The Bare Necessities:
Adolescent Food Insecurity and Disordered Eating

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Thesis declaration form

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Date: 15.06.23

Overview

This is a thesis to investigate the link between food insecurity and eating pathology in adolescents. Part one is a systematic review. This review examines literature worldwide and

summarises relevant research papers. The review breaks the research down into individual pathologies and then into meeting criteria for a diagnosis. Methodological limitations of the research are discussed.

Part two of this thesis is an original investigation into this link between food insecurity and eating disorder pathology in adolescents in UK. The research is a mixed methods study. Data was collected by means of an online survey. Results are in line with research from the US, and the first of this kind in the UK indicating that UK adolescents are at significant risk of eating pathologies. Qualitative data indicates that these changes may be long-lasting.

The third section is a critical appraisal of both the systematic literature review and the original empirical research paper. This part provides a more significant insight into the context of the research.

Impact Statement

Food insecurity has serious negative consequences that manifest in many ways including contributing to mental and physical ill-health. Food insecurity in the UK is rising at an alarming rate and there are a number of factors contributing to this including the after-effects of the COVID-19 pandemic, as well as UK's rising cost of living. Similarly, eating disorder

admissions for adolescents are also on the rise in the UK. Understanding the potential relationship between the two is important in order to better address both food insecurity and eating disorder prevention and treatment. Adolescence has historically been less researched: this is surprising considering it is the primary period for eating disorders to start. We also know that adolescents are more affected by food insecurity compared to their younger siblings.

A systematic review of the literature on food insecure adolescents and disordered eating behaviours was used to provide an overview of the evidence. To the authors knowledge, this is the first systematic review looking at the relationship between food insecurity and eating pathologies in adolescents. Taken together, the literature suggests that adolescents may be at a particular risk of eating pathologies, with binge eating being the pathology with the most evidence. Considerable methodological issues have been highlighted, such as measures for both food insecurity and eating pathology. As well as measurement, issues in sampling have also been uncovered, such as the lack of research being conducted outside of the US.

Addressing this gap in the literature, this empirical paper for the first time indicates that food insecure adolescents in the UK are at a significant risk of disordered eating behaviours and are more likely to be clinically impaired due to these behaviours. This original study highlights this group as a particular concern for both the policy makers and for the National Health Services in the UK.

Key recommendations from this paper are firstly, identifying and validating a universal measure of food insecurity for adolescents. Furthermore, clinicians should consistently ensure that they are considering food insecurity in their assessment, formulation, and treatment in eating disorder services. Moreover, learning can be shared with schools and food banks on how to best support this group and identify potential early warning signs for both food insecurity and disordered eating, leading to early intervention. Policy makers should consider the temporal availability of any food provision offered for this group, to ensure that the

symptomology is not exacerbated with a “feast-or-famine” cycle. This thesis attempts to draw attention to a previously neglected area of research, for an at-risk population.

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Part 1: Literature Review

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Part 1: Literature Review

The relationship between Food Insecurity and

Eating Pathology in Adolescents:

A Review of the Literature

Abstract

In the past decade, the relationship between food insecurity and mental health has started to emerge in the food insecurity literature. Specifically, evidence has suggested a relationship with disordered eating. However, this evidence is sparse for adolescence, and almost non-existent outside of the United States. This paper aims to review the available

evidence for the relationship between food insecurity and eating pathology in adolescents. Worldwide, 15 studies met criteria for this review, all of which were quantitative. The findings were collated and synthesized based on different eating pathologies: Binge eating/loss of control eating; weight and/or shape related dietary restriction; weight controlling behaviours; other disordered eating behaviours; body image and weight concerns; and clinically significant eating disorders. Fifteen studies conducted between 2017 and 2023 from two countries, primarily the United States, explored the connection between disordered eating behaviors and food insecurity. Various measurement tools were used, sample sizes ranged from 55 to 14,768, and age means ranged from 13 to 22. Most studies were cross-sectional (n=13), with a few longitudinal (n=3). The studies found associations between food insecurity and binge eating, compensatory fasting, unhealthy weight control behaviors, body image concerns, and clinically significant eating disorders. However, there were variations in results across studies. In conclusion, these research studies indicate a link between certain disordered eating behaviors and food insecurity, particularly in the case of binge eating disorder. However, comparing these studies is challenging due to variations in measurement tools and lack of validation of these tools, food insecurity levels within samples, limited research outside of the USA, and a shortage of longitudinal studies. Further research is warranted.

1.0 Introduction

Food insecurity (FI) is characterized by a lack of economic, social, and physical resources which restricts one's ability to have a "sufficient supply of nutritionally appropriate food" (Purdam et al., 2016, p. 1073). This incorporates situations where people are forced to seek food security in socially unacceptable ways (Coleman-Jensen et al., 2018). Those living in FI households will often depend on low-cost foods and food with low nutritional value or

"adjust their intake by reducing portions, skipping meals, or by going hungry" (Dush, 2020, p. 327). Household food security exists on a spectrum from high food security to very low food security (Coleman-Jensen et al., 2018).

Research has identified several negative consequences of FI in adults but does not yet provide an adequate picture of all members of a household. For adults experiencing FI this is frequently associated with health problems, such as, type II diabetes, hypertension, depression, and anxiety (Abdurahman et al., 2019; Arenas et al., 2019; Jones, 2017). Despite most research on the impact of living with FI being conducted on adults, 7.1% of all households with children in the United States experienced FI for both the parents and the children in 2018 (Coleman-Jensen et al., 2018). This is only around half of the 14% of all households that were reported FI at the same time, suggesting that the adults in the household try to protect their children from the impact of FI (Coleman-Jensen et al., 2018). However, research also suggests that these protective factors are mainly focused on younger children, and that older children and adolescents are more likely to experience FI than younger children in the same households (Coleman-Jensen et al., 2014). Adolescents are often overlooked in FI research compared to both younger children and adults, despite the literature suggesting that they are at particular risk (Dush, 2020).

The limited research on the impact of FI on adolescents is overwhelmingly negative in terms of health outcomes, clearly indicating a need for more research (Dush, 2020). Research suggests poorer overall health outcomes for adolescents living in FI (Coleman-Jensen et al., 2014), specifically: asthma (Kirkpatrick et al., 2010), increased rated of hospital admissions (Banach, 2016), anemia and lower bone mass amongst male adolescents (Eicher-Miller et al., 2009). Further evidence has also shown the negative impacts of FI specifically on adolescents living with type I diabetes (Mendoza et al., 2018). Alongside poorer physical health outcomes, a considerable amount of evidence has suggested that FI has negative impacts on mental health

for adolescents, but again, the literature is much more sparse than for the adult equivalent. Findings suggest adolescents are more vulnerable to both depression and suicidal ideation when they are living with FI (McIntyre et al., 2013).

There is a recognized link between FI and various eating pathologies. In 1996 Kendall and colleagues were the first to find a link between FI and increased eating pathology (Kendall et al., 1996), but research has only started to build in recent years. A 2020 review of available literature confirmed a consensus that FI is linked to eating pathology (Hazzard et al., 2020). However, the majority of these studies targeted adult populations, with a gap in the literature for adolescents. Research has started to fill this gap in recent years and with the peak age of onset for eating disorders being in adolescence (de Girolamo et al., 2018; Marzilli et al., 2018; Volpe et al., 2016), and with adolescents more likely to experience the consequences of FI than their younger siblings (Bauer et al., 2015; Fram et al., 2011), it is essential to understand the relationship between adolescents living with FI and eating pathology.

Numerous theories explain the link between food insecurity (FI) and eating behaviours, including the "feast-or-famine" cycle. FI often follows this pattern, where food availability fluctuates due to factors like monthly or weekly wages (Dinour et al., 2007). Universal benefit systems that disburse payments monthly can exacerbate this cycle (Dinour et al., 2007; Wilde & Ranney, 2000).

Research indicates that food restriction, intentional or not, triggers various cognitive, emotional, and behavioural consequences, such as increased food preoccupation, reactivity, and a propensity for binge eating once food becomes available (Polivy, 1996). The Minnesota Starvation Experiment by Keys et al. (1950) demonstrated similar patterns, with participants in the semi-starvation phase developing intense food preoccupation and those in the rehabilitation phase exhibiting binge-eating behaviours.

Qualitative studies with low-income samples also revealed restriction and binge-eating patterns mirroring the feast-or-famine cycle (Bove & Olson, 2006; Olson et al., 2007; Tester et al., 2016).

Alternatively, the "feast" phase alone can lead to disordered eating behaviours (Christensen et al., 2021). In FI, cycles of food deprivation followed by abundant food availability resemble patterns seen in dieters. Binging during the "feast" phase can prompt compensatory dieting to prevent weight gain or shape change (Stinson et al., 2018; West et al., 2019). This cycle has been observed in cultures valuing slenderness (Steiger & Bruce, 2007; Stein et al., 2007), increasing the risk of eating disorders among those with FI.

Another theory links FI to mental health through stress responses. Uncertainty about food availability triggers intense stress reactions, potentially impacting mental health (Weinreb et al., 2002). Stress in parents of food-insecure households could affect their parenting practices and, subsequently, their children's mental health (Alaimo et al., 2001). Parents from FI homes are more likely to employ restrictive feeding practices, which predict binge eating in children (Puhl & Schwartz, 2003).

Despite evidence of the association between FI and eating pathology, limited research has focused on adolescents, who appear to be at risk (Bauer et al., 2015; Fram et al., 2011). The "skinny, white, affluent girls" ("SWAG") stereotype in eating disorder research and treatment has contributed to this gap (Sonneville & Lipson, 2018). Research and assessment tools have often been validated on this sample (Cooper et al., 1989; Fairburn & Beglin, 1994), neglecting other populations like FI individuals who may have different motivations for dietary restriction, such as ensuring family members are fed (Middlemass et al., 2021). This overlooked aspect is crucial for understanding the parallel in restriction between ED research and FI populations, especially when using unvalidated ED measures on FI individuals.

FI interacts with multiple areas of life: geography, economy, biology and social (Dush, 2020), which can make it complicated to determine causal pathways. It is now commonly understood that it is not as simple as suggesting that altered nutrition causes health outcomes. A bigger contextual picture of adolescents with FI is needed therefore urgently and a step towards this is hearing from adolescents in the research (Fram et al., 2013; Willis & Fitzpatrick, 2016).

1.1 Aims of the review

This review aims to address the following question: "Are food insecure adolescents more likely to experience disordered eating and/or meet criteria for an eating disorder?". Even with an increase in recent literature on the impact of FI and the increasing levels of FI worldwide, there has not yet been a literature review on the relationship between FI and eating pathology in adolescents. This systematic review will be performed in accordance with international standards for conducting and reporting systematic reviews, using guidelines from the Cochrane Collaboration (Higgins et al, 2019).

2.0 Methods

2.1 Review and Search Strategy

This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement (Moher et al., 2009). Searches were performed using PsychINFO, MEDLINE and Web of Science from inception to 12th November 2022.

The search terms were: (Adolescents OR adolescent OR adolescence OR younger adults OR teenage OR Teen OR Youth OR youths OR Young adult OR student OR high school OR university) AND (eating pathology OR eating disorder OR eating behaviour OR eating OR anorexia OR bulimia OR binge OR restriction OR diet OR purge OR restriction OR obese OR emotional eating OR body dissatisfaction) AND (food poverty OR hunger OR food insecurity OR Food Insecurities OR Food Security OR low income OR household food insecurity OR poverty). By using *, these terms covered variations of each word in terms of spelling, combination, and spellings (For an example search strategy, please see Appendix A).

2.2 Study Selection and Data Extraction

Database searches were carried out and studies were identified for inclusion and exclusion. Figure 1 shows the PRISMA flow diagram of studies identified (Moher et al., 2009). The searches yielded a combined sample of 6,535 manuscripts (566 PsychINFO publications, 1119 MEDLINE publications and 4,850 Web of Science publications). Titles and abstracts were initially screened, with full texts determining eligibility. Duplicates and those not meeting the pre-determined inclusion criteria were removed. A manual reference search was then carried out by reviewing the reference lists of the eligible manuscripts. In total, when combining all searches and removing those not applicable, 15 papers were found to be appropriate for the review (Table 1).

2.3 Eligibility Criteria

2.3.1 Inclusion Criteria

The inclusion criteria were pre-determined: 1) only empirical studies including a majority adolescent sample, 2) either qualitative or quantitative design, 3) only published, peer-reviewed journals, 4) studies with a comparison sample. For this analysis, 10-24 years old will be considered ‘adolescents’ based on an updated broader definition of adolescence which is

more developmentally appropriate and incorporates the changing trends in our societies (Sawyer et al., 2018). Lifespan development markers change as society shifts over time and this affects when children transition to adulthood including leaving education and home etc. To keep information and research on adolescence current, age markers should adapt to reflect these changes (Sawyer et al., 2018). Furthermore, this large age range inclusion was chosen to represent 'older children' as research suggests that older children are twice as likely to experience FI than younger children (Fram et al., 2011).

2.3.2 Exclusion Criteria

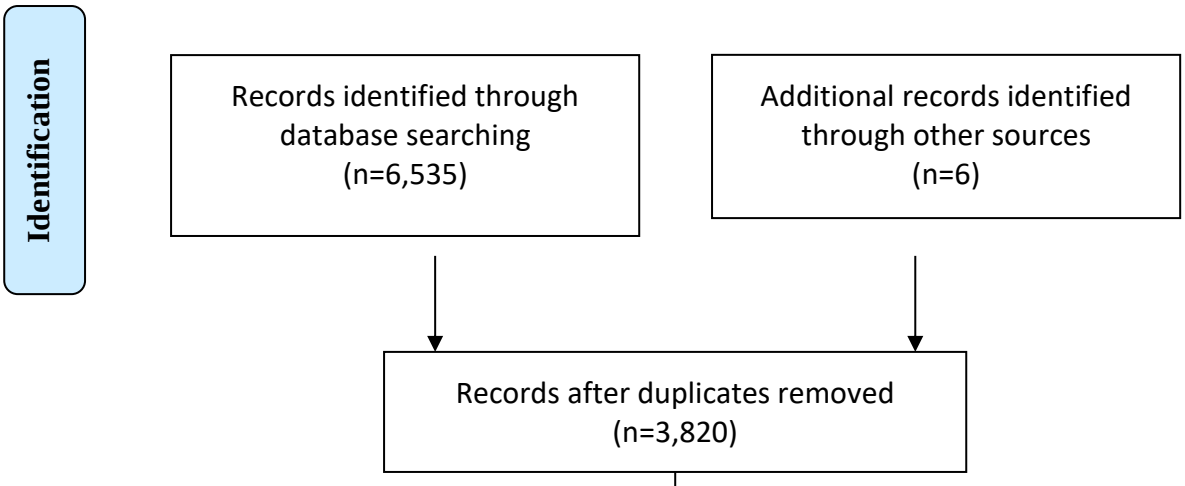
Narrative reviews or secondary systematic reviews were excluded from the analysis as well as any studies where English versions were not available.

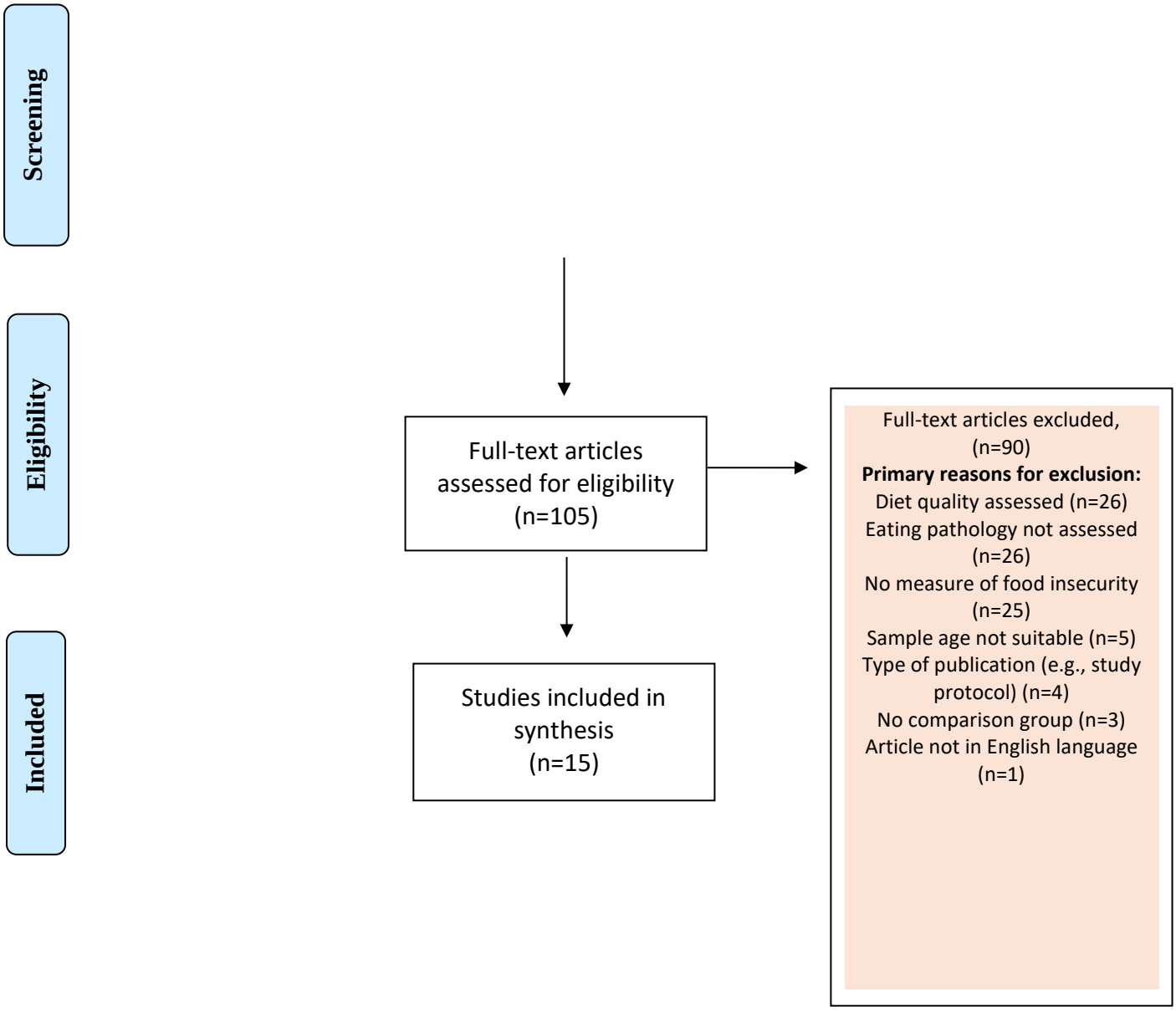
2.4 Data extraction and study quality assessment

In light of the potential diverse and heterogeneous nature of measures employed across the selected studies, this study will employ a narrative synthesis as the preferred method for data synthesis (Popay et al, 2006). The following data was extracted from the suitable studies: authors, date, country, study design, sample characteristics, outcome measures and summary of results. Study quality and risk bias based on methodology was assessed using the Standard Quality Assessment Criteria for Evaluating Primary Research Papers from a Variety of Fields checklist (Kmet et al., 2004). The studies were rated out of a possible 22. Each study that met criteria was rated as per the guidelines. There was no exclusion based on study rating, but when included, studies of poor quality were noted in the text. Results are shown in Appendix B.

Figure 1

PRISMA flow diagram of literature search (Page et al, 2021)




Screening
Eligibility
Included
Full-text articles assessed for eligibility (n=105)
Full-text articles excluded, (n=90)
Primary reasons for exclusion:
Diet quality assessed (n=26)
Eating pathology not assessed (n=26)
No measure of food insecurity (n=25)
Sample age not suitable (n=5)
Type of publication (e.g., study protocol) (n=4)
No comparison group (n=3)
Article not in English language (n=1)
Studies included in synthesis (n=15)

3.0 Results

Based on our criteria, 15 studies published between 2017 and 2023 were identified. From these studies, samples were from 2 countries (see table 1). The majority of the studies were from the United States (14 studies) and one study was from Spain (Shankar-Krishnan et al., 2021). Four of the studies (Hazzard et al., 2022; Hooper et al., 2020, 2022; West et al., 2019) were from the same cohort in Minnesota, US (Project EAT, EAT 2010 and Project F-EAT). Ratings on the quality of each study can be found in Appendix B. Ratings have been based on the Standard Quality Assessment Criteria for Evaluating Primary Research Papers from a Variety of Fields checklist (Kmet et al., 2004). The quality scores of the studies varied from 13 to 22. The majority of the studies (n=13) had a cross-sectional design, followed by longitudinal (n=3). Sample sizes ranged from 55-14,768. Age means ranged from 13-22. Christensen and colleagues' study (Christensen et al., 2021) was one of our studies selected where the actual age range was higher than the age of adolescents (18-78). However, the mean age was 21.75, with 70% of respondents being under 24, hence we have included the study in our sample.

