Appetite 200 (2024) 107570

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

The association between COVID-19 related income loss and diet quality: The mediating role of distress

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ARTICLE INFO

Keywords:
Income loss
Cost-of-living
Food insecurity
Diet quality
COVID-19
Distress

ABSTRACT

The COVID-19 lockdowns saw many individuals lose income, experience distress and increase intake of foods that would typically be considered less 'healthy' (more processed and less fresh produce). Establishing whether there are direct and indirect links between these variables would be of benefit in preparing for similar future events but also has implications for the current global financial climate, where many are experiencing relative decreases in income. Adults in two locations (UK and Australia) (N = 917) completed online questionnaires to explore the impact of the first COVID-19 lockdown on their change in income, emotional wellbeing (depression, anxiety, stress, loneliness), resilience and diet quality. A structural equation model revealed that income loss was indirectly associated with diet quality via distress. As such, the greater the loss of income experienced, the more distress reported; distress was then directly associated with a less nutritious diet. This pattern of results existed when data from both countries were combined but also when they were modelled individually. Our findings indicate that where individuals experience a sudden reduction of income there are likely to be negative consequences for both mental and physical health. It is plausible that these findings would extend to other circumstances in which sudden loss of income may be experienced such as reductions in state social care, rising inflation and interest rates and sudden increases to the general cost of living.

1. Introduction

On January 30, 2020, the WHO declared a global health emergency in response to the novel coronavirus respiratory disease (COVID-19) (Velaven & Meyer, 2020). At the time of the outbreak, modelling of the pandemic suggested that interventions were needed to mitigate against exponential growth in COVID cases in order to "flatten the curve" and to prevent overloading of medical services. In response, many countries issued directives to close shops, schools, non-essential businesses, and other places where people might gather.

As multiple industries became inactive (e.g. retail, travel industries), many lost their main source of income or became unemployed. In the UK, the impact of the first pandemic lockdown on income loss was estimated to account for approximately 68 million additional "poverty years" - the equivalent of 68 million people falling into poverty for the following year (Decerf et al., 2020). In Australia, unemployment rates increased to an all-time high of 7.1% (Munawar et al., 2021). It seems certain groups were also at higher risk of losing income and experiencing unemployment, particularly females (Yavorsky et al., 2021) and younger adults between the ages of 16–25 (Inanc, 2020).

Pandemic related income loss has been shown to be a major driver of stress, depression and anxiety (Wilson et al., 2021; Obrenovic et al., 2021; Hertz-Palmor et al., 2021). Where individuals were concerned about job losses, this was associated with higher levels of depression (Hertz-Palmor et al., 2021) and those who lost their jobs or experienced income loss tended to have the highest levels of anxiety and other adverse mental health outcomes (Ruegeron, Awiphan, Wongpakaran, Wogpakaren, & Nochaiwong, 2021).

Another outcome associated with the pandemic and lockdowns, was negative changes in dietary behaviour, with individuals reporting

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https://doi.org/10.1016/j.appet.2024.107570
Received 9 January 2024; Received in revised form 14 June 2024; Accepted 17 June 2024
Available online 19 June 2024

increased snacking, consumption of processed foods and reduced intake of fresh produce during this period (e.g. Robinson et al., 2021). Multiple studies have linked these changes in dietary eating patterns to emotional distress. A large national survey in France found that depression and anxiety were associated with unhealthy changes in dietary habits during the first lockdown (Deschasaux-Tanguy et al., 2021). Similarly, data from two large datasets from Italy, found that distress was associated with greater consumption of ultra-processed foods (Bonaccio et al., 2021), and research from the UK revealed that distress was associated with various different weight-promoting behaviours (Keenan et al., 2022).

