The association between COVID-19 related food insecurity and weight promoting eating behaviours: the mediating role of distress and eating to cope

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Abstract

Food insecurity (a lack of stable access to nutritious food) is reliably associated with obesity, although the underlying mechanisms are unclear. Past research indicates that this relationship may, in part, be explained by the distress of being food insecure and using food as a coping mechanism. While previous work has focused on long-term food insecurity, the first COVID-19 national lockdown presented a unique opportunity to establish if the same relationships existed for individuals experiencing pandemic related food insecurity. Adults in the United Kingdom (N = 211) were recruited three months after the first UK lockdown via social media. They completed questionnaires on COVID-19 related food insecurity, physical stress, psychological distress, eating to cope, drinking to cope, diet quality, and changes in weight promoting eating behaviours (e.g. consuming larger portions, increased snacking) since the start of the lockdown. A structural equation model revealed that food insecurity was indirectly associated with changes in weight promoting eating behaviours. As predicted, the more instances of pandemic related food insecurity, the more distress individuals reported. Distress was then associated with eating as a way of coping, which in turn was associated with increases in weight promoting eating behaviours. Food insecurity was also indirectly associated with diet quality, but this was via distress only. These results reflect similar pathways observed in individuals reporting chronic food insecurity and strengthens the evidence that distress and eating to cope are generic mediators of food insecurity and eating behaviour.

Keywords: Food insecurity, COVID-19, eating to cope, distress, eating behaviour

1. Introduction

Food insecurity refers to unreliable access to nutritionally adequate and safe foods, which is usually the result of a lack of financial resources. Prior to the COVID-19 pandemic, over 2 billion people globally were estimated to be experiencing moderate to severe food insecurity, including 5-9% of the population in the United Kingdom, Northern Europe and North America, with this number rising in recent years (FOA, 2019).

Food insecurity represents a major public health concern for numerous reasons, including the reliable association it shares with obesity in both adults and children (e.g. (Franklin et al., 2012; Nettle, Andrews, & Bateson, 2017). A number of different explanations have been put forward for this relationship, which initially focused on the availabilty of low-cost, energy-dense foods in areas where people are likely to experience food insecurity (i.e. more deprived neighbourhoods) (Freedman & Bell, 2009; Larson, Story, & Nelson, 2009). Although food availaility is certainly important, it is not the only mechanism, and programmes aimed at reducing the financial costs of healthy foods tend to have minimal impacts on weight outcomes (Capacci et al., 2012; McFadden et al., 2014), with the evidence for a link between food environments and obesity also mixed (Cobb et al., 2015). This has led to interest in a number of biological and psychological explanations (Bateson et al., 2021; Claassen, Klein, Bratanova, Claes, & Corneille, 2019; Kowaleski-Jones, 2019; Nettle et al., 2017; Nettle et al., 2019).

One avenue of interest has been the role of distress and maladaptive coping mechanisms in the relationship between socio-economic deprivation and obesity (Hemmingsson, 2014, 2018; Spinosa, Christiansen, Dickson, Lorenzetti, & Hardman, 2019). Recently Keenan, Christiansen, and Hardman (2021) found that food insecurity was indirectly associated with BMI via distress and eating to cope. Specifically, instances of food insecurity over the past 12 months were associated with greater distress, which in turn was associated with eating to cope, with eating to cope then associated with elevated BMI. A logical next step in testing this model would be to establish if the same pathways exist under different conditions of food insecurity, such as those relating to a global pandemic where the sources of difficulties accessing food and those impacted might vary. The first wave lockdown of COVID-19 created a unique set of circumstances whereby moderate to severe food insecurity in the UK increased to 16.2% in the first few weeks (Loopstra, 2020), with a 250% increase in May 2020 relative to pre-COVID-19 levels (Food Foundation., 2020). This was largely driven by two factors. Firstly, temporary shortages of certain foods and an

inability to access shops (Loopstra, 2020). Secondly, jobs loses for those in unstable employment (e.g. temporary or zero-hour contacts) or in careers where they could not relocate to working from home (e.g. hairdressers, chefs, constructions workers) meant some people became food insecure for the first time (Connors et al., 2020). Individuals who were already experiencing food insecurity, were living with disabilities, had dependents or were from the Black, African and Minority Ethnic (BAME) community were also disproportionately affected (Loopstra, 2020; Food Foundation, 2020). The pandemic also had a negative impact on mental health, with several large cohort studies reporting an increase in distress during the first few months of the lockdown (O'Connor et al., 2020; Smith et al., 2020). If individuals are increasingly food insecure, or have been made newly food insecure, and are experiencing greater distress, it is plausible that this could result in the increased use of food as a way of coping. Therefore, distress and eating to cope might mediate the association between food insecurity and eating behaviours.