3.1 Assessment of food insecurity and disordered eating

FI was operationalised in several different ways. The most frequently used measure used in different adaptations was the U.S Household Food Security Module (n=12; Bickle et al. 2000). Other measures used once each were: Radimer/Cornell (Radimer et al., 1990), Hunger Vital Sign (Hager et al., 2010) and the Spanish Child Food Security Survey (Shankar-Krishnan et al., 2018) . Parents reported the food security status on behalf of the adolescent in 4 of the studies (Hooper et al, 2020; Hooper et al, 2022; West et al, 2019; West et al, 2021) whilst adolescents reported directly in the remainder. FI ranged from 8.9% to 58% (when grouping marginal FI, low FI and very low FI if presented that way in the study).

The results have been collated and synthesized based on different eating pathologies. With different studies using different terms to define pathologies (e.g., restriction, compensatory fasting) we have attempted to arrange them into logical groupings.

3.2 Binge Eating / loss of control eating

Ten of the fifteen studies (Barry et.al, 2021; Bruening et al., 2017; Christensen et al., 2021; Hazzard et al., 2022; Hooper et al., 2022; Hooper et al., 2020; Linsenmeyer et al., 2021; Kim et al., 2021; Poll et al., 2020; West et al., 2021; West., 2019) included in this review looked at the association between binge eating and food security status. Some studies divided binge eating into objective and subjective binge eating. Some studies looked at "loss of control" eating as a construct of binge eating, which is assumed in all binge-eating (American Psychiatric Association, 2022). This was done due to the complexity in collecting accurate data for objective binge eating as well as the lack of evidence connecting the implications of the amount eaten and consequential effects (Shomaker et al., 2010). Therefore, it is felt that the sense of having "loss of control" is the essential component.

Looking specifically at the loss of control in eating for adolescents with FI, West and colleagues (2021) conducted a small (n= 60), cross-sectional study on a community sample of 12–17-year-olds. They used the Core Food Security Module (Bickle et al., 2000), a parental assessment of food security status and self-report measures for eating pathology. Using the EDE-Q (Fairburn et al., 1993) to measure loss of control eating, they found that adolescents living with higher household food-insecurity were more likely to report loss of control eating ($b = 0.662$, $t(59) = 5.09$, $p < .01$), after controlling for BMI, race, ethnicity, biological sex and age. They also found that when the ratio of income-to-needs was lower in households, there was an increased instance of loss of control eating in adolescents with higher levels of FI

($\Delta F(1,56) = 11.99$, $p < .01$). However, both loss of control eating and FI were non-normally distributed meaning outliers may have been driving these results.

Table 1

A list of all papers included in the systematic review

Study and Country	Design	(*n*)	Sample Characteristics (Mean age (SD), gender %, food insecurity %)	ED Measure	FI Measure	Quality Rating	Main findings
Barry, Sonneville and Leung (2021); US	C	804	Age median: 21.6 F: 50.4% M: 49.6% 47.8%= High food security 17.1%= marginal food security 16.3%= low food security 18.8%= very low food security	5-item Sick, Control, One stone, Fat, Food (SCOFF)	10-item US Adult Food Security Survey Module (past 12 month)	19	Positive SCOFF screens for marginal, low and very low food security when compared to high food security. This analysis was modified by sex but not by race/ethnicity.
Bruening, Lucio and Brennhofer (2017); US	C	55 dyads	Mean age: 14.6 (2.3) F: 43.6% FI= mothers 64.5% and adolescents 43.6% Very Low FI= parents 34.5% and adolescents 14.5%	Mindful Eating Questionnaire One question on binge eating: "In the past year, have you ever eaten so much food in a short period of time that you would be embarrassed if others saw you (binge eating)?"	6-item Food Security Survey Module modified for self-administration (Completed by both parent and child)	15	Adolescents more likely to binge eat than parent dyad. Race/ethnicity demographics were not collected or considered in the analysis.
Christensen, K. A., et al. (2021); US	C	578	Age mean: 21.8 Age range 18-78	The Clinical Impairment Assessment (CIA)	Radimer/Cornell	20	Students living with FI reported higher levels of objective binge

			52% food insecure				eating, compensatory fasting and ED related imparments at a significan level, when compared to those living without FI. Similarly, there were higher levels of ED diagnoses in the FI group There were no differences before of during the beginning of the pandemic. Differences were found between races, with black people more likely to experience food insecurity, and between ethnicities with Hispanic people also more likely to experience FI. These variable were not included in the analysis with eating behaviours.
El Zein, Shelnutt, Colby, et al. 2019; US	C	855	34.6% were 18-years-old 65.4% were 19-years-old Age range 18-19 F: 68.8 % M: 31.2% 12% low food security 7% very low security	Eating Attitudes Test-26	U.S. Department of Agriculture Adult Food Security Survey Module	22	Food-insecurity was more common among racial minority students, those living off-campus, Pell grant recipients, those with parents having a high school education or less, and non-meal plan participants.

							Logistic regression models, adjusted for demographics and meal plan enrollment, showed that food-insecure students had higher odds of poor sleep quality, high stress, disordered eating behaviors, and a GPA below 3.0 compared to food-secure students.
Frank, M. L., et al. (2021); US	C	232	Age mean: 19.90 (2.45) Age range F: 82.3 % M: X% 22% low food security 15.5%= very low food security	Emotional eating scale	U.S Household food security survey module	19	Food insecurity was positively associated with emotional eating controlling for body mass index. This was stronger in males. Race was collected but not reported in the analysis.
Hazzard, V. M., et al. (2022); US	C & L	1,813	EAT-I: 14.9 EAT-II: 19.5 EAT-I: 11–18 EAT-II: 16–23 F: 57.1 % M: 42.9 % Past-year severe FI was reported by 8.9% of the sample at EAT-I and 20.9% of the sample at EAT-II	Selected questions from several self-report measures	One item from the U.S. Household Food Security Survey Module	19	Cross-sectionally, severe FI associated with various disordered eating behaviors, strongest for extreme weight-control and binge eating. Longitudinally, severe FI predicted later binge eating, indicating a lasting link. Results are not broken down explicitly by ethnicity/race but

							adjustments were made using this variable.
Hooper, Mason, Telke, Larson, & Neumark-Sztainer, 2022; US	L	1340	Mean age: Baseline: 14.5 Follow-up: 22.0 F: 53.0 % M: 46.3 % T/NB: 0.7 % 37.8% food insecure	Adapted questions from the Questionnaire on Eating and Weight Patterns-Revised	Food insecurity was measured by parents using the US Household Food Security Survey Module	19	After adjustments were made for ethinicity/race and parental education Adolescent FI predicted longitudinally higher new onset on binge eating and a BMI of >30 kg/m2, but not unhealthy weight control behaviours.
Hooper, Telke, Larson, Mason, & Neumark-Sztainer, 2020; US	C	2285 Dyads	Mean age: 14.5 Age range: 10-22 F: 54.2 % M: 45.8 % 38.9% past year food insecure	Adapted questions from the Questionnaire on Eating and Weight Patterns-Revised	US Household Food Security Survey Module (Measured by parents)	22	A significant proportion of adolescents experienced household food insecurity, disordered eating, and overweight. Food-insecure adolescents exhibited lower breakfast consumption and a higher prevalence of unhealthy weight control behaviors compared to their food-secure counterparts. After adjusting for various factors including race, food insecurity remained associated with a higher prevalence of unhealthy weight control behaviours but was not linked to weight status or

							other eating behaviours.
Kim, B. H., et al. (2021); US	C	58	Age mean: 14.5 Age range: 11.1-18.9 F: 62.1 % M: 37.9 % 41% food insecure	The eating Disorders Examination Questionnaire Adolescent Version (EDE-A) (seven item, three factor version)	Self-report version of the food security survey module for youth ages 12 and older	18	In the full sample, FI was associated with greater BMI, higher shape/weight overvaluation, and greater number of binge eating episodes. Significant relationships for BMI, shape/weight overvaluation, body dissatisfaction and binge eating episodes was only see amongst Hispanic adolescents.
Linsenmeyer et al, 2021; US	C	164	Mean: 17.04, (2.26) Range: 12-23 TF: 17.1 % TM: 78.0 % NB: 4.9 % 21.2% food insecure	Sick, Control, One Stone, Fat, Food Questionnaire (SCOFF) Adolescent Binge Eating Disorder Questionnaire (ADO-BED) Nine-item avoidant/restrictive Food Intake Disorder Screen (NIAS)	Hunger Vital Sign	18	Transgender males scored significanly higher on the NIAS than transgender females Those with previous ED diagnoses scored significanly higher on the Hunger Vital Sign Ethnicity/race was not collected or considered in the analysis
Poll, K. L., et al. (2020); US	C	111	Mean age: 21 Age range: 19-23	Non-validated questions on	US Adult Food Security Survey Model	13	High school FI was significantly correlated with a

			9.9% food insecure	disordered eating behaviours, such as hoarding and binging	(+2 additional questions to assess childhood FI)		preoccupation of food, but not binge eating Collegiate FI was significantly correlated with a preoccupation with and hoarding of food. Demographic information on Race was collected but not utilised in the analysis.
Royer, Ojinnaka and Bruening (2021); US	C	533	Mean age= 20.4 Range: 18-25 F: 77.7% 42%= High food security 18%= marginal food security 18%= low food security 22%= very low food security	Eating Disorder Examination Questionnaire (EDE-Q)	US Department of Agriculture's Adult Food Security Survey Module	20	Food insecurity was significantly associated with global disordered eating behaviours, eating concerns, shape concerns and weight concerns There was a significant difference between the groups in terms of race/ethnicity, and this was not used in the main analysis.
Shankar-Krishnan, N., et al. (2021); Spain	C	426	age mean= 13.8. 47% female. 18.3% food insecure	The Body Shape Questionnaire (BSQ) for psychological distress & The Body Dissatisfaction sub-scale (EDI-BD) of the Eating Disorder	The Spanish Child Food Security Survey Module (9 items)	22	FI adolescents had: lower self-esteem, reduced positive affect, higher stress, lower coping skills, greater body dissatisfaction, and a higher drive for thinness. Dietary habits showed no

				Inventory (EDI-3)			significant difference.Results are not broken down by parental origin although adjustments are made using this variable.
West, Darling, Ruzicka, & Sato, 2021, US	C	60	Mean age: 13 Age range: 12-18 F: 53.3 %, M: 46.7 % Food insecurity: 18.3% = low 3.3%= very low	EDE-Q	Core Food Security Module (completed by parents)	16	Household FI was significantly positively associated with adolescent loss of control eating (after controlling for BMI, race, ethnicity, biological sex and age). Lower household income-to-needs was associated with greater LOC eating at higher levels of household FI. Race was used as a covariate in this study, but no further breakdown of results was made available.
West, Goldschmidt, Mason, & Neumark-Sztainer, 2019; US	L	2,179;	Mean Age: EAT-I: 14.9 (1.6) EAT-2: not reported Descriptives were split into High and Low SES: High SES N= 992 F: 49.7% Food insecure:3.4% Low SES N= 1187	Adapted questions from the Questionnaire on Eating and Weight Patterns-Revised	Food insecurity was measured by parents using the US Household Food Security Survey Module	20	In higher socioeconomic status (SES) adolescents, overweight/obesity, body dissatisfaction, dieting, and family weight-teasing were associated with a higher risk of binge eating. Among low-SES adolescents, overweight/obesit

	F: 55.4% Food insecure= 9.3%	y, dieting, and food insecurity were linked to an increased risk of binge eating. The impact of these risk factors was generally stronger in the high-SES group, but interactions with food insecurity couldn't be explored due to its low prevalence in this group. Analyses included adjustments for race/ethnicity but did not provide a breakdown based on these demographics.

Note. C= cross-sectional, L= longitudinal, F= female, M = male, TF = transgender female, TM = transgender male, NB = nonbinary, T/NB = transgender/non-binary.

Barry and colleagues (Barry et al., 2021) also looked at loss of control eating in a sample of 2000 university students, with over sampling in minoritized groups (e.g., ethnic/racial minorities, first-generation students). They used The SCOFF (Morgan et al., 1999) to assess for disordered eating and the 10-item US adult food security survey model to measure food security status. From their final sample of 804 students, they found that those who had reported FI were 1.78x more likely to experience loss of control eating than those who were food secure.

Large scale (n=1813, mean age= 14.9), cross-sectional data was obtained from the EAT-I, EAT-II and EAT-III cohorts (Hazzard et al., 2022). Project EAT (Eating and Activity in Teens and Young Adults) is a longitudinal investigation for eating in young people. EAT I, the baseline, was conducted in 1998-1999 by 4746 11–18-year-old students in Minneapolis. With follow-ups at 5-year intervals. Hazzard and colleagues (2022) found that when severe FI was the main effect in repeated cross-sectional models, it was significantly associated with binge eating ($p < .05$). This was the strongest effect of all eating behaviours in their study, along with extreme weight control behaviours. After adjusting for socio-demographic covariates, it was found that those who had been living in past-year severe FI had a 49% increased chance of reporting binge eating. In the same study, Hazzard and colleagues furthered this finding by also looking at the longitudinal associations between baseline EAT-I data and 5-year follow-up data (Cohort from EAT-II, mean age= 19.5) (Hazzard et al., 2022). They found that severe FI was found to predict 1.41x greater prevalence of binge eating 5 years later after adjusting for prior binge eating (Hazzard et al., 2022). This longitudinal association was almost as strong as the cross-sectional association, with binge eating 5-years later at 41% prevalence when accounting for binge eating at baseline and sociodemographic covariates. Importantly, Hazzard and colleagues (2022) only used one question, completed by the adolescents, to measure FI and this was adapted from the US Household Food Security Survey Module. West and colleagues' (2019) also looked at the relationship longitudinally within the

same EAT I and EAT II cohorts but grouped the data by socioeconomic status. They found that self-reported FI amongst adolescents from low socioeconomic status backgrounds in EAT I predicted binge-eating 5 years later in EAT II (RR = 1.4; 95% CI: 0.7, 2.7). Furthermore, Linsenmeyer's (2021) study of 164 youths from a transgender/ non-gender binary youths' clinic also found a significant relationship. When looking at scores on the Adolescent Binge Eating Disorder Questionnaire, they found that they were significantly positively correlated with increasing levels of FI (0.25, $p < 0.05$.).

Contrastingly, Hooper and colleagues (2020), larger scale study looking at adolescent/parent dyads (*n*=2285 dyads). They had also taken their sample from the same metropolitan area of Minneapolis as Hazzard and colleagues (2022) but from the wider EAT 2010/Project F-EAT cohorts. Importantly, they operationalised FI differently by including all 6 questions from the Household Food Security Survey Module and it being completed by the parents only. They found no significant relationship between FI and binge eating in their adolescent sample, with or without loss of control. However, they then did an 8-year follow-up study of 1,340 of the adolescents (Mean age= 22) and found that when compared to food secure homes, adolescents who lived in food insecure homes had significantly higher new-onset of binge eating at the eight-year follow-up (Hooper et al., 2022). However, prevalence of binge-eating from baseline to follow-up was not associated with food security status. Furthermore, the persistence of binge-eating over the 8 years was not significantly related to food security status (Hooper et al., 2022).

Moreover, when specifically looking at male college athletes, Poll and colleagues (2020) cross sectional study found that college students who had experienced high-school FI were not significantly more likely to binge eat when compared to their food secure peers (Poll et al., 2020). This was also not significant if they were experiencing current collegiate FI.

Christensen and colleagues (2021) also looked at binge eating in relation to food security status in a college sample. However, they divided binge-eating into 'objective' and 'subjective' binge-eating. They found that objective binge eating was significantly associated with FI (Partial η^2 = .02, p = .01). They found that alone, FI was related to an increased instance of reporting objective binge eating ($\chi 2$ (1) = 6.01, p = .02, ψ = .11). In terms of subjective binge eating, they found that FI was associated with increased reporting of subjective binge eating (χ^2 (1) = 4.84, p = .03, ψ = .01). However, this was only available in the supplementary material when dichotomizing participants into food insecure and food secure groups, and not in the continuous analysis reported in the main findings (Christensen et al., 2021). Interestingly, Kim and colleagues (2021) uncovered slightly different findings. They found no predictive power of FI on Objective Binge Eating (p = 0.6). They had divided their adolescent sample into two groups: 'clinical' or 'non-clinical'. Criteria for the 'clinical' group was met by reporting loss of control eating or binge eating a month prior to the study. However, they found that FI did predict a greater number of binge-eating episodes in those adolescents that had reported at least one (p < 0.01) (Kim et al., 2021).

A pilot study looking to better understand the risk and resiliency factors related to FI in mother-adolescent dyads focussed on 6 public housing sites in Arizona (Bruening et al., 2017). From their 55 dyads, they found a significant relationship with these dyads and binge eating (p=0.011), specifically, that the adolescents were more likely to binge eat compared to their mothers. Furthermore, they found that in food-insecure households, these adolescents had a 705% increased likelihood of binge eating if their parents also reported binge eating (p = 0.015).

3.3 Weight or shape related Dietary Restriction

There were four studies that looked at the relationship between FI and food restriction in adolescence. For these studies, care was taken to ensure dietary restriction was specified in the questioning as being due to weight or shape related reasons and not due to lack of availability of food.

In Hooper and colleague's (2020) cross-sectional study from the Project EAT-I cohort. They found that after adjusting for race/ethnicity, parental education, sex and age, there was a significant relationship between food-security level and fasting, namely that those who were food secure were more likely to report fasting (FI: 13·4 % v. FS: 10·0 %, P = 0·047). The symptoms of eating very little food and meal skipping were also associated with FI, but the relationship did not remain significant after adjustments.

Christensen and colleagues' (2021) cross sectional study from an American University found that students living with food-insecurity were more likely to report compensatory fasting (fasting to counteract the impact of previous or anticipated calorie consumption): χ^2 (1) = 19.40, $p < .01$, $\psi = .19$. Furthermore, this effect of food insecure adolescents being more likely to report compensatory fasting was still significant when compared to other disordered eating behaviours: Partial $\eta 2 = .02$, $p < .01$.

Kim and colleagues' (2021) study using a repeated measures design across a 'clinical' sample (i.e., those who had reported loss of control eating or binge eating a month prior to the study) and a 'community' sample (Kim et al., 2021) found contrary findings. Using The Eating Disorders Examination Questionnaire Adolescent Version (EDE-A; Burke et al., 2017) with a subscale for 'dietary restraint', they found no significant effect of food-security status when controlling for sample type (p=0.74). They used a seven-item, three-factor version, which has shown to measure eating disorders more equivalently for both black and white adolescents than the original version (Burke et al., 2017). Similarly, using the restraint subscale of the EDE-Q

(Fairburn et al., 1993) on an older sample of college students (mean age 20.4) in the U.S, Royer and colleagues (2021) found that restraint was not significantly associated with the food-security status of the students (χ^2 = 5.64; P = 0.13).

3.4 Extreme/unhealthy weight controlling behaviours

Five of the studies looked at compensatory and weight controlling behaviours such as purging, laxative use, diuretic use, and the use of diet pills.

Christensen's (2021) study broke down the different behaviours and found that there were no differences in the instances of reported self-induced vomiting (χ2 (1) = 1.71, *p* = .22, ψ = .06), laxative/diuretic use (χ2 (1) = 3.00, *p* = .11, ψ = .08) or excessive exercise (χ2 (1) = .90, *p* = .37, ψ = .04) when comparing those with food security to those with FI in their college sample.

Similarly, when Hooper and colleagues (2020) looked at extreme weight control behaviours other than fasting (described above), they found that prior to adjustments, food insecure individuals were significantly more likely than food secure individuals to use unhealthy weight control behaviours, more specifically: using laxatives and diuretics. However, once they had adjusted for parental education, ethnicity/race, sex and age, there was no association for volitional vomiting, skipping meals, diet pill use or diuretic use. They did find that laxative use was still significantly associated with FI (FI: 0·8 % v. FS: 0·3 %, P = 0·005) after adjustment. Hooper and colleagues (2022) in their 8-year follow up found that unhealthy weight control behaviours were highly prevalent in the food insecure group at both baseline (42.9%) and follow-up (51.9%), and of those who did not report unhealthy weight control behaviours at baseline, 42.8% were reporting them at follow-up. Of those who had previously reported unhealthy weight control behaviours at baseline, 64.1% found these behaviours persevered at follow-up. They found significant differences between the food

secure and food insecure group in unadjusted samples, however, this effect was no longer significant when adjusting for sociodemographic factors (Hooper et al., 2022).

Conversely, Barry and colleagues (2021) study found that those with very low food security were 3.04 times more likely to report self-induced vomiting than those with high food security. The measure of self-induced vomiting was a single question from The SCOFF (Morgan et al., 1999).

Hazzard and colleagues (2022) grouped these compensatory behaviours together as 'weight controlling behaviours' within their sample from the EAT-I cohort. They analysed both cross-sectional and longitudinal data. They grouped behaviors into either 'extreme weight control behaviours' (self-induced vomiting, diet pill use, laxative use, diuretic use) or 'unhealthy weight control behaviours' (fasting, skipping meals, eating very little food, using food substitutes, smoking more cigarettes). They found that cross-sectionally, FI was significantly associated with both extreme weight-control behaviours and unhealthy weight-control behaviours, with extreme weight-control behaviours (along with binge eating) having the strongest association with all disordered eating behaviours examined and FI (49% greater prevalence for each in those who reported FI compared to those who were food secure). Effect modification by age indicated the association with unhealthy weight related behaviours was stronger cross-sectionally amongst younger participants, and this association decreased with increasing age from 11-23. However, longitudinally, there was no relationship between FI and weight control behaviours.