There is good reason to believe that income loss, mental distress (e.g. depression, stress and anxiety) and dietary quality might be interlinked. In a review, Laraia et al. (2017) present evidence that income and job insecurity can result in a number of psychological and biobehavioural challenges (e.g. stress, sleep, cognitive capacity), which in turn make it harder to maintain a nutritious diet. Similarly, Claassen, Klein, Bratanova, Claes, and Corneille (2019) identified several environmental and psychological pathways through which socioeconomic status might influence BMI (Body Mass Index). The pathway with the most support was one through which social deprivation negatively influenced social factors (e.g. social support, belonging to a community), which then influenced stress and other psychological factors (e.g. depression, anxiety). The consequence of these disruptions is that some individuals then gain weight. The findings from these reviews are consistent with a popular theoretical model by Hemmingsson (2014; 2018). This model proposes that financial hardship can lead to a disharmonious social environment, emotional distress, and subsequent psychological overload. Increased cognitive load, coupled with reduced resilience, can translate in to weight promoting behaviours, such as consuming a less nutritious diet (i.e. eating more energy-dense hyperpalatable foods and less fresh produce). Several studies have now tested some of the predictions made by Hemmingsson's model (2014), with Spinosa et al. (2019) demonstrating that the association between socioeconomic status and BMI might be mediated by distress and using food as a coping mechanism. Later, Keenan et al. (2022) found that individuals during the first UK COVID-19 lockdown who were unable to access foods because of issues like food shortages or an inability to travel experienced greater distress and were more likely to engage in weight promoting behaviours (e.g. consuming larger portions, increased snacking). More broadly, Keenan et al. (2021) found that individuals experiencing chronic food insecurity (unstable access to nutritious foods, usually as a result of a lack of financial resources) were more likely to have a higher BMI, and this relationship was partly mediated by distress.

To the best of our knowledge, no studies have looked at the role of distress in mediating the relationship between income loss during the COVID19 pandemic and diet quality. Answering this question is important for two reasons. Firstly, we are living in a difficult global financial climate, with high inflation rates and many individuals experiencing relative decreases in income (Patrick & Pybus, 2022). Understanding how individuals respond to income loss more broadly, could help us understand the relationship between rising living costs and obesity (Robinson, 2022; Johnstone & Lonnie, 2023). Secondly, it is essential to understand how individuals were impacted by the recent pandemic in order to plan for potentially similar events in the future.

In order to understand the relationship between income loss, distress and diet quality, the pathway we planned to test relates to Hemmingsson's (2014) model and adaptations by Spinosa et al. (2019) and Keenan et al. (2021; 2022), but with COVID-19 related factors also considered. While distress has previously been conceptualised as consisting of depression, anxiety and stress (Keenan et al., 2021, 2022; Spinosa et al., 2019), in the current study we also included loneliness. This is because we anticipated levels of loneliness to be high during the pandemic, which is consistent with subsequent research (Dahlberg., 2020; Groarke et al., 2020), with loneliness also having been associated with greater levels of lockdown related depression and anxiety (Na et al., 2022; Okruszek et al., 2020). Resilience was also included because whilst it was not found to be a significant moderator in Spinosa et al. (2019), we reasoned it could be important in terms of dealing with the lockdowns. Research has subsequently indicated that those who reported greater trait resilience reported lower levels of depression during the lockdown (Na et al., 2022; Ran et al., 2020).

The current study sought to establish whether income loss from the COVID19 pandemic is indirectly predictive of a less nutritious diet and whether this association is mediated by distress (i.e. greater income loss would be expected to predict distress which in turn would directly predict a less nutritious diet). Resilience was also considered as a potential moderator of distress, with those reporting greater resilience predicted to be less likely to report reduced diet quality in response to distress. We collected data from two countries (United Kingdom, Australia), using the same set of variables. This made it possible to establish whether identical pathways existed for both countries, and thus whether any associations observed were robust.

2. Methods

2.1. Participants

Individuals were recruited via advertisements on social media sites, targeting individuals who were 18 and over. The data was collected as part of a multi-wave project, although only the data for wave 1 is presented in the current study. Data were collected pre-vaccine rollout between 31st May 2020 and 7th November 2020. During this time, UK citizens were under instructions to work at home (aside from key-workers), mandated wearing of masks, and socialising in groups of no more than six individuals (Institute for Government, 2022). Australian citizens were initially under national lockdowns, which restricted any international travel, social distancing and mask wearing. In May 2020, restrictions were eased and people allowed to meet in groups of five indoors and ten outdoors, although this was accompanied by intermittent regional lockdowns in response to local outbreaks (Kantis et al., 2020). Ethical approval for the study was granted by both the University of Salford's (Reference: HSR1920-089) and Swinburne University's (Reference: 2018/319) ethical research committees. The study was performed in accordance with the principles of the Declaration of Helsinki guidelines. All participants provided consent and participants were free to withdraw from the research at any point in time without revealing the reason for discontinuing.

