



The importance of food in studying economic hardship and well-being: Does food insecurity mediate the associations between income and stress and well-being in a UK representative sample?

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Abstract

Aim Efforts to tackle the global mental health crisis must be underpinned by a robust literature on the social determinants of mental health. Existing studies show consistent effects of economic hardship on mental health, emphasising the importance of basic needs, such as food. Outcomes are affected by family structure, with larger families and households with single adults experiencing greater budgetary strain. Our study aimed to investigate the extent to which effects of income on stress and well-being are mediated by food insecurity, whilst accounting for the effects of family size.

Subject and methods We surveyed a nationally representative sample ($n = 1004$) of UK adults, collecting key demographic information, plus data on food security (Household Food Security Survey Module Six-Item Short Form), perceived stress (four-item Perceived Stress Scale), and well-being (Office for National Statistics' four-item personal well-being measure).

Results Our results demonstrated that meaningful portions of the effects of income on stress (44%) and well-being (37%) can be accounted for by food insecurity. We also found that 42% of the effect of family size on perceived stress could be accounted for by the increased food insecurity experienced by larger families.

Conclusion Our results add to a growing body of evidence suggesting that tackling economic hardship and ensuring the satisfaction of material needs would support improved mental health outcomes. Further, given that evidence demonstrates important impacts of stress on other factors such as obesity and cognition, we argue that tackling poverty and ensuring food security would also have physical health benefits.

Keywords Income · Food insecurity · Well-being · Stress

Introduction

In recent years, there have been increasing calls from the public health community to focus on mental health, making a strong economic and humanitarian case for tackling the global mental health crisis (The Lancet Global Health 2020). The World Health Organization (WHO) recently published its world mental health report, stating that, “Ultimately, there is no health without mental health”. Their report emphasises the global burden of poor mental health, citing that one in eight people live with a mental health condition (WHO 2022). It also highlights the links between both poverty and

food insecurity and mental health outcomes (World Health Organization 2022). Numerous studies have demonstrated that people on lower incomes tend to have poorer subjective well-being than those on higher incomes (for a review, see Tay et al. 2018). However, the mechanisms by which income affects well-being remain understudied. In this research we expand on the ways income may impact stress and well-being by studying the potential role of food insecurity in shaping that association. In particular, people are food-insecure when a lack of income creates a situation where “they do not have access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life” (Food and Agriculture Organization of the United Nations 2001; see also Dowler and O’Connor 2012, p. 1).

We relied on Tay et al.’s (2018) organising framework, which states that income provides individuals with social status and resources that can promote well-being as a starting

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point for our hypotheses about income, food, and stress and well-being. In particular, a higher income can promote well-being, buffer against negative life events, and ensure the fulfilment of basic physical and psychological needs. Whilst living on a low income may be stressful in and of itself, we might expect to see particularly strong effects when people are unable to afford basic needs such as food. Indeed, among the stresses of living with insufficient income, the ability to satisfy such a fundamental survival need as food may be particularly important for levels of stress and well-being. In support of this, a study examining well-being in 123 countries, having food and shelter (basic needs) was found to account for most of the variance in life evaluations (Tay and Diener 2011). An increasing number of empirical studies support Tay et al.'s organising framework (for a review, see Thomson et al. 2022). Among those supporting studies, access to food has been identified as an important mediator between income and psychological well-being among women in Bangladesh (Jalal et al. 2015). We therefore aimed to examine the extent to which the relationship between income and stress and well-being can be explained by experiences of food insecurity, as opposed to the many other stressors of living on a low income.

There are known associations between food insecurity and mental health (Melchior et al. 2009; Liu et al. 2014; Nagata et al. 2019; Anampa-Canales et al. 2022), which tend to be stronger in more affluent countries (Elgar et al. 2021). Meta-analysis has shown that, among adults in the United States, food insecurity is associated with an increased risk of depression, anxiety, and sleep disorders (Arenas et al. 2019). A study in the USA found that parents who became food-insecure during the Great Recession reported a subsequent increase in parental stress, stating that they found it more challenging to meet their children's needs (Gee and Asim 2018). Indeed, the effects of income and food insecurity on stress and well-being are likely to be exacerbated in single-parent households and in households with more children, since already-limited resources become further stretched, creating "food stress" (Ward et al. 2012; Ward et al. 2013; Gundersen and Ziliak 2014; Landrigan et al. 2019). Meanwhile, partnered parents are buffered against stress: evidence suggests that partner intimacy reduces parenting stress in mothers (Mulsow et al. 2002), and that parenting support from non-parent partners buffers stress in custodial fathers after divorce (DeGarmo et al. 2008). Moreover, single parents have been identified as a vulnerable population, who tend to have experienced a variety of childhood adversities, as well as facing a greater number of worries in adulthood (Turner 2007; Broussard et al. 2012). It is therefore important to account for relationship status and family size when studying the effects of income and food insecurity on stress and well-being in adults.