3.5 Other disordered eating behaviour

This grouping was made up of several disordered eating behaviours which were less prevalent in the literature: preoccupation with food, chronic dieting, drive for thinness, emotional eating, and avoidant/restrictive eating patterns.

Barry and colleagues (2021) used The SCOFF (Morgan et al., 1999), a screening tool for eating disorders, in their study looking at the differences in disordered eating across food security status in students. One question on the SCOFF asks, 'Does food dominate your life?'. Barry and colleagues (2021) found a significant relationship ($p< 0.0001$) indicating that those with very low food security were more likely to respond 'yes' than those with high food security (PR 2.09, 95% CI 1.21 to 3.58). However, surprisingly, the highest number of 'yes' responses was seen in the marginal FI group (PR 2.83, 95% CI 1.74 to 4.62) and the low food security group (PR 2.81, 95% CI 1.70 to 4.64). Supporting this finding, using the 'eating concern' sub-scale of the EDE-Q, which looks at preoccupations with eating and food, Royer and colleagues (2021) found a significant inverse relationship with food security status ($x2 = 23.94$; $P < 0.001$; $b = 0.27$; $P < 0.001$) (i.e., observations of preoccupation with food increased uniformly as food security decreased). Poll and colleagues (2020) found that when looking at college male athletes, that high school FI was significantly correlated with food preoccupation, and that collegiate FI was correlated with both preoccupation and hoarding of food (Poll et al., 2020).

When using the drive for thinness subscale of the EDI-3, Shankar-Krishnan (2021) found that those who were food insecure had a higher drive for thinness than those who were food secure ($F(1, 85) = 11.72$; $p = .001$).

In cross-sectional analysis, adolescent FI and chronic dieting were found to be significantly associated, with no interaction effect of age ($p < .05$) (Hazzard et al., 2022). There were no longitudinal associations with chronic dieting.

In Frank and colleagues' (2021) cross-sectional study utilised the Emotional Eating Scale (EES) to measure emotional eating and the U.S Household food security survey module to measure FI (Frank et al., 2021). They found that when controlling for BMI, there was a significant relationship between FI and emotional eating ($B = 1.35$, 95% CI[0.24, 2.48]). This

relationship was stronger for males (95% CI[1.07, 6.54]) than females (95% CI[-0.29, 2.07]). Further analyses revealed that when looking at subtypes of emotional eating, food insecure males were significantly more likely to experience anger-induced emotional eating and depressive-induced emotional eating, but not anxiety-induced emotional eating. There were no significant differences in emotional eating subtypes for food insecure and food secure females.

The use of the Nine-Item Avoidant/Restrictive Food Intake Disorder Screen (NIAS; Zickgraf et al., 2018) with transgender and gender non-binary adolescents suggested a positive significant correlation between avoidant restrictive symptoms and FI ($p < 0.05$) (Linsenmeyer et al., 2021). Further analysis revealed that transgender-males scored significantly higher than transgender-females on the NIAS, regardless of food security status. The authors suggest this could be due to the fact that avoidant/restrictive food intake disorder prevalence may be greater among cisgender males than females, suggesting that gender identity may play a role, however, prevalence estimates between gender identities vary widely (Bourne et al, 2020).

It is important to point out that the NIAS is a measure of Avoidant and Restrictive eating, which measures food restriction due to "picky eating" (e.g., question 1: are you a picky eater?) and not due shape or weight related restriction like those reported in the "restriction" section above.

3.6 Body Image and Weight concern

Although not strictly disordered eating 'behaviour', The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM–5; American Psychiatric Association, 2013) includes body image and weight concern in the diagnostic criteria for Anorexia Nervosa. Furthermore, with body image and weight concern relating strongly to other disordered

behaviours, it felt important to capture this information as a potentially essential components in the management of eating disorders in food insecure adolescents.

Royer and colleagues (2021) found that weight concern was significantly associated with food security status (x2 = 11.13; P = 0.01), and that this relationship was negatively related to food security level (b = F;0.21; P < 0.001). Similarly, using the EDE-Q shape concern subscale, Royer and colleagues (2021) also looked at unhealthy perceptions of personal body composition in food insecure and food secure samples. They found a significant relationship between food security status and shape concern: (x2 = 12.92; P = 0.005). This was a negative relationship, with higher shape concern being associated with lower food security status (b = 0.17; P = 0.001).

Shankar-Krishnan and colleagues (2021) also used two measures of body dissatisfaction in their study with school children in Spain, the Body Shape Questionnaire (BSQ; Warren et al., 2008) and Body Dissatisfaction sub-scale (EDI- BD) of the Eating Disorder Inventory (EDI-3; Elosua et al., 2010). Both measures of body dissatisfaction indicated that lack of food security was related to an increased body dissatisfaction (BSQ: F(1, 85) = 10.22; p = .002; EDI-BD: F(1, 364) = 15.59; p = <.001). The significant relationship with the BSQ scores had a small effect (d=0.46 95% CI [-4.85 to -1.15]), and the EDI-BD had a large effect size (d=0.80 95% CI [-5.91 to -1.98]). This was the largest effect size in a study looking at multiple eating pathologies. Kim and colleagues (2021) also found in their US study there was a significant relationship between FI and body dissatisfaction, but only in Hispanic adolescents ($p < 0.01$). In the wider sample there was no significant relationship. (p=0.11).

Kim and colleagues' study (2021) found that across both samples (clinical and non-clinical), adolescents who were food insecure (mean ± SD = 2.9 ± 2.0) had higher scores on a measure of weight/shape overevaluation than those who were not food insecure (mean ± SE = 1.7 ± 2.3). When controlling for the sites of the different samples ('clinical' and 'non-clinical',

Kim and colleagues (2021) found that there was a significant relationship between FI and overevaluation of weight/shape (p=0.04).

In addition to students with very low food security being 3.04 times more likely to self-induce vomiting compared to those with high food security, Barry and colleagues (2021) also found that those students with very low food security were 2.07 times more likely to feel fat despite thinness than very food secure peers. Again, it is important to highlight that 30% of the sample were over the age of 24.

3.7 Clinically significant eating disorders

In this section, studies that included screeners for eating disorders or calculated probable diagnoses based on self-report responses were included. Four studies identified potential diagnoses in participants. Linsenmeyer and colleagues (2021) used The SCOFF measure (Morgan et al., 1999), with a cut-off of responding "yes" to two or more of the five questions as indicative of 'addressing features of anorexia nervosa and bulimia nervosa'. They found that there was a significant overall correlation of those scoring above their threshold on the SCOFF and FI status of transgender and non-gender binary youths ($r=0.28$, $p < 0.05$). Furthermore, they found a significant relationship in this group between previous eating disorder diagnosis and the scores on their FI measure, the Hunger Vital Sign ($F=3.08$, $p<0.05$).

Similarly, Barry and colleagues (2021) found that very and marginally food insecure adolescent students were more likely to screen positive for an eating disorder using the SCOFF when compared to students who were food secure. This was seen across both male and female students when sex-stratified, however, the effect estimate was stronger for males (PR males= 5.08, PR females= 1.86).

El Zein and colleagues (2019) looked at correlates and FI in first-year college students across multiple-institutions in the US (n=855). They used the Eating Attitudes Test-26 (EAT-

26) with a threshold score of 20 or higher indicating significantly problematic eating behaviours and high risk of disordered eating. They found that food insecure adolescents had a significantly higher odds of experiencing disordered eating behaviours when compared to food secure students (OR = 2.49, 95% CI: 1.20–4.90).

Christensen and colleagues (2021) found that there was a significant difference in the prevalence of likely eating disorders measured using a combination of the Eating Disorder Diagnostic Scale for DSM-5 and the Clinical Impairment Assessment between the groups ($p < .01$, NNT = 6.06) with 47.6% of the food insecure group reporting an eating disorder versus 31.1% of the food-secure group. A breakdown of diagnoses indicated that the different disorders were in the same order of frequency across both groups: OSFED (FS: 19.3%, NFS: 29.3%), Bulimia Nervosa (FS: 8.2%, NFS: 16.2%), Binge Eating Disorder (FS: 2.6%, NFS: 1.7%) and anorexia nervosa (FS: 1.0%, NFS: 0.4%). Overall, they found a significant effect of food security status on eating pathology ($p < .01$).

4.0 Discussion

The purpose of this review was to evaluate the literature on adolescent FI in relation to distinct eating pathologies. A discussion of the results of each pathology follows.

4.1 Binge Eating

Ten of the fifteen studies included in this review specifically including binge eating or loss of control eating, meaning this is by far the most studied eating pathology in this topic. This is not surprising, given the results of numerous studies investigating the association in adult samples. Only two of the ten studies found no association at all between food security level and binge eating (Hooper et al., 2020; Poll et al., 2020).

Excessive eating has emerged as the principal concern in FI adolescents (Hazzard et al., 2022). Hazzard and colleagues' (2022) found cross sectionally, that of all eating pathology measures, binge eating had the strongest effect size in food insecure adolescents. This was consistent with studies looking specifically at loss of control eating (Barry et al., 2021; West et al., 2021). We must be cautious with extrapolating these findings as research shows that loss of control eating is more prevalent than binge-eating in youth (Tanofsky-Kraff et al., 2020). Loss of control eating is a part of binge eating (DSM-5), but for it to be binge eating a measure of quantity would also be needed to indicate that more food was consumed than others would have in the same conditions. However, these findings add to the literature as binge eating in adolescents is difficult to assess (Byrne et al., 2019; Goldschmidt et al., 2008; Moustafa et al., 2021), and so mechanisms which are easier to assess can be used in proxy, such as loss of control eating. However, this means that we also must be cautious of the findings with binge eating, especially when studies are using un-validated measures. Hooper and colleagues found no significant relationship with FI for either binge eating or loss of control eating (Hooper et al., 2020). Future studies could use a measure for both to better assess the relationship. Furthermore, their use of parental proxy for food security status must be considered as a weakness.

Hazzard and colleagues' study further added to the literature with a longitudinal component with a 5-year follow-up (Hazzard et al., 2022). Along with other colleagues, they found that the association between binge eating and FI in adolescents is robust over time (Hazzard et al., 2022; West et al., 2019). Their findings suggest that the strength of the longitudinal association is almost as strong, suggesting robustness of the relationship over time. Interestingly, Hooper and colleagues (2022) found at their 8-year follow-up that although the majority of those who binge-ate at baseline still binge ate, this was no longer significantly associated with FI. However, they did find that FI was significantly associated with new

instances of binge-eating at the 8-year follow-up. This suggests that FI may be predictive of onset of binge eating, but potentially not in maintaining the binge eating behaviours long-term. This is in line with Kim and colleagues' (2021) cross-sectional study where they found that there was a relationship with FI, but only in terms of frequency for those who already binge-ate. This suggests that potentially not all adolescents who experience FI will binge eat, but a vulnerable sub-set who already binge eat, may binge eat more frequently when food insecure. This is useful for clinicians in identifying vulnerable groups.

Additionally, follow-up times were also longer for Hooper and colleagues' (2022) study, meaning that there may be a difference after the 5-year point (West's follow-up period) that reduces maintenance. Considering the ages of the cohort being in adolescence, this could be moving out of education and into employment, meaning that they may no longer experience FI, but the behaviour of binge-eating may still be engrained. It is important to consider measurement, with West and colleagues (2019) using a one question measure for assessing FI. Using only one question may have impacted the validity of their groupings based on food security status. However, this longitudinal data in adolescence is helpful as they indicate that there are potential predictive mechanisms at play that need to be further investigated. We know from research that in food insecure homes, parental restrictive feeding practices are more likely (Bauer et al., 2015). Furthermore, we know that parental restrictive feeding practices are predictive of binge eating (Puhl & Schwartz, 2003). Noting a potential long-term association and predictive relationship between FI and binge eating is just the start, and it is essential that underlying mechanisms are now explored further.

Considering that Hooper and colleagues (2020; 2022) and Hazzard and colleagues (2022) both used the same Project EAT samples, and yet found different results is important. This could be due to how FI was operationalised by Hooper and colleagues (2020; 2022) using a lower severity threshold from a 6-item measure and Hazzard and colleagues used a one item

assessment to assess severe FI. This shows the importance of measuring consistently and how a standardised measurement validated for this age bracket is needed in order for results to be truly comparable. It is also important to consider that data from the start of Project EAT is from 1998-9, a different economic and political climate to more recent times.

When looking at subjective and objective binge eating, Kim and colleagues (2021) found no relationship to objective binge-eating which is contrary to Christensen and colleagues (2021). They found no significant difference in terms of subjective binge-eating, but they found that students living with FI were significantly more likely to objectively binge eat. This contrary finding could be explained by age and stage of life, with over 5 years between the studies' mean ages. This age gap potentially signifies life changes, with 15-year-olds (Kim et al., 2021) being more likely to still live at home compared to 21-year-olds being more likely to live separately from parents in Christensen and colleagues' study (2021). With this in mind, the role of the caregiver must also be carefully considered when looking at binge eating in adolescents with FI, as Bruening and colleagues (2017) study indicated eight times the risk of binge eating if their mother also binge-ate. This supports the importance of family work in these young people, as detailed in the NICE adolescent and child guidelines for those with eating disorders. However, it is important to note that the study only utilised one question on binge-eating that gave no indication of severity or frequency, only that it had occurred at least once in the last 12 months, and only indicated by embarrassment at the amount. There is potential for this question to be misinterpreted dependant on circumstance. For example, if a family were food insecure and there was a scarcity of food, eating even a normal amount if it means that others may have to go without, which could be considered embarrassing. The study also scored relatively low on the quality assessment tool due to its design, sample size and reporting.

Potential mixed findings within the FI/binge eating association could be due to the potential cyclical "food stamp cycle" with loss of control eating when resources are abundant. Respondents may be responding with recency or overlooking past behaviours if they have moved onto another one, e.g., moving between binge-eating and restriction. This idea lends itself well to momentary measures, which have yet to have been used in binge eating contexts with this age group. Hazzard and colleagues (2023) study looking at momentary binge eating in relation to FI supports in an older sample supports the "food stamp cycle" hypothesis as they found that when food was more readily available, there was an increase in binge-eating symptoms in the following hours. Research looking at binge eating and food availability in adolescents using EMA would be important to clarify if this also applies to this age group and could be a factor in mixed results. If this is found, Hazzard and colleagues (2023) found that the relationship was buffered by food-related self-efficacy (e.g., confidence in feeding family on a budget). Increasing food-related self-efficacy has previously been related to a reduction in FI (Martin et al., 2016). When paired with Hazzard and colleagues (2023) results, this could suggest that stabilising self-efficacy could enable more consistent food availability throughout the month.

Poll and colleagues (2020) found no significant relationship between FI and binge-eating. Importantly, they did not use any validated measures to measure disordered eating behaviours and they had the lowest score on the quality rating tool compared to all the other studies. Aside from this, the lack of significance is interesting and could shed some light on who vulnerable groups may be. Their sample was all-male, college athletes. Although they found no effect for binge eating, the sample were more likely to be preoccupied with food at a high-school level and then more likely to hoard food at a college level. This could indicate a difference in gender, or specifically, potentially a later onset in males. This could be due to the temporal nature of societal pressures on males compared to females or potentially some

dynamics within family environments. Alternately, it could be due to pressures on athletes; specific diets or exercise regimes making them more focused on food.

The shame and stigma associated with binge eating (Duarte & Pinto-Gouveia, 2016) and increasing weight (Masheb et al., 2015) are among the reasons why supporting those with binge eating is vital. The literature reviewed suggests that adolescents living with FI will be more likely to binge eat and therefore are likely to have higher levels of shame and stigma, along with higher weight.

4.2 Weight or shape related dietary restriction

In terms of the relationship between food restriction and food security status, two out of the five studies broke down the pathologies and found that restriction was significantly more likely in the food insecure samples (Christensen et al., 2021; Hooper et al., 2020). Hooper's questions specified restriction must be due to "wanting to lose weight or not gain weight'. Similarly, Christensen and colleagues use of the EDE-Q meant restriction was needed to be "In order to prevent weight gain or counteract the effects of eating".

For the two studies that did not find significant effects of FI, this is in line with the "food stamp cycle" theory where dietary support (e.g., food stamps) is often provided at the start of the month and is more scarce at the end of the month, leading to involuntary restriction (Townsend et al., 2001). This is similar to the "feast or famine" cycle hypothesis (Dinour et al., 2007). Royer and colleagues noted in the text that this lack of association was "peculiar" (Royer et al., 2021). Kim and colleagues (2021) attributed their lack of significant findings to how restriction can be internally and externally driven due to lack of resources (Kim et al., 2021). The use of the seven-item, three-factor version of the EDE-Q in their study which includes "to influence your shape or weight?" in every question in the dietary restriction subscale which should have reduced but perhaps not completely eliminated misinterpretation

of the questions in this context. Interestingly, both studies that did not find a significant relationship between restriction and food security status used the Eating Disorders Examination Questionnaire or a version of it. This could indicate that there is some nuance in questioning which future studies might benefit from investigation. However, in the context of theories around ED symptoms being related to "feast-or-famine" in FI groups, Kim and colleagues' (2021) study adds value in using EMA measures, attempting to recreate "real-time" data. They found no significant relationship between FI adolescents and hunger and cravings throughout the day, however they acknowledge the sporadic data collection and suggest it is not a true representation of the day-to-day experience of their sample (Kim et al., 2021). The cyclical nature of binge/restriction cycles seen in food insecure populations lends itself to EMA methodologies, but more research will need to be done to understand how to capture this data most effectively, potentially thinking about the temporal availability of food (e.g., when universal credit is received) and sampling.

4.3 Extreme/unhealthy weight controlling behaviours

The results for extreme/unhealthy weight controlling behaviours were mixed. Only one study found a link between FI and self-induced vomiting (Barry et al., 2021). Importantly, 30% of this sample was over the age of 24 which may skew the data when comparing it to other studies with younger age ranges. Unfortunately, the results are not broken down by age and so we cannot determine the association was only present for adults. Furthermore, their study used one question from The SCOFF to measure self-induced vomiting: "Do you ever make yourself sick because you feel uncomfortably full?" with a yes/no response. Responses give no indication of severity or frequency. Their measure of FI may also limit the results as FI status has the possibility to change drastically over the period of 12 months for university students (Bruening et al., 2018).

In Hooper and colleagues' (2020) study, many analyses no longer found significant differences between food secure adolescents and food insecure adolescents after adjusting for sociodemographic factors. Similarly, Hooper and colleagues (2022) findings of lack of significance after adjustments indicate that sociodemographic factors play a significant role and should always be adjusted for to avoid inflated significance in weight controlling behaviours. However, even prior to adjustment they found no significance with self-induced vomiting. Significantly, their sample was much younger than Barry and colleagues (2021), and the measure for FI was reported by the parents.

Interestingly, the longitudinal data (Hazzard et al., 2022) suggests that adolescents reporting FI during the preceding year showed a greater tendency to control weight in ways that were not healthy, for example, skipping meals and fasting, but only up until the age of 20 (Hazzard et al., 2022). This is inconsistent with Hooper and colleagues (2020) who only found significance with a younger sample, or with Barry and colleagues' (2021) study who did find significance but with an older sample. However, the "weight controlling behaviours" operationalised were slightly different. Future studies should ensure these behaviours are broken down individually.

Hazzard and colleagues (2022), whose study was a younger sample (11-18), found significant relationship when grouping together weight controlling behaviours, including self-induced vomiting. Hazzard and colleague's finding is interesting as it is contrary to the popular belief that FI is more strongly related to eating pathologies in adults than adolescents (Hazzard et al., 2020). This may be to do with purchasing power or the fact that adolescents may be more likely to use unhealthy weight management strategies than adults. Unfortunately, the EAT project did not collect data on food security status at the second follow-up, meaning this data does not have the opportunity to be as longitudinally explored like the rest of the data in the

project. It would also be interesting to look at parental dyads in this context, similarly to how Bruening and colleagues (2017) did, to see the similarities.

4.4 Other Disordered eating behaviour

Barry and colleagues' (2021) finding of the marginally food insecure group being more likely to be preoccupied with food than the very low severity group is interesting, and qualitative research in children could give some indication of why this might be. Leung and colleagues (2020) found when interviewing food insecure 7–14-year-olds, that thoughts about food are often repressed as a coping mechanism for hunger (Leung et al., 2020). This could be reflected in Barry and colleagues' (2021) findings in that students who are the most food insecure are more likely to repress feelings about food and hunger and therefore less likely to report them as preoccupying when compared to those who are moderately food insecure. Additionally, this could be due to 'worry' about food being an early indicator of FI.