The purpose of the current study was to broadly replicate the model set out in Keenan, Christiansen, and Hardman (2021) but with adjustments to reflect lockdown related food insecurity. Food insecurity formed the main input variable with adjustments made to reflect financial as well as pandemic related reasons for difficulties accessing food (e.g., inability to access shops, lack of food available). Distress and maladaptive coping mechanisms (eating to cope and drinking alcohol to cope) were included as the key mediating variables in this model. These seem especially pertinent given that the pandemic was associated with increases in mental distress (Gray et al., 2020; Panday et al., 2021), increases in emotional eating (McAtamney et al., 2021; Cecchetto et al., 2021) and increased alcohol use (Chodkiewicz, Talarowska, Miniszewska, Nawrocka, & Bilinski, 2020; Jacob et al., 2021; Koopmann, Georgiadou, Kiefer, & Hillemacher, 2020; Rodriguez, Litt, & Stewart, 2020; Stanton et al., 2020). The main deviation from the model outlined in Keenan, Christiansen and Hardman (2021) was the removal of BMI as an outcome variable given that differences in BMI require time to become evident. Instead, changes in weight promoting eating behaviours were included (e.g., consuming larger portions and increased snacking) because if individuals are using food or drinking alcohol as ways of relieving distress, it was reasoned these might manifest in these sorts of eating behaviours. Diet quality was also included because eating and drinking to cope might manifest in changes to the types of food consumed, which is consistent with reports of individuals eating more processed foods and less fruit and vegetables during the lockdown (Murphy et al., 2020; E. Robinson et al., 2021).

The model being tested was that COVID-19 lockdown related food insecurity would be indirectly associated with an increase in weight promoting eating behaviours since the start of the lockdown and a less healthy diet, via the mediating pathway of distress and eating and drinking to cope. Specifically, food insecurity would be associated with distress (emotional and physical stress); greater distress would be associated with eating and drinking to cope; and greater eating and drinking to cope would be associated with increasesin weight promoting eating behaviours and poorer diet.

2. Methods

2.1. Participants

Individuals were recruited online via paid adverts on Facebook targeting 18–80-year-olds living in England. As reimbursement for their time, participants were offered the chance to enter a prize draw to win one of three cash prizes (1 x £100, 1 x £50, 1 x £25). Based on the formula by Kim (2005) it was estimated that 228 participants would be needed for a close-fitting Comparative Fit Index (CFI) of model fit ($df = 24$, $\alpha < .05$, 80% power). We recruited slightly over this number to allow for incomplete responses. Ethical approval for the study was granted by the University of Salford's Health Research Ethics Committee (HSR1920-094). The study ran from the 17th June 2020 to 11th July 2020 (approximately the third and fourth months after the initiation of the first UK COVID19 lockdown)

2.2. Measures

2.2.1. Demographic information: To characterise our sample, participants were asked their age (in years), gender, location in the UK, height and weight, ethnicity (Asian-British, Asian-Other, Black-British, Back-Other, Mixed-Any, White-British, White-Other, other ethnic origin group, I prefer not to answer this question), total household income per year (9–point scale: 1 = < £20,000, 2 = £21,000 - £30,000, 3 = 31,000 - £40,000, 4 = £41,000 -£55,000, 5 = £55,000 - £70,000, 6 = £71,000 - £85,000, 7 = £86,000 - £99,000, 8 = >£100,000, 9 = prefer not to say) and highest level of education (9-point scale: 1= none, 2 = GCSE[1] grade D or

[1] The GCSE programme of education typically runs between ages 14-16 in the United Kingdom

below or equivalent, 3 = GCSE grade C or above or equivalent, 4 = A-level or equivalent, 5 = university degree or equivalent, 6 = postgraduate qualification or equivalent, 7 = Masters or equivalent, 8 = PHD or equivalent, 9 = prefer not to say). Participants were also asked about their employment status (employed full-time, employed part-time, unemployed looking for work, unemployed not looking for work, retired, student, unable to work due to health or disability, stay at home parent / homemaker, maternity leave, voluntary employment, prefer not to say, other). The wording and response options for all questions in the study can be found in supplementary materials 1

