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The impact of the cost of living crisis and food insecurity on food purchasing behaviours and food preparation practices in people living with obesity

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The data that support the findings of this study are available on the Open Science

Framework (https://osf.io/7kfgx/)

1   **Abstract**

2   Lower income households are at greater risk of food insecurity and poor diet quality

3   than higher income households. In high-income countries, food insecurity is associated with

4   high levels of obesity, and in the UK specifically, the cost of living crisis (i.e., where the cost

5   of everyday essentials has increased quicker than wages) is likely to have exacerbated

6   existing dietary inequalities. There is currently a lack of understanding of the impact of the

7   current UK cost of living crisis on food purchasing and food preparation practices of people

8   living with obesity (PLWO) and food insecurity, however this knowledge is critical in order to

9   develop effective prevention and treatment approaches to reducing dietary inequalities.

10   Using an online survey (N = 583) of adults residing in England or Scotland with a body mass

11   index (BMI) of $\geq 30 kg/m^2$, participants self-reported on food insecurity, diet quality, perceived

12   impact of the cost of living crisis, and their responses to this in terms of food purchasing

13   behaviours and food preparation practices. Regression analyses found that participants

14   adversely impacted by the cost of living crisis reported experiencing food insecurity.

15   Additionally, food insecurity was associated with use of specific purchasing behaviours (i.e.,

16   use of budgeting, use of supermarket offers) and food preparation practices (i.e., use of

17   energy-saving appliances, use of resourcefulness). Exploratory analyses indicated that

18   participants adversely impacted by the cost of living crisis and who used budgeting had low

19   diet quality, whereas use of meal planning was associated with high diet quality. These

20   findings highlight the fragility of food budgets and the coping strategies used by PLWO and

21   food insecurity during the cost of living crisis. Policy measures and interventions are urgently

22   needed that address the underlying economic factors contributing to food insecurity, to

23   improve access to and affordability of healthier foods for all.

24   **Keywords:** Food insecurity, Obesity, Cost of living, Food purchasing, Food preparation, Diet

25

26 **1. Introduction**

27   By 2035 it is predicted that approximately 24% of the global population will be living

28 with obesity, which is almost double the prevalence recorded in 2020 (World Obesity

29 Federation (WOF), 2023). In high-income countries, obesity is disproportionately

30 represented in low-income groups, a trend that has become more pronounced over the past

31 60 years (Bann et al., 2018), and more recently during the COVID-19 pandemic (Brown et

32 al., 2023; Robinson et al., 2021; Storz, 2020). One possible reason for this may be

33 experiences of food insecurity.

34   Food insecurity refers to the limited or uncertain availability of nutritionally adequate

35 and safe to consume food (Food and Agricultural Organisation (FAO) et al., 2017). Those

36 who are food insecure are more likely to be living with obesity (Brown et al., 2019), which

37 seems paradoxical given that having limited access to food suggests a reduced amount of

38 food intake, rather than an excess. This association has been related mechanistically to the

39 Resource Scarcity Hypothesis (Dhurandhar, 2016) and the Insurance Hypothesis (Nettle et

40 al., 2017). The Resource Scarcity Hypothesis proposes that overeating and subsequent

41 adiposity are a physiological response to threatened food supplies. Similarly, the Insurance

42 Hypothesis posits that individuals store body fat in anticipation of future shortfalls in food

43 supplies. Additional interpretations of the obesity-food insecurity paradox are related to

44 healthy foods being expensive (e.g., Aggarwal et al., 2011; Darmon & Drewnowski, 2015;

45 Johnstone & Lonnie, 2023) and food insecurity being associated with poor dietary quality

46 (e.g., Keenan et al., 2021; Leung & Tester, 2019; Ranjit et al., 2020). Low expenditure on

47 food is associated with less-healthy food purchasing practices among low-socioeconomic

48 groups (Douglas et al., 2015; Pechey & Monsivais, 2016). In the United Kingdom, adults on

49 low incomes (the poorest fifth of UK households) would need to spend 50% of their

50 disposable income to consume a healthy diet according to government guidelines, whereas

51 the richest fifth would only need to spend 11% (Food Foundation, 2023b). This stark contrast

52 highlights the food-insecure environment that is faced by households with low-incomes that

53   may predispose the consumption of a low-quality diet and increase risk of developing obesity

54   and other diet-related comorbidities.

55   Since late 2021, many countries have been experiencing a 'cost of living crisis' that is

56   being driven by the rapidly increasing cost of everyday essentials like food and utilities (i.e.,

57   inflation), which has not been met with increases to household incomes (Hourston, 2022).

58   Drivers of inflation can include climate change disasters (e.g., draughts and flooding), where

59   extreme weather events and temperature variability can affect crop yields driving the price of

60   goods higher than usual; conflict (e.g., the war in Ukraine) where Russia (a major oil-

61   producing nation) can impact crude oil supply leading to supply disruptions and subsequent

62   price escalation; or being highly reliant on imports such as food (e.g., Brexit), where trade

63   barriers can hamper food imports and so disrupt supply chains. The COVID-19 pandemic

64   has also added to this economic turmoil in many countries by increasing governments' and

65   individuals' debts, as well as the prices of goods before the crisis itself. As a result, in 2022

66   average prices across the globe rose by 9% (International Monetary Fund, 2022) and in

67   June 2023 in the UK, the cost of food and non-alcoholic beverages rose to 17.4% (Gooding,

68   2023).

69   High inflation rates have directly impacted the affordability of food, both directly

70   through food price rises and indirectly through constrained budgets due to increasing

71   utilities, housing and services costs. These cost of living pressures are leading to rises in

72   food insecurity (i.e., having limited or uncertain availability of nutritionally adequate and safe

73   to consume food). In the UK, the Food Standards Agency's Food and You 2 most recent

74   survey reported that 25% of households were experiencing food insecurity (Armstrong et al.,

75   2023), which is the highest prevalence recorded since the survey began in late 2020 where

76   only 16% of households were experiencing food insecurity (Armstrong et al., 2021). Like

77   obesity, the cost of living crisis has disproportionately impacted households with low-

78   incomes who may be less resilient to sudden price increases. The current economic crisis is

79   thereby amplifying existing challenges faced by those from poorer households and likely

3

80   widening inequalities (Johnstone et al., 2023). As food is seen as a variable cost, it is likely

81   that food quality and variety may be compromised as a means of survival (Puddephatt et al.,

82   2020; Williams & Dienes, 2022). The consequences of low diet quality are well documented,

83   particularly as being one of the primary risk factors for non-communicable diseases (Hyseni

84   et al., 2017). The cost of living crisis may not only contribute to increased experiences of

85   food insecurity, but may also perpetuate high levels of obesity producing more diet and

86   health inequalities for those living with obesity (Robinson, 2023).

87   Given the challenges posed by the cost of living crisis, households with low-incomes

88   have responded by using 'coping strategies' to mitigate experiences of food insecurity,

89   specifically, the ways in which households purchase and prepare food (Douglas, 2023;

90   Eicher-Miller et al., 2023; Johnstone et al., 2023). In relation to food purchasing behaviours,

91   Dietlevesen et al. (2023) reported that households with low-incomes often engage in bulk

92   purchasing to benefit from bulk-buy discounting, and Adams (2023) reported that women

93   experiencing food insecurity made use of 'bargain bins' and coupons to maximize their

94   purchasing power. However, in the UK, the food that is on promotion has recently been

95   flagged for its tendency to be high in fat, sugar and salt (HFSS), which has been found to

96   contribute to excess food intake (Watt et al., 2023). Households with low-incomes also report

97   engaging in financial budgeting as this allows households to manage limited resources

98   effectively (Douglas, 2023; Power et al., 2018). However, given the higher cost of healthier

99   food (relative to less healthy food), the 'healthiness' of food may be deprioritised

100   (Puddephatt et al., 2020; Robinson et al., 2022). In relation to food preparation practices,

101   households with low-incomes typically use batch cooking (Williams & Dienes, 2022), meal

102   planning (Power et al., 2018), pad out meals with starchy foods (Ditlevsen et al., 2023), and

103   use energy-saving appliances such as air fryers (Nayak & Hartwell, 2023). Taken together,

104   although the aforementioned purchasing and food preparation practices are highly adaptive

105   and likely to be beneficial in the immediate (i.e., to escape hunger when living with a low

106   income), prolonged use of these strategies may negatively impact health in relation to diet

107   quality and variety (Seligman & Berkowitz, 2019; Tarasuk, 2001).

4

108   There is a lack of understanding of the magnitude and impact of the current cost of

109   living crisis on food purchasing behaviours and food preparation practices of PLWO and

110   food insecurity. Better evidence is critical to highlight and inform the development of policy

111   measures and interventions aimed at supporting this group make healthy food choices. The

112   aim of the current study was therefore to quantify in a sample of PLWO, the perceived

113   impact of the cost of living crisis on food insecurity, and whether food insecurity in turn is

114   associated with the use of food purchasing behaviours and food preparation practices. It was

115   hypothesised that (1) those adversely impacted by the cost of living crisis will be more likely

116   to experience food insecurity, and (2) food insecurity will be associated with use of cost-

117   effective cooking practices and purchasing behaviours.

118   **2. Methods**

119   2.1.   Participants

120   The inclusion criteria were participants aged between 18-65-years old, who resided

121   in England or Scotland, were the primary grocery shopper, and had a BMI of over 30 kg/m^2.

122   Participants were recruited between February 2023 and May 2023, predominantly using the

123   participant recruitment website, Prolific (www.prolific.com) (approximately 98% of the

124   sample). Participants were also recruited using advertisements on social media (Twitter, now

125   known as X) and paid advertisements on Facebook. Advertisements on Facebook were

126   targeted to individuals between the ages of 18 and 65-years who had 'liked' Facebook

127   pages that were related to weight management (e.g., WeightWatchers) or food insecurity

128   (e.g., budget cooking). Participants who completed the study through Prolific were

129   reimbursed for their time. Participants who completed the study through social media could

130   anonymously enter into a prize drawer to win Amazon vouchers (1 x £100, 1 x £50, 1 x £25).

131   Ethical approval was obtained from the University of Liverpool Research Ethics Committee,

132   Ethics number 12027.

133   A total of 654 participants completed the survey. Data were excluded from analyses

134   for participants who were not the primary grocery shopper (n = 10), did not have a BMI ≥30

135 kg/m^2 (n = 44), who failed to correctly respond to ≥ 3 attention checks (n = 2), who answered

136 'prefer not to say' to whether their daily functioning was affected (n = 5) or their ethnicity (n =

137 1). A minority of participants (n = 9) reported that they were third-gender/non-binary and

138 these participants were removed from data analysis because the small sample size could

139 lead to this subgroup having a disproportionally large effect on other regression coefficients.

140 As this study is part of a wider study using structural equation modelling to explore the

141 barriers to purchasing healthy and sustainable food (Stone et al., 2023), *a priori* sample size

142 calculations indicated that a minimum of 500 participants were needed for adequate power

143 (≥80%, α = 0.05; https://doi.org/10.17605/OSF.IO/BYZKP). The analytical sample size was

144 583 participants (89% of original sample).