However, whilst Royer and colleagues (2021) also found that those who were food insecure were more likely to be concerned with food when compared to food secure, their relationship was uniform in that the preoccupation increased with severity of FI. This could be due to severity of the sample, which would fit with the above, but it also could be due to measurement. Only one question from the 'eating concern' EDE-Q subgroup specifically addresses preoccupation: "Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?". This is compared to the SCOFF's question "Does food dominate your life?". Again, the nuance in language is important and open to misinterpretation, especially for those who are food insecure in whom these measures have not been validated. Food insecure individuals may find that food dominates their life, but this could be due to worries about when their next meal is coming from. This makes the use of the EDE-Q and SCOFF in this context a big limitation.

Poll and colleagues (2020) study adds to the literature on food preoccupation as the internal behaviours (e.g., the mental preoccupation) seem to escalate into behavioural changes over time (e.g., hoarding). More studies would need to be conducted to explore this relationship. Furthermore, the study sample is a selection of male athletes, eating disorders are thought to be less prevalent in males (Kjelsås et al., 2004; Merikangas et al., 2010). The fact that the sample was all male needs to be considered, as there may be sex differences due to societal pressures or familial protective factors at different times.

Shankar-Krishnan and colleagues (2021) findings of drive for thinness being higher in those who are food insecure also reflect the importance of measurement validation. When questions on preoccupation are not specifically indicative of being due to eating, shape or weight reasons, then scores may be artificially inflated in those with FI. Support might be needed from other areas other than eating disorder services such as food banks and government schemes. This is similar to findings linking FI to chronic dieting, as someone not eating to lose weight and someone not eating due to lack of food supply is entirely different. Again, Hazzard and colleagues' (2022) finding that this was no longer significant at follow-up indicates younger adolescents may be more at risk of FI impacting their eating behaviours. Frank and colleagues' (2021) findings indicate that again the impacts of FI could not only be different across the lifetime, but also based on gender.

Furthermore, the use of the NIAS in Linsenmeyer and colleagues' (2021) study means that participants were asked "Even when I am eating a food I really like, it is hard for me to eat a large enough volume at meals". This question could be potentially confusing for someone with FI and could be interpreted as "it's hard for me to eat a large enough volume due to availability of food". Linsenmeyer and colleagues (2021) additionally found that transgender-males scored significantly higher than transgender-females, suggesting that gender identity

may be a key variable in food avoidance/restriction. However, this analysis did not control for food security status.

4.5 Body image and weight concerns

Studies were unanimous with food insecure adolescents more likely to report weight-concerns/body dissatisfaction (Kim et al., 2021; Royer et al., 2021; Shankar-Krishnan et al., 2021).

Kim and colleagues (2021) found a significant relationship between body dissatisfaction and FI, but only in Hispanic adolescents. This could also be due to Social Comparison Theory; whereby Hispanic adolescents may have different social 'ideals' to non-Hispanic adolescents. However, they suggest that due to evidence that higher FI is predictive of higher weight in adolescence, that the relationship with body dissatisfaction may be moderated by internalised weight stigma or weight-related victimisation (Kim et al., 2021). Research looking at weight-stigma and/or weight related victimisation across different races/ethnicities could help understand this further. With a higher prevalence of obesity amongst minority adolescents with the highest increases amongst African-American adolescents, followed by Hispanics (Ogden et al., 2002), the relationship moderating relationship of race/ethnicity on FI and body dissatisfaction needs to be explored. Interestingly, a large study (n= 14,768) found that food insecure children with a mean age of 10.2, were more likely to report body dissatisfaction, but that this was even more likely for food insecure African-American children (odds ratio=2.32; $P<0.001$) (Altman et al., 2019). However, it was also more likely for children with a normal BMI (odds ratio=1.76; $P<0.001$). This suggests that adding BMI as a measure is not enough to explain this relationship, especially considering the Eurocentric origins of the BMI. Altman and colleagues' study (2019) could also indicate that this relationship is evident in childhood and potentially a pre-cursor for disordered eating. The

associations between body dissatisfaction and shame may impact young people's relationships with asking for help, including accessing food banks, especially if they feel they look overweight.

Studies were also unanimous on finding that food insecure adolescents were more likely to over-evaluate their shape/weight than those who were not food insecure (Barry et al., 2021; Kim et al., 2021). Additionally, Kim and colleagues' study (2021) found this across both samples (clinical and non-clinical). This suggests that even those food insecure adolescents who do not meet 'clinical' criteria (e.g., they did not report disordered eating a month prior to the study) still experience the effects of FI on their weight/shape overvaluation. This could be extrapolated to suggest that FI can contribute to negative appraisals of body image, potentially being a precursor for disordered eating.

The relationship between food insecure adolescents being more likely to both over-evaluate their weight/shape and to experience body dissatisfaction should definitely be considered in future studies, with the role of race in both also being explored.

4.6 Clinically significant eating disorders

All studies looking at probable diagnoses were unanimous in their findings that adolescents who were food insecure were more likely to screen positive using self-report measures (Barry et al., 2021; Christensen et al., 2021; El Zein et al., 2019; Linsenmeyer et al., 2021).

Barry and colleagues (2021) finding that likely diagnoses were more prevalent in males which the authors describe as "unexpected and interesting". They used the SCOFF measure (Morgan et al., 1999), and the only comparison study that used the SCOFF in our sample is on transgender and non-binary adolescents (Linsenmeyer et al., 2021), so results are not comparable. However, one study with an age mean just above our cut-off also made use of the

SCOFF (Zickgraf et al., 2022). However, we have previously discussed how the use of the SCOFF with food insecure individuals, who the SCOFF has not been validated on may falsely inflate scores due to interpretation of the questions.

However, the authors theorise this could be due to the number of eating disorder risk factors for females being comparatively higher prior to college, meaning that college FI is significantly more impactful for males, who had exposure to less risk previously. For example, calorie deprivation prior to college is significantly more likely to be experienced by females (Larson et al., 2009)which could utilise similar mechanisms to FI (e.g., calorie restriction), making college FI less of a risk factor to those who had already experienced these behaviours. Another hypothesis made by Hernandez and colleagues is that females are better skilled at acquiring food in the context of FI, meaning some of the negative consequences may be mitigated in comparison to their male counterparts (Hernandez et al., 2017). More studies are needed to explore sex differences. However, neither of the other studies using alternate measures found sex differences in likely diagnoses.

Linsenmeyer and colleagues (2021) found significant differences between SCOFF scores, previous eating disorder diagnosis and the scores on their FI measure indicating that the SCOFF could be a valid measure not just for those who are food insecure but also for those who are transgender and non-binary. It is, however, important to note that the SCOFF cannot provide definitive eating disorder diagnoses (Kutz et al., 2020). Furthermore, this review has also highlighted several other limitations of using the SCOFF with this sample, namely the use of the question “Does food dominate your life?” and how this could potentially artificially inflate scores. Lastly, the SCOFF has no temporal anchor for questions, unlike many other eating disorder measures.

Christensen and colleagues’ (2021) study is the only one to date in adolescents which has additionally broken down the data into individual diagnoses. There was a significant

difference in likelihood between each diagnosis, with results indicating that those with FI were significantly more likely to have a probable diagnosis of bulimia nervosa only. This is contrary to studies in adults that report an increased likelihood of a binge-eating disorder diagnosis (Rasmusson et al., 2019). It also seems to go against the sizable amount of evidence suggesting the increased prevalence of binge eating behaviours presented earlier in this review. This could be due to the fact that they had relatively low prevalence on binge-eating disorder in their sample (n=12). It could also be due to sampling methods, with Rasmusson and colleagues collecting a wider variety of respondents with online recruitment compared to Christensen and colleagues sampling from one specific American University. El Zein and colleagues (2019) sample consisted of students across multiple institutions, however, their measure did not allow them to break down their results into specific diagnoses.

4.7 Limitations

This review has several limitations. Firstly, all but one study was conducted in the USA. Five of the studies used the same cohort from a small population in St Paul's. More studies are needed in the rest of the world to understand the impact that FI is having on adolescents. Additionally, the measures for FI and eating pathologies are inconsistent throughout the various studies, making comparisons and conclusions drawn from these comparisons tenuous. Similarly, measures of FI or the method of application vary from study to study, with some using measures by caregivers and some by the adolescents themselves. Lastly, current measures of eating pathology have not been validated on food insecure individuals. Many questions in popular measures (e.g., The SCOFF) do not specify the pathology must be due to weight and/or shape reasons, which will artificially inflate the responses received.

4.8 Conclusions

Clinicians can make use of this data by understanding that there is evidence for FI impacting eating pathologies and that this group can often be overlooked and under-represented in research. Particular attention will need to be paid to diverse groups who are under researched and at higher risk of FI. More research is needed worldwide, outside of the U.S. Measurement of eating pathology needs to be validated on food insecure samples and then standardised measures will be needed. This would allow for consistency and comparability across different countries. Longitudinal studies have shown some promise in helping to explore the impact, but more are needed to truly understand predictive mechanisms, which will be important to uncover not only for identifying higher-risk groups but also potentially clinically in treatment. Mechanisms of note from the research so far that should be further explored are family systems and caregiver dynamics, restrictive feeding practices, gender-identity, food-related self-efficacy, shame, and stigma. Developmental considerations should also be taken into account with the unique experiences of adolescents being accounted for in study design and analysis. It is essential all of this is done with more diverse samples, to allow for more generalisability of the findings.

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Part 2: Empirical Paper

“Even if that meant there being no food for me”: Adolescent food insecurity and disordered eating in the UK

Abstract

Background: The relationship between food insecurity and disordered eating has not been explored in the UK. Research in the US suggests that those who are food insecure are more likely to have disordered eating. This relationship has been significantly under-researched in adolescents, who are at a higher risk of food insecurity than their younger siblings and at the peak onset age for eating disorders.

Aim: To explore the relationship between food insecurity and specific eating disorder behaviours and diagnoses. To also explore the impact the COVID-19 lockdown had on eating behaviours in these groups and if any changes are enduring.

Method: 579 adolescents in the UK completed an online survey measuring their food insecurity, their eating pathology and their clinical impairment based on their eating behaviours.

Results: Severely food insecure adolescents were significantly more likely to report instances of binge eating, self-induced vomiting, laxative or diuretic use, compensatory fasting and excessive exercise. They were also more likely to be clinically impaired due to these behaviours. There were also more likely to meet probable criteria for binge-eating disorder, anorexia nervosa, bulimia nervosa, and otherwise specified feeding or eating disorders. They were also more likely to report disordered eating during the UK's first COVID-19 lockdown, and for these negative changes to have remained or escalated.

Conclusions: The findings suggest that food insecure adolescent in the UK may be of particular risk of eating pathology and that with the concerning increases in food insecurity in the UK and rise in eating disorder referrals warrants more research and consideration for this particular group.

1.0 Introduction

Food Insecurity (FI) has been defined as "the inability to acquire or consume an adequate quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so" (Dowler & O'Connor, 2012, p.12). Food insecure households will often rely on cheaper food with low nutritional value or compensate in portion-size, frequency of meals or by not eating at all (Dush, 2020). FI can apply to stress and worry caused by uncertainty around obtaining food, but it can also have life-threatening consequences (Hendriks, 2015). It is important to acknowledge that FI covers a broad range of experiences and is experienced on a continuum (Coleman-Jensen et al., 2018; Hendriks, 2015).

Worldwide, FI is a rising concern to public health, and this is only expected to increase further (FAO, 2017). Action Against Hunger estimates that worldwide, 3.1 billion people can't afford a healthy, nutritious diet with 150 million children not having their nutritional needs met. Consequently, 45% of all deaths to children under five are linked to undernutrition. FI rates are highest in low-income countries; however, this is a worldwide problem and 8-20% of some high-income countries' populations experiencing FI (Pollard & Booth, 2019) . Research within these countries has shown that the low-income communities within these countries that are disproportionately impacted by FI (Wolfson et al., 2021). Furthermore, FI is disproportionately experienced by minoritized racial and ethnic groups (Odoms-Young & Bruce, 2018).

It is important to note that poverty and FI are not interchangeable despite an association. You can live in poverty and not be FI, as you can be not living in poverty and still experience FI (Coleman-Jensen et al., 2018). Research has demonstrated that poverty can impact FI status differently depending on the temporal nature of the household's poverty (Mahadevan & Hoang, 2016). Research shows that there are causes of FI other than poverty, such as conflict, climate change and the economic state of a country.

1.1 Food Insecurity in the UK

In the United Kingdom (UK), there has been a sharp increase in FI over the past decade (Pautz & Dempsey, 2022). During the first UK COVID-19 lockdown, a preliminary report by Loopstra estimated that the number of FI adults in the UK quadrupled (Loopstra, 2020). There were specific contributing factors to this sudden increase, with 40% of the experiences thought to be due to shortages of food in supermarkets alone, those who experienced income losses, parents with children who were supposed to be receiving free school meals and those who needed to self-isolate being severely impacted as well (Loopstra, 2020). In the first national lockdown starting in March 2020, 50% of families with children entitled to free school meals were not able to access the scheme (Parnham et al., 2020), putting a huge strain on families already under strain. The UK experienced a new dimension of FI during COVID-19, where food acquisition was harder not just for financial reasons. Families who normally relied on lower-cost products due to their financial situations found that they were unable to acquire these due to supply shortages meaning there was a higher demand for all groceries.

In the aftermath of COVID-19 and the wake of the Russian-Ukraine war, the UK is currently experiencing a critical cost-of-living crisis, with rising costs of inflation and further shortages of products impacting the affordability of food (Broadbent et al., 2023). As of March 2022, 15% of the UK was food insecure according to the UK Government's Food Standards Agency's bi-annual report, having increased by 60% since the start of the pandemic (The Food Foundation, 2023).

By March 2023, this number had grown to 20% meaning that over 3 million more people in the UK were living with FI. This means that in the UK, over 13 million people are struggling to eat or be fed by others. Households with children were disproportionately impacted, with over 25% of households with children under the age of 16 being food insecure

in September 2022 (The Food Foundation, 2023). Consequently, it is estimated that there are 4 million children in the UK living with FI.

Between March and June 2022, 16 million Britons cut back on their spending on food and other household essentials, with 94% attributing this to the rise in the cost of their food (ONS, 2023). Those living in the most deprived areas of Britain were more likely to have reduced their spending on food and essentials (ONS, 2023). Alarming data from the Trussell Trust (Trussell Trust, 2023), the UK's largest provider of emergency food (Food Banks), highlights that between April 2022 and March 2023, more than 760,000 people were forced to utilise emergency provision from The Trussell Trust for the first time, even more that during the peak of the pandemic. This same period saw the highest number of emergency food parcel provision since the charity began, with an increase of over 50% from the same period 3 years before. Research has shown that accessing emergency provision through a food bank is an indicator for severe FI (Loh et al., 2021). While we know that FI is increasing within in the United Kingdom, this is not a new problem, and the UK has had among the highest rates of FI in Europe for many years (British Medical Journal, 2019). However, a lack of rigorous methodological practice has left many unanswered questions regarding the consequences of food security on the UK population and how this has changed over time (Pool & Dooris, 2022).

The known consequences of FI can be detrimental, and it has been identified as a significant public health concern associated with many negative health related outcomes in adults including diabetes, asthma and hypotension (Gundersen & Ziliak, 2015; Holben & Pheley, 2006). Furthermore, children living with FI are more likely to be hospitalised, have higher blood pressure, and to have poorer overall physical health (Cook et al., 2006; Gundersen & Kreider, 2009; Hernandez & Jacknowitz, 2009; South et al., 2019; Thomas et al., 2019).

As well as physical health, FI has unsurprisingly been linked to numerous mental health conditions. Psychological distress, depression and stress have been found to be reliably

associated with FI in a recent systematic review and meta-analysis (Pourmotabbed et al., 2020). Furthermore, a recent narrative review specifically on research from the five years prior, draws attention to research suggesting a potential bi-directional relationship between mental health concerns and FI (Myers, 2020). Some longitudinal research suggests that in addition to FI having negative consequences on mental health, poor mental health can impact one's ability to obtain food in socially acceptable ways, for example by not being able to work and generate an income (Bruening et al., 2017; Huddleston-Casas et al., 2009). Bruening and colleague's (2017) systematic narrative review identified a vicious cycle of mental health difficulties and FI, and how they can both be a cause and a consequence. Furthermore, longitudinal analysis of Birth Cohort Data identifies how maternal depression can predict FI in children later in life (Noonan et al., 2016).

Although a considerable amount of research has been conducted looking at the negative physical health impact of FI, very little research has been conducted looking at the relationship between FI and eating disorders (Hazzard et al., 2020). Estimates suggest that there are over 700,000 individuals in the UK living with an eating disorder (The National Institute for Health and Care Excellence, 2019). Eating disorders account for another serious public health concern due to their association with poor physical health, psychosocial impairment, psychiatric co-morbidity and suicidality (Gibson et al., 2019; Hudson et al., 2007; Swanson et al., 2011). Importantly, patterns of disordered eating that do not meet threshold for clinical diagnosis are also of significant concern due to their association with less nutritiously adequate diets (Larson et al., 2009), increased instances of depressive symptoms (Hazzard et al., 2019; Stice & Bearman, 2001), suicidality (Crow et al., 2008; D. S. Kim & Kim, 2009) and can often be a precursor for diagnosable eating disorders (Stice et al., 2011, 2017).

This link between FI and disordered eating was first identified in 1996 by Kendall and colleagues (Kendall et al., 1996) but research has only really been dedicated to the field in the

past decade (Hazzard et al., 2020). Becker and colleagues (Becker et al., 2017, 2019) found that 17% of adults living with FI met diagnostic criteria for eating disorders. Comparison studies have found that there is an increased likelihood of bulimia nervosa and binge eating disorder for individuals living with FI (Becker et al., 2017, 2019; Bruening et al., 2012; Lydecker & Grilo, 2019; Rasmusson et al., 2019).

Research into the link between FI and disordered eating in adolescents has been conducted almost exclusively in the United States of America (US), with only one study taking place outside of the US. Although a recent study on eating disorder healthcare professionals in the UK identified that they were seeing an increasing number of those referred to eating disorder services with FI (Kuehne et al., 2023). In adolescents, FI has been found to be linked to compensatory restriction (Christensen et al., 2021; Hooper et al., 2020; Linsenmeyer et al., 2021) and other extreme and/or unhealthy weight controlling behaviours such as purging, laxative use and diuretic use (Barry et al., 2021; Christensen et al., 2021; Hazzard et al., 2022; Hooper et al., 2020). However, by far the greatest pathology of interest has been binge eating, with the overwhelming amount of evidence suggesting that FI is linked to binge eating in adolescents (Bruening et al., 2017; Christensen et al., 2021; Hazzard et al., 2022; B. H. Kim et al., 2021; West et al., 2019). With the relationship with binge eating being more established in the literature, more research on other pathologies would be beneficial as it is clear that research indicates differences but there is variability in the findings.

Older children and adolescents are often overlooked in FI research when in comparison to both younger children and adults, regardless of the literature suggesting this exposure (Dush, 2020) . Evidence suggests that if a family is living with FI, parents are more likely to protect the youngest of their children from experiencing FI by ensuring they are provided with food, making their older siblings twice as likely to be impacted (Bauer et al., 2015; Fram et al., 2011). Moreover, adolescents themselves often also choose to forgo any food they may have if that

means that their younger siblings will not be without (Waxman et al., 2015). This could explain why when looking at indicators of adolescent mental health, FI was more strongly associated when compared to other indicators of social economic status (McLaughlin et al., 2012).

There have been several theories presented to explain the association between FI and eating, including the "feast-or-famine" cycle. Typically, FI presents in a "feast-or-famine" cycle, where varying levels of food availability at any given time impact the amount of food consumed, for example the potential relative abundance of food after receiving a monthly or weekly wage (Dinour et al., 2007). With the way many universal benefits systems are set up, this has the potential to magnify this cycle where benefits are received once a month (Dinour et al., 2007; Wilde & Ranney, 2000). Importantly, research has demonstrated that when food is restricted, either intentionally or not, a plethora of cognitive, emotional and behavioural consequences occur such as: food preoccupation, higher levels of reactivity and an increased propensity to binge eat when food is no longer restricted (Polivy, 1996). Keys' Minnesota Starvation Experiment was one of the first studies looking at the impact on nutritional rehabilitation after famine. The study consisted of three stages: baseline, semi-starvation and nutritional rehabilitation, each with their own emotional and behavioural consequences (Keys et al., 1950). The study found that those in the semi-starvation phase developed an intense preoccupation with food and that those in the rehabilitation phase with more available food were more likely to demonstrate binge-eating behaviours (Keys et al., 1950). The pattern of behaviour seen in The Minnesota Starvation Study mimics what we would expect in the feast-or-famine cycle, similar patterns of restriction and binge-eating depending on availability have also been found in qualitative studies from low-income samples (Bove & Olson, 2006; Olson et al., 2007; Tester et al., 2016).

Alternately, it is thought that even the "feast" part of the cycle alone can lead to disordered eating behaviour (Christensen et al., 2021). As we have already discussed, FI can

lead to cycles of food deprivation and adequate availability of food, which mimics the patterns of eating often seen in dieters. The "overeating" or binging seen in the "feast" phase of the cycle for those with FI has been found to promote compensatory dieting to prevent potential weight-gain or shape-change (Stinson et al., 2018; West et al., 2019). This cycle of binge-eating with compensatory dieting has been demonstrated in cultures that value slenderness (Steiger & Bruce, 2007; Stein et al., 2007). As a result of these binge/restriction cycles, it is thought that those with FI can be at a higher risk of eating disorders.