In summary, our aim was to examine the extent to which the relationship between income and stress and well-being can be explained by experiences of food insecurity, whilst accounting for potentially exacerbating effects of other important variables such as relationship status and the number of children in the household. Firstly, we predicted that income would be positively associated with well-being and negatively associated with perceived stress. Secondly, we predicted that greater food insecurity would be associated with higher levels of stress, and poorer well-being. Finally, we predicted that food insecurity would mediate the associations between income and stress, and income and well-being.

Methods

This study was approved by the Northumbria University research ethics system (ethical approval number 23967). We surveyed a nationally representative sample of 1004 people using the recruitment platform Prolific.co between 5 and 12 June 2020. Prolific provides a UK representative sample by screening participants based on age, gender, and ethnicity in proportion to data derived from the UK's national census. The survey was hosted online using Online Survey. The survey asked a range of questions, with some of the responses being used for other studies. The measures pertinent to this study are as follows.

Participant age

Respondents' ages were measured by asking them to select their age bracket from the following options: 18–25, 26–35, 36–45, 46–55, 56–69, and 70 years or older, with an option to select "prefer not to say". For analysis, age brackets were coded using values of 1 (18–25) to 6 (70 years or older) for all study participants who responded to this question.

Participant gender

Gender was reported by selecting one of the following options: "Male", "Female", "Non-binary/third gender", "Prefer to self-describe", and "Prefer not to say". Three respondents declined to report a gender.

Income bracket

Income data were collected by asking participants, "Please estimate your annual household income after tax in 2019". Income brackets were as follows: under £10,000, £10,000–19,999, £20,000–29,000, £30,000–39,000, £40,000–49,000, £50,000–59,000, £60,000–69,000, £70,000–79,000, £80,000–89,000, £90,000–99,000, and

£100,000 or more. Options were also available for “Don't know” and “Prefer not to say”. Income was coded using an ordinal scale for analysis using values of 0 (under £10,000) to 10 (£100,000 or more) and “missing” (where participants did not respond).

Food insecurity measure

Food insecurity was assessed using the Household Food Security Survey Module Six-Item Short Form (HFSSM; USDA Economic Research Services 2020). The measure classifies households as having high, marginal, low or very low food security. Data for this study were collected in June 2020, at a time when the COVID-19 pandemic had disrupted people's normal routines. We therefore amended the time-frame of HFSSM questions, changing the phrasing from “in the last 12 months” to “since the COVID-19 lockdown”. Responses to questions in the HFSSM were coded as an interval-level variable, in accordance with guidance issued by the US National Center for Health Research (USDA Economic Research Services 2020).

Relationship status

Relationship status was assessed using the following options: “Single”, “Married”, “Living with a partner”, “Separated”, “Divorced”, and “Widowed”. There was also an option for participants to select “Prefer not to say”. For analysis, we simplified these options into two categories—“Single, divorced, separated or widowed”, which would generally indicate a single-adult household, and “Married or living with partner”, which would typically indicate a two-adult household.

Number of children in the household

To assess the number of children in the household, we asked “Since the COVID-19 lockdown, how many children in your household are under 17 years of age?” Possible responses ranged from “0” to “10 or more” in increments of 1.

Perceived Stress Scale

We measured perceived stress using the four-item Perceived Stress Scale (PSS4), which has been found to have acceptable reliability and validity (Cohen et al. 1983). The PSS4 uses a five-point Likert scale with responses ranging from “0, never” to “4, very often”. Items 2 and 3 of the scale were reversed, so that a higher score would correspond to greater stress. The scores were then summed, resulting in a score that ranged from 0 to 16, with 0 corresponding to no perceived stress and 16 to high perceived stress.