2.2. Demographic information

To characterise our sample, participants were asked their age (in years), gender, height and weight, which of 10 options best described the industry they worked in (Response options: Health and social care, Education, Retail, Hospitality and leisure, Manufacturing, Professional services, Construction, Transport and storage, Student), and their living situation (Response options: live alone, live with other adults, live in a family unit, live as a single parent, live with elderly or 'at risk' adults).

2.2.1. Current income and income loss

Participants were asked "prior to the COVID-19 situation, how much did you earn after taxes?", with a free text box to enter a number, followed by options to indicate if this amount was: weekly, fortnightly, monthly or yearly. They were also asked "how much do you currently earn after taxes?", with the same response options as the previous question. Participants in the UK reported in Pounds Sterling and participants in Australia reported in Australian Dollars. To standardise income scores across the two regions, z-scores for prior income were created within each sample. This meant a common unit was used for each individual which reflected the number of standard deviations in income from the mean observed within their country's sample. A percentage for wage change scores was then calculated based on prior and

current income, with a negative score representing a loss of income and a positive score as an increase.

2.2.2. COVID-19 related questions

Participants were asked how their work had changed because of the COVID-19 situation (Options: My work situation has not changed, I am working from home some of the time, I am working from home all of the time, I am working reduced hours, I am no longer working), amount of time spent daily watching, listening or reading media about the COVID-19 situation (less than 1 h, 1–2 h, 2–3 h, 3–4 h, more than 4 h), time spent socialising daily with people who they do not live with (less than 30 min, 30mins to 1 h, 2–3 h, 3–4 h, more than 4 h), if they had been affected by COVID (I am leaving the home only when essential, I am in self-isolation because I have been in close contact with a confirmed case, I know someone who has been diagnosed with COVID-19, I have been diagnosed with COVID19), whether they had been tested for COVID-19 (Yes, No), and if they currently had any COVID symptoms (Yes, No).

2.2.3. Depression, anxiety and stress

The 21-item self-report depression, anxiety and stress scale was used (Henry & Crawford, 2005). Example question "I felt down-hearted and blue". Items are rated on a scale from 0 (did not apply to me at all) to 4 (applied to me very much or most of the time). Scores for each subscale was calculated by summing the scores for the relevant items. Higher scores represent a greater experience of depression/anxiety/stress.

2.2.4. Loneliness

Participants completed the 3-item UCLA Loneliness Scale (Russell, 1996). Example question: "How often do you feel isolated from others". Response options ranged from 1 to 3, with 1 being "hardly ever or never" to 3 being "often". A sum score was calculated with a high score representing greater loneliness.

2.2.5. Brief resilience scale (BRS)

The six-item brief resilience scale was used (Smith et al., 2008). Example question: "I tend to bounce back quickly after hard times". This assesses an individual's ability to bounce back or recover from stress. Response options range from 1 to 5 with 1 being "Strongly disagree" and 5 "Strongly agree". Scores were summed, with a high score representing greater resilience.

2.2.6. Dietary screening tool

A brief dietary screening tool developed by Bailey et al. (2009) was used, but with some food names slightly adapted for a UK and Australian audience. Example question: "How often do you usually consume fresh nuts, such as almonds, cashews, walnuts or brazil nuts?" Food items included: whole grain breads, whole grain cereals (e.g. porridge, muesli, Weetabix), seafood that is not fried, servings of vegetables, carrots, sweet potatoes or pumpkins, rocket, spinach, swiss chard or Kale, broccoli/cauliflower, fruit consumed per day, servings of olive oil, legumes (e.g. lentils or chickpeas), fresh nuts such as almonds, cashews and walnuts, servings of low-fat cheese or yoghurt per day, and dietary supplements. Response options ranged from 'never', 'less than once a week', '1 or 2 times a week', '3 or more times a week', 'every day or almost every day'. These items were positively scored and added to the following items which were reverse scored: non-diet soft drinks or cordials, sweets or chocolate, crisps or something similar, pies, sausage rolls or chips, cake, biscuits, ice-creams or doughnuts, lunchmeats, take-aways. A higher score is indicative of a more nutritious diet (i.e. more fresh produce and less processed foods).