Another theory that has been proposed for the relationship, this time between FI and overall mental health, is related to stress responses. It is thought that when the availability of food becomes uncertain, a mechanism is triggered causing an intense stress reaction which can impact mental health (Weinreb et al., 2002). It is also thought that parenting practices could potentially be impacted by the stress that parents of food insecure households are under, consequentially impacting their children's mental health (Alaimo et al., 2001). Furthermore, we know that parents from FI homes are more likely to instil restrictive feeding practices (Bauer et al., 2015) which we also know are predictive of binge eating in the children (Puhl & Schwartz, 2003).

Despite the evidence, there has been limited research into FI and eating pathology, especially in adolescents who, based on the presented evidence seem to be an at-risk group (Bauer et al., 2015; Fram et al., 2011). One reason for this is thought to be because of the previously assumed "skinny, white, affluent girls" ("SWAG") misconception around eating disorders (Sonneville & Lipson, 2018). This "SWAG" stereotype influenced eating disorder research and treatment, with assessment tools, prevention methods and treatment options shaped around this "SWAG" sample (Cooper et al., 1989; Fairburn & Beglin, 1994). Another influence of "SWAG" samples relevant to this sample is identifying and defining key constructs of eating disorders such as "dietary restraint". In line with the "SWAG" samples,

"dietary restraint" is usually related to weight/shape motivations in current eating disorder measures (Cooper et al., 1989; Fairburn & Beglin, 1994). FI individuals will likely have additional motives for dietary restriction, such as to ensure other members of their households are fed (Middlemass et al., 2021). This overlooked aspect of the parallel in restriction in the ED research is vital to understand more, especially when current ED measures used have likely not been validated on FI populations.

Adolescence is a pivotal transition period in the lifespan for independence and responsibility (Arnett, 2000). The transition to university has found adolescents being vulnerable to FI due to the financial burden with housing, high costs of tuition and books (Carnevale et al., 2015; Senack & Donoghue, 2016; Walizer et al., 2018). Financial burden for students can impact food security, leading to less money budgeted for food, a reduction in food intake or an increase in cheaper foods which are often energy-dense with low nutritional value (Bruening et al., 2016). A study looking at multiple universities across the United States of America found that 19% of first year students were food insecure, with a further 25.3% at risk (El Zein et al., 2019). This relationship seems to not correlate to community rates in the local area, suggesting that undergraduates are disproportionately affected (Payne-Sturges et al., 2018). Furthermore, young adulthood can also be a significant period as resources devoted to protecting young people from FI may be withdrawn with age, for example free school meals (Bruening et al., 2020). The rates of FI were highest amongst students identifying themselves as from a racial minority in El Zein and colleagues study (2019). Previous literature has demonstrated that specific ethnic groups are at higher risk of negative outcomes from FI due to marginalisation and financial barriers as a result of racial discrimination (Payne-Sturges et al., 2018; West et al., 2019). Furthermore, research has also shown us that these minoritized groups are the least likely to receive support (A. J. Comber et al., 2011).

In the Project EAT (Eating and Activity in Teens and Young Adults) cohort study, reports of past year FI more than doubled between wave one of the study, and wave two, when the cohort mean age went from 14.9 to 19.5 (Hazzard et al., 2022). This indicates a shift between age ranges, possibly because parents living in food insecure households tend to protect younger children from the impacts of FI more than they will adolescents (Hazzard et al., 2022). This fits with previous literature which suggests that older children are twice as likely to experience FI than younger children (Fram et al., 2011).

The peak age of onset of anorexia, bulimia and binge eating disorder ranges from 16-18 (de Girolamo et al., 2018; Marzilli et al., 2018; Volpe et al., 2016) making research into this relationship in adolescents even more vital as a potential to better understand risk factors to be better able to provide early intervention.

When FI research has been done with adolescents, it has often been criticised for the instruments used, with many not directly asking for the adolescent's experience of FI, and instead asking for a parental proxy of household FI, which may not be wholly representative of the individuals experience (Crous, 2017; Shankar-Krishnan et al., 2021).

1.2 Aims

With both the percentage of the population living with FI and the amount of eating disorder referrals alarmingly increasing in the UK over the last few years (Solmi et al., 2021), it is essential that we better understand the link in this relationship. It feels of particular importance to prioritise this research on adolescents, who have been neglected in research despite being an at-risk group, not only for eating disorder but also for removal of protective factors from FI. Furthermore, with the continuing cost of living crisis and the after-effects of the pandemic, this area should remain a priority for both research and its application clinically. To the best of the author's knowledge, no research has been conducted in the UK to investigate

the link between disordered eating and FI, and in adolescence only one study has been conducted outside of the US.

1.3 Hypotheses

H1: When compared to those with no food insecurity, adolescents with food insecurity will report more binge-eating episodes and compensatory behaviours. Moreover, that they will report a significantly higher level of impairment from eating disorder symptoms

H2: That adolescents with food insecurity will more likely meet criteria for a diagnosis of an eating disorder than those without food insecurity, when controlling for ethnic background and religion.

H3: That there will have been a difference in changes in eating behaviours during the COVID-19 lockdown dependant on groupings by food security status, and that there would also be a difference in if these changes were enduring.

2.0 Methods

2.1 Design

An observational design was chosen due to just one study taking place outside of the US we were not able to assume that this relationship was the same, meaning a larger sample using an observational design was more appropriate. By opting for an observational approach, we were able to gather data from a diverse sample of adolescents within a real-world context, providing valuable insights into the complexities of this relationship within different cultural and socioeconomic contexts.

2. 2 Participants

Adolescents living in the United Kingdom between the ages of 16-19 were recruited to take part in an online study on their eating behaviour (*n*= 582; M_{age} = 16.99, SD= 0.95, range= 16-19). With the peak age of onset of anorexia, bulimia and binge eating disorder ranging from 16-18 (de Girolamo et al., 2018; Marzilli et al., 2018; Volpe et al., 2016) and older siblings more likely to experience the consequences of FI than their younger siblings (Bauer et al., 2015; Fram et al., 2011) this age range was selected. With the aim of recruiting a diverse sample within this age range, further study criteria only demanded that participants understood written English and had access to the internet. Participants were offered an opportunity to enter a ballot after completing the study to win one of 20 draws for a £20 voucher at a UK based clothes retailer. The final sample for analysis after unlikely respondents were removed was 579. Table 1 shows details of participant characteristics.

Table 1

Demographic characteristics of sample

Demographic	*n*	M (SD)
Age	579	17 (1.0)
BMI	485	22.9 (5.3)
Demographic	*n*	%
Gender Identity		
Male	78	13.5
Female	396	68.4
Non-Binary	64	11.1
Any other Gender Identity	38	6.6
Prefer not to say	3	0.5
Ethnic Background		
Any other mixed background	18	3.1

Any other white background	36	6.2
Asian / Asian mixed	49	8.5
Black African/ Black African mixed	9	1.6
Black Caribbean/ Black Caribbean Mixed	8	1.4
Irish / Irish Traveller	9	1.6
Middle Eastern	4	0.7
White (Welsh/English/Scottish/Northern Irish/ British)	440	76.0
Prefer not to say	6	1.0
Religion		
Christian (including all Christian denominations)	93	16.1
No Religion	433	74.8
Muslim	14	2.4
Any Other Religion	37	6.4
Missing	2	0.3
Food Insecurity Status		
Food Secure	352	60.8
Moderately	159	27.5
Severely	68	11.7
Education		
In full or part-time education	505	87.2
Not in education	65	11.2
Prefer not to say	9	1.6
Employment		
In Full or part-time employment	214	37.0
Not employed	346	59.8

Prefer not to say	19	3.3
In receipt of state benefits		
Yes	33	5.7
No	507	87.6
Prefer not to say	39	6.7
Consider self to have a Disability		
Yes	176	30.5
No	375	65.0
Prefer not to say	28	4.8
Formal Eating Disorder Diagnosis		
Yes, currently	51	8.8
Yes, previously	45	7.8
No	458	79.1
Prefer not to say	25	4.4

Note: Table 1 contains the demographic characteristics of the analytic sample (n= 579). The sample sizes varied due to missing values for the following variables: Gender Identity (n= 577), BMI (n= 485), Education (n= 570), Employment (n=560), benefits (n= 540) and disability (n=551).

2. 3 Procedure

The study was approved by the University College London research ethics committee. For six months between September 2022-Feburary 2023, the online survey was open, and recruitment was active. Contextually, during this time, the UK was going through a cost-of-living crisis following the COVID-19 pandemic (see introduction for more details). The online survey platform 'Qualtrics' was used to collect study data.

Having a comparable sample size in the food insecure group was a priority, and some purposive sampling was utilised in order to meet our target. This was done by reaching out to UK wide food charities and food banks to support with recruitment via email and social media.

Although we had a positive response, uptake of the survey via these routes was minimal. With 98% of 16–24-year-olds in the UK owning smartphones (Statista, 2023), we decided to target social media platforms. We ran Instagram adverts from November 2022 to February 2023. These adverts included a study poster requesting UK 16–19-year-olds to tell us more about their eating behaviours (Appendix D). Using this opportunity sample yielded a larger uptake.

Clicking the link took participants to the participant information sheet (Appendix E), which provided information about the purpose of the study. All participants were informed that their data was anonymous and that they were able to skip questions if they did not want to answer them. All participants then had to confirm they understood and consented to the study Appendix F). As there were questions relating to FI and eating pathology, at the end of the study participants were signposted to The Trussell Trust and Beat (A UK support charity for people with eating disorders).

A power analysis using G*Power3 was run, (Faul, Erdfelder, Lang, & Buchner, 2007) based on a medium effect size of .25 (with alpha set at .05, beta at .8, number of groups= 2, number of measures= 2, correlation among repeated measures = .5 and non-sphericity correction=1). This produced a minimum total sample size of 34.

With this, there is an 82% chance of correctly rejecting the null hypothesis of no significant effect on the interaction with 17 in the food-insecure group and 17 in the non food insecure group for a total of 34 participants.

2. 4 Measures/ The Questionnaire (Appendix G)

2. 4.1 Demographics

Demographic information was collected from each participant including age, ethnic background, religion, gender, level of education, employment status, whether they/their family

were in receipt of state benefits and whether they had a current or previous formal eating disorder diagnosis. Religion was collected to capture any nuances of religious food practices including the observation of religious fasting and the acceptability of some foods (Cohen, 2021).

2.4.2 The Clinical Impairment Assessment

The Clinical Impairment Assessment (CIA) is used to assess the impact on functioning of an individual's eating psychopathology (Bohn & Fairburn, 2008). The CIA is made up of 16 Likert-style questions based on the past 28 days. Responses range from 0 "not at all" to 3 "a lot". Global scores can be calculated by adding the scores of all 16 responses. Higher scores indicate greater impairment. Scores of 16 or higher are thought to indicate the presence of an eating disorder with excellent accuracy (Reas et al., 2016). The CIA has shown moderate to strong discriminant and convergent validity in adolescent samples as well as to be a reliable measure of severity of impairment (Jenkins, 2013; Raykos et al., 2019; Reas et al., 2010). In this study, internal consistency of the CIA was excellent with the value for Cronbach's Alpha being .97.

2.4.3 The Eating Disorder Diagnostic Scale 5

The Eating Disorder Diagnostic Scale 5 (EDDS-5; Stice & Ragan, 2002) is a 23-item self-report scale used as an assessment for several eating disorders (anorexia nervosa, bulimia nervosa, binge eating disorder and otherwise specified feed or eating disorder). This asks questions about eating pathology over the last 3-6 months. By summarising the responses, a composite score can be calculated (Stice et al., 2004). The EDDS-5 gives an indication of probable diagnoses. The EDDS-5 has demonstrated strong reliability and validity with adolescent samples (Stice et al., 2004) and has previously

been used in research looking at the relationship between FI and eating pathology (Becker et al., 2017; Christensen et al., 2021).

2.4.4 Food Insecurity Experience Scale

The Food Insecurity Experience Scale (FIES) has been used to measure FI. In 2014, the United Nations Food and Agriculture Organisation developed the 'Voices of the Hungry project'. They developed the 8 question FEIS to capture the experiences of people's access to food in a way that would make world-wide data easily comparable. This is part of the UN's Sustainable Development Goal to end hunger and FI by 2030. Cross culturally the FIES has shown validity (Smith et al., 2017) and it has been translated into 200 languages (Cafiero et al., 2018). The FIES is currently used by the Department for Work and Pensions' Family Resources bi-annual survey in the UK. Due to its frequent use in the UK, and its high validity, the FIES was selected to be used in this study.

Both a raw score and a categorical score can be calculated from each respondent. The raw score is the sum of scores. The categorical data categorises participants into either "food secure", "Moderately food insecure" and "Severely food insecure" dependant on their answers.

2.4.5 Qualitative Questions

Following quantitative data questions, participants were presented with the two optional open-ended questions for qualitative analysis. Question One: Tell us about the impact of the first national lockdown (23rd March 2020-1st June 2020) on your eating. Did you find yourself eating more or less or different types of food? Did the pattern of your eating change? Question Two: If there were changes in your eating habits, were these enduring changes? i.e., are these changes of habit still with you today? how is your eating now?

2.5 Probable Eating Disorders

Probable eating disorder diagnoses were identified using a combination of the EDDS-5 and the CIA. Probable eating disorder classification of anorexia nervosa, bulimia nervosa, binge-eating disorder or other specified feeding or eating disorder (OSFED) was conducted using individuals self-reported eating disorder symptomology (EDDS-5) and their impairment based on this symptomology (CIA).

Likely diagnoses for anorexia nervosa, bulimia nervosa and binge-eating disorder were given if a probable diagnosis was indicated by the EDDS-5 and the participant also scored 16 or above in the CIA, indicating a group of symptoms relating to a specific diagnosis with a high level of impairment. Any other criteria indicated by the EDDS-5 (e.g., purging disorder, low-frequency binge-eating disorder) paired with a CIA score of 16 or above were classified as the otherwise specified feeding or eating disorder (OSFED). To ensure a low rate of false diagnosis, conservative measures were used: if there was indication of a probable diagnosis from the EDDS-5, but with no clinical impairment indicated by the CIA, no likely diagnosis was given. Similarly, scores for the CIA indicated clinical impairment but the EDDS-5 gave no clear probable diagnosis, individuals were identified as having no ED diagnosis.

This is based on previous research which identified low rates of false positives for probable eating disorders using similar diagnosis criteria (i.e., <2%; Forbush et al., 2017, 2018).

2.6 Statistical Analysis

2.6.1 Quantitative analysis

A number of approaches were used to ensure the data-set was clean, therefore maintaining data high integrity. All cases with improbable BMIs were flagged and removed (e.g., BMI of 4), as well as those with inconsistent answers to questions measuring the same construct (e.g., the CIA and the question on interference in the EDDS-5). Furthermore,

qualitative responses indicative of unlikely valid participants were removed. In total, 3 respondents were removed for potentially invalid responses.

Analyses were performed using IBM SPSS Version 28. Firstly, demographic characteristics were compared across each level of our independent variable: food secure, moderately food insecure, severely food insecure. An ANOVA was conducted to explore differences across the levels and age, and a Kruskal-Wallis one-way analysis of variance was conducted to determine differences in BMI. A series of Chi-Square Goodness of Fit Tests were also performed to determine whether the proportion of gender, ethnic background, religion, and other demographic characteristics were equal between the three levels of food security status.

A Kruskal-Wallis one-way analysis of variance was conducted for individual frequencies of eating pathologies across the levels of FI status (e.g., Instances of binge-eating, self-induced vomiting, laxative use, fasting and exercise related to weight loss). A Chi-Square Goodness of Fit Test was run to compare ED related impairment by FI status.

Finally, multinominal logistic regression was used to calculate odds ratios, to compare the risk of potential diagnosis as a function of food security status. Potential covariates were reviewed for inclusion based on guidance from prior research, allowing for control over confounding variable (i.e., variable which the literature suggests may predict the independent variable and outcome). Ethnic background and religion were both included as covariates in the regression model. For the regression analyses, the reference group for each eating disorder diagnosis was ‘no diagnosis’.

2.6.2 Qualitative analysis

A conventional inductive content analysis was performed on written responses. The aim of a content analysis was to gain a further understanding of the data with objective description. Themes or categories were inductively extracted from the data (Elo & Kyngäs, 2008; Hsieh & Shannon, 2005). Uncertainty for criterion for each category was discussed and documented below. Quantitative data captured the frequency of each category and is presented in percentages of total responses analysed.

Question One responses were categorised into one of four categories: 'disordered eating', 'Significant changes in eating', Stayed the same' or 'Positive change'. Question Two responses were categorised: 'negative changes remained', 'decline in eating behaviours', 'Positive changes remained', 'Improvement in eating behaviours', or 'fluctuation in eating behaviours'.

The criterion for question one categories was based on word choices. The category for 'disordered eating' included specific words denoting disorder such as "purge", "restrict", "binge", or specifically mentioning not eating for at least a day or using adjectives such as "obsessive", "controlling" or "severe". In the 'significant changes' category, participants reported "much more/less" of something unhealthy, or missing meals, or eating at unusual times. The 'stayed the same' category, included participants reporting no changes or that changes were minimal. 'Positive changes' incorporated any healthier changes, for example "I ate healthier", or reporting that disordered eating became less disordered, such as less purging or less restriction. Healthier food choices, such as increased fresh fruit and vegetable consumption, a decrease in junk food, and positive changes to eating patterns such as now eating 3 meals a day, were also in this category.

The second question sought to assess whether the lockdown changes to eating behaviour endured. Respondent's reports were categorised into 4 categories: 'negative changes

remained', 'decline in eating behaviours', 'Positive changes remained', 'Improvement in eating behaviours', or 'fluctuation in eating behaviours'.

If attribution to behaviours change was given to the participants, this was also incorporated as additional information, but it was not captured in the percentages.

3.0 Results

3.1 Quantitative Analysis

3.1.1 Demographic differences across the levels of food insecurity

The participants fell into groups of food secure (n=352), moderately food insecure (n=159) and severely food insecure (n=68). These three groups did not differ significantly in terms of age, BMI, gender or employment status (Table 2).

A Chi-Square Goodness of Fit Test (Table 2) showed that there was a statistically significant difference in ethnic backgrounds between the three levels of food security status: X^2 (6, 573) = 23.89, p < 0.001 with a higher majority of participants from any white or white mixed ethnic background in the 'food secure' groups (86.8% vs 77.6% and 76.5%). This was with a weak effect size (Cramer's V= 0.144).

A Chi-Square Goodness of Fit Test (Table 2) showed that there was a statistically significant difference in religion across the groups, X^2 (6, N = 577) = 18.36, p < 0.01 with more Christianity seen in the food secure group and higher levels of 'any other religion' seen in the moderately and severely food insecure groups.

Further Chi-Square Goodness of Fit Tests (Table 2) showed that there was a statistically significant difference seen across the groups in terms of being in full-time or part-time education (X^2 (4, N = 579) = 22.84, p < 0.001), in receipt of benefits (X^2 (4, N = 579) = 32.88, p < 0.001), experience of disability (X^2 (4, N = 577) = 34.77, p < 0.01) and formal eating disorder

diagnosis (X^2 (6, N = 579) = 24.59, p < 0.001). Those who were severely food insecure were more likely not to be in full or part-time education (26.5% vs 13.2% and 7.4%); to be receiving Universal Credit (17.7% vs 8.2 and 2.3); to consider themselves to have a disability (55.9% vs 37.3% and 22.5%) and to report a current eating disorder diagnosis (19.1% vs 10.1% and 6.3%).

Table 2

Group differences by food security status

	No Food Insecurity (n=352)		Moderately Food Insecure (n= 159)		Severely Food Insecure (n= 68)		Test Statistic
	M (SD)		M (SD)		M (SD)		
Age	17.0 (1.0)		17.0 (0.9)		17.1 (1.0)		F(2, 576) = 0.69, p = .504.
BMI	22.7 (5.0)		23.2 (5.7)		22.8 (6.3)		H(2, 482) =1.26, *P= 5.33*
	n	%	*n*	%	*n*	%	
Gender Identity							
Male	52	14.8	21	13.2	5	7.4	X^2 (8, N = 579) = 15.13, p = 0.057
Female	250	71.0	102	64.2	44	64.7	
Non-Binary	28	8.0	23	14.5	13	19.9	
Other Gender Identity	20	5.7	13	8.2	5	7.4	
Ethnic Background							
White/ white mixed	303	86.9	121	77.6	52	76.5	X^2 (6, 573) = 23.89, p < 0.001***
Asian/ Asian mixed	34	9.7	13	8.3	6	8.8	
Black/ black mixed	4	1.1	8	5.1	5	7.3	
Any other / other mixed	8	2.3	14	9.0	5	7.3	
Religion							
Christian	64	18.2	21	13.3	8	11.8	X^2 (6, 577) = 18.36, p < 0.01**
Muslim	11	3.1	3	1.9	0	0	
Any other	12	3.4	16	10.1	9	13.2	
No religion	264	75.2	118	74.7	51	75.0	

In full or part-time education							
Yes	319	90.6	137	86.2	49	72.1	X^2 (4, N = 579) = 22.84, p <
No	26	7.4	21	13.2	18	26.5	0.001***
Employment Status							
Yes	121	34.4	69	43.4	24	35.3	X^2 (4, N = 579) = 6.08, p = 0.194
No	222	63.1	83	52.2	41	60.3	
In receipt of benefits							
yes	8	2.3	13	8.2	12	17.6	X^2 (4, N = 579) = 32.88, p <
no	326	92.6	130	81.8	51	75.0	0.001***
Consider self to have a disability							
Yes	79	22.5	59	37.3	38	55.9	X^2 (4, N = 577) = 34.77, p < 0.01**
No	254	72.4	93	58.9	28	41.2	
Formal ED diagnosis							
Currently	22	6.3	16	10.1	13	19.1	X^2 (6, N = 579) = 24.59, p <
Previously	21	6.0	15	9.4	9	13.2	0.001***
Never	297	84.4	121	76.1	40	58.8	

Note. Table 2 contains the demographic characteristics of the analytic sample (n = 579). The sample sizes varied due to missing values for the following variables: Gender Identity (n = 577), BMI (n = 485), Education (n = 570), Employment (n =560), benefits (n = 540) and disability (n =551).