2.2.2. COVID-19 related questions: Participants were asked if they previously had, or currently have COVID-19 (Yes diagnosed, I think so, No, Prefer not to say), were self-isolating (Yes, No), or if they had experienced health problems relating to the virus. They also reported if their job or income had been affected by lockdown (Yes, No, Don't know Prefer not to say), who they had been living with (Partner, Children, Parents, Grandparents, Siblings, Friends, Housemates, Other, Prefer not to say), how many were in their household during lockdown, how many of these were children (number selected) and if they were a keyworker (Yes, No, Prefer not to say) (Key worker broadly defined as working in jobs essential to the running of the country which continued as normal). See supplementary material 2 for further definitions of key workers and descriptive statistics for COVID-19 related question responses.

2.2.3. Household Food Insecurity (HHFI): An adapted version of the 10-item United States Department of Agriculture Household Food Security Survey Module was used (USDA, 2012). These questions ask about instances where individuals have struggled to acquire or consume food, for example, by having to skip meals or consume smaller portions than desired. The standard wording of the questions focus on a lack of financial resources to afford foods but for the purposes of measuring pandemic related food insecurity these were adjusted in line with Loopstra (2020) to measure food insecurity arising during lockdown. In each question, this was achieved by replacing the phrase "in the last 12 months…because there wasn't enough money for food" with the words "During the Covid-19 lockdown (started 23rd March 2020)" (see supplementary materials 1 for exact wording). Where individuals indicated any instance of food insecurity, they were then asked if this was due to the

following reasons: (i) they did not have enough money for food; (ii) the shops did not have the food they needed; (iii) they could not go out and did not have any other way to get the food needed; or (iv) other reasons. If they selected other, they then had the option to provide a written answer. As per the standard scoring (USDA, 2012), answers of "often true" "sometimes true", "almost every month", "some months but not every month", and "yes", were coded as 1 and all other responses as zero. The sum of positive scores reflected household food insecurity, with scores ranging from 0 (no food insecurity) to 10 (very high household food insecurity).

2.2.4. Psychological distress: The 21-item self-report Depression, Anxiety, and Stress Scale (DASS) (Henry & Crawford, 2005) was used (Response options: 0 = Never, 1 = Sometimes, 2 = Often, 3 = Almost always). As per the scoring guidelines from Henry & Crawford 2005), scores for each subscale were summed and then multiplied by two. High scores represented greater symptoms (e.g., depression). Macdonald's Omega (ω_T) was used as the reliability coefficient (Revelle & Zinbarg, 2009), with scores for each of the three subscales being: depression ω_T = .95, anxiety ω_T = .92, and stress ω_T = .94.

2.2.5. Physical symptoms of stress: The nine item physical symptoms of stress questions from Keenan, Christiansen and Hardman (2021) were used. These ask individuals to rate how they have been affected by different symptoms of physical stress (e.g., sleep problems, headaches, constant fatigue) over the past month. See supplementary materials 1 for exact wording. Response options ranged from 0-4, with 0 being "not been bothered at all" and 4 "extreme bother". An average was calculated with higher scores indicating greater symptoms of physical stress. For the current data ω_T = .91

2.2.6. Eating to cope: To measure the extent to which individuals used food as a coping mechanism, the five-item subscale of the Palatable Eating Motives Scale was used, which has good internal reliability and validity (Burgess, Turan, Lokken, Morse, & Boggiano, 2014). Participants read the statement "Below is a list of reasons that people sometimes give for eating tasty foods and drinks, such as: [a list of sweet, salty fast foods and sugary drinks provided]. Thinking of the times you ate these kinds of foods/drinks, how often would you

say you ate/drank them for each of the following reasons?" Example reasons included 'to forget your worries' and 'because it helps to lower your stress'. Response options: "Never / Almost Never", "Some of the time", "Half of the time", "Most of the time", "Almost always / Always". As per the scoring instructions, the mean was calculated for all items, with higher scores indicating greater use of food as a coping mechanism. For the current data ω_T = .94.