Personal well-being score

Well-being was recorded using the Office for National Statistics' four-item personal well-being measure (Office for National Statistics 2018). The measure records responses to questions about four components of well-being: life satisfaction, the extent to which life is perceived as worthwhile, happiness, and anxiety. It uses an 11-point Likert scale with responses ranging from “0, not at all” to “10, completely”, with the anxiety item being reverse-scored. Scores for each item are summed to give a score ranging from 0 to 40, where 0 is extremely poor well-being and 40 is very high well-being.

Analysis

Analyses were carried out in IBM SPSS Statistics 26 and used the PROCESS macro (v3.5, Hayes, 2017). We used linear regression models and Sobel tests to test for mediation effects. Our models aimed to assess:

- (1) Whether there was a relationship between income and perceived stress, and
- (2) whether any relationship between income and perceived stress was mediated by food insecurity.
- (3) Whether there was an association between income and well-being, and
- (4) whether any relationship between income and well-being was mediated by food insecurity.

We included age, gender, relationship status, and the number of children in the household as covariates in all our regression models.

Results

Our sample consisted of 1004 respondents. The sample was nationally representative in terms of age, gender, and ethnicity. Key descriptive statistics for the sample are shown in Table 1. Food insecurity scores ranged from 0 to 8.48 (mean = 1.35, SD = 2.54), representing a broad range of food insecurity experiences. Perceived Stress Scale scores ranged from 0 to 16 (mean = 5.88, SD = 3.41), and well-being scores ranged from 0 to 40 (mean = 23.81, SD = 8.07). Thus, the full possible range of perceived stress and well-being were captured.

We first ran a regression to establish that our key predictor, income, was predictive of food insecurity. We controlled for age, gender, relationship status, and the number of children under the age of 17 in the household, since larger families on lower incomes are more likely to be food-insecure.

Table 1 Demographic characteristics of our sample (n = 1004)

		Frequency	Percentage
Age bracket	18–25	121	12.1
	26–35	183	18.2
	36–45	191	19
	46–55	160	15.9
	56–69	292	29.1
	70+	55	5.5
	Missing	2	0.2
Gender	Male	485	48.3
	Female	516	51.4
	Missing	3	0.3
Income bracket	< £10,000	93	9.3
	£10,000–19,000	160	15.9
	£20,000–29,000	201	20.0
	£30,000–39,000	153	15.2
	£40,000–49,000	105	10.5
	£50,000–59,000	71	7.1
	£60,000–69,000	44	4.4
	£70,000–79,000	36	3.6
	£80,000–89,000	17	1.7
	£90,000–99,000	13	1.3
	£100,000+	31	3.1
	Missing	80	8
Food security status	High food security	717	71.4
	Marginal food security	94	9.4
	Low food security	85	8.5
	Very low food security	77	7.7
	Missing	31	3.1
Simplified relationship status	Single, divorced, separated or widowed	350	34.9
	Married or living with partner	644	64.1
	Missing or prefer not to say	10	1.0
Children under 17	0	738	73.5
	1	138	13.7
	2	87	8.7
	3	28	2.8
	4	7	0.7
	5+	6	0.6
Ethnicity	Asian/Asian British: Bangladeshi	6	0.6
	Asian/Asian British: Chinese	18	1.8
	Asian/Asian British: Indian	25	2.5
	Asian/Asian British: Pakistani	19	1.9
	Black: African	15	1.5
	Black: British	12	1.2
	Black: Caribbean	10	1
	Other	69	6.9
	Prefer not to say	16	1.6
	White and Asian	9	0.9
	White and Black African	2	0.2
	White and Black Caribbean	6	0.6
	White British	789	78.6
	White: Gypsy or Irish Traveller	1	0.1
White: Irish	6	0.6	

Table 2 Regression results with USDA food insecurity score (continuous), as the outcome variable

Predictor	<i>b</i>	<i>se(b)</i>	β	<i>p</i>	Fit
(Intercept)	3.68	0.38		<0.01**	
Income bracket	-0.25	0.03	-0.24	<0.01**	
Age	-0.39	0.06	-0.23	<0.01**	
Gender	0.04	0.16	0.01	0.79	
Number of children under 17	0.44	0.08	0.17	<0.01**	
Simplified relationship status	-0.29	0.18	-0.05	0.11	
					$R^2 = 0.15$

b represents unstandardized regression weights, with *se* representing the standard error. β represents the standardized regression weights. * $p < .05$, ** $p < .01$