2.3. Procedure

The UK questionnaires were hosted on Gorilla.sc™ (Newbury, UK), and the Australian questionnaires on Qualtrics.com (Seattle, USA). Both platforms were accessed by participants via a weblink. After reading an information sheet and providing consent, participants completed questions on demographic information, COVID-19 and daily life questions, the DASS, resilience, loneliness questionnaires and finally the dietary quality scale. These were presented in a fixed order each time.

2.4. Data analysis

A structural equation model was created to test the hypothesis that a decrease in income resulting from the COVID-19 pandemic would be indirectly associated with changes in diet quality, via distress. Because a change score was being used as the main predictor variable, the baseline value for each individual's income prior to the COVID-19 lockdown was added as a control variable.

A total of 918 participants provided complete responses on all variables needed to calculate bootstrapped indirect effects. One participant was removed for being under the minimum age of 18 for participation, leaving a total of 917.

To test model fit, a range of indices were generated. For the standardised root mean residual (SRMR), values under 0.08 were considered indicative of good fit. The root mean square error of approximation (RMSEA) parsimony adjusted measure is reported with values less that than 0.06 considered excellent fit, values greater than 0.06 but less than 0.08 as good and between 0.08 and 0.10 as acceptable (Browne & Cudeck, 1993; Hu & Bentler, 1999). The Tucker Lewis index (TLI) was deemed as acceptable above 0.90 and good above 0.95 (Hu & Bentler, 1999).

As three separate measures of emotional stress were taken via the DASS (depression, anxiety, stress) alongside a measure of loneliness, a confirmatory factor analysis was performed to establish how these might load on to a latent variable for 'Distress'. A confirmatory factor analysis (Bollen, 1989) was used with a Maximum Likelihood Estimator to validate this measurement model. The same indices of model fit were used as for the structural model.

To test the hypothesised indirect effects between food insecurity and both changes in weight promoting eating behaviours and diet quality, bias corrected bootstrapping was used with 95% confidence intervals ($N = 1000$). For direct effects between variables, beta values are reported in Fig. 1, and unstandardised regression coefficients in Table 3.

Before running the model, the effect of age on variables of theoretical interest (distress and diet quality) was investigated via correlations. Where age had a statistically significant influence, it was controlled for in the model.

3. Results

Pooled information from both countries is presented first, followed by individual analyses for the UK and Australia.

3.1. Descriptive statistics (pooled data)

The combined Australian and UK sample ($N = 917$) was mostly female (77.7%), with 23.4% reporting no longer working in response to COVID-19; 8.5% were working reduced hours, 47.8% were either working exclusively or partially from home, and only 20.2% reported no change to their work situation. Of the sample, 3.2% were underweight, 44.3% of normal weight, 37.4% overweight and 15.1% living with obesity. See Table 1 for further descriptive statistics.

3.2. Latent variable for distress

Several different measurements of wellbeing were taken; (i.) Depression, Anxiety and Stress (from the DASS scale) and (ii.) loneliness. A confirmatory factor analysis (CFA) was performed (with data from both the Australian and UK samples combined) to identify if these loaded on to the same variable. A modification index of 69.06 and a theoretical rationale that loneliness and depression would be linked