2.2.7. Drinking to cope: To measure the extent to which individuals used alcohol to cope, the three-item subscale of the abbreviated Drinking Motives Questionnaire was used, which has good reliability and validity (Kuntsche & Kuntsche, 2009). Participants read the statement "Thinking of all the times you consume alcohol, how often would you say that you drink for each of the following reasons?" (e.g. "To forget about your problems?"). Response options: "Never / Almost Never", "Some of the time", "Half of the time", "Most of the time", "Almost always / Always". As per the scoring instructions, the mean was calculated across items, with higher scores indicating greater use alcohol as a coping mechanism. For the current data ω_T = .92

2.2.8. Diet quality: To measure the extent to which individuals consumed a nutritious diet, a validated 20-item food frequency questionnaire was used (S. M. Robinson et al., 2017), which has been shown to positively correlate with nutrient intake and to provide comparable results to a larger 129 item scale (Bingham et al., 1994). Over the previous 3-month period, participants rated on a 10 item scale their average consumption of listed foods per week (1 = Never, 5 = 2-4 per week, 10 = 6+ per day). Scoring involved (i) recoding frequencies as times per week (ii) standardising scores by subtracting the means and dividing by the standard deviations for each food item (iii) multiplying each score by coefficients identified in S. M. Robinson et al (2017), (iv) summing all scores per participant. Higher scores represent a diet that conforms to typical healthy eating recommendations (i.e. more fruit and vegetables and less processed foods). For the current data ω_T = .74

2.2.9. Changes in weight promoting eating behaviours since COVID-19 lockdown: To measure whether individuals had increased or decreased weight promoting eating behaviours, items were adapted from E. Robinson et al., (2021) and included the wording 'How do you

feel the Covid-19 lockdown affected your eating behaviours?'. Participants responded to six questions ('snacked', 'eaten large meals', 'ate fruit and vegetables', 'eaten a healthy and balanced diet', 'dieted/fasted', 'skipped meals') using a 7-point response scale (1= A lot less, 4 = the same, 7 = A lot more). Scores for 'ate fruit and vegetables' and 'eaten a healthy and balanced diet' were reverse scored and then added to the scores for 'snacked' and 'eaten large meals.' A positive sum of these scores represents an increase in weight promoting eating behaviours during lockdown. For the current data $\omega_T = .83$.

2.3. Procedure

The questionnaires were hosted via online surveys (JISC, Bristol) which participants accessed via a web link. After reading an information sheet and providing consent, they completed questions on demographic information, height and body weight and answered questions about their exposure to COVID-19. The following questionnaires were then presented in a fixed order: pandemic-related household food insecurity, eating to cope, drinking to cope, changes in weight promoting eating behaviours since the start of lockdown, food frequency, depression, anxiety and stress scale and symptoms of physical stress. Finally, participants were debriefed and given the option to be entered into the prize draw. Total participation time was roughly 25 minutes.

2.4. Data analyses

A structural equation model was created to test the hypothesis that COVID-19 related household food insecurity would be indirectly associated with changes in weight promoting eating behaviours and poorer diet quality, via distress and maladaptive coping mechanisms (eating to cope and drinking to cope). All modelling was conducted in AMOS version 26 (IBM, New York). A total of 246 participants reached the end of the survey but only 213 provided complete responses on all variables needed to calculate bootstrapped indirect effects. If participants provided missing data for any variables. their data had to be removed. A further two were removed for providing unfeasible food frequency scores (i.e. eating every food type more than seven times per day).

To test model fit, a range of indices were generated. For the standardised root mean residual (SRMR) values under 0.08 were considered indicative of good fit. The root mean square error of approximation (RMSEA) parsimony adjusted measure is reported with values less that than 0.06 considered good fit and values greater than 0.06 but less than 0.08 as acceptable (Hu & Bentler, 1999). The Tucker Lewis index (TLI) and Comparative Fit Index (CFI) were deemed as acceptable above .90 and good above .95 (Hu & Bentler, 1999).

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

To test the hypothesised indirect effects between food insecurity and both changes in weight promoting eating behaviours and diet quality, bias corrected bootstrapping was used with 95% confidence intervals (N = 1,000). For direct effects between variables, beta values are reported in figure 1, and unstandardised regression coefficients in table 3.

Before running the model, the effect of gender on each variable in the model was investigated via independent samples t-tests. Where gender had a statistically significant influence, it was controlled for in the model.