145 2.2.   Procedure

146   This study operated as a cross-sectional online questionnaire study hosted on

147 Qualtrics. All participants were asked to read the Participant Information Sheet prior to

148 providing informed consent electronically and completed a series of screening questions to

149 ensure they met the eligibility criteria. All participants then completed a series of questions

150 about demographics, food insecurity, diet quality, the impact of the cost of living crisis, and

151 the use of food purchasing behaviours and food preparation practices in response to the

152 cost of living crisis. The survey took approximately 30-minutes to complete.

153 2.3.   Measures

154   Measures are outlined in the order that they were displayed to the participant. Within

155 each section, items were presented in a randomised order to eliminate order bias. Built into

156 these questions (excluding the demographic questionnaire) were attention checks such as "*It*

157 *is important that I pay attention. Please select 'Strongly Agree'".* Participants who made

158 three or more errors on the attention checks were excluded. For participants who took part

159 via social media, a reCAPTCHA was used at the start of the study to protect against bots

160 and malicious programs. A reCAPTCHA was not necessary for those who took part using

161   Prolific. Despite recruiting from Prolific using our inclusion criteria, a set of parallel screening

162   questions were used during the survey to ensure participants met the eligibility criteria.

163   *2.3.1. Demographic questions*

164   Participants self-reported their age (in years), the country they resided in, their height

165   (in feet/inches or in centimetres) and weight (in kilograms or in stones/pounds). Participants'

166   height and weight were used to compute BMI. Participants also reported their gender (three-

167   point scale: 1 = male, 2 = female 3 = third-gender/ non-binary). Gender was recoded into a

168   binary variable: 0 = female, 1 = male, with those third-gender/non-binary removed (n = 9).

169   Ethnicity was recorded following the UK Governments list of ethnicities (15-point scale: 1 =

170   White British, 2 = White Irish, 3 = Other White background, 4 = Black – Caribbean, 5 = Black

171   – African, 6 = Other Black background, 7 = Asian – Indian, 8 = Asian – Pakistani, 9 = Other

172   Asian background, 10 = Mixed – White and Black Caribbean, 11 = Mixed – White and Black

173   African, 12 = Other Mixed background, 13 = Chinese, 14 = Any other ethnicity not listed, 15

174   = Prefer not to say). Ethnicity was recorded into a binary variable: 0 = Black, Asian, and

175   Minority Ethnic (BAME), 1 = White, with those reporting 'prefer not to say' excluded (n = 1).

176   Participants also indicated the number of adults and children under 18-years in household

177   (summed to give household size) and their highest level of education (six-point scale: 1 = No

178   formal qualification, 2 = Secondary School, 3 = College/ Sixth Form, 4 = Apprenticeship, 5 =

179   Undergraduate Degree, 6 = Postgraduate Degree). Education was recoded into a binary

180   variable: 0 = no degree, 1 = degree level. Furthermore, participants were asked to indicate

181   their household income using a nine-point scale: 1 = < £5,200, 2 = £5,200 to £10,399, 3 =

182   £10,400 to £15,599, 4 = £15,600 to £20,799, 5 = £20,800 to £25,999, 6 = £26,000 to

183   £36,399, 7 = £36,400 to £51,999, 8 = £52,000 to £77,999, 9 = ≥ £78,000).

184   Participant's daily functioning was recorded by assessing how limited it was, from

185   limited to not limited (So et al., 2003), with those reporting 'prefer not to say' excluded (n =

186   5). Participants were asked to select their dietary preference from a list of: Omnivore (eats

187   meat or fish), Vegetarian (eats no meat or fish), Pescatarian (does not eat meat but does eat

188 fish), Vegan (eats no food/drink derived from animals), or Flexitarian (mainly vegetarian but

189 occasionally eats meat) to assess whether dietary preference acted as a covariate for diet

190 quality, as vegetarian diets have been shown to have higher diet quality than non-

191 vegetarians (Parker & Vadiveloo, 2019). Lastly, participants were asked 1) which

192 supermarket they primarily used to purchase groceries, 2) the method used to purchase

193 foods either in-store, or online, and 3) who they did the grocery shopping with (using a six-

194 point scale: 1 = Alone, 2 = Spouse/partner, 3 = Children, 4 = Other relative(s), 5 = Friend(s),

195 6 = Carer(s)).

196 *2.3.2. Household food insecurity*

197   Household food insecurity was assessed using the United States Department of

198 Agriculture Household Food Security Survey Module (10-item; USDA-10) (USDA, 2012).

199 This scale asked questions about food accessibility to assess food security score; for

200 example, "*in the last 12 months, were you ever hungry but didn't eat because there wasn't*

201 *enough money for food?"* with Likert response options of "*Yes*", "*No*" and "*Do Not Know*".

202 Responses of '*Yes'*, '*Often'*, '*Sometimes'*, '*Almost every month'*, and '*Some months but not*

203 *every month'* were coded as affirmative (i.e., given a score of 1). The sum of affirmative

204 responses to the 10 questions were used to indicate the participant's raw food insecurity

205 score. Higher scores on the USDA-10 were indicative of greater food insecurity (possible

206 range: 0-10). McDonald's Omega for the current study was excellent at $\omega_T = 0.95$.

207 *2.3.3. Diet Quality*

208   A validated 20-item food frequency questionnaire was used to assess diet quality

209 (Robinson et al., 2017). This measure positively correlates with nutrient intake and results

210 are comparable to a longer 129 item scale (Bingham et al., 1994). Participants were asked

211 to think about the last three months and rate on a 10-item Likert scale their average

212 consumption of 19 foods (1 = never, 2 = less than once/month, 3 = 1-3- per month, 4 = once

213 a week, 5 = 2-4 per week, 6 = 5-6 per week, 7 = once a day, 8 = 2-3 per day, 9 = 4-5 per

214 day, 10 = 6+ per day). The included foods were: white bread, brown and wholemeal bread,

8

215 biscuits, apples, bananas, melon, pineapple, kiwi and other tropical fruits, green salad,

216 garlic, marrow and courgettes, peppers, yoghurt, eggs, white fish, oily fish, bacon and

217 gammon, meat pies, potatoes (boiled, mashed, and jacket), chips, pasta.

218   To estimate diet quality, several steps were conducted (1) recoding frequencies as

219 times per week (2) standardising scores by subtracting the means and dividing by the

220 standard deviations for each food item (3) multiplying each score by coefficients identified in

221 Robinson et al. (2017), and (4) summing all scores for each participant. Scores of zero were

222 indicative of a diet that conformed to healthy eating guidelines (i.e., high in fruit and

223 vegetables and low in processed foods). Higher scores (≥ 0) were indicative of a diet that

224 conformed more strongly to typical healthy eating recommendations. Scores below zero

225 were indicative of a diet that did not conform to healthy eating guidelines. Use of this variable

226 was not planned in the pre-registration for the analyses and was therefore included for

227 exploratory analysis only.

228 *2.3.4. Impact of the Cost of Living Crisis*

229   The impact of the cost of living crisis was assessed with five items taken from UK

230 supermarket Sainsbury's cost of living survey (J Sainsburys PLC, 2023). These items were

231 selected based on their relevance to assessing the impact of the cost of living crisis as no

232 existing validated tools exist. Participants were asked to indicate how much they agreed or

233 disagreed with each item using a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly

234 Agree): (1) My income allows me to save for the future (reverse coded), (2) I am going into

235 debt to pay for everyday essentials, (3) I am unable to pay for all of my bills, (4) I have cut

236 my spending on everyday essentials, (5) I have cut my spending in other areas to be able to

237 afford the everyday essentials. McDonald's Omega for question set used in the current study

238 was excellent at $\omega_T = 0.85$.

239 *2.3.5. Cost of Living – Food Purchasing Behaviours*

240   To assess the use of food purchasing behaviours in response to the cost of living

241 crisis, a 10-item existing questionnaire was used, also taken from Sainsbury's cost of living

242 survey (J Sainsbury PLC, 2023), as this question set assessed whether particular food

243 purchasing behaviours had been used in response to the cost of living crisis as no existing

244 validated tools exist. Participants were asked to think about the last three months and to

245 indicate how much they agreed or disagreed with 10 statements using a five-point Likert

246 scale (1 = Strongly Disagree, 5 = Strongly Agree): (1) Cut back on the quantity of food to

247 afford other essentials (e.g., energy bills), (2) Cut back on the quality of food to afford other

248 essentials (e.g., energy bills), (3) Shop around supermarkets for the best deals, (4) Bought

249 more own-brand food and drink, (5) Stuck to a strict budget when buying food and drink, (6) I

250 have changed the days of the week/time of day I shop in order to get the best deals/prices,

251 (7) Been to the supermarket less because I can't afford to travel there (either fuel or public

252 transport, (8) Cut back on healthy food to afford other essentials (e.g., energy bills), (9)

253 Bought smaller amounts of dried goods (e.g., pasta, lentils) so I only buy what I need, (10)

254 Bought more discounted / 'yellow sticker' food and drink. McDonald's Omega for the

255 question set used in current study was excellent at $\omega_T = 0.86$.

256 *2.3.6. Cost of Living - Food Preparation Practices*

257 To assess use of food preparation practices in relation to the cost of living crisis, a

258 nine-item existing questionnaire was used, also taken from the supermarket Sainsbury's cost

259 of living survey (J Sainsbury PLC, 2023), as this question set assessed what food

260 preparation practices might have been utilised in response to the cost of living crisis as no

261 existing validated tools exist. Participants were asked to think about the last three months

262 and indicate how much they agree or disagree with the following nine statements using a 5-

263 point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree): (1) Used appliances (e.g.