Table 3 Regression results with Perceived Stress Scale score, as the outcome variable

Predictor	<i>b</i>	<i>se(b)</i>	β	<i>p</i>	Fit
(Intercept)	8.23	0.50		<0.01**	
Income bracket	-0.16	0.05	-0.11	<0.01**	
Age	-0.69	0.07	-0.31	<0.01**	
Gender	0.93	0.21	0.14	<0.01**	
Number of children under 17	0.33	0.11	0.10	<0.01**	
Simplified relationship status	-0.62	0.24	-0.09	0.01*	
					$R^2 = 0.16$

b represents unstandardized regression weights, with *se* representing the standard error. β represents the standardized regression weights. * $p < .05$, ** $p < .01$

This confirmed that income and age were negatively associated with food insecurity score, whilst the number of children in the household was a significant positive predictor of food insecurity (see Table 2). We found no effect of gender, or of simplified relationship status.

Our next regression model established whether the variables in our first model (Table 2) were associated with perceived stress. Older and wealthier respondents reported lower perceived stress, and men reported lower perceived stress than women. Having a larger number of children in the household was predictive of higher levels of perceived stress, as was being divorced, separated, widowed, or single as compared with being married or living with a partner (Table 3).

Next, we assessed whether our predictor variables (also see Tables 2 and 3) were associated with reported well-being. Income and age were positively associated with well-being scores, as was being married or living with a partner. Our other predictors, gender and the number of

Table 4 Regression results with well-being score as the outcome variable

Predictor	<i>b</i>	<i>se(b)</i>	β	<i>p</i>	Fit
(Intercept)	17.11	1.25		0.00	
Income bracket	0.53	0.11	0.16	<0.01**	
Age	0.69	0.18	0.13	<0.01**	
Gender	-0.55	0.51	-0.03	0.29	
Number of children under 17	-0.44	0.27	-0.05	0.11	
Simplified relationship status	2.28	0.59	0.14	<0.01**	
					$R^2 = 0.08$

b represents unstandardized regression weights, with *se* representing the standard error. β represents the standardized regression weights. * $p < .05$, ** $p < .01$

Table 5 Regression results with perceived stress score as the outcome variable, and food insecurity score (our hypothesised mediator) included with the initial predictors

Predictor	<i>b</i>	<i>se(b)</i>	β	<i>p</i>	Fit
(Intercept)	7.14	0.52		<0.01**	
Food insecurity score	0.29	0.04	0.22	<0.01**	
Income bracket	-0.09	0.05	-0.06	0.05	
Age	-0.57	0.08	-0.25	<0.01**	
Gender	0.92	0.21	0.14	<0.01**	
Number of children under 17	0.18	0.11	0.05	0.10	
Simplified relationship status	-0.53	0.24	-0.08	0.02*	
					$R^2 = 0.20$

b represents unstandardized regression weights, with *se* representing the standard error. β represents the standardized regression weights. * $p < .05$, ** $p < .01$

children in the household, did not show statistically significant associations with reported well-being (Table 4).

To examine potential mediation effects, we then added food insecurity to the predictors in the model displayed in Table 3, with perceived stress as the outcome. Food insecurity was a statistically significant predictor of perceived stress (see Table 5 and Fig. 1). In addition, although the previous associations of income, age, and gender with perceived stress remained, the effect of the number of children in the household was extinguished once food insecurity score was accounted for. Including food insecurity score improved the model fit (see Tables 3 and 5), and a formal mediation test suggested that 42% of the total effect of number of children on perceived stress ($b = 0.31$, $se(b) = 0.11$, 95% CI = 0.09, 0.52) was driven by food insecurity ($b = 0.13$, $se(b) = 0.04$, 95% CI = 0.06, 0.21).

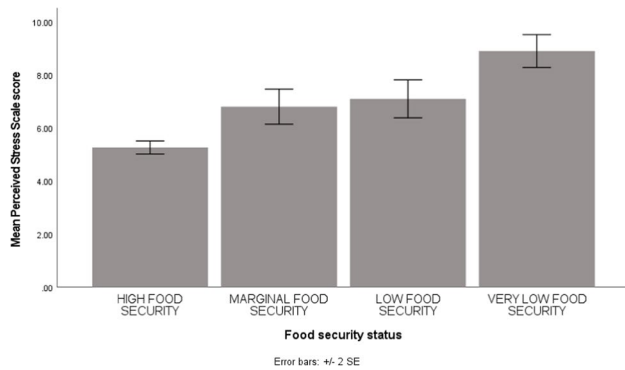


Fig. 1 Mean perceived stress scores by food security category

The original effect of income on stress (see Table 3) was attenuated when food insecurity was added to the model (see Table 5). Mediation analysis suggested that the association between income and perceived stress is mediated by food insecurity score ($b = -0.07$, $se(b) = 0.01$, 95% CI = -0.10 , -0.05), with 44% of the total effect ($b = -0.16$, $se(b) = 0.05$, 95% CI = -0.25 , -0.07) being indirectly accounted for by food insecurity.