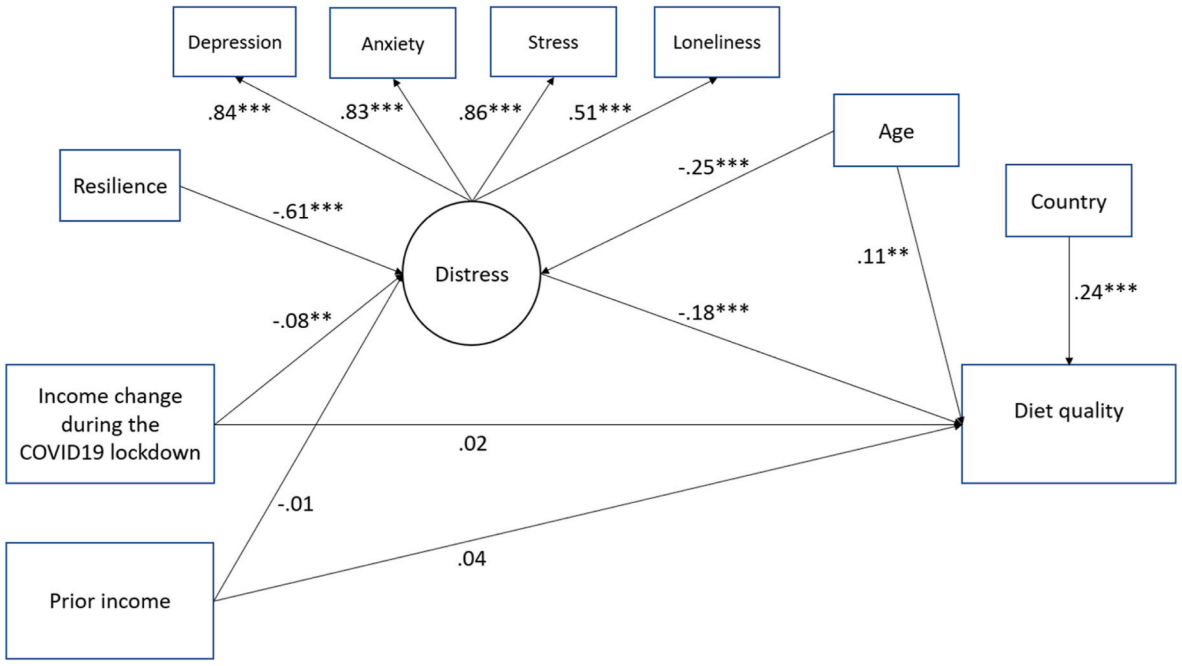

Fig. 1. Associations between COVID-19 related income-loss, distress and diet quality. Values are standardised regression coefficients * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. For ease of interpretation, residuals and covariances are not visually represented.

Table 1
Descriptive statistics and tests of difference for the Australian and UK samples and overall pooled (N = 917).

	Australia (N = 547)		UK (N = 370)		Test of differences	Overall (N = 917)	
	Mean (SD)	Range	Mean (SD)	Range		Mean (SD)	Range
Depression [a]	10.06 (9.80)	0 to 42	13.86 (10.66)	0 to 42	$t(743.5) = 3.95$, $p < 0.001$	11.66 (10.39)	0 to 42
Anxiety [a]	5.30 (7.13)	0 to 42	10.50 (8.16)	2 to 36	$t(725.7) = 5.20$, $p < 0.001$	7.44 (7.96)	0 to 42
Stress [a]	11.55 (9.14)	0 to 42	15.77 (10.46)	0 to 40	$t(723.6) = 4.22$, $p < 0.001$	13.26 (9.91)	0 to 42
Loneliness [a]	5.36 (2.00)	3 to 9	5.68 (1.94)	3 to 9	$t(915) = 0.34$, $p = 0.012$	5.49 (1.98)	3 to 9
Resilience [a]	20.26 (5.45)	6 to 30	18.57 (5.04)	6 to 30	$t(915) = -1.69$, $p < 0.001$	19.57 (5.35)	6 to 30
Diet quality [b]	63.97 (13.52)	21 to 94	52.94 (16.28)	13 to 99	$t(694.5) = -11.02$, $p < 0.001$	59.50 (15.66)	13 to 99
Age	48.89 (15.50)	18 to 87	30.24 (12.14)	18 to 73	$t(898.9) = -18.65$, $p < 0.001$	41.34 (16.92)	18 to 87
BMI [c]	27.91 (7.08)	16.7 to 68.7	26.13 (6.67)	16.5 to 63.07	$t(849) = -3.68$, $p < 0.001$	26.97 (6.37)	16.5 to 68.7
Prior income [d] (weekly wage)	$902.07 (648.48)	0 to 7015.12	£263.79 (314.63)	0 to 3000	Not comparable	n/a	n/a
Income change (as a % score)	−17.32 (36.50)	−100 to 100	−9.90 (37.53)	−100 to 100	$t(788.3) = 2.76$, $p = 0.003$	−14.31 (37.08)	−100 to 100

Note. BMI = Body Mass Index.
[a] A high score represents greater symptoms e.g., depression, anxiety, stress, resilience, loneliness.
[b] High scores represents a diet that is typically considered healthier i.e. more fruit and vegetables and less processed foods.
[c] 851 participants provided complete responses needed to calculate BMI.
[d] Details for Australian participants in Australian Dollars, and values for UK participants in Pounds Sterling. Values represent weekly income after taxes.

meant a covariance was added between the error terms for these variables. The final model was a very good fit for the data (TLI = 0.998, RMSEA = 0.024, SRMR = 0.005), with each measurement having a significant loading onto the latent variable 'distress' (β> (+/- 0.51, p < 0.001).