264 oven, hob etc.) less for cooking to save money on energy bills, (2) Used appliances such as

265 air-fryers more to save money on energy bills, (3) Ate cold meals or ones that don't need to

266 be cooked to save money on energy bills, (4) Cooked meals from scratch, (5) Reduced the

267 amount of food that I waste, (6) Padded out meals with more filling foods e.g. pasta,

268 potatoes, (7) Plan all meals for the week in advance, (8) Batch cooked meals for the week in
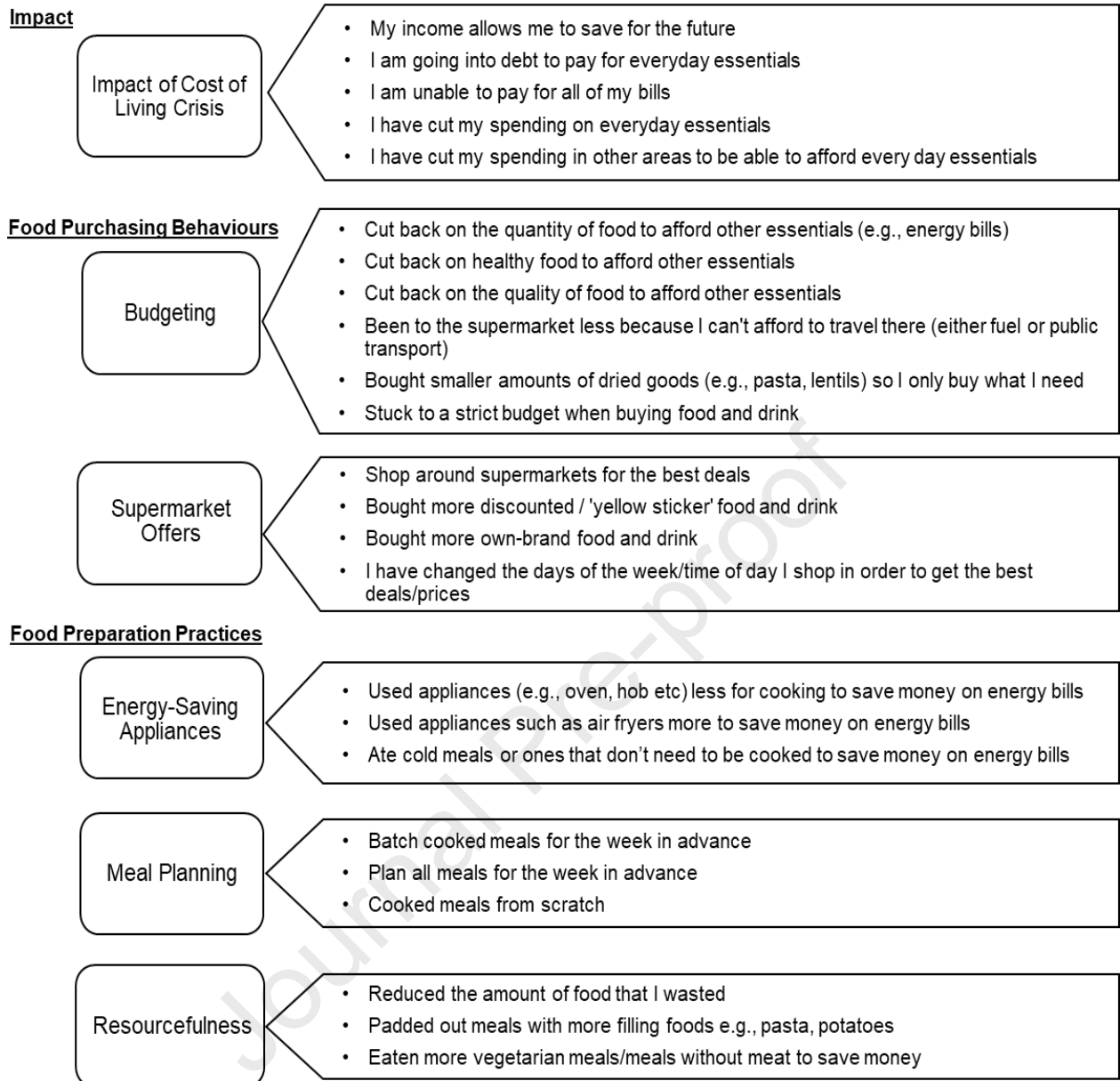
269   advance, (9) Eaten more vegetarian meals / meals without meat. McDonald's Omega for the

270   question set used in the current study was acceptable at $\omega_T = 0.69$.

271   2.4.   Data analysis

272   Hypotheses and the analytic plan were pre-registered on Open Science Framework

273   (https://doi.org/10.17605/OSF.IO/BYZKP). IBM SPSS Statistics 28 (IBM Corp, 2021) was

274   used for all data analyses.

275   *2.4.1.   Principal Component Analysis (PCA)*

276   Principal component analysis (PCA) with oblimin rotation was used as we expected

277   components to be correlated. A PCA was used to reduce down the complex number of items

278   into main themes, whilst retaining the same information relating to the measures of impact of

279   the cost of living crisis, purchasing behaviours and food preparation practices, in order to

280   create composite variables for each. Eigenvalues of ≥ 1.0 were deemed acceptable for

281   extraction. Pattern matrixes were inspected for components with Eigenvalues of ≥ 1.0 and

282   loadings of ≥ 0.5 were deemed strong enough for component loading. The first PCA

283   indicated that only one component existed for the impact of the cost of living crisis measure

284   (comprised of five individual items) explaining 63.63% of variance. This composite variable

285   was named 'impact of cost of living crisis' where higher scores indicated being more

286   adversely impacted by the cost of living crisis. The second PCA on food purchasing

287   behaviours indicated that there were two components which were labelled as follows; 1 =

288   use of budgeting (45.50% variance explained), 2 = use of supermarket offers (11.56%

289   variance explained). The third PCA on food preparation practices indicated that there were

290   three components labelled as follows; 1 = use of energy-saving appliances (31.73%

291   variance explained), 2 = use of meal planning (18.13% variance explained), 3 = cooking

292   resourcefully (10.70% variance explained). Reliability analyses were also conducted using

293   McDonald's Omega (ω_T) on the six components identified by the PCA to assess for scale

294   reliability. See Supplementary Materials for full results, and Figure 1 for a visual summary of

295   PCA results.

Impact

Impact of Cost of Living Crisis
- My income allows me to save for the future
- I am going into debt to pay for everyday essentials
- I am unable to pay for all of my bills
- I have cut my spending on everyday essentials
- I have cut my spending in other areas to be able to afford every day essentials

Food Purchasing Behaviours

Budgeting
- Cut back on the quantity of food to afford other essentials (e.g., energy bills)
- Cut back on healthy food to afford other essentials
- Cut back on the quality of food to afford other essentials
- Been to the supermarket less because I can't afford to travel there (either fuel or public transport)
- Bought smaller amounts of dried goods (e.g., pasta, lentils) so I only buy what I need
- Stuck to a strict budget when buying food and drink

Supermarket Offers
- Shop around supermarkets for the best deals
- Bought more discounted / 'yellow sticker' food and drink
- Bought more own-brand food and drink
- I have changed the days of the week/time of day I shop in order to get the best deals/prices

Food Preparation Practices

Energy-Saving Appliances
- Used appliances (e.g., oven, hob etc) less for cooking to save money on energy bills
- Used appliances such as air fryers more to save money on energy bills
- Ate cold meals or ones that don't need to be cooked to save money on energy bills

Meal Planning
- Batch cooked meals for the week in advance
- Plan all meals for the week in advance
- Cooked meals from scratch

Resourcefulness
- Reduced the amount of food that I wasted
- Padded out meals with more filling foods e.g., pasta, potatoes
- Eaten more vegetarian meals/meals without meat to save money

Figure 1: Schematic representation of the Principle Component Analysis on survey items relating to the impact of cost of living crisis, food purchasing behaviours, and food preparation practices. The identified components for each measure are indicated by rectangular boxes, with the individual items that loaded onto each component also shown.

2.4.2. Normality and Covariates

Preliminary analyses assessed the distribution of outcome variables (food insecurity,

and the six components from the PCA: impact of cost of living, budgeting, supermarket

offers, energy-saving appliances, meal planning, and resourcefulness). Kolmogorov Smirnov

tests indicated that outcome variables were skewed (data not shown, $p > .05$). As a result,

Spearman's Rho correlations and Mann-Whitney U tests were used to assess for the

310   presence of covariates. Spearman's Rho correlations showed that age was significantly and

311   negatively correlated with food insecurity (r_s = -.256, p < .001) and budgeting (r_s = -.148, p <

312   001). Mann-Whitney U tests showed that there was a significant difference in food insecurity

313   (U = 34112, p <.001), budgeting (U = 32571, p <.001), and energy-saving appliances (U =

314   34136, p <.001) depending on level of daily functioning, where scores were higher if daily

315   functioning was limited. There was a significant difference in use of meal planning (U =

316   32598, p = .043) and resourcefulness (U = 31529, p = .009) depending on online shopper

317   status, where scores were higher for those were online shoppers. There was also a

318   significant difference in use of energy-saving appliances (U = 18085.50, p = .018) depending

319   on ethnicity, where scores were higher for those who identified as White. There was a

320   significant difference in use of budgeting (U = 33424, p = .002), energy-saving appliances (U

321   = 31723, p < .001), meal planning (U = 34251.50, p = .007), and resourcefulness (U =

322   31098, p < .001) depending on gender, where scores were higher for those who were

323   female. No other demographic variables were significantly associated with outcome

324   variables. For each outcome variable, we selected significant covariates to be controlled for

325   in subsequent analyses.

326   *2.4.3. Regression Analyses*

327   For the main data analysis, a series of regressions were used to predict food

328   insecurity and to predict each component that was generated from the PCA (budgeting,

329   supermarket offers, energy-saving appliances, meal planning, and resourcefulness). Linear

330   regression assumptions were assessed and no assumptions were violated. First, a

331   hierarchical multiple regression using the 'enter' method was used to determine whether

332   being more impacted by the cost of living crisis (component variable generated by PCA)

333   predicted food insecurity whilst controlling for age and daily functioning (regression model 1:

334   impact of cost of living → food insecurity). Second, a hierarchical multiple regression using

335   the 'enter' method was used to explore whether experiences of food insecurity predicted

336   using budgeting in response to the cost of living crisis whilst controlling for age, daily

337   functioning, and gender (regression model 2: food insecurity → budgeting). Third, a linear

338   regression was used to explore whether experiences of food insecurity predicted using

339   supermarket offers in response to the cost of living crisis (regression model 3: food insecurity

340   → supermarket offers). Fourth, a hierarchical multiple regression using the 'enter' method

341   was used to explore whether experiences of food insecurity predicted cooking using energy-

342   saving appliances in response to the cost of living crisis whilst controlling for ethnicity, daily

343   functioning, and gender (regression model 4: food insecurity → energy-saving appliances).

344   Fifth, a hierarchical multiple regression using the 'enter' method was used to explore

345   whether experiences of food insecurity predicted using meal planning in response to the cost

346   of living crisis whilst controlling for online shopper status and gender (regression model 5:

347   food insecurity → meal planning). Finally, a hierarchical multiple regression using the 'enter'

348   model was used to explore whether experiences of food insecurity predicted cooking

349   resourcefully in response to the cost of living crisis whilst controlling for online shopper

350   status and gender (regression model 6: food insecurity → resourcefulness).

351   *2.4.4.   Sensitivity analysis*

352   A sensitivity analysis was run where primary regression analyses were re-examined

353   with participants who were identified as extreme outliers on measures of diet quality using

354   boxplots were removed (n = 15). Extreme outliers are data points that are more extreme

355   than Q1 - 3 * interquartile range (IQR) or Q3 + 3 * IQR.