3.1.2 Individual Food Insecurity and Eating Disorder Pathology

The next set of analyses looked at reported frequencies of specific behaviours across the three levels of food security. The five behaviours investigated were: instances of binge eating, instances of self-induced vomiting, instances of laxative or diuretic use, instances of compensatory fasting and instances of excessive exercise, as reported in the EDDS-5. For each behaviour, the assumptions of normality were violated as demonstrated by Shapiro-Wicks test and by visual inspection of histograms depicting a positively skewed distribution. Hence, the use of non-parametric tests.

Visual inspections of interval plots indicated differences in frequencies across all five behaviours for all the three levels of food security-status. A series of Kruskal-Wallis one-way

analysis of variance analyses indicated that the median in frequencies of each behaviour were statistically significantly different between the different levels of food security-status (Table 3).

There was homogeneity of variances, for binge eating frequency, as assessed by the Levene's test for equality of variances, $p > .05$. The Kruskal-Wallis one-way analysis of variance indicated a significant difference between frequency of binge-eating for each level of FI: $H(2) = 19.61$, $p < 0.001$. Post hoc analyses with a Bonferroni correction were conducted to determine where the significance lay. They showed that that reports of binge eating were significantly higher in severely food insecure individuals when compared to those who were food secure $t=-3.97$, $p < 0.001$, with a medium effect size as highlighted by the Cohen's D of -0.549 and a mean difference of -1.488. This is also the case when comparing severely food insecure and moderately food secure groups: $t= -2.57$, $p < 0.05$ with a smaller effect size as indicated by a Cohen's D of -0.390 and a mean difference of -1.030.

For self-induced vomiting, the assumption of equality of variance was violated as demonstrated by the Levene's test, and our choice of non-parametric testing was still suitable. A Kruskal-Wallis one-way analysis of variance indicated a statistically significant difference across the levels of food security in frequency of behaviour: $H(2) = 15.81$, $p < 0.01$. Post hoc analyses with a Bonferroni correction demonstrated that there was only a significant difference between those who were food secure and those who were severely food insecure $t=-2.69$, $p < 0.05$ showing that the frequency of self-reported self-induced vomiting is higher in those who are severely food insecure when compared to those who are food secure, with a small effect size demonstrated by the Cohen's D of -0.374 and a mean difference of -0.674.

For laxative and/or diuretic use, the assumptions were again violated, and a Kruskal-Wallis one-way analysis of variance indicated a statistically significant difference across the levels of food security in frequency of behaviour: $H(2) = 31.58$, $p < 0.001$. Post-hoc analyses

indicated that when compared to severely food insecure, there were statistically significant differences between both the food secure ($t=-4.97$, $p < 0.001$) and moderately food insecure ($t=-3.70$, $p < 0.001$) with medium effect sizes of -0.667 and -0.547 and mean differences of -0.865 and -0.709 respectively. These indicated that those in the severely food insecure group were significantly more likely to report laxative or diuretic use than those in both the moderately food insecure and food secure groups

For compensatory fasting, a Kruskal-Wallis one-way analysis of variance demonstrated significant differences between the groups $H(2) = 40.29$, $p < 0.001$. Post-hoc analyses found these differences to lie between food secure individuals when compared to both moderate ($t=-4.77$, $p < 0.001$) and severe ($t=-5.73$, $p < 0.001$) FI whereby both food insecure groups were more likely than the food secure group to report compensatory fasting. There was a medium effect for the difference between food secure and moderately food insecure (Cohen's D= -0.538, MD= -1.645) and a large effect size for the difference between food secure and severely food insecure (Cohen's D= -1.098, MD= -3.361). Post-hoc analyses also revealed a difference between moderately and severely food insecure: $t=-2.71$, $p < 0.05$, with a medium effect size (Cohen's D= -0.560, MD= -1.716).

Finally, for excessive exercise, a Kruskal-Wallis one-way analysis of variance demonstrated significant differences between the groups $H(2) = 10.02$, $p < 0.01$. Post-hoc analyses indicated that when compared to severely food insecure, there were statistically significant differences between both the food secure ($t=-3.44$, $p < 0.01$) and moderately food insecure ($t=-3.17$, $p < 0.01$) with medium effect sizes of -0.507 and -0.508 and mean differences of -1.360 and -1.362 respectfully.

Using the CIA's cut off for indication of clinical impairment of 16, the sample was divided into a dichotomous "above clinical threshold" or "below clinical threshold". Across the three levels of food security status, a Chi-Square Goodness of Fit Test indicated a

significant difference between the three groups: X^2 (2, N = 579) = 44.99, p < .001 (Table 3). In the severely food insecure group, 89.71% were above clinical threshold, as compared to 74.21% of the moderately insecure sample and 52.84% of the food secure sample. This result is weakly associated with a Cramer's V of 0.279.

Probable ED diagnoses were made conservatively, based on both the EDDS-5 and the scores from the CIA (as described in the methodology). When those with any probable ED were compared to those without, a Chi-Square Goodness of Fit Test indicated a significant difference between the levels of food security: X^2 (2, N = 579) = 37.44, p < .001 (Table 3). Of the severely food insecure group, 82.35% met criteria for any eating disorder diagnosis, compared to 62.26% for the moderately food insecure and 45.17% for the food secure sample. The Cramer's V indicated a weak effect size of 0.254.

When comparing specific probable eating disorder diagnoses across the three levels of food security status (i.e., Anorexia nervosa, bulimia nervosa, binge-eating disorder and OSFED), a Chi-Square Goodness of Fit Test indicated a statistically significant difference X^2 (8, N = 579) = 53.86, p < .001 (Table 3), with a small effect size (Cramer's V= 0.216).

Table 3

Eating disorder pathology by food security status

	Food Secure		Moderately FI		Severely FI		Test Statistic
	M (SD)		M (SD)		M (SD)		
Instances of Eating Disorder Behaviour							
Binge eating	2.1 (2.7)		2.6 (2.5)		3.6 (2.9)		H(2) = 19.61, p < 0.001***
Self-Induced vomiting	0.5 (1.8)		0.7 (1.8)		1.2 (2.1)		H(2) = 15.81, p < 0.01**
Laxative or diuretic use	0.2 (1.1)		0.4 (1.3)		1.1 (2.1)		H(2) = 31.58, p < 0.001***
Compensatory fasting	1.7 (2.7)		3.3 (3.6)		5.0 (4.0)		H(2) = 40.29, p < 0.001***
Excessive exercise	1.9 (2.6)		1.9 (2.5)		3.2 (3.3)		H(2) = 10.02, p < 0.01**
	n	%	*n*	%	*n*	%	
Eating Disorder Impairment							
Above clinically impaired threshold	186.0	52.8	118	74.2	61	89.7	X^2 (2, N = 579) = 44.99, p < .001***
Below Clinically Impaired threshold	166.0	47.2	41	25.8	7	10.3	
Eating Disorder diagnosis (dichotomous)							
Any ED diagnosis	159	45.2	99	62.3	56	82.4	X^2 (2, N = 579) = 37.44, p < .001***
No diagnosis	193	54.8	60	37.7	12	17.6	
Eating Disorder Diagnoses							
Anorexia nervosa	16	42.1	14	36.8	8	21.1	X^2 (8, N = 579) = 53.86, p < .001***
Bulimia nervosa	22	48.9	13	28.9	10	22.2	
Binge-eating disorder	4	33.3	2	16.7	6	50	
OSFED	117	53.4	70	32.0	32	14.6	
No ED	193	72.8	60	22.6	68	4.5	

Note. Food secure sample (*n*= 352), Moderately FI sample (*n*= 159) and Severely FI sample (*n*= 68).

A multinomial logistic regression was performed to model the relationship between the predictors and the indicated eating disorder diagnosis (No eating disorder, Anorexia Nervosa, Bulimia Nervosa, Binge Eating Disorder or OSFED). A p value of 0.05 was employed for all tests. Due to the limited nature of the sample, the covariates included in the analysis (ethnic background and religion) were made binary into either "white background" or "Any other ethnic background" and "religious" and "non-religious". This was essential in order to have validity of fit for the model, which otherwise would have had 82 cells with zero frequencies.

The addition of the predictors to a model that contained only the intercept significantly improved the fit between model and data, X^2 (16, N = 579) = 63.36, Nagelkerke R^2 = .116, p < .001. Goodness of fit was explored by conducting a Pearson's test and the Deviance chi-square statistic, neither of these were significant, indicating that the model is a good fit. As shown in Table 4, the only significant unique contribution was made by food security status.

Table 4

Predictors' Unique Contributions in the nominal Logistic Regression (N = 579)

	Likelihood Ratio Tests		
Effect	Chi-Square	df	Sig.
Intercept	.00	0	.
Food security status	54.77	8	<.001**
Ethnic Background	6.81	4	.146
Religious	4.40	4	.354

Note. X^2= amount by which -2 log likelihood increases when predictor is removed from the full model. *p < .05, **p < .01.

The reference group was those with no probable eating disorder diagnosis. Accordingly, each predictor has four parameters, one for anorexia nervosa vs no diagnosis, one for BN vs no diagnosis, one for binge eating disorder vs no diagnosis and one for OSFED vs no diagnosis.

To facilitate the interpretation of differences between predictors, each of the predictor variables had been standardized to mean 0, standard deviation 1. The parameter estimates are shown in Table 5.

Table 5

Parameter Estimates Contrasting the non-eating disorder diagnosis Group versus Each of the Other likely diagnoses (N = 579)

Probable Diagnosis		B	OR	Sig.	95% Confidence Interval for Exp(B)	
					Lower Bound	Upper Bound
Anorexia Nervosa (Vs. no eating disorder)	Intercept	-2.377		<.001		
	Severely Food Insecure	2.188	8.921	<.001	3.144	25.315
	Moderately Food Insecure	1.176	3.242	.003	1.480	7.103
	Food Secure	0[b]	.	.	.	.
	Any non-white ethnic background	-.800	.449	.127	.161	1.254
	White ethnic background	0[b]	.	.	.	.
	Religious	-.030	.970	.941	.438	2.149
	Non-religious	0[b]	.	.	.	.
Bulimia Nervosa (Vs. no eating disorder)	Intercept	-2.054		<.001		
	Severely Food Insecure	2.064	7.879	<.001	3.015	20.592
	Moderately Food Insecure	.764	2.146	.047	1.009	4.565
	Food Secure	0[b]	.	.	.	.
	Any non-white ethnic background	-.534	.586	.246	.238	1.446
	White ethnic background	0[b]	.	.	.	.
	Religious	-.150	.861	.697	.405	1.829
	Non-religious	0[b]	.	.	.	.

Binge Eating Disorder (Vs. no eating disorder)	Intercept	-3.823		<.001		
	Severely Food Insecure	3.333	28.009	<.001	6.828	114.887
	Moderately Food Insecure	.645	1.906	.465	.338	10.743
	Food Secure	0[b]	.	.	.	.
	Any non-white ethnic background	-1.509	.221	.164	.026	1.852
	White ethnic background	0[b]	.	.	.	.
	Religious	.346	1.413	.596	.394	5.073
	Non-religious	0[b]	.	.	.	.
Otherwise specified feeding and eating disorder (Vs. no eating disorder)	Intercept	-.337		.010		
	Severely Food Insecure	1.566	4.786	<.001	2.345	9.771
	Moderately Food Insecure	.787	2.197	<.001	1.430	3.374
	Food Secure	0[b]	.	.	.	.
	Any non-white ethnic background	-.499	.607	.059	.362	1.019
	White ethnic background	0[b]	.	.	.	.
	Religious	-.425	.654	.063	.418	1.024
	Non-religious	0[b]	.	.	.	.

Note. OR = odds ratio associated with the effect of a one standard deviation increase in the predictor; the reference category is 'no probable eating disorder diagnosis'.

In summary, the log odds of having a probable ED diagnosis increases for all diagnoses when moving from food secure to food insecure. The general log odds of meeting criteria for a probable diagnosis of anorexia nervosa Vs. not having an eating disorder will increase by 8.92 if moving from food secure to severely food insecure. Furthermore, this also applies when moving from food secure to moderately food insecure, with an increase of 3.24. Similarly, with bulimia nervosa, the general log odds of meeting criteria for a probable diagnosis Vs. not having an eating disorder will increase by 7.88 if moving from food secure to severely food

insecure. For food secure to moderately food insecure, the increase is 2.15. In terms of probable binge eating disorder, the general log odds of meeting criteria for a probable diagnosis Vs. not having an eating disorder will increase by 28.01 if moving from food secure to severely food insecure. The general log odds of meeting criteria for a probable diagnosis of OFSED Vs. not having an eating disorder will increase by 4.79 if moving from food secure to severely food insecure. For food secure to moderately insecure, the increase is 2.20.

3.2 Qualitative analysis

The qualitative part of the questionnaire was made up of two questions: (1) "Tell us about the impact of the first national lockdown (23rd March 2020-1st June 2020) on your eating. Did you find yourself eating more or less or different types of food? Did the pattern of your eating change?" and (2) "If there were changes in your eating habits, were these enduring changes? i.e., are these changes of habit still with you today? how is your eating now?". Below is the quantitative analysis of the content, followed by the qualitative analysis of each question.

3.2.1 Quantitative analysis of qualitative data

Of the 579 participants, 527 responses to Question One were analysed and 477 responses to Question Two. A small number of responses were excluded from analysis as the response offered insufficient information to allocate a category e.g. "I can't remember, sorry" or binary "yes"/"no" answers. Frequencies of identified themes for Question One and Question Two across the three levels of food security are presented in Table 6 and Table 7.

Table 6

Frequencies of themes for responses to Question 1 per sample

	Food Secure	Moderately FI	Severely FI
	n (%)	n (%)	n (%)
Disordered Eating	61 (18.9)	41 (29.8)	31 (48.4)
Significant changes	158 (49.1)	81 (56.0)	27 (42.2)
Positive Changes	48 (14.9)	6 (4.3)	4 (6.3)
Stayed the same	49 (15.2)	7 (5.0)	2 (3.2)

Note. Food secure sample (*n*= 322), Moderately FI sample (*n*= 141) and Severely FI sample (*n*= 64)

Additional information on what participants believed contributed to these changes, was captured in three sub themes: impact of routine/structure, emotional impact, or financial/supply impact.

Table 7

Frequencies of themes for responses to Question 2 per sample

	Food Secure	Moderately FI	Severely FI
	n (%)	n (%)	n (%)
Stayed bad	61 (21.3)	50 (38.5)	21 (35)
Got worse	42 (14.6)	15 (11.5)	19 (31.7)
Stayed good/improved	126 (43.9)	35 (26.9)	9 (15)
Fluctuates	59 (20.6)	31 (23.9)	11 (18.3)

Note. Food secure sample (*n*= 287), Moderately FI sample (*n*= 130) and Severely FI sample (*n*= 60)

3.2.2 Qualitative analysis

Four key themes were identified from the responses to question one, namely (1) Disordered eating behaviours, (2) Significant changes in eating, (3) Positive changes in eating, and (4) No changes in eating. These four themes represent the main descriptive content in the responses (Hsieh & Shannon, 2005; Elo & Kyngäs, 2008).

Theme 1: Disordered eating behaviours.

Of the 527 participants, 133 people explicitly mentioned disordered eating behaviours in relation to their eating during the first lockdown. A number of participants reported receiving treatment for an eating disorder or being referred for eating disorder treatment during this period. Common behaviours were binging, purging (either through vomiting, laxatives or excessive exercise), and restricting. Patterns of behaviour often oscillated between binging and restricting.

Food secure group (n=322).

18.9% of this group reported disordered eating behaviours consistent with the behaviours described above. Restriction was more commonly mentioned than binge/purge behaviours. The toll of lockdown on daily life and routine, and then the emotional impact this had on individuals, was more significant than external pressures from the media, although "clean-eating" and "glow-ups" were often reported.

> "The stress of the pandemic made the world feel out of control so in order to reclaim it, I began restricting my eating as a sort of coping mechanism."

Moderate food insecure group (n=141).

29.8% of this group reported some disordered eating. The most common behaviours outlined above were reported, with a greater number of "binge-restrict" cycles reported. Underpinning eating behaviour changes, participants reported a lack of routine, and the emotional toll of lockdown. A small number of individuals openly talked about the financial pressure and media influences:

> "I found myself binge eating more, with a lot of the food being poorer quality. No longer getting food at school meant I suffered from iron defiencies etc. I struggle with my image (most likely from seeing fake images online instead of real people) which made me feel guilty about eating. I'd then skip meals, eventually snacking in the late hours of the night. I desperately wanted to drop weight, and felt guilty after eating, especially larger meals. I lost a lot of weight but have begun putting it back on towards the end of COVID when I was stressed about returning to society and gcses etc etc"

Severe food insecure group (n= 64).

48% of responses in the severe FI group reported some disordered eating behaviours. Behaviours were the common behaviours identified with an increase in participants reporting binging and restricting cycles. Additional patterns emerged in this group of individuals regularly foregoing food to ensure other family members had enough to eat. Furthermore, periods of not eating were quite often due to lack of resources, and these followed 'typical' restriction patterns. These external factors were the most common named attributers to the change in eating, with routine and emotional impact equally much less frequently mentioned.

> "I flipped between starving myself and binging, making myself quite ill. Binging became common; Mother would commonly let my younger brother eat whenever he would like, even if that meant there being no food in the house for me to eat at regular mealtimes. This led to me feeling I needed to hoard food to be able to eat properly."

Theme 2: Significant changes.

From the 3 groups (food secure, moderately food insecure and severely food insecure), a total of 266 out of 527 respondents reported significant changes to their eating behaviours

without specifically mentioning eating disorder words or extreme behaviours. Participants described: eating a lot less, eating more, losing weight, putting on large amounts of weight. Individuals mainly attributed eating changes to routine: for example, not waking up before online school, missing breakfast and sometimes lunch too due to unusual routines and sleeping habits. Emotional hunger and loss of appetite were also regularly cited as causes for the changes in behaviour. External pressures were also referenced, with "Chloe Ting's" and "Joe Wick's" workout challenges frequently mentioned.

Food secure Group (n= 322).

49.1% of this group reported significant changes. Of this sample, the majority indicated change was due to changes in routine or daily structure (e.g., online schooling).

> "I found myself eating less as there was less of a structure to the day being at home. Compared to school, where there is an allocated lunch or break time, I didn't have that, so I just didn't feel the need to eat anything in those periods of time while at home."

Moderately food insecure group (n=141).

56.0% were categorised as having significant changes in their eating. Similarly, this group reported the majority of changes being due to a change in their usual routine.

> "Cos nobody could see me when I was at home, I ate more and more some days as nobody was there to judge me. Other days I'd eat less cos it was hard for parents to get to supermarkets to get food in, so I just didn't bother eating. I was also really bored so wanted more food than usual. Everyone kept fit in lockdown and Joe Wicks and stuff made me feel even worse about myself than I already did."

Severely food insecure Group (n=64).

42.2% of the food insecure group reported significant changes in eating behaviours. This group was split, with half indicating that change was due to routine, and half indicating it was due to factors such as finances or supermarket supplies.

> "During the lockdown a lot of people were stocking up on food so entire aisles would be empty. As we can't afford much this meant I had to eat less to make sure there was enough in the coming days to feed everyone. However, I felt like the things I was eating were more unhealthy and junk food because they were cheap and pretty easily accessible. Due to lockdown we also couldn't do the shopping as regularly."

Theme 3: Positive changes.

58 participants out of 527 indicated that any changes to their eating behaviours were an improvement. Individuals in this category spoke about becoming "healthier" and eating 3 proper meals a day. Their parents prepared home-cooked meals, they tried different foods and felt overall they had a better relationship with food. Some participants in this category had previously struggled with their eating behaviours and lockdown allowed them an opportunity to improve their eating.

Food Secure Group (n= 322).