3. Results

3.1. Descriptive statistics

The sample (*N*=211) was mostly female (75.4%) and white (93.4%), and 39.3% were full-time employed, 18.0% were part-time employed, and 42.7% were unemployed, retired, students, in voluntary work, identified as housewives/husbands or selected other; 70.0% reported having achieved an undergraduate degree or higher. In terms of living circumstances, 14.2% lived alone, 40.8% lived with one other adult, 45.0% with two or more adults; 72.0% had no children under the age of 18 in the household, 11.9% lived with one child, and 16.1% with two or more children; 22.7% had an annual household income of less than £20,000 per annum, 19.4% between £21,000 and £30,000, 28.6% between £31,000 and £55,000 and 18.4% over £55,000 per annum, with 10.9% preferring not to answer. Mean BMI (± SD) was 28.18 (± 6.46) kg/m^2 with 1.0% of the sample being underweight, 36.9% of healthy weight, 31.3% with overweight and 30.8 % with obesity. Those variables which could be described in terms of means and standard deviations are included in Table 1.

Table 1. Sample descriptives and questionnaire scores (N = 211)

	Mean	Standard deviation	Range of scores
Household food insecurity [a]	1.74	1.91	0 to 9
DASS – Depression [a]	28.68	11.72	14 to 56
DASS – Anxiety [a]	23.13	9.73	14 to 54
DASS – Stress [a]	29.32	10.93	14 to 56
Physical stress symptoms [a]	2.34	.91	1 to 5
Eating to cope [a]	2.13	1.04	1 to 5
Drinking to cope [a]	1.80	1.03	1 to 5
Diet quality [b]	.95	.75	-.56 to 2.92
Weight promoting eating behaviours during lockdown [c]	17.58	4.17	4 to 28
BMI kg/m^2	28.18	6.46	17.8 to 62.3
Age (y)	46.92	15.47	18 to 80

Note. BMI = Body Mass Index, DASS = Depression Anxiety Stress Scale.

[a] A high score represents greater symptoms e.g., of food insecurity, psychological and physiological stress

[b] High scores represents a diet that is typically considered healthier i.e. more fruit and vegetables and less processed foods

c A high score represents an increase in weight promoting eating behaviours during lockdown

3.2. Instances of food insecurity.

Of the instances of food insecurity reported, the most cited reason was the shops not having the necessary foods available. See table 2 for more details

Table 2: The reasons provided for experiencing COVID-19 related food insecurity

Reason	Number of responses	As a % of all responses
Did not have enough money for food	38	10.9
Shops did not have the food needed	183	52.6
Could not go out and did not have any other way to get the food needed	91	26.1
Other (not listed above)	36	10.4
Total	348	100.0

3.3. Latent variable for distress

Two separate measurements of distress were taken; (i.) physical symptoms, and (ii.) psychological symptoms using the Depression, Anxiety and Stress (DASS) scale (Henry & Crawford, 2005). A confirmatory factor analysis (CFA) was performed which showed that each measurement had a highly significant loading onto the latent variable 'distress' (β>.81,

p<.001). The overall fit of the model was good for the fit indices barring the RMSEA (CFI = .99, TLI = .96, RMSEA = .136, SRMR =.019), although it is notable that with low degrees of freedom (df = 2 for the current latent variable), RMSEA often falsely rejects a well fitted model (Kenny, Kaniskan, & McCoach, 2014).

3.4. Model evaluation

The final model with covariances included was an acceptable to good fit for the data (CFI = .950, TLI = .907, SRMR = .046, RMSEA = .093). A covariance was added between the error terms for drinking to cope and eating to cope, between the error terms for diet quality and changes in weight promoting eating behaviours during lockdown and between gender and household food insecurity. Covariances were added based on modification indices (all >8.12) and between exogenous variables (i.e. food insecurity and gender).