3.3. Model evaluation

The final model (with data from both samples combined) was a satisfactory fit for the data (TLI = 0.902, SRMR = 0.074, RMSEA = 0.087). Covariances were added between country and both age and prior income. Covariances were also added between age and both prior income and income loss.

3.4. Wage loss and diet quality

Consistent with our hypothesis, there was a significant indirect effect of wage loss on diet quality via distress (see Table 2 for hypothesised indirect effects). As expected, this indirect effect was accounted for by income loss being directly associated with greater distress, and distress directly associated with a less nutritious diet (see Table 3 for direct associations between variables). This indicates that individuals who

Table 2
Hypothesised indirect effects for both samples separately and combined (unstandardised bootstrapped regression coefficients).

Association	Australian sample			UK sample			Combined sample		
	b(SE)	p	95%CI	b(SE)	p	95%CI	b(SE)	p	95%CI
Income change → distress → diet quality	0.301 (0.145)	0.007	0.117 to 0.618	0.182 (0.136)	0.021	0.034 to 0.550	0.221 (0.102)	0.011	0.078 to 0.438

Table 3
Direct associations between variables (unstandardised regression coefficients) for both samples separately and then combined.

Association	Australian sample		UK sample			Overall sample			
	b (SE)	p	95%CI	b (SE)	p	95%CI	b	p	95%CI
Income change → distress	−0.757 (0.285)	0.008	−1.267 to −0.268	−0.751 (0.395)	0.037	−1.388 to −0.137	−0.648 (0.233)	0.005	−1.113 to −0.224
Income change → diet quality	−0.202 (0.564)	0.720	−1.300 to 0.589	0.773 (0.838)	0.356	−0.883 to 2.139	0.245 (0.477)	0.607	−0.553 to 0.973
Prior income [a] → distress	−0.098 (0.282)	0.728	−0.568 to 0.300	−0.693 (0.441)	0.116	−1.638 to 0.205	−0.072 (0.232)	0.758	−0.471 to 0.351
Prior income [a] → diet quality	0.275 (0.554)	0.620	−0.797 to 1.068	0.966 (0.934)	0.301	−1.555 to 3.591	0.562 (0.475)	0.237	−0.585 to 1.680
Distress → Diet quality	−0.397 (0.077)	<0.001	−0.540 to −0.204	−0.242 (0.102)	0.017	−0.451 to −0.070	−0.325 (0.062)	<0.001	−0.440 to −0.214
Age → Distress	−0.140 (0.019)	<0.001	−0.169 to −0.111	0.000 (0.037)	0.995	−0.068 to 0.050	−0.124 (0.014)	<0.001	−0.150 to −0.103
Age → Diet quality	0.087 (0.038)	0.020	0.010 to 0.141	0.102 (0.077)	0.186	−0.058 to 0.240	0.104 (0.035)	0.003	0.057 to 0.167
Resilience → Distress	−0.960 (0.056)	<0.001	−1.069 to −0.833	−1.014 (0.086)	<0.001	−1.146 to −0.865	−0.967 (0.047)	<0.001	−1.085 to −0.871
Country → Diet quality	n/a	n/a	n/a	n/a	n/a	n/a	7.485 (1.145)	<0.001	5.222 to 9.574

[a] These values represent z-scores.

experienced income loss reported greater distress and subsequently ate a less nutritious diet. Importantly, a non-significant direct association between income change and diet quality indicates that any change in diet quality was not simply due to an inability to afford more nutritious foods.

3.5. UK and Australian sample

To establish if the same indirect and direct relationships observed in the combined dataset also existed in the individual countries, data from the UK and Australian samples were analysed separately.

The UK sample comprised a larger percentage of students (48.9% in the UK sample and 4.0% in the Australian sample) (see Table 4 for a detailed split of professions). The UK sample was also younger, had higher levels of depression, anxiety, stress, loneliness, a lower starting income, experienced less wage loss and had a less typically nutritious diet (See Table 1 for further details).