356   *2.4.5.   Exploratory Analyses*

357   The current study was pre-registered on the Open Science Framework

358   (https://doi.org/10.17605/OSF.IO/BYZKP). Additional, unplanned, hierarchical regression

359   analyses were carried out as exploratory analyses to explore how cost of living impact

360   scores were associated with diet quality, and the association between purchasing

361   behaviours and food preparation practices with diet quality scores. As in section 2.4.2.,

362   covariates were identified by using Spearman's Rho correlations and a series of Mann-

363   Whitney U tests with diet quality (outcome variable). From these analyses, there was a

364   significant difference in diet quality scores depending on gender, where scores were higher

365   for females (U = 29551, p < .001), and ethnicity, where scores were higher for those who

366   identified as BAME (U = 11412, p = .002). No other demographic variables were significantly

367   associated with diet quality and consequently gender and ethnicity were controlled for in

368   subsequent analyses that used diet quality as the outcome variable. Hierarchical regression

369   analyses were run, and assumption checks indicated that none were violated. Using

370   hierarchical regression, regression model 7 explored whether cost of living impact scores

371   predicted diet quality whilst controlling for gender and ethnicity (regression model 7: cost of

372   living impact → diet quality). Using multiple hierarchical regression, regression model 8

373   explored whether use of budgeting, supermarket offers, energy-saving appliances, meal

374   planning, and resourcefulness predicted diet quality whilst controlling for gender and

375   ethnicity (regression model 8: food purchasing behaviours and food preparation practices →

376   diet quality).

377   **3. Results**

378   3.1.   Sample Characteristics

379   Descriptive statistics of the sample characteristics are presented in Table 1. In the

380   sample, 63.1% were female and 36.90% were male with a mean age of 40.3 years, and a

381   mean BMI of 37.92 kg/m^2. Food insecurity scores indicated that 37.4% of the sample were

382   experiencing food insecurity, which is higher than the UK average of 6-10% (Brown et al.,

383   2023; FAO, 2019). Participants had a mean diet quality score of 0.23, which was indicative

384   of a healthy diet (Robinson et al, 2017). Most participants resided in England (90.1%;

385   n=524), and described their ethnicity as White (90.1%). For education, 49.3% were educated

386   to degree level. For annual household income, 44.3% reported an annual household income

387   of ≤ £26,000. For health conditions, 41.5% had a health condition that limited their daily

388   function. The majority of adults were omnivores (79.2%), who were mostly in-store shoppers

389 (69%), with a mean household size of 3.7, and who primarily shopped alone (34.5%) or with

390 a spouse/partner (23.3%).

391 **Table 1:** Means (±*SD*) of participant characteristics, food insecurity and the impact of the

392 cost of living crisis (N = 583)

Measure	Mean ± *SD*	Min	Max
Age (years)	40.25 ± 11.66	19	65
BMI	37.92 ± 6.85	29.56	83.25
Household size	3.72 ± 1.39	2	10
Food insecurity (USDA-10[a])	2.43 ± 2.80	0	10
Diet quality score[b]	0.23 ± 1.15	-4.52	7.42

Measure	n (%)
Ethnicity:	
White:	
English/Welsh/Scottish/Northern-Irish/British	499 (85.6)
Irish	6 (1.0)
Other White background	20 (3.4)
Black:	
Caribbean	7 (1.2)
African	16 (2.7)
Mixed or Multiple ethnic groups:	
White and Black Caribbean	9 (1.5)
White and Black African	1 (0.2)
Other Mixed background	1 (0.2)
Asian or Asian British:	
Indian	5 (0.9)
Pakistani	10 (1.7)

Chinese	1 (0.2)
Other Asian background	8 (1.4)

Education:

No formal qualification	8 (1.4)
High School	98 (16.8)
College/ Sixth Form	160 (27.4)
Apprenticeship	30 (5.1)
Undergraduate Degree	191 (32.8)
Postgraduate Degree	96 (16.5)

Dietary preference:

Omnivore (eats meat or fish)	462 (79.2)
Vegetarian (eats no fish or meat)	28 (4.8)
Pescatarian (does not eat meat but does eat fish)	15 (2.6)
Vegan (eats no food/drink derived from animals)	11 (1.9)
Flexitarian (mainly vegetarian but occasionally eats meat)	35 (6.0)
None of these	32 (5.5)

Gender:

Female	368 (63.1)
Male	215 (36.9)

Country:

England	525 (90.1)
Scotland	58 (9.9)

Daily functioning:

Limited	240 (41.2)
Not limited	343 (58.8)

Household income per annum:

< £5,200	23 (3.9)

17

£5,200 to £10,399	60 (10.3)
£10,400 to £15,599	90 (15.4)
£15,600 to £20,799	85 (14.6)
£20,800 to £25,999	73 (12.5)
£26,000 to £36,399	72 (12.3)
£36,400 to £51,999	79 (13.6)
£52,000 to £77,999	61 (10.5)
≥ £78,000	40 (6.9)
Primary supermarket:	
Aldi	135 (23.2)
Asda	105 (18.0)
Co-Op (The Co-Operative)	12 (2.1)
Lidl	56 (9.6)
M&S (Marks and Spencer)	5 (0.9)
Morrisons	51 (8.7)
Ocado	8 (1.4)
Sainsburys	52 (8.9)
Tesco	141 (24.2)
Waitrose	5 (0.9)
Iceland	10 (1.7)
Getir[c]	1 (0.2)
Heron Foods	1 (0.2)
Abel & Cole	1 (0.2)
Online shopper:	
Yes	181 (31.0)
No	402 (69.0)
Shopping companion:	

18

Alone	201 (34.5)
Spouse/partner	136 (23.3)
Children	34 (5.8)
Other relative(s)	26 (4.5)
Friend(s)	2 (0.3)
Carer(s)	3 (0.5)

393 Note. [a] = food insecurity measure. [b] = positive scores (those above zero) reflect a healthy

394 diet quality, with higher scores being indicative of a healthier diet. Negative scores (those

395 below zero) reflect a lower diet quality, with lower scores being indicative of a less healthy

396 diet (Robinson et al., 2017). [c] online grocery delivery using an app.

397 3.2. <u>Regression Analyses</u>

398 Figure 2 provides a visual overview of the collective results from the eight regression

399 analyses.
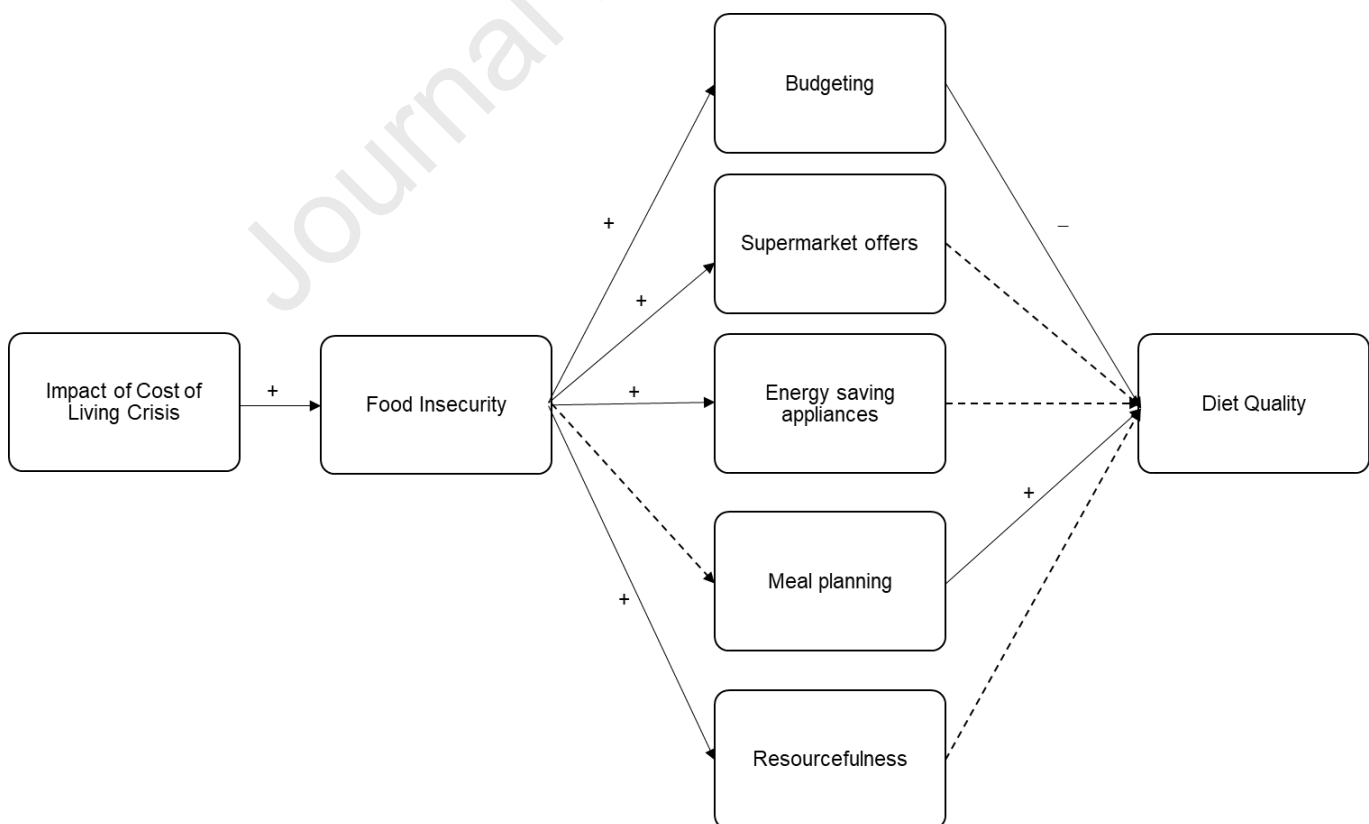
400
401
402 **Figure 2.** Schematic representation of the results of the regression analyses. Significant
403 associations are denoted with a solid arrow, and non-significant associations are denoted

404 with a dashed arrow. Directionality is reflected using '+' for positive associations and '–' for
405 negative associations. Associations with diet quality are exploratory
406
407 *3.2.1. The association between impact of the cost of living crisis and food insecurity scores*

408   The first step in this regression model consisted of age and daily functioning, the

409 impact of the cost of living crisis was then added as a second step (Table 2). The overall

410 regression model predicted 41% of variance in food insecurity scores (R^2 = .41, F(3, 579) =

411 136.53, *p* < .001). Age and daily functioning predicted approximately 9% of variance in food

412 insecurity scores, but only age was a significant predictor with higher food insecurity in

413 younger participants. After controlling for age and daily functioning, step two predicted

414 approximately 33% of variance in food insecurity, with cost of living impact scores being

415 positively associated with food insecurity scores, which is consistent with our hypothesis.

416 **Table 2:** Hierarchical multiple regression analyses showing age, daily functioning, and the

417 impact of the cost of living crisis as predictors of food insecurity

Variable	Cumulative		Simultaneous		
	R^2-change	*F*-change	B	*p*	*95% CI*
Food insecurity (1)					
<u>Step 1</u>					
Age	0.09	F(2, 580) = 27.71, *p* < .001	-.04	< .001	[-.05, -.02]
Limited daily functioning [yes/no]			-.25	.189	[-.62, .12]
<u>Step 2</u>					
Impact of cost of living crisis	0.33	F(1, 579) = 323.36, *p* < .001	1.73	< .001	[1.54, 1.91]

418 *Note.* B = unstandardised regression coefficient. *(1) = regression model 1. 95% CI =* 95%

419 confidence intervals.