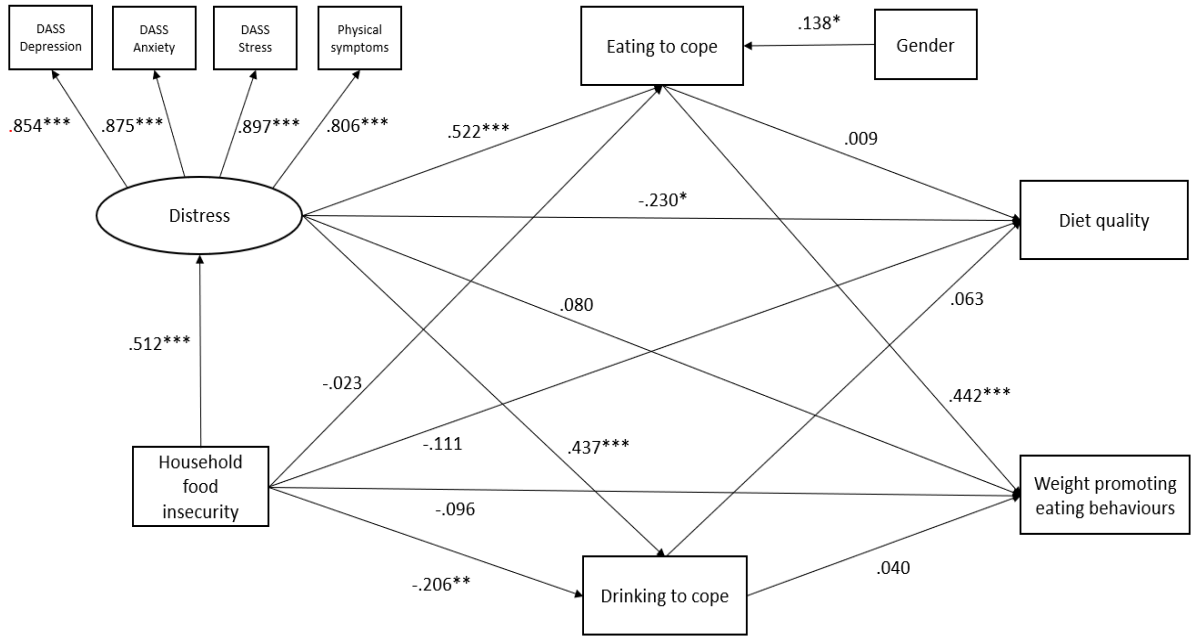

Figure 1: Associations between COVID-19 related food-insecurity, changes in weight promoting eating behaviours and diet quality via symptoms of a distress, and both eating and drinking to cope. Values are standardised regression coefficients * p <.05, ** p<.01, ***p<.001. For ease of interpretation, residuals and covariances are not visually represented. DASS = depression, anxiety, and stress scale.

3.5. Food insecurity and weight promoting eating behaviours.

It was hypothesised that household food insecurity would be associated with increases in weight promoting eating behaviours via distress and maladaptive coping strategies (eating to cope and drinking to cope). Consistent with this prediction, food insecurity was not directly associated with changes in weight promoting eating behaviours (see table 3 for direct associations) but there was a significant indirect effect of food insecurity on weight promoting eating behaviours via distress and eating to cope (see table 4 for hypothesised indirect effects). Food insecurity was directly associated with greater distress; distress was associated with increased eating to cope; and eating to cope associated with more weight promoting eating behaviours.

The indirect pathway between food insecurity and weight promoting eating behaviours via distress and drinking to cope was not significant, due to the absence of a direct effect of drinking to cope on changes in weight promoting eating behaviours.

3.6. Food insecurity and diet quality

It was also hypothesised that household food insecurity would be associated with diet quality via symptoms of distress and maladaptive coping strategies (eating to cope and drinking to cope). There was no significant direct association between food insecurity and diet quality and the two indirect pathways between food insecurity and diet quality via distress and either eating to cope or drinking to cope were also non-significant.

As is evident from table 3, food insecurity was directly associated with elevated distress, which in turn was associated with increased eating to cope, drinking to cope and poorer diet quality. However, neither eating to cope nor drinking to cope were directly associated with diet quality, indicating that the pathway between food insecurity and diet quality did not involve either coping strategy.

Table 3. Direct associations between variables (unstandardised regression coefficients)

Association	b (SE)	p	95%CI
FI → distress	2.69 (.35)	.002	2.05 to 3.27
FI → eating to cope	-.01 (.04)	.798	-.09 to .07