14.9% of food secure respondents reported positive changes. The majority attributed this change to more family-based, homecooked meals and more time to look after themselves. Some attributed these changes to social media e.g., trying new recipes from Instagram or following 'healthy' accounts

"We ate as a family, so my meals were very regular. I struggled with eating at school, so being at home with accessible safe foods was a big improvement"

Moderately insecure group (n= 141).

4.3% of the moderately secure group reported positive changes to behaviour with positive changes as described above. All attributions mentioned were due to healthier home cooking.

"I was eating more healthy and home cooked food because there was time to make it and less eating out options"

Food insecure group (n= 64).

6.3% of food insecure participants described positive change. The majority of the four described problematic eating prior to lockdown. None of them spoke about the positive influence of family life.

"I started eating more regularly and food types that match the meal in larger healthier portions and i felt comfortable enough to leave food if i got full. I stopped snacking as much and hardly snuck food at night."

Theme 4: Stayed the same.

Of the entire sample, of 527 participants, 58 indicated that their eating behaviours did not vary from pre-lockdown patterns. Participants spoke about their diet, their portion sizes and the frequency of their meals remaining largely the same. If there were variations, these were

short-lived. The most common fluctuation was an increase in snacking although often it was not indicated if this was healthy or unhealthy snacks.

Food secure group (n= 322).

15.2% of the food secure group reported staying the same.

"There was no notable impact. Even if there was some impact, it was very mild and did not affect my mental or physical health significantly. Nor was any effect caused by my own health."

Moderately food insecure group (n= 141).

Only 5.0% of the food insecure group (7 participants) reported no or little change.

"I think I ate about the same, maybe more snacking and junk food than usual out of boredom? But overall, I didn't notice much of a difference in volume or type of food."

Severely Food insecure Group (n= 64).

Only 2% of people from the food insecure sample (2 participants) had their eating remain the same.

"I struggle with my weight not due to my image but due to the fact that my family lives in poverty and has done since my dad stopped paying maintenance. Lockdown did Jack all for my weight I didn't gain any I didn't lose any"

Question 2.

Question 2 asked if the changes seen during lockdown had been sustained up until the time the survey was responded to. Of the food secure group, 21% retained the poorer eating behaviour changes developed during lockdown. 38.5% of the moderately insecure sample and 35% of the severely food insecure sample retained poorer eating behaviours. Looking at participants who reported that their eating habits had got progressively worse since lockdown, this was 14.6% of the secure group, 11.5% of the moderate group, and 31.7% of the severely food insecure group.

In terms of sustaining or making positive progress in eating behaviours since lockdown, 43.9% of the secure sample either sustained positive changes to their eating or their eating behaviours improved. While only 26.9% of the moderately secure sample and 15% of the insecure sample reported positive change resulting from or after lockdown. Similar amounts of each sample have experienced fluctuations in their eating behaviours since lockdown with 20.6% of the food secure sample, 23.9% of the moderately insecure sample and 18.3% of the severely insecure sample.

4.0 Discussion

The goal of this research was to investigate how food security status impacts eating pathology for adolescents living in the UK. Our quantitative findings show that adolescents experiencing past-year severe FI reported significantly more episodes of binge eating, self-induced vomiting, laxative use, compensatory fasting, and excessive exercise in the past 4 weeks, when compared to those who are food secure or only moderately food insecure. As well as this, severely food insecure individuals were more likely to have eating behaviours that are associated with significant impairment in their functioning consistent with a clinical diagnosis.

Overall, those who were severely food insecure were more likely to meet the criteria for any probable eating disorder diagnosis, and to meet criteria for the probable specific diagnoses of Anorexia nervosa, bulimia nervosa, binge eating disorder and OSFED. This likelihood was not impacted by either participant's religion or by their ethnic background.

Our qualitative findings supported quantitative results that during the first UK COVID-19 lockdown the severely food insecure experienced significantly more abnormal eating behaviours. All groups had significantly impacted diets, but the food secure adolescents reported more positive changes or reported that their eating behaviours where not significantly impacted during the first lockdown. For the severe food insecure group negatively affected during lockdown, these negative changes were more likely to have deteriorated further after 2 years, compared to food secure and moderately insecure. Any positive changes that occurred during the COVID-19 lockdown were more likely to be sustained by those adolescents who were food secure.

To the author's knowledge, this is the first study of its kind in the UK, looking at the link between disordered eating and FI in any age group in any population, clinical or non-clinical. This lack of research is surprising when the Royal College of Psychiatrists reported an 82 percent increase in hospital admissions for eating disorders over the past 5 years in 2021, and a 90 percent rise in admissions for children and adolescents (Royal College of Psychiatrists, 2022). Furthermore, a recent study published in 2023 in the UK on Eating Disorder Health Care Practitioners found that they expressed concern about their knowledge gap in the link between the two, with them reporting that they perceived more than a fifth of their patients to have experienced FI in the past 12 months, with that number only expected to rise (Kuehne et al., 2023).

Our first hypothesis was that more binge-eating and compensatory behaviours would be seen in the food insecure groups, and that they would have a higher level of impairment

from these behaviours compared to food secure: this hypothesis was supported. Specifically, we found that adolescents reporting FI had significantly more episodes of binge eating, self-induced vomiting, laxative use, compensatory fasting, and excessive exercise when compared to those who are food secure.

Our second hypothesis that food insecure groups were more likely to meet criteria for probable specific eating disorders was also met, when controlling for ethnic background and religion.

Our third hypothesis was that there would have been different changes in eating behaviour experienced by the three groups over the 1st UK COVID-19 National lockdown, and that these changes may have had different longevity. This hypothesis was supported, with disordered eating in the severely food insecure group showing the largest change in disordered eating and with these negative changes more likely to be sustained or deteriorate compared to the food secure group. Moreover, the food secure group were more likely to experience positive changes or to have their diet remain the same. Furthermore, these positive changes were more likely to be sustained than positive changes in the food insecure groups.

When looking at specific compensatory behaviours, our findings for binge eating were in line with many previous studies mainly from the US, showing that there is increased binge eating in food insecure populations (Becker et al., 2017; Bruening et al., 2017; B. H. Kim et al., 2021; Linsenmeyer et al., 2021; Stinson et al., 2018; West et al., 2019; Zickgraf et al., 2022). However, unlike Christensen and colleagues (2021), we did not break-down binge eating into subjective and objective. It is therefore possible that our significance could be accounted for by the objective binge eating only and that the results may have been different if we had asked specifically about objective and subjective binge eating, unlike how the EDDS-5 asks generally about binge eating.

When looking at other specific compensatory behaviours, we found increased frequency of self-induced vomiting and excessive exercise in our severely food insecure group, also, in line with previous literature (Barry et al., 2021; Becker et al., 2017). Contrary findings from Christensen and colleagues (2021) can potentially be explained by the different levels of food insecurity severity in each study. Becker's sample was from a local food bank in a low-income, marginalised population whereas Christensen's was from a single university. Christensen suggests that their lack of significance for self-induced vomiting and excessive exercise could be due to the level of severity of FI, which is supported by our study. Our research divided the groupings into two different levels of FI, moderate and severe. Our Bonferroni correction indicated that moderately food insecure was statistically indistinguishable from our food secure group in terms of self-induced vomiting frequency, suggesting that this is a particular problem for those with severe FI. On the other hand, Christensen and colleagues' study was conducted in one US university where FI levels were generally low.

With extreme weight-control behaviours Hazzard and colleagues (2022) also found a significantly higher incidence of extreme weight control behaviours (self-induced vomiting, diet pill use, laxative use, diuretic use) in adolescents with FI when compared to those without. They found a 49% greater prevalence of these behaviours for those who had experienced past year severe FI compared to those who had not, after adjusting for socio-demographic covariates (Hazzard et al., 2022). This is consistent with our findings of increased laxative or diuretic use for those with severe FI. However, it is important to note that Hazzard and colleagues only used one item for assessing past year severe FI, and that their findings need to be approached with caution. Furthermore, in their study, these behaviours were not assessed for their severity or frequency, just for their binary "yes" or "no" presence (Hazzard et al., 2022). Moreover, they found that the use of extreme weight control behaviours was not significantly associated

with FI 5 years later. Other studies also give indication that there is a significant relationship between weight-controlling behaviours and food security status: In Hooper and colleagues (2022) study of adolescents, of all eating pathologies measured, laxative use was one of the only symptoms which remained significantly associated with FI after adjustments were made for socio-demographic factors.

We found a significant relationship between food security status and compensatory fasting. This finding is not surprising, as previous literature from a Spanish sample of adolescents found higher levels of body dissatisfaction and higher drive for thinness for those with FI (Shankar-Krishnan et al., 2021). It is consistent with research on FI and weight and/or shape related restriction (Christensen et al., 2021; Hazzard et al., 2022; Hooper et al., 2020). Hazzard and colleagues provided insight into the potential long-term effects of the relationship. They found that the relationship between 'Unhealthy Weight Control Behaviours' (i.e., fasting, skipping meals, eating very little food, using food substitutes, and smoking more cigarettes) and food security status was only significant up until the age of 20 (Hazzard et al., 2022). This suggests that this effect may be of particular significance to younger adolescents. Supporting this, Hooper and colleagues (2022) found that adolescent FI was no longer predictive of unhealthy weight control behaviours at an 8-year follow-up (mean age 22) after adjusting for ethnicity and race. However, Christensen and colleagues found in their cross-sectional study, that this effect was still significant after the age of 20, with a mean age of 21.8. Both studies had differences in their samples, including their severity of FI. Hazzard and colleagues' sample was much larger and from different schools in the area. Furthermore, their research specifically targeted a geographic area with high deprivation and had a greater severity of FI. Limitations in Christensen's sample have already been discussed and could explain the contrary findings. Another key difference that needs to be taken into consideration is the method used to measure FI, with Hooper and colleagues (2020; 2022) using a parental proxy and Hazzard and

colleagues only used one question to assess FI, rather than a validated measure (Hazzard et al., 2022).

Our results also indicated that there was a greater level of impairment as a result of disordered eating behaviours for the severely food insecure individuals. This is in line with all available research for adolescents (Christensen et al., 2021). Furthermore, we found that food insecure adolescents were more likely to meet diagnostic criteria for probable eating disorders (anorexia nervosa, bulimia nervosa, binge eating disorder and otherwise specified feeding or eating disorder). Overall, we found higher prevalence of meeting criteria for any probable eating disorders in both food insecure groups as compared with the food secure group (SFI: 82.35%, MFI: 62.26%, FS: 45.17%), with increased log-odds for each individual diagnosis when moving from food secure to food insecure. This was in line with Christensen and colleagues' study (2021) and is unsurprising considering the demographic analyses indicating those who were food insecure were more likely to already have a diagnosis of an eating disorder.

When considering the risk of individual eating disorders occurring to a diagnosable threshold, the results suggest that severely food insecure adolescents in the UK will have a higher likelihood of meeting criteria for probable binge eating disorder diagnosis than no eating disorder diagnosis when compared to food secure adolescents. The findings from our multinominal logistic regression suggest that adolescents are 28 times more likely to have binge eating disorder rather than no eating disorder if they are experiencing severe FI, compared to those with food security. This was the highest significant odds ratio in the model, which is not unexpected. However, 28x is very high, and we must interpret it with caution. The confidence intervals suggest that the true odds ratio lies between 6.828 and 114.887, meaning that there is likely to be a high odds ratio but that the point estimate is within a large range. This could be due to a number of factors, the sample size for binge eating disorder is comparatively small

compared to the other disorders. Furthermore, the relationship could have a threshold effect, meaning that there is only significance at a certain level of food security status. This is also indicated in the post-hoc analysis our initial comparative analyses where we found a significant difference in the frequency of binge eating between severely and moderately food insecure individuals. Further studies with larger sample sizes are needed to further understand this relationship. Past research has demonstrated the strength of this link, with Hazzard and colleagues (2022) larger scale study (*n*=1,813) finding that those adolescents who had experienced past year severe FI experienced a 49% greater prevalence of binge eating than those who were food secure. Our findings are in line with previous literature linking binge-eating disorder to FI in adults (Rasmusson et al., 2019). Although, this differs from the findings of Christensen and colleagues (2021) in adolescents, who suggested their lack of findings were due to sampling as described above. The mean age of our sample is 5 years younger than Christensen's, which supports the idea that recruitment sample could be a significant factor.

In terms of other probable diagnoses, we found that severely food insecure adolescents are 8.21x more likely to have anorexia nervosa than no eating disorder, compared to those with food security. Although this differs from Christensen and colleagues (2021) findings, it fits with the views of eating disorder healthcare practitioners in the UK who view restricting presentations within food insecure samples with concern and deserving of further research (Kuehne et al., 2023). The likelihood for bulimia was similar with 7.879x and the confidence interval was much smaller (CI: 3.015-20.592). OSFED was the only likely diagnosis that found significant differences in the likelihood between both severely food insecure- food secure and moderately food insecure- secure. We found that severely food insecure adolescents are 4.7866x more likely to have OSFED than no eating disorder, compared to those with food security and that those with moderate FI are 2.197x more likely to have OSFED than no eating disorder, compared to those with food security. Christensen and colleagues (2021) also found

the same relationships for both bulimia and OSFED. The lack of significance in their study for anorexia nervosa and binge eating disorder is interesting and surprising, but again could be due to sampling issues.

Our third and final hypothesis was also met with results finding that food insecure individuals were more likely to experience disordered eating during the COVID-19 lockdown and that if there were negative changes, they were more likely to be sustained 2 years later than the food secure adolescents. Furthermore, it was more likely that those that were food secure to experience no change or even positive changes to their eating behaviours. This fits with previous literature which suggests that those with food security are more able to cope with disruptions to their food supply (Swinnen et al., 2021). However, with no baseline reported, sometimes it was hard to tell if a change in behaviour was problematic, for example if someone said "I ate much less food and much less frequently" this could be considered problematic, but if we had been given some baseline context that this person had previously been regularly binging, it could be captured as a healthier change. When there was uncertainty, responses were not categorised as disordered, which may have potentially led to an overly conservative analysis.

It is important to note that the largest contributing factor for the severely food insecure group reporting disordered eating was external factors such as lack of resources. This indicates that disordered eating reported is not due to 'typical' disordered eating motives, as measured by the EDDS-5. However, when taken together with the quantitative results, which indicate that there are food insecure individuals who experience disordered eating as a result of shape or weight it feels quite contrary. This could be explained by several things. Firstly, that the eating disorder measures used (EDDS-5 and CIA) are not suitable for this group. Secondly, it could be representative of the "feast-or-famine" cycle, with lack of resources leading to a period of restriction, leading to binging behaviours, which then may lead to shame or weight

gain which then drives ‘typical’ disordered eating motives. If this is the case, then the evidence suggests that these external drivers into disordered eating (e.g., lack of resources) may shift into ‘typical’ disordered eating drivers which then sustain the disordered eating patterns years after. Alternately, it could indicate that there are two sub-types of disordered eating in food insecure populations, some internally driven and some externally due to circumstances.

When considering all the results found above, it is important to consider the sample and the context. Overall, the studies demographic analyses demonstrated that there were significant differences in demographics across the groups, with a higher percentage of white participants in the food secure category. This is consistent with prior research in the area suggesting that FI is disproportionately experienced by minoritized racial and ethnic groups (Odoms-Young & Bruce, 2018). Sadly, additional research indicated that these marginalised groups are the least likely to access assistance from public health services (Comber, 2011; Huryk et al., 2021). There were also significant differences across the groups in terms of religion, this again is in line with previous literature, suggesting that there may be nuances due to religious food practices and religious fasting (Cohen, 2021). In our sample, it appeared that the food secure group were more likely to describe themselves as Christian than the other two groups and that there was a higher instance of ‘any other’ religion in both FI groups compared to the food secure group.

Unfortunately, due to the limited scope of the sample, further analyses were not possible, and when included in the multinominal logistic regression model, these categories had to be collapsed further into binary ‘white and non-white’ and ‘religious and non-religious’. This was essential to run the model due to small sub-populations, meaning there would have been combinations in the model with no participants in, therefore impacting the integrity of the model. Dichotomising ethnic background into “white” and “non-white” was also necessary for West and colleagues in their model (2019). When these binary variables were added to the

model, they did not significantly improve the model. When analyses did allow for our original number of categories for ethnic background and religion, results remained largely similar. However, the integrity of those findings was questionable due to the missing data. This does not fit with previous literature, which suggests that religious and cultural beliefs influence the relationship between FI and disordered eating (Pilgrim & Bohnet-Joschko, 2019). However, this may have been due to the nuance which was not captured in the dichotomous categories. Our sample is largely consistent with the "SWAG" sample discussed in the introduction. Our demographic was relatively homogeneous consisting mainly of white, food-secure, non-religious, females. We had lower representation of respondents identifying as being from a black ethnic background when compared to the national population (GOV, 2019). Further studies are needed with larger sub-populations of diverse samples.

Further demographic analysis indicates differences in likelihood of attending school with less chance of attending for the severely insecure sample, then the moderately insecure sample followed by the food secure sample. Although we cannot assume attainment based on attendance, previous research has suggested that children's school engagement is negatively impacted by FI (Ashiabi, 2005) and that lower educational attainment results (Heflin et al., 2022). This may potentially be a barrier to higher education and thus exacerbating inequalities.

With university degrees becoming a prerequisite for many professional job roles (OECD, 2019) this is likely to exacerbate inequalities. The value of higher education and the consequences on the economy for less people being able to achieve places in higher education has been further identified (Baum et al., 2010; Carnevale et al., 2013). This is at such a significant level that the UN have identified the importance of equal access to affordable, further education and development as one of their sustainable developmental goals (OECD, 2019). Further exacerbation on the problem may be experienced by drop-out, and the resulting lack of school lunch availability.

It may have been interesting to ask more specifically about stages of education in our sample e.g., university, college or secondary school. Previous literature suggests that the first year of university can make individuals uniquely susceptible to FI due to transitioning into a new environment and all that comes with it (Pancer et al., 2000). Furthermore, it is thought that the burdens of FI in university can impact academic performance (El Zein et al., 2019), with it having a negative impact on first year university students' academic performance even after adjusting for high school academic performance (van Woerden et al., 2019). Moreover, food insecure adolescents in higher education are disproportionately more likely to fail, withdraw from a course or to drop out entirely from higher education (Mechler et al., 2021). However, the lack of significance of age across our three levels of FI does not necessarily lend to this being mirrored in our results.

The severely food insecure group in our study were more likely to acknowledge themselves to have a disability that the two other groups and this difference was statistically significant. This is in line with previous literature which suggests that food insecure individuals have poorer overall physical health (Cook et al., 2006; Gundersen & Kreider, 2009; Hernandez & Jacknowitz, 2009; South et al., 2019; Thomas et al., 2019). This link is important to understand as this may further complicate the relationship with eating and need to be considered when considering offering psychological support.

Our measure of FI was a strength, but also a limitation of the study. It is well known in this field that there are inconsistencies with measuring FI, especially that of adolescence. It is typically assumed that children will have a parental proxy, and adults will self-report, however, adolescents fall somewhere in the middle. Some researchers have used parental proxies while others have asked adolescent directly. Literature has demonstrated the limitation of parental proxy as this may underestimate the impacts of FI on adolescents (Nord & Hanson, 2013). Our study utilises self-report for adolescents, to capture their subjective experience. The Food

Insecurity Experience Scale, which we utilised in the study, has been frequently used in the UK in the Department for Work and Pensions Family Resources Annual Survey. However, with the majority of studies taking place in the US, using different measures such as the U.S Household Food Security Module, make comparison difficult.

For our qualitative data, the homogeneity of our sample may have impacted the content analysis in terms of the categories respondents were placed in. Potentially, disordered eating syntax may be more common for the 'SWAG' sample, and less so for the non-SWAG sample, who may not understand their behaviours as typical of the labels and lexicon e.g., binge/purge, and hence may be less likely to participate in this kind of research. More in depth qualitative interviews may shed some information on these issues and be able to uncover more specific detail or how to increase representation of minority ethnic groups.

Furthermore, we must consider the psychometric measurements used for disordered eating with the current sample. We have discussed the complications in measurement due to the SWAG samples that these measures were developed and validated on. We must acknowledge that these measures may not accurately capture the experiences and potential symptomology in more diverse backgrounds, such as those living with FI and that this may have led to potentially inflated estimates of the number of food insecure adolescents with disordered eating. For example, for food insecure adolescents, there may be constructs such as 'loss of control eating' in binge eating, may be confused for when you feel you should not be eating due to the scarcity of food. Furthermore, the nuance found by previous research in the difference between subjective and objective binging for people with FI needs to be considered (Christensen et al., 2021). For example, in the EDDS-5 the question on binge eating says, "given the circumstances". This is potentially unclear, and someone living with FI may have thought that it was in relation to the rising cost of living. Furthermore, in the CIA the question "Over the past 28 days, to what extent have your eating habits, exercising or feelings about

your eating shape or weight made you worry?". Contextually, someone with FI may have worried due to eating when there is scarce resource, not because of weight or shape related reasons. It is essential that measures are validated on heterogeneous samples, as someone who is worried or skipping meals due to finances does not necessarily fit the criteria for an eating disorder as these motives are very different.