420   *3.2.2. <u>Experiences of food insecurity and the use of food purchasing behaviours and food</u>*

421   *<u>preparation practices in relation to the cost of living crisis</u>*

422   A further four hierarchical multiple regression analyses were used to analyse the

423   association between experiencing food insecurity and the use of budgeting, energy saving

424   appliances, meal planning, and resourcefulness in relation to the cost of living crisis (Table

425   2). In the absence of any covariates, a linear regression was used to analyse the association

426   between experiencing food insecurity and the use of supermarket offers in relation to the

427   cost of living crisis (regression model 3, not presented in Table 3).

428   **<u>Table 3:</u>** Hierarchical multiple regression analyses showing significant covariates and food

429   insecurity as predictors of using budgeting, energy-saving appliances, meal planning, and

430   resourcefulness

Variable	Cumulative		Simultaneous		
	R^2-change	*F*-change	B	*p*	*95% CI*
<u>Food purchasing behaviours:</u>					
Budgeting (2)					
<u>Step 1</u>					
Age	0.08	F(3, 579) = 16.76, *p* < .001	-.00	.556	[-.01, .00]
Limited daily functioning [yes/no]			-.18	.005	[-.30, -.05]
Gender [female/male]			-.16	.010	[-.28, -.04]
<u>Step 2</u>					
Food insecurity	0.36	F(1, 578) = 367.51, *p* < .001	.21	< .001	[.19, .24]
<u>Food preparation practices:</u>					

Energy-saving appliances (4)

<u>Step 1</u>

Limited daily functioning [yes/no]	0.06	F(3, 579) = 11.22, $p < .001$	-.21	.020	[-.38, -.03]
Gender [female/male]			-.32	< .001	[-.49, -.14]
Ethnicity [BAME/White]			.40	.005	[.12, .68]

<u>Step 2</u>

Food insecurity	0.09	F(1, 578) = 64.10, $p < .001$	.12	< .001	[.09, .16]

Meal planning (5)

<u>Step 1</u>

Online shopper status [yes/no]	0.02	F(2, 580) = 4.60, $p = .010$	-.14	.120	[-.31, .04]
Gender [female/male]			-.19	.022	[-.36, -.03]

<u>Step 2</u>

Food insecurity	0.00	F(1, 579) = 1.85, $p = .174$	.02	.174	[-.01, .05]

Resourcefulness (6)

<u>Step 1</u>

Online shopper status [yes/no]	0.04	F(2, 580) = 11.11, $p < .001$	-.13	.073	[-.28, .01]
Gender [female/male]			-.27	< .001	[-.40, -.13]

<u>Step 2</u>

Food insecurity	0.06	F(1, 579) = 39.26, $p < .001$	.08	< .001	[.05, .10]

431   Note. B = unstandardised regression coefficient. (2) = regression model 2, (4) = regression

432   model 4, (5) regression model 5. *95% CI* = 95% confidence intervals.

433   *Food purchasing behaviours in relation to the cost of living crisis*

434   In regression model 2, predicting *use of budgeting*, the first step of the regression

435   consisted of age, daily functioning, and gender, and food insecurity was added as a second

436   step. The overall regression model predicted 44% of variance in budgeting (R^2 = .44, $F_{(4,}$

437    $_{578)}$ = 112.40, p < .001). Age, daily functioning, and gender predicted approximately 8% of

438   variance in budgeting, although only daily functioning and gender were significant predictor

439   of budgeting, where there was higher use of budgeting for those who had limited daily

440   functioning due to a medical problem, and who were female. After controlling for age, daily

441   functioning, and gender, step two predicted approximately 36% of variance in budgeting,

442   with food insecurity scores being positively associated with use of budgeting.

443   In regression model 3, predicting *use of supermarket offers*, the regression model

444   predicted approximately 13% of variance in use of supermarket offers (Adjusted R^2 = .13,

445    $F_{(1,581)}$ = 85.97, p < .001). Specifically, there was a positive association between food

446   insecurity scores and use of supermarket offers (B = .11, p < .001, 95% CI [.09, .12]).

447   *Food preparation practices in relation to the cost of living crisis*

448   In regression model 4, predicting *use of energy-saving appliances*, the first step of

449   the regression consisted of daily functioning, gender, and ethnicity, and food insecurity was

450   added as a second step. The overall regression model predicted 15% variance in use of

451   energy-saving appliances (R^2 = .15, $F_{(4, 578)}$ = 25.36, p < .001). Daily functioning, gender,

452   and ethnicity predicted approximately 6% of variance in use of energy-saving appliances,

453   where there was higher use of energy-saving appliances in those who had limited daily

454   functioning due to a medical problem, were female, and who identified as White. After

455   controlling for daily functioning, gender, and ethnicity, step two predicted approximately 9%

456   of variance in use of energy-saving appliances, with food insecurity scores being positively

457   associated with use of energy-saving appliances.

458   In regression model 5, predicting *use of meal planning*, the first step of the regression

459   consisted of online shopper status and gender, and food insecurity was added as a second

460   step. The overall regression model predicted 2% variance in use of meal planning (R^2 = .02,

461 F(3, 579) = 3.69, *p* = .012). Only gender was a significant predictor of meal planning, where

462 there was higher use of meal planning for those who were female. After controlling for online

463 shopper status and gender, step two predicted approximately 0% of variance in use of meal

464 planning, with food insecurity scores not being associated with use of meal planning in

465 relation to the cost of living crisis.

466   In regression model 6, predicting *cooking resourcefully*, the first step of the

467 regression consisted of online shopper status and gender, and food insecurity was added as

468 a second step. The overall regression model predicted 10% variance in cooking

469 resourcefully (R^2 = .10, F(3, 579) = 20.98, *p* < .001). Online shopper status and gender

470 predicted approximately 4% of variance in cooking resourcefully, although only gender was a

471 significant predictor of cooking resourcefully where higher resourceful cooking was reported

472 in those who were female. After controlling for online shopper status and gender, step two

473 predicted approximately 6% of variance in cooking resourcefully, with food insecurity scores

474 being positively associated with resourceful cooking in relation to the cost of living crisis.

475 3.3.   Sensitivity analysis

476   A sensitivity analysis was conducted where primary regression analyses were re-run

477 with extreme outliers on measures of diet quality removed. The pattern of results were

478 consistent whereby: 1) there was a positive association between cost of living crisis impact

479 scores and food insecurity, 2) a positive association between food insecurity and use of

480 budgeting, supermarket offers, use of energy-saving appliances, and resourcefulness, and

481 3) no association between food insecurity and use of meal planning. Please see

482 Supplementary Materials for detailed results.

483 3.4.   Exploratory Analyses

484 *3.4.1. The association between impact of the cost of living crisis and diet quality scores*

485   In regression model 7, predicting diet quality, the first step of the regression

486 consisted of gender and ethnicity, and cost of living impact score was added as a second

487 step (Table 4). The overall regression model predicted 8% variance in diet quality (R^2 = 0.08,

488   F(3, 579) = 17.66, *p* < .001). Gender and ethnicity predicted approximately 5% of variance in

489   diet quality. Gender and ethnicity were statistically significant predictors of diet quality, where

490   those who were female and identified as BAME had a higher diet quality. After controlling for

491   gender and ethnicity, step two predicted approximately 3% of variance in diet quality scores

492   with cost of living impact scores being negatively associated with diet quality.

493   **Table 4:** Hierarchical multiple regression analyses showing gender, cost of living impact,

494   budgeting, supermarket offers, energy-saving appliances, meal planning, and

495   resourcefulness as predictors of diet quality.

Variable	Cumulative		Simultaneous		
	R^2-change	*F*-change	B	*p*	95% CI
Diet quality (7)					
Step 1					
Gender [female/male]	0.05	F(2, 580) = 16.83, *p* < .001	- .47	< .001	[-.66, -.28]
Ethnicity [BAME/White]			-.66	< .001	[-.96, -.36]
Step 2					
Cost of living impact	0.03	F(1, 579) = 18.30, *p* < .001	-.21	< .001	[-.30, -.11]
Diet quality (8)					
Step 1					
Gender [female/male]	0.06	F(2, 580) = 16.83, *p* < .001	-.42	< .001	[-.61, -.23]
Ethnicity [BAME/White]			-.65	< .001	[-.94, -.35]

Step 2

Budgeting	0.08	F(5, 575) = 10.71, $p < .001$	-.22	< .001	[-.35, -.10]
Supermarket offers			-.04	.581	[-.17, .10]
Energy-saving appliances			-.06	.187	[-.16, .03]
Meal planning			.25	< .001	[.15, .35]
Resourcefulness			.07	.330	[-.07, .20]

496 Note. B = unstandardised regression coefficient. (7) = regression model 7. (8) = regression

497 model 8. *95% CI* = 95% confidence intervals.

498 *3.4.2.* <u>*Use of food purchasing behaviours and food preparation practices in relation to the*</u>

499 <u>*cost of living crisis and their association with diet quality*</u>

500 In regression model 8, predicting diet quality, the first step of the regression

501 consisted of gender and ethnicity, and budgeting, supermarket offers, energy-saving

502 appliances, meal planning, and resourcefulness were added as a second step (Table 4). The

503 overall regression model predicted 14% of variance in diet quality (R^2 = 0.14, F(7, 575) =

504 12.86, $p < .001$). Gender and ethnicity predicted approximately 6% of variance in diet quality

505 and, as in regression model 7, both were statistically significant predictors of diet quality.

506 After controlling for gender and ethnicity, step two predicted approximately 8% of variance in

507 diet quality scores, where food budgeting and meal planning were significant predictors. Use

508 of budgeting was negatively associated with diet quality, whereas use of meal planning was

509 positively associated with diet quality. There were no associations between use of energy-

510 saving appliances, use of supermarket offers, and use of resourcefulness with diet quality

511 scores.

512 **4. Discussion**

513 4.1. <u>Key findings</u>

514   We investigated, in a sample of PLWO, the perceived impact of the cost of living

515   crisis on experiences of food insecurity, and how these experiences of food insecurity are, in

516   turn, related to food purchasing behaviour and food preparation practices. We found that

517   those adversely impacted by the cost of living crisis experienced food insecurity, with the

518   composite variable that represented impact of the cost of living crisis explaining 33% of

519   variance in food insecurity. While we hypothesised that food insecurity scores would be

520   associated with use of cost-effective food purchasing behaviours and food preparation

521   practices in relation to the cost of living crisis, this hypothesis was only partially supported in

522   our findings. Food insecurity was associated with use of budgeting, supermarket offers,

523   energy-saving appliances, and cooking resourcefully. Food insecurity was not found to be

524   associated with the use of meal planning. Exploratory analyses of associations between food

525   purchasing behaviours and food preparation practices in relation to diet quality showed that

526   use of budgeting was negatively associated with diet quality, whereas use of meal planning

527   was positively associated.