In our final model (Table 6), we added food insecurity score to the model shown in Table 4, to assess whether food insecurity mediated the association between income and well-being. Food insecurity was a statistically significant negative predictor of well-being (see Table 6 and Fig. 2). Including food insecurity score improved the model fit (see Tables 4 and 6), and the strength of the association between income and well-being was reduced. Results of the mediation analysis supported partial mediation of the association

Table 6 Regression results with well-being as the outcome variable, and food insecurity score (our hypothesised mediator) included with the initial predictors

Predictor	<i>b</i>	<i>se(b)</i>	β	<i>p</i>	Fit
(Intercept)	19.58	1.30		<0.01**	
Food insecurity score	-0.76	0.11	-0.24	<0.01**	
Income bracket	0.33	0.11	0.10	<0.01**	
Age	0.42	0.19	0.08	0.02*	
Gender	-0.49	0.51	-0.03	0.33	
Number of children under 17	-0.08	0.27	-0.01	0.78	
Simplified relationship status	2.23	0.58	0.13	<0.01**	

$R^2 = 0.13$

A significant *b*-weight indicates the semi-partial correlation is also significant. *b* represents unstandardized regression weights, with *se* representing the standard error. β represents the standardized regression weights. * $p < .05$, ** $p < .01$

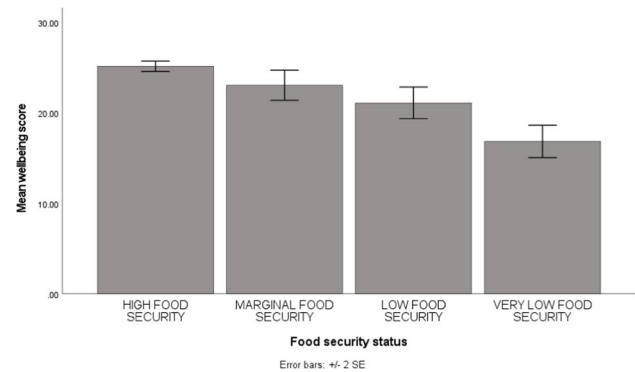


Fig. 2 Mean well-being scores by food security category

between income and well-being by food insecurity, with 37% of the total effect of income on well-being ($b = 0.52$, $se(b) = 0.11$, 95% CI = 0.30 , 0.74) being accounted for indirectly by food insecurity ($b = 0.19$, $se(b) = 0.04$, 95% CI = 0.12 , 0.26).

Discussion

Our study investigated the associations between income, food insecurity, and perceived stress and well-being. We assessed the extent to which variation in stress and well-being can be attributed to food insecurity, whilst accounting for the more general effects of income. Consistent with our expectations, people on lower incomes reported greater perceived stress and poorer well-being. Meaningful proportions of the effects of income on both stress (44%) and well-being (37%) were accounted for by food insecurity, even when controlling for age, gender, relationship status, and the number of children in the household. Our results also showed that those adults who had more children in their household reported greater perceived stress—a relationship which was mediated by food insecurity (42%), indicating that adults in larger families experience more food stress.

Our findings are generally in line with prior literature, supporting previous evidence that income and food insecurity are both associated with indicators of well-being (Tay et al. 2018; Johnson and Markowitz 2018). Food insecurity was strongly associated with levels of adult stress, and our results supported the idea of an exacerbating effect of family size (Olson et al. 1996; Gundersen and Ziliak 2014), reinforcing prior findings of increased parental stress levels during school holidays, when the lack of school food provision can result in holiday hunger (Stretesky et al. 2020). Although we did not observe any association between relationship status and food insecurity, we found that being single, divorced, separated, or widowed was associated with greater perceived

stress and poorer reported well-being. This suggests effects of partner support that are independent of food insecurity but likely relate to other emotional and practical benefits reported in prior research (Mulsow et al. 2002; DeGarmo et al. 2008).