FI → drinking to cope	-.11 (.04)	.019	-.20 to -.03
FI → weight promoting eating behaviours	-.21 (.16)	.245	-.51 to .10
FI → diet quality	-.04 (.01)	.162	-.09 to .01
Distress → eating to cope	.05 (.01)	.003	.04 to .07
Distress → drinking to cope	.04 (.01)	.003	.03 to .06
Distress → weight promoting eating behaviours	.03 (.04)	.479	-.05 to .10
Distress → diet quality	-.02 (.01)	.023	-.03 to -.01
Eating to cope → weight promoting eating behaviours	1.77 (.30)	.002	1.23 to 2.34
Eating to cope → diet quality	.01 (.06)	.930	-.11 to .11
Drinking to cope → weight promoting eating behaviours	.16 (.27)	.666	-.38 to .66
Drinking to cope → diet quality	.05 (.05)	.306	-.04 to .13
Gender [a] → eating to cope	.30 (.12)	.002	.11 to .50

[a] Males (0), females (1)

Table 4. Hypothesised indirect effects

Association	**b (SE)**	**p**	**95% CI**
FI → distress → eating to cope → weight promoting eating behaviours	.26 (.08)	.001	.13 to .45
FI → distress → eating to cope → diet quality	<.01 (.01)	.976	-.02 to .02
FI → distress → drinking to cope → weight promoting eating behaviours	.02 (.04)	.571	-.06 to .12
FI → distress → drinking to cope → diet quality	.01 (.01)	.244	-.01 to .02

4. Discussion

The current study sought to establish how pandemic-related food insecurity might be associated with self-reported changes in eating behaviours that promote weight gain (e.g. consuming larger portions, increased snacking) and poorer diet quality, via the mediating pathway of distress and maladaptive coping strategies (eating and drinking to cope). As predicted, an indirect association existed between food insecurity and eating behaviours, through distress and eating to cope. As such, greater food insecurity was associated with more distress; distress associated with increased eating to cope and eating to cope with more weight promoting eating behaviours. The pathway between food insecurity and diet quality was slightly different with food insecurity associated with increased distress and distress then associated with a less healthy diet, without the presence of eating or drinking to cope.

Levels of food insecurity rose across many nations during the COVID-19 pandemic of spring 2020 (Gaitan-Rossi, Vilar-Compte, Teruel, & Perez-Escamilla, 2021; Kent et al., 2020; Lauren et al., 2021; Loopstra, 2020). This is of concern because of the reliable associations between food insecurity, poor diet (e.g., Leung, Epel, Ritchie, Crawford, & Laraia, 2014) and obesity (e.g., Franklin et al., 2012; Nettle et al., 2017), with higher body weight also a known risk factor for more serious COVID-19 illness (Malik et al., 2021; Yang, Hu, & Zhu, 2021). Understanding the nature of these associations and the underpinning mechanisms is therefore critical to inform prevention and develop treatments. To this end, the current study sought to establish whether the model set out by Spinosa et al (2019) and Keenan, Christiansen and Hardman (2021) would apply under different conditions of food insecurity. If distress and maladaptive coping strategies mediated the relationship between pandemic related food insecurity and eating behaviour, this would suggest a generalised mechanism by which difficulties accessing and securing food might influence food intake, and ultimately obesity. In the current study participants were asked to reflect on their experiences since the start of the first UK lockdown (approximately three months after the first lockdown). The main sources of food insecurity related to a lack of food being available in the shops (52.6%) and individuals not being able to visit food stores (26.1%). These statistics are comparable to Loopstra (2020) who similarly found that a lack of foods available in the shops (39%) and individuals not being able to visit food stores (16%) were the main sources of food insecurity at the beginning of the first UK wide lockdown. Critically, only 10.9% of instances of food insecurity in the current study were due to a lack of financial resources, suggesting that the current study is not capturing the same instances of

food insecurity observed prior to the COVID19 pandemic. The findings from the current study combined with Keenan, Christiansen and Hardman (2021) suggest that under different conditions of food insecurity (chronic food insecurity in Keenan, Christiansen & Hardman, 2021 and acute pandemic-related food insecurity in the current study), some individuals will experience distress and use food as a way of coping. This in turn might lead to an increase in weight promoting eating behaviours and weight gain.

A second motivation for running the current study was to further investigate *how* eating to cope in response to the distress of being food insecure might be associated with eating behaviour. In Keenan, Christiansen and Hardman (2021), eating to cope was associated with BMI but not diet quality. It was reasoned that this could be due to eating as a coping mechanism manifesting in changes to behaviours known to lead to weight gain (e.g. consuming larger portions, increased snacking; Bellisle, 2014; Rolls, Morris, & Roe, 2002) rather than changes in diet quality. This would be consistent with research showing that behaviours such as consuming larger portions can be affected by food insecurity (Nettle et al., 2019) and feeling socially deprived (Sim et al., 2018). Over time, these behaviours would be likely to lead to weight gain. The current study appears to support this suggestion with eating to cope associated with increases in self-reported weight promoting eating behaviours but not diet quality.

