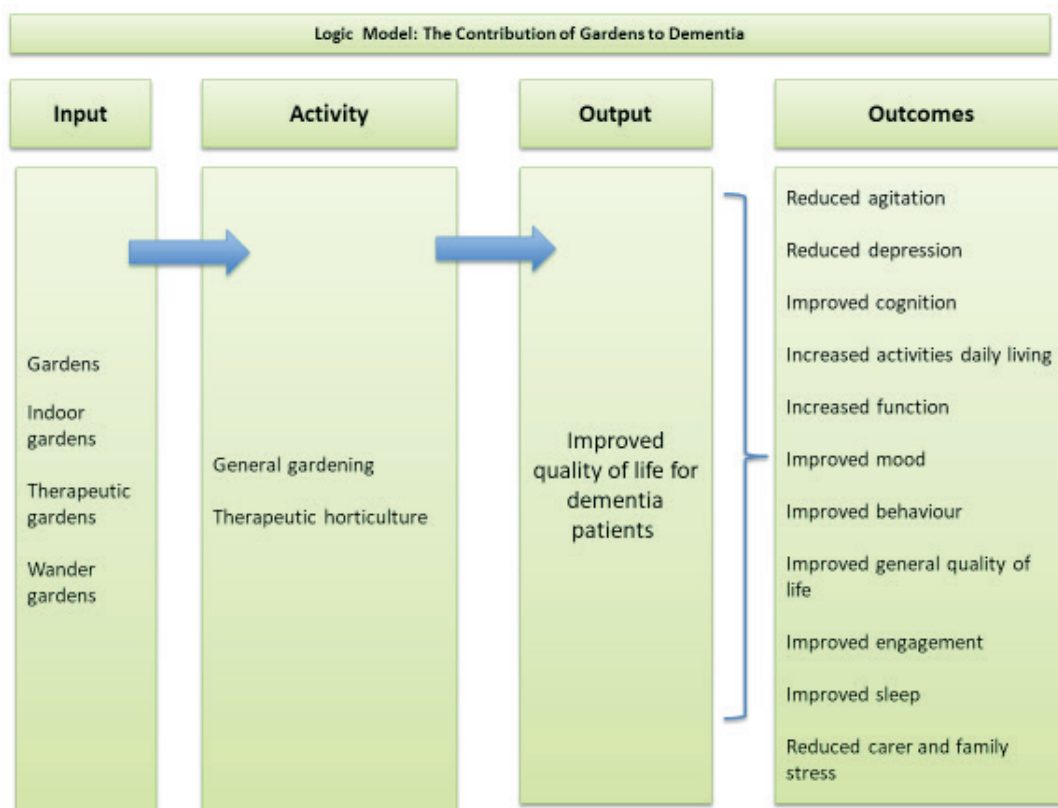


Figure 6 - Logic Model 2: Contribution of Gardens to Dementia

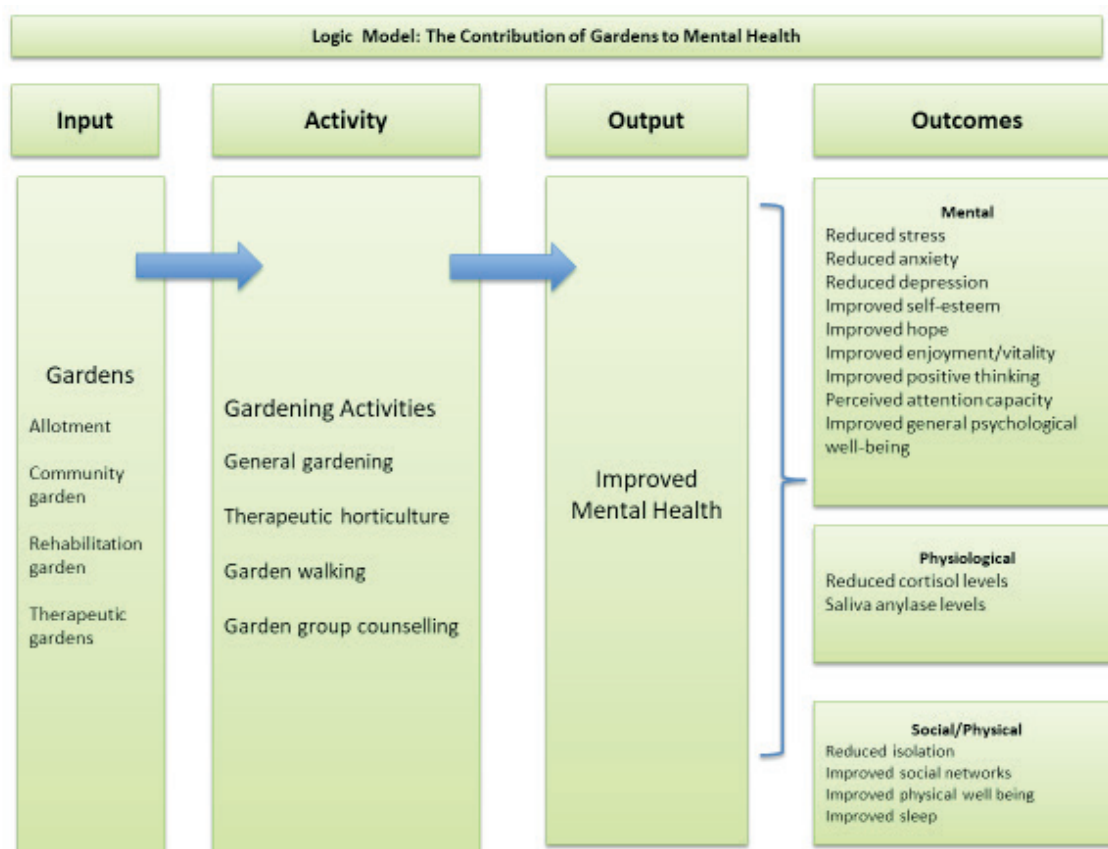


Figure 7 - Logic Model 3: Contribution of Gardens to Mental Health

5. Discussion



This report has provided an overview of the evidence for gardens as an intervention that could promote health and wellbeing in a range of populations. This has significance for public health and health care as there is a need to explore alternative methods of service provision. The social prescribing movement within the UK has attracted interest from the NHS and commissioners and as such, this report presents a timely overview of the evidence base supporting the use of gardens as an activity within a social prescribing framework. However, recognition of the diversity of garden types, interventions and subsequent methods used to evaluate these needs to be communicated to enable decision making to take account of and accept the limitations of RCT's and meta-analyses within the context of nature based approaches.

Initially, this review located over 7,000 papers that included some form of nature based approach to wellbeing. The inclusion and exclusion criteria helped to sift and sort those papers relevant for gardening – however, the resultant 67 papers indicated a significant gap in the evidence base. There was a limited number of studies that have used physiological outcomes measures, and considering the need for health promotion and prevention, it is surprising that physiological outcomes have not been included as key outcomes indicators. Equally, there was a lack of natural experiments, however, as noted in this review, this is likely to be influenced by the challenges associated with refining the intervention and then controlling for confounders. Similarly, there was also a lack of studies that had undertaken a cost benefit analysis and whilst there has been an increase in projects