Whilst our study has good power and all the benefits of a representative sample, our inferences are limited by its correlational nature. Though it seems plausible that food insecurity has a causal impact on stress and well-being, we cannot draw such a conclusion based on a correlational study taken in isolation. There are, however, natural experiments in the form of programmes designed to reduce food insecurity, which provide opportunities for further investigation. Such programmes include direct cash transfer schemes, nutrition assistance programmes, and holiday club provision (Haushofer and Shapiro 2016; Long et al. 2021a, b; Loopstra 2018). Evidence suggests that parents' well-being is improved after their children begin attending holiday clubs designed to reduce food insecurity, although the main mechanism for the increased well-being appears to be reduced parental social isolation (Long et al. 2021a, b). Whilst evidence suggests that monthly cash transfers should increase food security and improve well-being (Haushofer and Shapiro 2016), this evidence from holiday clubs highlights an additional social benefit to such schemes that would not necessarily be offered by cash transfer schemes.

The correlational nature of our analysis also means that we are unable to exclude the possibility of confounding variables (Wilms et al. 2021). For example, poor health may be a cause of both low income and poor well-being. Further, relationships between income and health are likely bi-directional, making such relationships challenging to untangle. Ideally, experimental research designs should be employed to enable inferences about causality. Future research might take advantage of natural experiments, for example by studying how interventions such as the introduction of a universal basic income affect food insecurity, and mental as well as physical health (Johnson et al. 2023).

Whilst our analysis helps to determine the extent to which food insecurity, rather than other stresses experienced by those with low incomes, can account for differences in well-being, it does not account for those factors which might cushion people from food insecurity. Future studies could seek to investigate the extent to which factors such as psychosocial resources or coping strategies (e.g., rationing or food sharing and food bank use) can moderate associations between income and stress and well-being.

In addition to reducing stress and improving well-being, policies aimed at addressing economic hardship and food insecurity could have further downstream consequences. The mental health effects of food insecurity may also have knock-on effects for cognition. For example, recent

evidence suggests that the association between food insecurity and cognitive impairment is partially mediated by anxiety and depression (Cai and Bidulescu 2023). Further, there is a well-documented association between food insecurity and obesity. This association has been explained by viewing weight gain as an adaptive response to periods of food shortage (Dhurandhar 2016; Nettle et al. 2017). One of the mechanisms delivering this response may well be food insecurity-induced stress, since stress has been linked to obesity through a suite of behavioural and physiological responses (Tomiya 2019). Further, there appear to be secondary effects, with family stressors exacerbating the effects of food insecurity, thereby increasing the odds of being overweight or obese (Lohman et al. 2009). It is therefore plausible that action to increase food security may not only reduce the risk of overweight and obesity directly, but may also act indirectly by reducing family stressors. Further, it may reduce the risk of poor mental health and thereby of cognitive impairment, suggesting that a suite of health and well-being benefits could result from tackling food insecurity.

In conclusion, our data support the idea that meaningful portions of the effects of income and family size on stress and well-being can be accounted for by food insecurity. However, it is also clear that important independent effects of income remain, indicating the importance of tackling both food insecurity more specifically, and economic hardship more generally. Given the downstream consequences of increased stress and diminished well-being for other important outcomes such as obesity and cognitive functioning, we suggest that interventions to reduce economic hardship and food insecurity are likely to improve physical and cognitive, as well as mental, health.

Author contributions (using CRediT taxonomy) **Dr Gillian V. Pepper:** Conceptualization, methodology, investigation, data curation, formal analysis, writing (original draft preparation), writing (review and editing), visualisation.

Prof. Margaret Anne Defeyter: Conceptualization, resources, writing (review and editing), supervision, funding acquisition.

Prof. Paul Stretesky: Conceptualization, methodology, investigation, data curation, writing (review and editing), project administration.

Dr Emily Mann: Conceptualization, methodology, investigation, data curation, writing (review and editing), project administration.

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Data availability Data are available upon request from the corresponding author.

Code availability Not applicable.

Declarations

Ethics approval This study was approved by the Northumbria University research ethics system (ethical approval number 23967).

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent for publication Not applicable.

Conflicts of interest/Competing interests The authors declare no conflicts of interest.

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