Despite these differences, in both samples, income loss was indirectly predictive of a less nutritious diet via distress (Table 2). Income loss was also directly associated with greater distress and distress directly associated with a less nutritious diet (Table 3). Both models were a satisfactory fit for the data (UK sample: TLI = 0.960, RMSEA = 0.056, SRMR = 0.056. Australian sample: TLI = 0.901, RMSEA = 0.092. SRMR = 0.069).

4. Discussion

The current study sought to establish how income loss during the COVID-19 pandemic might have influenced diet quality, and the role of distress in this relationship. As hypothesised, there was a significant indirect effect of income loss on diet quality via distress; namely, greater income loss was predictive of greater distress, and higher distress predicted a less nutritious diet.

In the current study, income loss on its own was not significantly associated with reduced diet quality; this relationship was only significant when distress was included. This suggests that it was not a reduction in affordability *per se* that was important in driving diet quality but how people responded emotionally to any loss of income. Some individuals might have financial stability, or strong support networks, and are better able to cope with a short-term drop in income. However, for others, even a slight decrease in income might lead to acute emotional distress. In our dataset, those individuals who reported greatest distress in response to income loss were at the greatest risk of consuming a less 'healthy' diet. These individuals would theoretically be at elevated risk of other negative downstream consequences, such as weight gain. Given that obesity costs the NHS around £6.5 billion per year (Department of Heealth and Social Care Media Centre, 2023), and is reliably associated with negative health outcomes such as cardiovascular disease, diabetes and certain cancers (Bhaskaran et al., 2014; Finer, 2015), identifying drivers of weight gain are important.

Why income loss did not directly predict diet quality is not immediately clear. One possibility is that governmental financial support during the pandemic might have softened any impact of income loss. Many countries implemented such support packages (OECD, 2020). In the UK a furlough scheme paid workers for up to 80% of the hours they were not able to work owing directly to the pandemic (UK Government, 2021). In Australia, businesses were paid to cover employee wages for companies that experienced significant downturn during the lockdown (OECD, 2020). These schemes may have prevented people from falling into direct food poverty and might have limited the impact that income loss had on the ability to afford foods, However, income subsidised from the government might still accompany a level of uncertainty about the future, which may explain the association observed between income loss and distress. Perhaps income loss is just one of several factors that contributes to or, exacerbates distress, and it is the culmination of these factors that results in poor diet.

In the current study, the pathway between income loss, distress and diet quality was observed when data from two countries (Australia and the UK) was combined but also when the two samples were analysed separately. Aside from different geographical locations and government support packages, the two samples also varied in terms of their composition. The Australian sample contained a broader array of professions, and had a mean age and standard deviation that is reflective of the working population (M = 48.9, SD = 15.5). In contrast, approximately 45% of the UK population were students, with a younger mean age of 30.2 (SD = 12.14). However, despite the differences between

Table 4
Details of occupation split by Australian and UK sample. Numbers represent percentages with count values in brackets.

	Australian sample (N = 547)	UK sample (N = 370)
Education	12.8 (70)	16.4 (61)
Retail	18.1 (99)	4.8 (18)
Hospitality and leisure	3.8 (21)	5.6 (21)
Manufacturing	18.5 (101)	0.3 (1)
Professional services	1.6 (9)	2.4 (8)
Health and social care	20.8 (114)	16.9 (62)
Transport and storage	11.2 (61)	0.3 (1)
Student	4.0 (22)	48.9 (181)
Other	7.9 (43)	0 (0)
Missing	1.3 (7)	4.6 (17)

these two samples, the consistency of the pathway between income loss and diet quality suggests the role of distress in mediating the relationship between income loss and distress is fairly robust.