using Social Return on Investment models, there were only 2 located in this review. Finally, some studies had limited methodological rigour particularly with nutrition-based studies which needed to control for confounders such as diversity in teaching & learning styles used to promote improvements in nutrition through gardening.

Small sample sizes, lack of a standard methodological framework and poorly articulated interventions have resulted in an evidence base that demonstrates positive effect, but lacks rigour to support the commissioning of services. Studies mostly demonstrate correlation as opposed to causation, which will have implications for future funding of these services. However, there is an increasing penchant to both triangulate and synthesise data to demonstrate effect. Soga's (2017) meta-analysis demonstrates a first step towards a method that can delineate between the diversity of outcomes to focus on and capture interventions that can later be combined and analysed. The proposed methodology developed as a result of this review, could provide a robust framework that could be adapted for future evaluations of the impact of gardens on health and wellbeing.

The dearth of evidence associated with evaluating the impact of gardening on physiological outcomes was surprising. Whilst some papers have attempted to measure cortisol levels, BMI, blood pressure, and diabetes physiological measures such as glycaemic levels, the lack of baseline data or medical history to support any change in physiological outcomes has meant that the evidence for the use of gardens to help with physical

activities is scarce. This is significant as globally there is a pressing need to manage the growing levels of obesity and prevent the onset of long term conditions such as type 2 diabetes. Nursing and medical involvement in the development and design of natural experiments is essential if the evidence for gardening is to demonstrate an effect on physiological outcomes.