528   4.2.   Impact of the cost of living crisis and food insecurity

529   The finding that those who were negatively impacted by the cost of living crisis

530   experienced food insecurity is in line with previous literature that has highlighted the

531   detrimental effects of economic hardship on food security (Brown et al., 2023; Douglas,

532   2023). Additionally, these findings align with recent Office of National Statistics data showing

533   that households with the lowest incomes experience higher than average inflation rates,

534   which is due to low-income households being more affected by high food and energy prices

535   arising from the cost of living crisis (Office for National Statistics, 2023). The current cost of

536   living crisis is another example of an economic shock where inflation rates, particularly food

537   prices, are rising but wages are not. Moreover, the cost of living crisis is likely exacerbating

538   financial pressures that were already experienced by those on low-incomes, and as a result,

539   have made it even more challenging to afford or access a healthy diet (Johnston et al., 2023;

540   Robinson, 2023). The cost of living crisis is therefore likely to continue to exacerbate social

541   inequalities in dietary outcomes which may have short and longer-term consequences for

542   population health but particular impact for PLWO.

543   Less healthy food is significantly cheaper to purchase than healthier food (Darmon &

544   Drewnowski, 2015; Food Foundation, 2023b) and it is possible that an unintended

545   consequence of the cost of living crisis is promoting unhealthy food choice through an

546   individual's inability to afford a healthy diet (Food Foundation, 2023a). This finding is

547   complemented by our exploratory analyses that indicated PLWO who were adversely

548   impacted by the cost of living crisis were more likely to have a low quality of diet. Individuals

549   experiencing economic hardship may prioritize more affordable energy-dense foods over

550   diet quality as shown in previous studies prior to the current cost of living crisis (Puddephatt

551   et al., 2020), which may contribute to an increase in body weight and exacerbate existing

552   diet and health inequalities.

553   4.3.   Experience of food insecurity and the use of budgeting

554   Our study showed a positive association between food insecurity and use of

555   budgeting, which aligns with previous research and suggests that individuals facing food

556   insecurity use budgeting techniques to stretch limited financial resources (Conklin et al.,

557   2013; Laraia et al., 2017; Nieves et al., 2022; van der Velde et al., 2022). As food is seen as

558   flexible within budgets (Ditlevsen et al., 2023; Lindow et al., 2022; Puddephatt et al., 2020),

559   food budgets often suffer cutbacks to account for other, more pressing expenses (e.g.,

560   increased housing or energy costs). Indeed, we showed that participants reported that they

561   reduced the quantity (35.2% of survey participants), quality (42.7% of survey participants),

562   and healthiness of food (29.2% of survey participants) to afford rising energy bills (Table S4).

563   As a result, budgeting may encourage cheaper, less healthy food purchases (Pechey &

564   Monsivais, 2016), which may ultimately promote weight gain and obesity (Laraia, 2013; Patil

565   et al., 2017). The findings from our exploratory analyses confirmed this supposition and

566   indicated that use of budgeting strategies was associated with low diet quality.

567   4.4.   Experience of food insecurity and the use of supermarket offers

568   The positive association found between food insecurity and use of supermarket

569 offers is sensical given previous literature reporting that rising food prices are a primary food-

570 related concern of UK consumers (Armstrong et al., 2023). Using supermarket offers allows

571 consumers to capitalize on discounted food items thereby helping to mitigate the impact of

572 rising food prices. While supermarket offers, such as promotions/lowering prices on

573 seasonable fruits and vegetables, can be important policy levers for encouraging healthier

574 diets (Piernas et al., 2022), the number of products on promotion that are HFSS far outweigh

575 the number on healthier food (Furey, 2022). However, findings from our exploratory analyses

576 indicate that use of supermarket offers were not associated with diet quality, which may

577 suggest that alone, supermarket offers are not a significant driver in dietary decisions, or

578 reflect the temporary, dynamic nature of discounts on food groups.

579 4.5.   Experience of food insecurity and the use of energy-saving appliances

580   We reported a positive association between food insecurity and use of energy-saving

581 appliances (including eating food cold). It is likely that PLWO and food insecurity use these

582 food preparation practices as a way of reducing utility costs associated with food

583 preparation. Additionally, energy-saving appliances, such as slow cookers and air fryers,

584 may be used due to the convenience they offer (Callender et al., 2021; Kopetsky et al.,

585 2021), and although air fryers are viewed by households with low-income as healthier than

586 traditional frying methods (Adams, 2023), their use does not necessarily determine that the

587 product chosen to be cooked is any healthier. Likewise, meals that do not require cooking

588 tend to be more highly processed (Parnham et al., 2022) and so consumption is likely to

589 elicit a low quality diet (Harb et al., 2023). However, our exploratory analysis found no

590 relationship between use of energy-saving appliances and diet quality suggesting that diet

591 quality and use of energy-saving appliances per se may not be detrimental for adiposity in

592 PLWO.

593 4.6.   Experience of food insecurity and the use of resourcefulness

594   Food insecurity was found to be associated with use of resourceful cooking. This

595   might be due that fact that resourceful cooking has become normalised within the food

596   practices of households experiencing food insecurity and so has become as an essential

597   coping strategy for stretching limited food resources, with the cost of living crisis heightening

598   the need for such resourceful behaviours. This finding is in line with the Resource Scarcity

599   Hypothesis (Dhurandhar, 2016), as the cost of living crisis has threatened household food

600   supplies. However, some strategies, such as using starchy foods to pad out meals, might

601   result in excess energy intake at the individual level (Lindberg et al., 2022). Notwithstanding

602   this, these findings highlight the adaptive nature of individuals living with obesity in the face

603   of food insecurity and financial challenges, which is analogous with previous research

604   (Watson et al., 2022). Importantly, and in contrast to our earlier supposition, exploratory

605   analyses showed that resourceful cooking was not associated with diet quality. Therefore,

606   this coping strategy may be beneficial for PLWO and food insecurity to reduce the financial

607   burden of food costs, without impacting on diet quality.

608   4.7.   Experience of food insecurity and the use of meal planning

609   Interestingly, we did not find a significant association in PLWO between food

610   insecurity and the use of meal planning. Within the existing literature, the association

611   between meal planning and the experience of food insecurity is mixed. On the one hand,

612   previous research suggests that meal planning can be a helpful strategy for managing food

613   insecurity in the USA (Gundersen & Garasky, 2012). Yet, on the other hand, previous

614   literature also from the USA has found no difference between food secure and food insecure

615   households in their use of meal planning (Ranjit et al., 2020). The lack of association found

616   here may reflect how PLWO have different eating behaviours compared to those without

617   obesity as research suggests that PLWO may have less structured meal plans (Ducrot et al.,

618   2017). Another possibility is that the current study's sample already consisted of individuals

619   who were actively engaged in meal planning, as it is common that behavioural treatments for

620   obesity include support with meal planning (Wing, 2004). Findings from our exploratory

621   analyses indicated that use of meal planning was associated with high diet quality, which

622   lends support to behavioural treatments for obesity that include support with meal planning.

623   4.8.   Implications

624   The current research has several practical implications. Firstly, our findings

625   emphasise the urgent need for policies and interventions that address the underlying

626   economic factors that contribute to food insecurity among vulnerable populations particularly

627   for PLWO, which aligns with recommendations made elsewhere (e.g., Food Foundation,

628   2023a). Secondly, our findings underscore the need for comprehensive legislative reforms in

629   ensuring that promoted foods are in favour of health, which contradicts the UK Government's

630   recent delay on plans to ban multi-buys on HFSS and buy one get one free on HFSS

631   products (GOV, 2023b). Thirdly, our findings highlight the fragility of food budgets and how

632   dedicated voucher schemes, where money is ringfenced for healthy food purchases, may be

633   beneficial. The importance of this is underscored by other evidence that people experiencing

634   food insecurity often prioritise foods with long-shelf lives (e.g., tins) over fresh fruit and

635   vegetables (Shinwell & Defeyter, 2021). An example of an active voucher scheme is the

636   UK's 'Healthy Start' scheme, where low-income pregnant mothers (10 weeks into their

637   pregnancy) and parents/caregivers who are responsible for at least one child under 4-years

638   of age, can sign up to receive vouchers to purchase healthy food and vitamins. This scheme

639   has successfully seen participating families increase the nutritional composition of their

640   shopping baskets (Griffith et al., 2018). However, recent digitisation of the Healthy Start

641   vouchers into pre-paid cards has received criticism where families have reported

642   experiencing difficulties using the cards, leading to hardship and humiliation (Defeyter et al.,

643   2022). Therefore, although voucher schemes appear a promising intervention, they must be

644   carefully implemented to ensure they are easily accessible.

645   4.9.   Strengths and Limitations

646   Our study has several strengths, including pre-registered analyses, well powered

647   regression analyses, and rigorous sensitivity analyses. Further, individuals with low-incomes

648   are characteristically hard to reach. Nevertheless, our sample consisted of a variety of

649   household incomes, with over half of the sample reporting an income below 60% of the

650   median for the United Kingdom which is often used as a measure of poverty (GOV, 2023a).

651   However, there are several limitations to the study. Our study is constrained by its cross-

652   sectional design as only associations can be inferred. Future research should consider using

653   a longitudinal design to assess changes in food insecurity, food purchasing behaviours, and

654   food preparation practices in line with changing inflation rates, or by using Directed Acyclic

655   Graphs to assess causal inference rather than associations (Van Cauwenberg et al., 2023).

656   Additionally, it is important to acknowledge the presence of low R^2 values for some

657   regression analyses, which may suggest that there are other variables that have not been

658   explored in this paper. Furthermore, the sample was predominately White ethnicity, despite

659   a concerted effort to recruit diversely. One of the key indicators of obesity is ethnicity (NHS

660   Digital, 2022), and so it would be beneficial to explore whether findings differed between

661   ethnicities. However, it could be argued that the sample is representative of the relative

662   population sizes of England and Scotland (Office for National Statistics, 2021; Scottish

663   Consensus, 2011). In this respect, however, the sample would benefit from being recruited

664   from all nations of the UK rather than solely England and Scotland, given the cost of living

665   crisis has been experienced across the UK (Food Foundation, 2023a). Finally, our data were

666   self-reported and some measures, such as the diet quality measure, may suffer from

667   inaccuracies and response bias. Notably, a parallel qualitative study is currently underway

668   within the wider project that is exploring the lived experiences of PLWO and food insecurity

669   in relation to their experiences of shopping in a supermarket for healthy food. Therefore,

670   these qualitative data may shed further light on some of the outstanding questions arising

671   from the current work.

672   **5. Conclusion**

673   This paper illuminates the disproportionate impact economic crises have on people

674   experiencing food insecurity and has added to this understanding, from the perspective of

675   PLWO. These data support fiscal and governmental environmental measures to transform

676   the food system in the UK, to address these diet and health inequalities.