These findings are important as they add support for theories like Hemmingsson's model (2014; 2018) of social deprivation. This model proposes that social disadvantage might drive distress, which can promote certain unhealthy behaviours, such as consuming reduced food quality or increased alcohol intake. This model has now been tested with different forms of social disadvantage as predictor variables and demonstrates a robust pattern of results. Spinosa et al. (2019) showed that socio-economic status (SES) could trigger this pathway, with those who reported lower SES being more likely to be distressed, to use food as a coping mechanism and to have a higher BMI. In a subsequent study, Keenan et al. (2021) found that experiencing food insecurity (having unstable access to food, often due to a lack of financial resources) was indirectly associated with BMI via distress and using food as a coping mechanism. More recently, Keenan et al. (2022) found that individuals who were made temporarily food insecure during the COVID-19 pandemic because, for example, desired foods were sold out, or they were not being able to visit shops due to closures of public transport were also at greater risk of distress, and reported being more likely to engage in weight promoting eating behaviours such as, increased snacking and consuming larger portion sizes. The current study extends this work by showing that a decrease in income can have a similar impact on distress and diet quality as both socio-economic status and food insecurity. It would therefore appear that low socioeconomic status, food insecurity and income loss all appear to activate a sense of distress and consuming a less nutritious diet in response. More broadly, these findings are also consistent with work indicating that Psychosocial factors such as mental distress in response to financial hardship can influence diet and BMI (Claassen et al., 2019; Laraia et al., 2017).

Although data for the current study were collected during the COVID-19 pandemic, they have implications for both the current global economic climate and obesity epidemic (Johnstone & Lonnie, 2023; Robinson, 2022). Owing to global issues such as the war in Ukraine, inflation has risen sharply, which has not typically been matched by rising wages, equating to a real-terms loss in income (Patrick & Pybus, 2022). Food bank use has more than doubled in the UK since 2017 (Trussel Trust, 2023) and approximately 40% of British consumers were concerned about their ability to afford food next month (Food Standards Agency, 2022). While these points highlight that individuals might have less funds to purchase 'healthy' foods, which tend to be on average three times more expensive than low quality foods (Food Foundation, 2022), our results suggest that a real-term drop in income of this kind is also likely to trigger distress and distress related decreases in diet quality (i.e. people consuming more processed and less fresh produce). Policy makers wishing to tackle the rise in obesity should not neglect the wider environment in which consumers live. Where there is uncertainty about income and increases in distress, public health is likely to suffer. This is broadly consistent with commentary by researchers in the field who argue that the cost-of-living crisis might be feeding the paradox of obesity (Johnstone & Lonnie, 2023; Robinson, 2022).

The data from the current study also have implications for planning around the potential for other similar future events. If another pandemic were to occur the current data suggests that protecting incomes is likely to have a benefit on health outcomes, whilst neglecting this might lead to distress and negative health behaviours. Detrimental health behaviours are in turn likely to place added pressure on health service providers.

4.1. Strengths and limitations

A strength of the current study was the inclusion of data from two different countries, ensuring the results have greater generalisability to a wider audience, although not necessarily to all countries. In terms of limitations, our data is correlational and cross-sectional, so it is not possible to infer causality. Dietary data was self-reported and via a food frequency questionnaire, so may be susceptible to reporting biases. The associations between variables in this model were relatively modest and other factors such as an inability to visit certain outlets (e.g. visiting supermarkets) may have influenced the association between income loss and diet quality. These variables were not measured, so their influence cannot be quantified in the current model. Similarly, having pre-existing health problems, or being responsible for multiple dependents might also contribute towards levels of distress.

5. Conclusion

The present study shows that COVID-19 pandemic related income loss was associated with psychological distress, which in turn was associated with a less nutritious diet. This pattern of indirect and direct associations was shown across two separate countries with differing samples. Overall, these findings suggest that in the event of a future pandemic, consideration should be given to the role of ensuring income stability to reduce distress and knock-on effects on behaviours like food choice.

Availability of data and materials

Available upon request.

Ethical approval and consent to participate

This research was approved by the University of Salford's research ethics committee (HSR1920-089) and Swinburne's Human Research Ethics Committee (2018/319).

CRediT authorship contribution statement

Gregory S. Keenan: Writing – original draft, Methodology, Formal analysis. **William S. Royle:** Software, Project administration, Methodology, Conceptualization. **Lynne Marrow:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Andrew Scholey:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Sarah Benson:** Writing – review & editing, Software, Project administration, Methodology, Conceptualization. **Lauren J. Owen:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of competing interest

AS has received research funding, honoraria, conference support and consultancy from the nutrition industry. All other authors declare no competing interests.

Data availability

Data will be made available on request.

Acknowledgements

We are grateful to all participants who volunteered to take part in this study.

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