The papers in the scoping review were predominantly based on the impact of gardens on mental wellbeing and in particular, Dementia. However, the evidence base that include participants with dementia is small as a result of the challenges associated with the inclusion of people with dementia to participate in studies when consent is compromised. Moreover, similar to other findings there is a need to explore the cost-effectiveness of gardening and other nature based activities on long term conditions that now threaten the sustainability of the NHS and health care globally.

A number of studies captured the impact of 'accessing' a garden or green space. However, the extraneous variables in such studies have been poorly controlled making findings from 'access' studies redundant as they fail to demonstrate causation or correlation. The challenges of establishing effect with complex interventions is not confined to gardens or nature based activities, and the growth in pre-test/post-test as a methodology is testament to the need for baseline measures to control variability in many complex health conditions. Hence, the need for robust experimental studies that can isolate specific outcomes and control variability is required to truly demonstrate the effect of gardens on health, wellbeing and long term conditions.

5.1 Strengths and Limitations of the Review Method

This scoping review searched for evidence on the impact of gardens on a range of conditions to ensure that all relevant data was captured and reported. In doing so, the review identified significant challenges as a result of the diverse descriptions that related to gardens. Whilst the review has accounted for this range through comprehensive, sensitive searching and a robust inclusion and exclusion criteria, there may be some papers that report on gardens that were missed. The scoping review therefore provides some understanding about the types of evidence and methods that have been used to measure the impact of gardens on key conditions. The evidence included has not been appraised for the methodological quality but has instead reported on the range and types of methods used in order to understand the common approaches with which a future methodological framework could emerge.

5.2 Conclusion

The brief was to provide evidence that would support the use of gardens as a nature based intervention to promote health and wellbeing. Although the methodologies and interventions varied, the evidence base overwhelming supported the use of gardens as an activity that could promote wellbeing. Moreover, these activities were reflected in Bragg et al (2017) Green Framework which suggests that gardens positively impact on people through everyday life such as home gardening, health promotion through nature based activities such as digging and community gardening through to and green care that uses more structured approaches for people with defined needs.



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<http://www.bmj.com/content/350/bmj.g7818> - proms bmj article

https://midlandsandlancashirecsu.nhs.uk/images/Logic_Model_Guide_AGA_2262_ARTWORK_FINAL_07.09.16_1.pdf