677   **6.   CRediT authorship contribution statement**

678   **Rebecca A Stone:** Conceptualization, Methodology, Formal analysis, Investigation, Data

679   Curation, Writing - original draft, Project administration. **Adrian Brown:** Conceptualization,

680   Methodology, Writing - review & editing. **Flora Douglas:** Methodology, Writing - review &

681   editing, Funding Acquisition. **Mark A Green:** Formal analysis, Writing - review & editing,

682   **Emma Hunter:** Methodology, Writing - review & editing, **Marta Lonnie:** Methodology,

683   Writing - review & editing, Visualization, **Alexandra M Johnstone:** Methodology, Writing -

684   review & editing, Funding Acquisition, **Charlotte A Hardman:** Conceptualization,

685   Methodology, Formal analysis, Writing - review & editing, Supervision, Funding Acquisition.

686   All authors have approved the final article.

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Impact

Impact of Cost of Living Crisis

- My income allows me to save for the future
- I am going into debt to pay for everyday essentials
- I am unable to pay for all of my bills
- I have cut my spending on everyday essentials
- I have cut my spending in other areas to be able to afford every day essentials

Food Purchasing Behaviours

Budgeting

- Cut back on the quantity of food to afford other essentials (e.g., energy bills)
- Cut back on healthy food to afford other essentials
- Cut back on the quality of food to afford other essentials
- Been to the supermarket less because I can't afford to travel there (either fuel or public transport)
- Bought smaller amounts of dried goods (e.g., pasta, lentils) so I only buy what I need
- Stuck to a strict budget when buying food and drink

Supermarket Offers

- Shop around supermarkets for the best deals
- Bought more discounted / 'yellow sticker' food and drink
- Bought more own-brand food and drink
- I have changed the days of the week/time of day I shop in order to get the best deals/prices

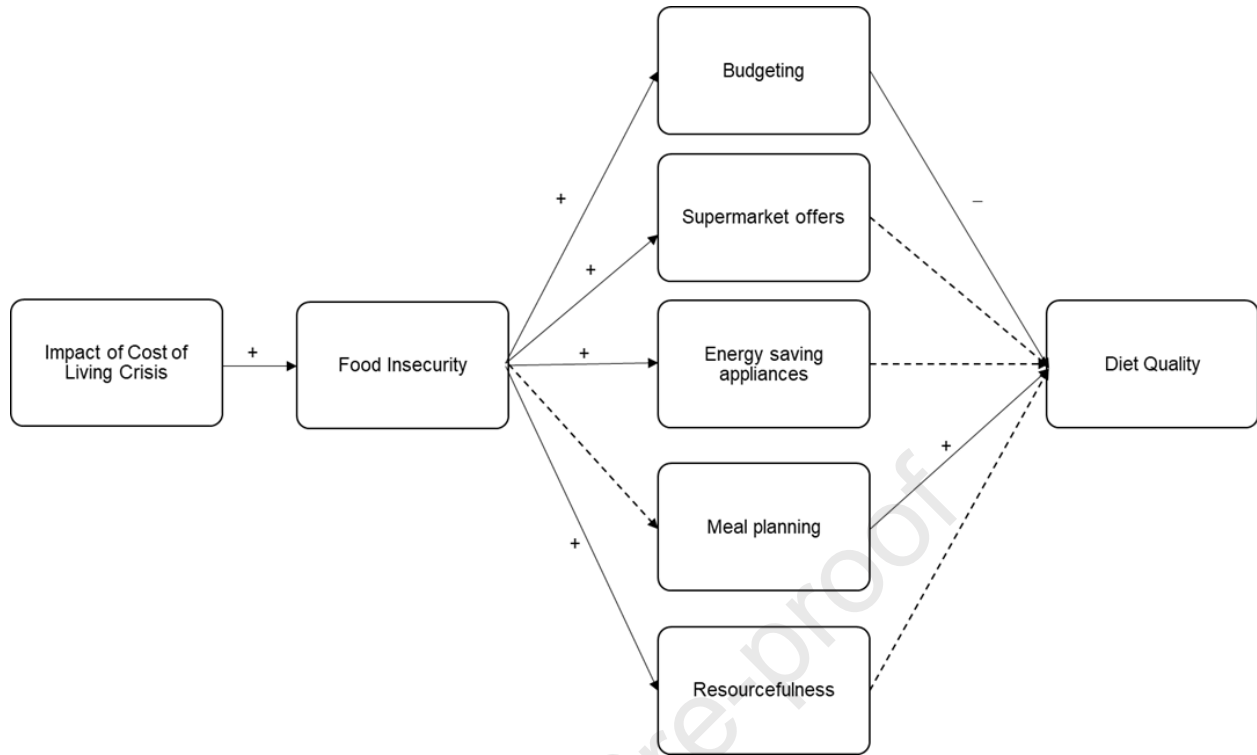**Food Preparation Practices**

Energy-Saving Appliances

- Used appliances (e.g., oven, hob etc) less for cooking to save money on energy bills
- Used appliances such as air fryers more to save money on energy bills
- Ate cold meals or ones that don't need to be cooked to save money on energy bills

Meal Planning

- Batch cooked meals for the week in advance
- Plan all meals for the week in advance
- Cooked meals from scratch

Resourcefulness

- Reduced the amount of food that I wasted
- Padded out meals with more filling foods e.g., pasta, potatoes
- Eaten more vegetarian meals/meals without meat to save money

Ethical Statement

Ethical approval for the involvement of human subjects in this study was granted by

University of Liverpool Research Ethics Committee, Ethics number 12027, Dated 06/02/2023

Declarations of interest

AB reports honoraria from Novo Nordisk, Office of Health Improvement and Disparity, Johnson and Johnson and Obesity UK outside the submitted work and is on the Medical Advisory Board and shareholder of Reset Health Clinics Ltd. CAH reports research funding from the American Beverage Association, and honoraria from International Sweeteners Association and International Food Information Council for work outside of the submitted manuscript. RAS, AMJ, MAG, EH, FD and ML report no declarations of interest.

<u>**Supplementary Materials**</u>

1. <u>Principle component analysis</u>

1.1. <u>Cost of living impact</u>

1.1.1. *Pre-analysis checks and data preparation*

The sampling adequacy was acceptable (Kaiser–Meyer–Olkin (KMO) = .78) and Bartlett's test of sphericity demonstrated that correlations between items were large enough for PCA ($\chi^2(10)$ = 1454.58, $p < .001$. Therefore, a Principal Component Analyses (PCA) was performed using Oblimin rotation with Kaiser Normalization. The PCA revealed one component that explained 63.63% of variance; component one Eigenvalue = 3.18.

1.1.2. *Results*

The means and standard deviations of measures of the impact of the cost of living scores are displayed in Table S1.

<u>Table S1</u>: Responses to cost of living impact questions. Values represent percentages of completed responses for each question.

	N	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
My income allows me to save for the future	583	3.3	17.2	11	27.3	41.3
I am going into debt to pay for everyday essential	583	22	31.7	14.6	22	9.8
I am unable to pay for all of my bills	583	25	34	10.1	21.3	9.6
I have cut my spending on everyday essentials	583	3.8	13.4	11.3	46.5	25

I have cut my spending in other areas to be able to afford everyday essentials	583	4.8	9.9	10.5	45.6	29.2

As seen in Table S2, all measures loaded onto one component and this was termed 'impact of cost of living crisis'.

Table S2: Principal component analysis for measures of the impact of the cost of living crisis

	Component Matrix
Variable	Component 1 (impact of cost of living crisis)
My income allows me to save for the future	.783
I am going into debt to pay for everyday essentials	.828
I am unable to pay for all of my bills	.810
I have cut my spending on everyday essentials	.777
I have cut my spending in other areas to be able to afford everyday essentials	.790

1.2.   Food purchasing behaviours

1.2.1. Pre-analysis checks and data preparation

The sampling adequacy was acceptable (KMO = .89) and Bartlett's test of sphericity demonstrated that correlations between items were large enough for PCA ($\chi^2(45) = 2242.49$, $p < .001$. Therefore, a Principal Component Analyses (PCA) was performed using Oblimin rotation with Kaiser Normalization. The PCA revealed two components that explained 56.68% of variances; component one Eigenvalue = 4.55 (variance explained = 45.50%), and component two Eigenvalue = 1.16 (variance explained = 11.56%).

1.2.2. Results

The means and standard deviations of measures of food purchasing behaviours in response to the cost of living crisis are displayed in Table S3.

Table S3: Responses to food purchasing behaviours in response to the cost of living crisis questions. Values represent percentages of completed responses for each question.

	N	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Cut back on the quantity of food to afford other essentials (e.g., energy bills)	583	12.2	24.9	12.7	35.2	15.1
Cut back on the quality of food to afford other essentials (e.g., energy bills)	583	9.3	17.5	9.4	42.7	21.1
Shop around supermarkets for the best deals	582	5	11.8	9.6	41.2	32.2
Bought more own-brand food and drink	583	3.8	4.3	8.2	41.9	41.9
Stuck to a strict budget when buying food and drink	583	5.3	18.9	16.1	38.9	20.8
I have changed the days of the week/time of day I shop in order to get the best deals/prices	583	20.8	41.9	13.4	16.8	7.2

Been to the supermarket less because I can't afford to travel there (either fuel or public transport)	583	32.4	30.7	12.2	14.2	10.5
Cut back on healthy food to afford other essentials (e.g., energy bills)	583	13.4	27.4	13.2	29.2	16.8
Bought smaller amounts of dried goods (e.g., pasta, lentils) so I only buy what I need	582	12.9	24.5	13.9	37.7	10.8
Bought more discounted / 'yellow sticker' food and drink	583	8.2	16.1	16	30.9	28.8

As seen in Table S4, all measures loaded onto one of two components. Component one, labelled '*Budgeting*' was made up of 'cut back on the quantity of food to afford other essentials (e.g., energy bills)', 'cut back on healthy food to afford other essentials (e.g., energy bills)', 'cut back on the quality of food to afford other essentials (e.g., energy bills)', 'been to the supermarket less because I can't afford to travel there (either fuel or public transport)', 'bought smaller amounts of dried goods (e.g., pasta, lentils) so I only buy what I need', and 'stuck to a strict budget when buying food and drink'. The second component, labelled '*Supermarket Offers*' was made up of 'shop around supermarkets for the best deals', 'bought more discounted / 'yellow sticker' food and drink', 'bought more own-brand food and drink', and 'I have changed the days of the week/time of day I shop in order to get the best.

Table S4: Principal component analysis pattern matrix for measures of food purchasing

behaviours in response to the cost of living crisis (significant loadings in bold)

	Rotated Component	
Variable	Component 1 (*Budgeting*)	Component 2 (*Supermarket offers*)
Cut back on the quantity of food to afford other essentials (e.g., energy bills)	**.906**	-.096
Cut back on healthy food to afford other essentials (e.g., energy bills)	**.846**	.030
Cut back on the quality of food to afford other essentials (e.g., energy bills)	**.841**	.005
Been to the supermarket less because I can't afford to travel there (either fuel or public transport)	**.634**	-.025
Bought smaller amounts of dried goods (e.g., pasta, lentils) so I only buy what I need	**.526**	.221
Stuck to a strict budget when buying food and drink	**.446**	.358
Shop around supermarkets for the best deals	-.220	**.928**
Bought more discounted / 'yellow sticker' food and drink	.171	**.658**
Bought more own-brand food and drink	.251	**.580**
I have changed the days of the week/time of day I shop in order to get the best deals/prices	.091	**.564**

1.3.   Food Preparation Practices

1.3.1. *Pre-analysis checks and data preparation*

The sampling adequacy was acceptable (KMO = .73) and Bartlett's test of sphericity demonstrated that correlations between items were large enough for PCA (χ^2(36) = 1103.17, p < .001. Therefore, a Principal Component Analyses (PCA) was performed using Oblimin rotation with Kaiser Normalization. The PCA revealed three components that explained 60.56% of variances; component one Eigenvalue = 2.86 (variance explained = 31.73%), component two Eigenvalue = 1.63 (variance explained = 18.13%), component three Eigenvalue = 1.01 (variance explained = 10.70%).