In contrast to eating to cope, drinking to cope was not associated with either of the two outcome variables (diet quality or weight promoting eating behaviours during lockdown). Whilst alcohol consumption has been shown to influence eating behaviours (Laitinen, Ek, & Sovio, 2002) and the first COVID-19 lockdown may have seen increases in alcohol consumption (Chodkiewicz et al., 2020; Jacob et al., 2021; Koopmann et al., 2020; Rodriguez et al., 2020; Stanton et al., 2020), it did not appear that distress caused by pandemic related food insecurity influenced what people ate as a result of alcohol intake.

Our findings have practical implications for interventions and policy agendas for future pandemics. Data from the current study suggest that even temporary disruption to the food supply chain is likely to be associated with distress and maladaptive coping. Maintaining open channels of food supply will likely be important in minimising the negative health implications of individuals using food and alcohol as coping mechanisms. This is of particular relevance to countries which rely on just-in-time supply chains, who import a large quantity of food produce and are vulnerable to the challenges of panic buying and

stockpiling, as was widely reported during the COVID19 pandemic (Power, Doherty, Pybus, & Pickett, 2020; Torero, 2020). Alternatively, where disruptions are inevitable, providing ways of helping individuals overcome their distress might have positive consequences for short- and long-term health outcomes. This could be by way of stress reduction (Manzoni et al., 2009), mindfulness training (Katterman, Kleinman, Hood, Nackers, & Corsica, 2014), or intuitive eating interventions (Burnette, Davies, & Mazzeo, 2021), which have all been shown to be effective counter measure to emotional eating. Identifying ways to supplant emotional maladaptive coping in childhood is also likely to be of particular benefit.

4.1. Strengths, limitations and future research

A strength of the current study is that the sample were relatively affluent, indicating that a different population was tested relative to previous work looking at the effects of distress and eating to cope on eating behaviour in chronically food insecure populations (e.g. Keenan, Christiansen & Hardman, 2021) but with similar pathways observed. In terms of limitations, participants were based in England ,so these results might not generalise to all countries. While gender was controlled for in the model, the sample was largely female (75.4%) and white (93.4%), meaning it was not possible to fully test the gender or race differences observed in other studies (e.g., Hernandez, Reesor, & Murillo, 2017; Nettle et al., 2017; Townsend, Peerson, Love, Achterberg, & Murphy, 2001). Data in the current study are also correlational and cross-sectional, so it was not possible to infer causality, although the pathways observed are consistent with theoretical models and other empirical studies (Hemmingsson, 2014; Keenan, Christiansen & Hardman, 2021; Spinosa et al., 2019). The data were retrospective and collected across June and July 2020, which was during the pandemic but after the initial restrictions began on the 23rd March 2020. It is therefore possible that some individuals may have forgotten or overemphasised their experiences of food insecurity. With participants recruited online, this means that individuals who do not own a computer or mobile phone might be underrepresented.

The associations between variables in this model were relatively modest and other factors such as changes in metabolic rate and physical inactivity may also be important (Kowaleski-Jones, 2019). Such variables were not considered in the current study and future research which explores pathways involving these variables would be useful. Future research may wish to investigate the impact of food insecurity on individuals with different living

circumstances. Having pre-existing health problems, difficulties accessing shops, or be responsible for multiple children might be particularly stressful and be more likely to push people to maladaptive coping mechanisms.

4.2. Conclusion

The current study found that COVID-19 lockdown related food insecurity is associated with increases in weight promoting eating behaviours, which are explained by distress and eating to cope. Interventions seeking to reduce unhealthy eating in response to food insecurity might benefit from targeting sources of perceived stress and subsequent coping mechanisms.

Author contributions

GSK and CAH developed the study. GSK collected the data and PC contributed to data analysis. GSK wrote the manuscript with the input of CAH, PC and LJO. All authors have reviewed and approved the final article.

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Availability of data and materials

Available upon request

Ethical approval and consent to participate

This research was approved by the University of Salford's Research Ethics Committee (HSR1920-094).

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