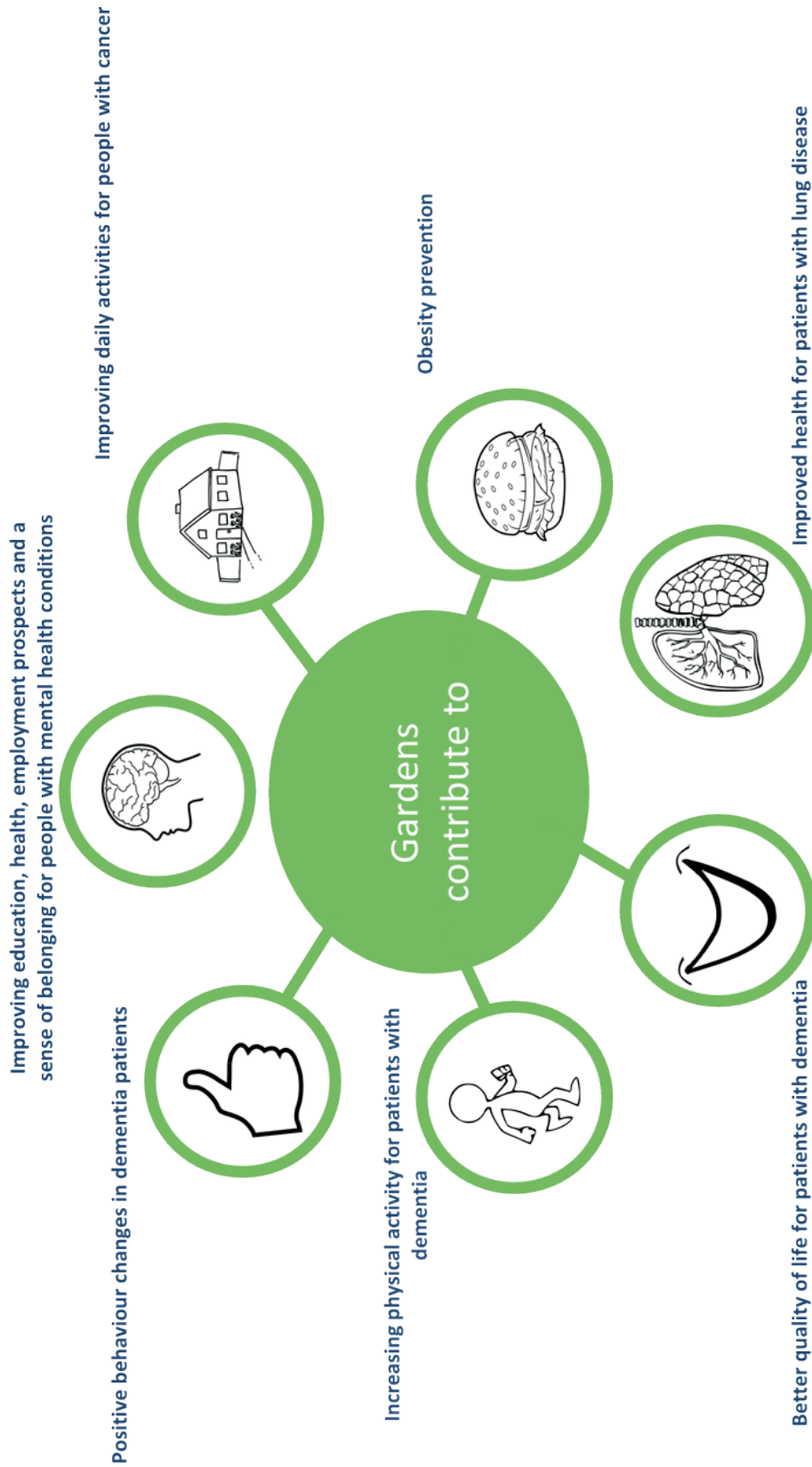
Appendix 1: Resources searched

RESOURCES SEARCHED AND RESULTS PER RESOURCE (searches undertaken by experienced information specialist MM)