1.3.2. Results

The means and standard deviations of measures of food preparation practices in response to the cost of living crisis are displayed in Table S5.

Table S5: Responses to food preparation practices in response to the cost of living crisis questions. Values represent percentages of completed responses for each question.

	N	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly agree
Used appliances (e.g. oven, hob etc.) less for cooking to save money on energy bills	583	10.1	17.2	8.4	41.2	23.2
Used appliances such as air-fryers more to save money on energy bills	583	20.6	16	7.5	23.7	32.2
Ate cold meals or ones that don't need to be	583	19	30.4	10.1	28.8	11.7

cooked to save money on energy bills					
Cooked meals from scratch	583	5.8	10.1	14.1	43.6	26.4
Reduced the amount of food that I waste	583	3.6	6.3	11.5	48	30.5
Padded out meals with more filling foods e.g. pasta, potatoes	583	8.1	14.6	12.9	42.2	22.3
Plan all meals for the week in advance	583	16.8	24.7	13	26.6	18.9
Batch cooked meals for the week in advance	583	19.9	31	14.9	25.7	8.4
Eaten more vegetarian meals / meals without meat	583	22.8	25	13.6	26.8	11.8

As seen in Table S6, all measures loaded onto one of three components. Component one, labelled '*Energy Saving Appliances'* was made up of 'used appliances (e.g. oven, hob etc.) less for cooking to save money on energy bills', 'used appliances such as air-fryers more to save money on energy bills', and 'ate cold meals or ones that don't need to be cooked to save money on energy bills'. The second component, labelled '*Meal Planning'* was made up of 'batch cooked meals for the week in advance', 'plan all meals for the week in advance', and 'cooked meals from scratch'. The third component, labelled '*Resourcefulness'* was made up of 'reduced the amount of food that I waste', 'padded out meals with more filling foods e.g. pasta, potatoes', and 'eaten more vegetarian meals / meals without meat.'

Table S6: Principal component analysis pattern matrix for measures of food preparation practices in response to the cost of living crisis (significant loadings in bold)

Variable	Rotated components		
	Component 1 (*Energy saving appliances*)	Component 2 (*Meal planning*)	Component 3 (*Resourcefulness*)
Used appliances (e.g. oven, hob etc.) less for cooking to save money on energy bills	**.825**	-.008	.147
Used appliances such as air-fryers more to save money on energy bills	**.800**	.265	-.217
Ate cold meals or ones that don't need to be cooked to save money on energy bills	**.699**	-.174	.239
Batch cooked meals for the week in advance	.141	**.806**	-.014
Plan all meals for the week in advance	.000	**.799**	.034
Cooked meals from scratch	-.131	**.518**	.377
Reduced the amount of food that I waste	.111	.036	**.730**
Padded out meals with more filling foods e.g. pasta, potatoes	.333	-.051	**.648**

| | Eaten more vegetarian meals / meals without meat | -.131 | .131 | **.590** |

1.4. <u>Reliability analysis</u>

The scale reliability of each construct identified by the PCA was assessed using McDonald's Omega (ω_T). McDonald's Omega was high for impact of cost of living crisis (0.85), budgeting (0.85), supermarket offers (0.71) and energy saving (0.73), and moderate for meal planning (0.66) and resourcefulness (0.52) (Hinton et al., 2014).

2. Sensitivity analysis

Main regression analyses were re-run with extreme outliers excluded (n = 15, N = 268).

2.1. <u>The association between impact of the cost of living crisis and food insecurity scores</u>

As seen in Table S7, hierarchical multiple regression analysis was used to analyse the effect of being impacted by the cost of living crisis on experiences of food insecurity. The first step in this regression model consisted of age and daily functioning, the impact of the cost of living crisis was then added as a second step. The overall regression model predicted 41% of variance in food insecurity scores (R^2 = .41, F(3, 564) = 132.35, p < .001). Age and daily functioning predicted approximately 9% of variance in food insecurity scores, but only age was a significant predictor with higher food insecurity in younger participants. After controlling for age and daily functioning, step two predicted approximately 32% of variance in food insecurity, with higher cost of living impact scores being associated with higher food insecurity scores, which is consistent with our hypothesis.

<u>Table S7</u>: Hierarchical multiple regression analyses showing age, daily functioning, and the impact of the cost of living crisis as predictors of food insecurity

Variable	Cumulative	Simultaneous

	R^2-change	F-change	B	p	95% CI
Food insecurity					
(1)					
<u>Step 1</u>					
Age	0.09	F(2, 565) = 26.98, p < .001	-.04	< .001	[-.05, -.02]
Daily functioning			-.27	.163	[-.65, .11]
<u>Step 2</u>					
Impact of cost of living crisis	0.32	F(1, 564) = 313.26, p < .001	1.75	< .001	[1.55, 1.94]

Note. B = unstandardised regression coefficient. *(1) = regression model 1.*

1.1.1. *Experiences of food insecurity and the use of food purchasing behaviours and food preparation practices in relation to the cost of living crisis*

A further four hierarchical multiple regression analyses were used to analyse the association between experiencing food insecurity and the use of budgeting, energy saving appliances, meal planning, and resourcefulness in relation to the cost of living crisis (Table S8). In the absence of any covariates, a linear regression was used to analyse the association between experiencing food insecurity and the use of supermarket offers in relation to the cost of living crisis (regression model 3, not presented in Table S8).

<u>Table S8:</u> Hierarchical multiple regression analyses showing significant covariates and food insecurity as predictors of using budgeting, energy-saving appliances, meal planning, and resourcefulness

Variable	Cumulative		Simultaneous		
	R^2-change	F-change	B	p	95% CI

Food

purchasing

behaviours:

Budgeting (2)

Step 1

Age	0.08	F(3, 564) = 16.71, *p* < .001	-.00	.545	[-.01, .00]
Limited daily functioning [yes/no]			-.17	.006	[-.30, -.05]
Gender [female/male]			-.17	.007	[-.29, -.05]

Step 2

Food insecurity	0.35	F(1, 563) = 353.68, *p* < .001	.21	< .001	[.19, .24]

Food

preparation

practices:

Energy-saving

appliances (4)

Step 1

Daily functioning	0.05	F(3, 564) = 10.68, *p* < .001	-.21	.022	[-.38, -.03]
Gender			-.31	< .001	[-.49, -.13]
Ethnicity [BAME/White]			.39	.009	[.10, .68]

Step 2

Food insecurity	0.09	F(1, 563) = 60.98, *p* < .001	.12	< .001	[.09, .15]

Meal planning

(5)

<u>Step 1</u>

Online shopper status [yes/no]	0.02	F(2, 565) = 3.91, p = .021	-.12	.190	[-.29, .06]
Gender			-.19	.029	[-.35, -.02]

<u>Step 2</u>

Food insecurity	0.00	F(1, 564) = 1.40, p = .237	.02	.237	[-.01, .05]

Resourcefulness

(6)

<u>Step 1</u>

Online shopper status	0.04	F(2, 565) = 11.25, p < .001	-.14	.069	[-.28, .01]
Gender			-.27	< .001	[-.41, -.13]

<u>Step 2</u>

Food insecurity	0.06	F(1, 564) = 36.45, p < .001	.07	< .001	[.05, .10]

Note. B = unstandardised regression coefficient. (2) = regression model 2, (4) = regression model 4, (5) regression model 5.

<u>Food purchasing behaviours in relation to the cost of living crisis</u>

In regression model 2, predicting *use of budgeting*, the first step of the regression consisted of age, daily functioning, and gender, and food insecurity was added as a second step. The overall regression model predicted 43% of variance in budgeting (R^2 = .43, F(4, 563) = 108.79, p < .001). Age, daily functioning, and gender predicted approximately 8% of variance in budgeting, although only daily functioning and gender were significant predictor of budgeting, where there was higher use of budgeting for those who had limited daily functioning due to a medical problem, and who were female. After controlling for age, daily

functioning, and gender, step two predicted approximately 35% of variance in budgeting, with higher food insecurity scores being associated with higher use of budgeting.

In regression model 3, predicting *use of supermarket offers*, the regression model predicted approximately 12% of variance in use of supermarket offers, Adjusted R^2 = .12, $F(1, 566)$ = 81.62, *p* < .001). Specifically, there was a positive association between food insecurity scores and use of supermarket offers (B = 0.11, *p* < .001, 95%CI [.08, .13]).

Food preparation practices in relation to the cost of living crisis

In regression model 4, predicting *use of energy-saving appliances*, the first step of the regression consisted of daily functioning, gender, and ethnicity, and food insecurity was added as a second step. The overall regression model predicted 14% variance in use of energy-saving appliances (R^2 = .14, $F(4, 563)$ = 24.10, *p* < .001). Daily functioning, gender, and ethnicity predicted approximately 5% of variance in use of energy-saving appliances, where there was higher use of energy-saving appliances in those who had limited daily functioning due to a medical problem, were White, and who were female. After controlling for daily functioning, gender, and ethnicity, step two predicted approximately 9% of variance in use of energy-saving appliances, with higher food insecurity scores being associated with higher use of energy-saving appliances.

In regression model 5, predicting *use of meal planning*, the first step of the regression consisted of online shopper status and gender, and food insecurity was added as a second step. The overall regression model predicted 2% variance in use of meal planning (R^2 = .02, $F(3, 564)$ = 3.08, *p* = .027). Only gender was a significant predictor of meal planning, where there was higher use of meal planning for those who were female. After controlling for online shopper status and gender, step two predicted approximately 0% of variance in use of meal planning, with food insecurity scores not being associated with use of meal planning in relation to the cost of living crisis.

In regression model 6, predicting *cooking resourcefully*, the first step of the regression consisted of online shopper status and gender, and food insecurity was added as a second step. The overall regression model predicted 10% variance in cooking

resourcefully (R^2 = .10, F(3, 564) = 20.12, p < .001). Online shopper status and gender predicted approximately 4% of variance in cooking resourcefully, although only gender was a significant predictor of cooking resourcefully where higher resourceful cooking was reported in those who were female. After controlling for online shopper status and gender, step two predicted approximately 6% of variance in cooking resourcefully, with higher food insecurity scores being associated with higher resourceful cooking in relation to the cost of living crisis.