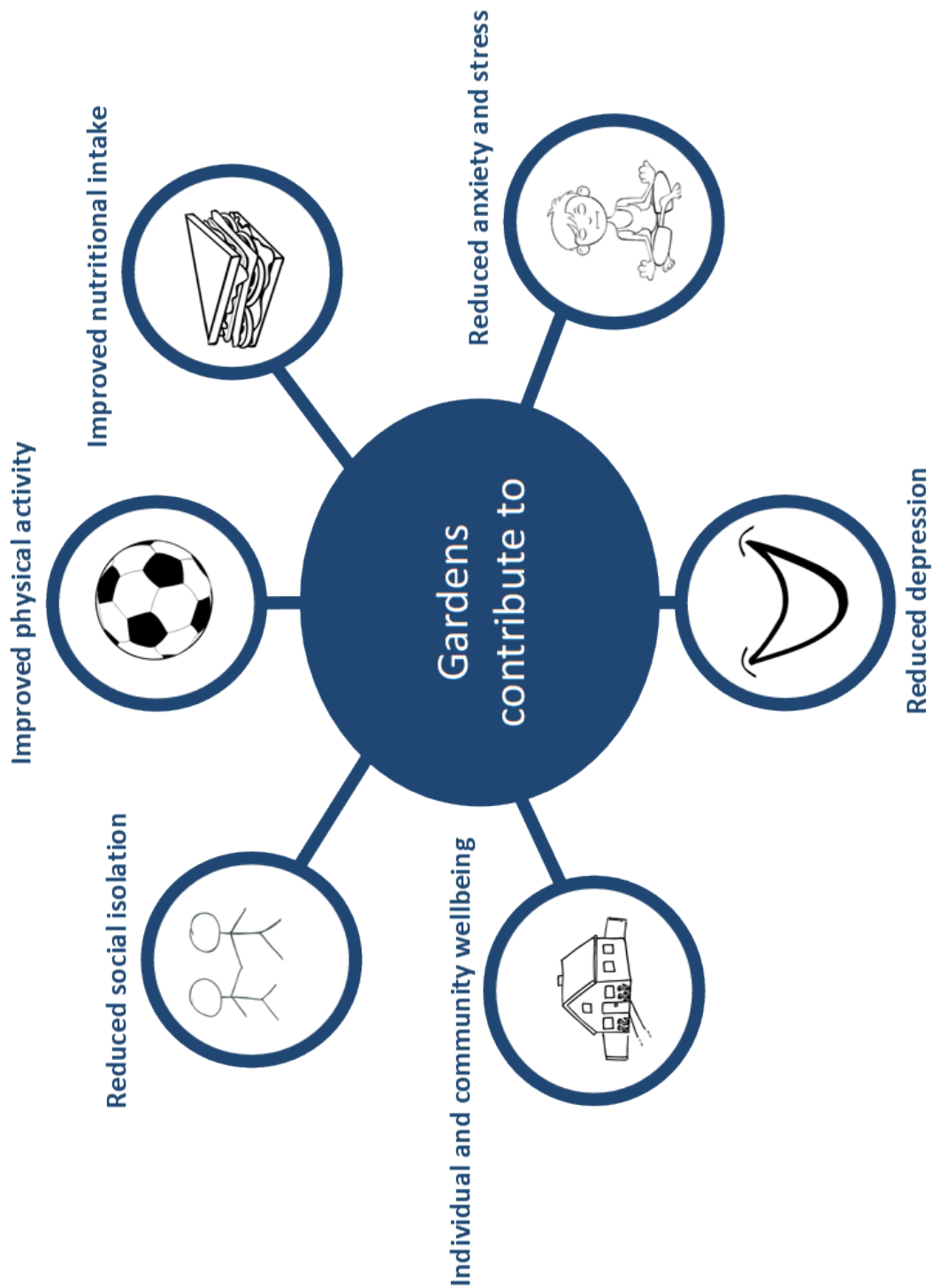
Source	Platform (if relevant)	Date searched	Results
Medline	OVID	120517	1460
CINAHL	EbscoHost	150517	1423
PsycInfo	EbscoHost	150517	584
HMIC	HDAS	150517	269
AMED	HDAS	150517	337
Greenfile	EbscoHost	150517	704
Environment Complete	EbscoHost	150517	1615
Cochrane Library	Wiley	190517	344 CDSR: 12 DARE:10 CENTRAL: 321 TECH ASSESS:1
DoPHER	eppi.ioe.ac.uk/webdatabases4/Intro.aspx?ID=9	190517	14
Social Care Online	www.scie-socialcareonline.org.uk/	190517	241
Joanna Briggs Systematic Reviews and Implementation Reports	Wolters Kluwer	190517	4
Web of Knowledge/ Science		190517	721
NIHR Journals Library	www.journalslibrary.nihr.ac.uk/#/	210517	4
Google Scholar	scholar.google.co.uk	210517	580
Scopus		210517	767
PubMed		210517	133
Grey Literature			
Thrive	www.thrive.org.uk	210517	3
European Centre for Environment and Human Health	www.ecehh.org	210517	8

Source	Platform (if relevant)	Date searched	Results
American Horticultural Therapy Association	www.ahta.org/	210517	See key journal 'Journal of Therapeutic Horticulture' below
The Kings Fund	www.kingsfund.org.uk/	210517	2
MIND	www.mind.org.uk	210517	4
Care Farm UK	www.carefarminguk.org	210517	7
National Trust	www.nationaltrust.org.uk/	210517	0
English Heritage	http://www.english-heritage.org.uk/	210517	0
Friends of the Earth	https://www.foe.co.uk/	210517	0
DEFRA	www.gov.uk/government/organisations/department-for-environment-food-rural-affairs	210517	0
Natural England	publications.naturalengland.org.uk/	210517	18
Other	Found ad-hoc	210517	5
Key Journals			
Journal of Therapeutic Horticulture		210517	24
Journal of Environmental Psychology		210517	5
Environment and Behaviour		210517	1
International Journal of Environment and Health		210517	0
Journal of Public Health		210517	3
Journal of Epidemiology and Community Health		210517	8

Appendix 2: Infographic Conditions



Appendix 3: Infographic Wellbeing Outcomes







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