It is important to acknowledge that these quantitative analyses do not give indication of causality, and we must consider the bi-directional nature of food security status where as well as FI impacting mental health, an individual's mental health may impact their food security e.g., by not being able to work and receive a salary (Myers, 2020; Bruening et al., 2017). Secondly, the retrospective nature of the content analysis has limitations due to the length of time we are asking for participants to recall (2 years). Moreover, our measure for FI is for the last year, and so may not be representative of the true food security status of the respondents at that time. As already discussed, the homogeneity of the sample was also a limitation, limiting the generalisability of the findings. It is also worth highlighting that there were some methodological limitations to the study. All participants were self-selecting, meaning that could choose whether to take part in the research or not. This makes the research more susceptible to bias as research often attracts individuals who have an interest or link to the subject matter (Olsen, 2014). Furthermore, the study was "shared" on Instagram by a popular influencer for body positivity. This may mean caution has to be taken when generalising these findings as those who responded may have a significant relationship with disordered eating. However, using a platform like Instagram lent itself as a potential strength of the study, by not going through clinical services which may be misrepresentative of food insecure individuals who have disordered eating. The use of these retrospective self-report measures could also be considered a limitation. However, previous research in the field using Ecological Momentary Assessment (EMA), where data is collected 'in real time', does not differ in terms of findings

(Kim et al., 2021). Moreover, although we used rigorous methodology using both symptom status and clinical impairment was used for determining probable ED diagnoses, the use of self-report measures may have inflated estimations of ED psychopathology when compared to a clinical interview and diagnosis. Although, some evidence has demonstrated increased candour due to the anonymous nature of some self-report measures (Keel et al., 2002). Moreover, even if the number of probable diagnoses was inflated, research shows that patterns of disordered eating that does not meet clinical threshold for an eating disorder is still concerning as it can often be a precursor for diagnosable eating disorders (Stice et al., 2011, 2017).

Another potential limitation of the study which must be acknowledged is the context. The UK is currently experiencing a cost-of-living crisis, post COVID-19 and due to the Russia-Ukraine conflict triggering an energy crisis (Guan et al., 2023) and shortages/increased costs of certain foods. Although the economic climate in the UK is still in turmoil, it is not necessarily generalisable to other time-points, and this must be considered in the FIES questioning focusing on "past-year".

4.1 Conclusion and recommendations

Overall, this novel study looking at adolescents living with FI in the UK and their related eating pathology illuminates important information for both policymakers and clinicians in the UK. It is important that adolescent FI is addressed as a public health concern, especially in the context of the current climate where the numbers of those being made food-insecure is increasing. The impact that the effects of FI could be having on the similarly rising rates of eating disorder referrals is important to consider, which research is already starting to consider (Kuehne et al., 2023). Public interventions for addressing FI should ensure they include measures for adolescents, which this study and previous literature suggests may be at

a particular risk, especially when paired with the typical onset age of eating disorders. This study highlights the cyclical nature of disordered eating, in line with theories of FI and disordered eating such as the "feast-or-famine" theory. Considerations need to be made about the temporal availability of food for those who are food insecure, and how this is approached. For example, monthly payments may in fact reinforce this disordered pattern on eating, and more frequent instalments or provision may counter it. Furthermore, subsidising healthy options such as vegetables would allow the opportunity for healthier, lost cost meals, as typically low-cost food is often calorie dense and nutritionally poor. This could also be contributing to the "feast-or-famine" cycle.

In terms of eating disorder clinicians, a multi-disciplinary input would be essential for this population. Clinicians should also be considering the full context of the individuals they are supporting, including their food security status. Healthcare practitioners in the UK have expressed fear of inducing shame when asking questions related to food security status (Kuehne et al., 2023),so careful consideration needs to be taken to in ensuring that this information is captured sensitively. This would be essential in terms of setting and continuation of meal plans, and in terms of access and affordability of food. If there is a temporal impact, then meal plans could be adjusted for this. Furthermore, if food banks are to be relied upon for these recommended meal-plans, adolescents would likely need support with access and the emotional impact of access. Moreover, psychoeducation should be being provided to employees of these food banks, to ensure there are as few barriers to access as possible. With the ego syntonic nature of some eating disorders, having to actively go to a foodbank to receive food would likely be highly challenging, especially for those who are overweight. Moreover, the associated stigma, fear, and embarrassment frequently experienced by individual foodbank users in the UK will likely also have an impact (Garthwaite, 2016). These emotions may also impact help-seeking behaviours, with individuals not accessing treatment due to strong

emotions such as shame (Palakshappa et al., 2017) or feeling undeserving if they feel they don't meet typical 'criteria' for an eating disorder (McPherson, 2020). Recent research has demonstrated that current understanding and confidence in knowledge in the cross-over for eating disorders and FI is low amongst UK healthcare practitioners, emphasising a need for (Kuehne et al., 2023).

Other considerations for clinicians should be on potential mediators for FI, and the associated psychological impact. FI has been frequently linked to adverse childhood experiences (Alaimo et al., 2001; M. Chilton et al., 2017; M. M. Chilton et al., 2014; Jackson et al., 2019; Sun et al., 2016). Clinicians therefore should ensure they are providing a trauma-informed approach. This is also significant when considering the impact of FI on individuals mental health and the bi-directional relationship. The familial relationship will also have to be considered and accommodated for, with food insecure individuals more likely to work unusual shift patterns (Storz et al., 2022), meaning that patients and their family members may not be able to attend regular appointments.

Studies looking at current treatment provision for disordered eating could shed light on where adjustments need to be made and where additional support can be offered. This may even include looking at eating disorder psychometric measures, which are often used in treatment, either at triage or assessment. If there are problems in wording of these measures, it may mean that those with FI are being incorrectly identified as having Eds or that their behaviours are due to weight/shape related reasons, these may require revision. It is important for clinicians to consider the development and validation of measures that they use, and how the unique experiences and circumstances of those living with FI may not be captured by such measures. Although these measures would still be able to offer valuable insight in terms of disordered eating, it is imperative these are used contextually and with caution. The supplementary use of qualitative questions may support with this.

This study shows the significant increased potential for adolescents living with severe FI to suffer from a range of disordered eating behaviours, and to an extent that impairs them clinically. Moreover, qualitative data indicates that these changes are more likely to be enduring for severely food insecure adolescents over time. The data suggests that food secure and moderately insecure adolescents' eating patterns may be less vulnerable and less affected by unusual circumstances such as the 2020 COVID-19 lockdown. Lockdown provided a unique set of conditions showing the effect on eating behaviour when a food insecure adolescent becomes more food insecure and has normal routine and structures removed. As discussed, issues with screening tools and lack of awareness and knowledge make this group less likely to access help and less likely to be supported, and much more likely to experience shame related to food scarcity and food bank use. With the current cost-of-living crisis in the UK, dramatically rising FI and all-time high adolescent eating disorder referrals in the UK, it is essential that more research is done into this under-researched area.

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Part 3: Critical Appraisal

Introduction

This is a critical appraisal of my research journey investigating the relationship between adolescent food insecurity and eating pathology. In the first section, I have traced how my practical work in eating disorders in my first job began my research interest into adolescents. Then how my understanding and awareness of the wider social context of treating eating disorders came into focus. Various jobs then led me to understand how research can inform and change policies in a practical sense, and that this should be at the forefront of the research focus. I believe that this research can then promote new theories and models of understanding and treating eating disorders. I then detail how my interest in food insecurity developed. In section 2 I examine the methodology and ethical dilemmas that arose with that. I then move on to discuss the results and potential changes I would have made to my study. I finish by thinking about future studies.

Previous experiences and theoretical orientation

Eight years working in eating disorder services has played a pivotal role in shaping my understanding and interest in individuals' relationships with food. It was inevitable that this work and interest would leading me to a thesis in this area. Perhaps the biggest influence on this research can be traced back to my time working in an in-patient ward where I first became interested in the underpinnings and triggers of disordered eating. At this facility the treatment

was, of necessity, medically oriented and we preserved life with feeding tubes, weight monitoring, and suicide prevention. But it was clear from talking to the patients that there were many factors affecting their relationship with food that were not being addressed. I came to understand from clients the helplessness and hopelessness they felt in moving forward from eating disorders was often linked to their helplessness in their social situations they were discharged into. I came to understand this social context might involving trauma, abuse, or deprivation. I became passionate about advocating for specific support for young clients being discharged into difficult social and family situations: the helplessness and lack of power these clients expressed had a profound effect on me and raised many questions about social justice and mental health support implications. I read extensively and this led to my current research interest is in looking at specific social factors underpinning disordered eating as an alternative or alongside traditional weight and shape concerns.

It is interesting to look back and note that throughout my early work experience, food insecurity was not something that was routinely asked about or thought about in the services I worked in. It is not something I personally considered either. As in-patients, individuals were given strict meal plans to follow, without asking about food security status or providing appropriate education and support at discharge if they were food insecure. This lack of being sensitive to individuals' circumstances implicated in our duty of care. Some individuals will of course have been food insecure and being discharged with food plans that would likely have been impossible to stick to financially. The shame associated with asking for help when food insecure likely making this dynamic even more challenging.

Most of the patients in this inpatient facility were 18-21 and adolescence is recognised as the primary onset period for eating disorders, making this age group the obvious population for my research. Seeking the views of young people and giving them a voice is very important to me, and very often researchers ask parents to report on the experiences of young people,

rather than asking adolescents themselves. My work experience showed me that this age group have a very strong grasp of their own issues. This led to my methodological choice of obtaining the views of adolescents and incorporating some qualitative questions to provide rich additional information. I feel this is important to help us anticipate vulnerability in certain groups and ask the right questions, actively seeking eating disorder information so that we can understand the different mechanisms underpinning food insecurity and disordered eating behaviours and tailor early intervention.

My research interest in food insecurity specifically started with my clinical training during the COVID-19 pandemic. It is not unsurprising that many individuals I have worked with over the past three years have been struggling financially, exacerbated towards the end of training with the increasing cost-of-living crisis. I have worked with people who have not been able to afford their medication, as it has been a stark choice between that or putting food on the table for their family. It was a unique and deeply worrying time for many families. During COVID-19, I also followed ED news and learned that CAMHS Eating Disorder referrals increased by 35.4% during this period, and three million in UK were short of food and trying to access foodbanks (Pautz & Dempsey, 2022; Royal College of Psychiatrists, 2022)

It was extremely concerning, and I wanted to explore if these were related and if they impacted each other. Why was there such a large increase in eating disorders over that period? Obvious answers included schools moving online, losing that stability and support structure and routine, boredom and anxiety alongside increasing pressure for exams with constant uncertainty. But the lack of school meals particularly stood out as significant to me because of the distress this caused and the fundamental drive for survival potentially being activated relating to not having enough to eat. There was considerable media attention given to compensatory food parcels that were inadequate or just did not arrive. I remembered

photographs of food parcels from distressed parents on Twitter. It was a truly awful situation and meanwhile people were panic buying in supermarkets leading to shortages.

I was very surprised to start reading and see such consistent results in adult populations. I was also surprised by the lack of literature on adolescents, with the onset of ED typically peaking during that age period it seemed like a huge gap in the literature. There was not a single study from the UK, and a small number of studies taking place in the US. I spoke to my supervisor who had recently supervised another trainee on the use of food banks and eating pathology in adults, and she was also keen to explore the relationship in adolescents. The project I was originally offered was on adolescents with eating disorders' experiences of the COVID-19 lockdown, and I was very interested and felt this was an important area to focus my research on in this unique situation. But I have a strong sense of social justice and felt it was important to make my doctoral research something that aligned with my values. I really wanted to explore the link with between disordered eating and food insecurity. I have never had the freedom to choose a research topic and being able to target this important area and to have my supervisors full support was amazing and I am so grateful for that. I am passionate about this research study because my work experiences have demonstrated that research supports mechanisms for change. I used research in one job to help gain funding for wellbeing workshops in eating disorder services, and in another job as a researcher gained traction in a new pathway for autistic people with eating disorders: my research focused on how we can improve treatment and outcomes. I was fortunate to be given the opportunity to see this through to practical changes with setting up the pathway and piloting it on an inpatient multidisciplinary team.

These experiences have brought me to the type of research I wanted to do: targeting and supporting the mechanisms of changes to ED treatments and protocols. I have carried this principle of pushing for change forward to the current thesis where I believe both small and

major changes are needed in the treatment pathway for eating disorders and food insecurity and this research journey is just beginning. We have yet to understand how eating pathology features in food insecure adolescents and it seems doubtful that this is the same manifestation as the typical eating disorder ideals of shape and weight. We can improve eating disorder outcomes for food insecure adolescents by understanding the potentially different mechanisms at work and providing specific measures to ask the right questions and a tailored prevention and treatment pathway.

At the same time in a macro-sense, we need to strongly advocate for food insecurity to end in UK as a social and political goal because privileged and non-privileged, our entire society is deeply disturbed that people, and especially children, in UK are going hungry.

I started this project with little knowledge on the topic and became conscious that I approached the topic from a position of privilege. I felt guilt as I was looking through online journals and media articles of people worrying about food from a comfortable home. I have never had to worry about where my next meal was coming from and nor if I could afford to eat. Nor have I ever experienced any disordered eating. This research has heightened my awareness of this privilege. It has made me more aware of basic needs that have consistently been met in my life, while others have not had this experience. This awareness has driven me to want to advocate for those who do not have these basic needs met. Also, where awareness of this issues is not yet wide-spread to help make it more commonly understood as an issue.

> "Privilege is when you think something is not a problem because it is not a problem to you".

Methodology

One of the biggest dilemmas was concerned with whether or not we should compensate the participants. It was a really complicated ethical dilemma: we did not want to 'bribe' food insecure people to take part in the study with the offer of voucher, but we were aware incentivises were necessary to compensate for time. In particular, to draw 16-year-olds away from Tik-Tok and Instagram and keep their interest for the 10 minutes it took to do the study was a challenge. After much debate we decided to offer vouchers in a prize draw. This was a successful option and if doing a larger-scale study again, I would follow this model.

Recruitment was a challenge at first and a social media learning curve. I decided to target charities and food banks to ensure that I recruited enough food insecure individuals to make the research meaningful. I had some positive responses from charities and food banks, with some re-tweets and many sharing my recruitment poster. However, the recruitment numbers were slow and not reflective of the high level of interest in people sharing the questionnaire. I concluded that Twitter and Facebook, where the majority of shares were, were not frequently used by the target age group. I moved to Instagram and quickly saw a response. The study was shared on a popular influencer's Instagram stories. Their content focuses on body-positivity and often speaks about disordered eating recovery, and they have over half a million followers. This is likely to have swayed my sample, with people concerned with disordered eating or in disordered eating recovery more likely to have clicked the link to do the survey. From there, I stayed with Instagram and started advertising. I was able to tailor those who saw my adverts and started with the 16–19-year-old age group in the UK. My final few adverts ran only for 16–19-year-old males as the data was heavily skewed to female respondents. These adverts had a much slower uptake, with males seemingly less responsive.

This brings me to the issue of advertising the study. We decided to advertise without specifically mentioning food insecurity or disordered eating, and instead saying that it was a study on adolescent eating behaviours. This was not to deceive anyone, and the information on

the role of food insecurity in the research was clearly presented in the information sheet. However, we decided we did not want to exclude or include or confuse anyone with over-complicated terms e.g., “Food insecurity”. I think this was the right decision: the responses to the survey we could see online were very positive with a few comments stating they found it “therapeutic”, and others just agreeing.

I also questioned what the point of the research was. We know from previous research that there is a link, but does the ‘pathology’ matter? It was helpful in highlighting the effect on adolescents in the UK, and in the crude sense I think that pathologies might be helpful, but it also felt slightly uncomfortable. I think that overall, pinpointing what the likely problems are within a large group is very important in giving a starting point for either of my goals of systemic change or clinical intervention. I also found that based on the research I found I had endless recommendations and had to cut these down. I do think there is so much to do, and I reduced political change recommendations due to a lack of funding availability at this time (to be taken up later) and focused on changes that are possible coming from clinicians, food bank workers and researchers. I think an interesting reflection is that the majority of the research had been conducted in the US, with the majority of these participants likely falling into the lower income brackets and what that means in terms of American Healthcare.

I felt the use of an online questionnaire and some qualitative questions, which is my preferred method for research, was a good choice. It gave me a more satisfying research picture and gave me a strong sense of being connected to the individuals who responded and allowing them to voice concerns. On the downside it was time consuming and coming up with a model to quantify these results statistically was challenging, and unfortunately, I felt I did not have space to give justice to these responses as it would have been another paper. But some were particularly poignant and stayed with me for a long time.

Results

I spent considerable time looking for statistical model to suit the information I wanted to extract, and I was really disappointed in having to collapse the demographic variables of ethnicity and religion for the logistical regression model. I spent a month attempting to do it any other way and met with multiple statisticians to talk it through. I felt that I created a crude representation of the data, and when studies such as Kim and colleagues' (2021) were finding significance only for Hispanic adolescents, it felt important to break everything down as much as possible, in case there are groups who are most at risk. However, even with the demographics broken down into fewer categories, there was still no significant effect on the model.

Seeing the results was quite shocking. I think I expected some sort of significance but to have everything fit the literature so accurately, I found somehow quite upsetting and I had to re-run several analyses. I even completely started again on one occasion: re-cleaning my entire dataset to ensure the results were correct.

Unfortunately, the odds ratio in the model for binge-eating disorder disappointed me. It felt so largely inflated that I felt it was 'phoney' and that potentially all my other results were too. Again, I spoke to a statistician who helped explain to me why this might be and how it did not invalidate my results.

I was pleasantly surprised at the number and depth of qualitative responses we received. I was moved by the responses, and grateful that they were being shared with me. It felt difficult knowing the age of some of these participants and their vulnerability, but the importance of these voices being heard made it easier to justify.

Potential changes to the research

If I could start over again, I would include co-production into my research. Having spoken to food insecure individuals who have lived with disordered eating after the

questionnaire was published and having seen the qualitative responses to the open-ended questions, specific elements of the research have been highlighted to me.

I would now want to ask more about family relationships. I am interested in the household structures themselves, how many of these adolescents still lived at home? How many had siblings? I am really concerned with this "older sibling" role, how it has been given and taken on? I think it is important to better understand family dynamics and expectations that we can address. I am also interested in the messages within households, with parental proxies often underestimating adolescent food insecurity, I would like to explore why this is. What were the messages about food? What were the messages being shared about obtaining food? I understand that there is a limit to how many questions a 16-year-old will comply with before they go back to Tik-Tok, so I know a lot of these additional ideas I have now would not have been feasible and may have led to a lot less data. In fact, many of these suggestions would have led to different studies entirely.

From my informal conversations with people with eating disorders impacted by food insecurity the role of shame is very significant. This is a complex relationship, and I don't think I could begin to unpick it with my questionnaire, but it has made me think about my mixed method approach and how much space I had for something that I felt was important. Reading the qualitative responses made me very emotional. I was shocked, angered and saddened by what I read. Reading the responses several months after they had been submitted left me feeling upset me that these young people had put these words into response 'boxes', without any containment or support. I feel a sense of duty to ensure that their voices are heard. I wish I could have included everyone's responses in my paper, I can only hope they feel I reflected all of their experiences and they were 'heard'.

For my own study, I would have liked to have added one question about where they were situated in their family e.g., only child, older sibling, younger sibling. I think this could have been one quick change that could have unlocked a lot of information.

I struggled with wanting to do qualitative vs quantitative research into this topic for a long time. I am still of the belief that quantitative research 'gets the ball rolling' with research topics but qualitative research will give us more in-depth understanding of the drivers and maintaining factors and what we can do to address them. I am glad I opted for quantitative research because people are shocked and moved by statistics and not necessarily one or two voices and their personal experience. With the lack of research on this in the UK, I felt it was important to firstly provide statistics to show how wide-spread the problem potentially is. I feel this is urgent given the current cost of living crisis and increasing food bank use. The choice to anonymise data also made the process feel more remote, and I felt removed from the participants. I can only hope I adequately reflected views within the scope limitations of my study. I hope in the future these voices will be heard in more detail. One thing my current placement at an adolescent mental health charity has taught me is individual change vs system change. It is so incredibly moving to work with an individual and to see their change over time, but we have to acknowledge that we only have the potential to reach few this way. Impacting systems, although less rich, has the potential to touch many more lives.

Practically, there are a few things I would have like to have done, such as ask for a measure of subjective and objective binge eating and include data on ethnicity as mentioned. However, I do believe that if research is not harmful to anyone involved, and is methodologically sound, then it can only be beneficial to the field. I think all research has a capacity to inform and by saying I would have done something differently means I would like to have done a different study.

One thing I would do differently now is to make the qualitative questions on the cost-of-living crisis, not on COVID-19 lockdowns. I think that would make it more relevant but also more valid with all experiences recent and not two years retrospectively.

Future studies

I think future studies would need to target the food insecure as a population and determine the components underpinning disordered eating. Firstly, a qualitative study to explore family dynamics and parental messages given around eating and adolescent interpretation of this. Secondly a large-scale study to explore the potential drivers of disordered eating in food insecure adolescents by looking into the feast-or-famine cycle (Dinour et al., 2007) in response to food scarcity compared to weight and shape preoccupation or other drivers such as trauma. A longitudinal study would also be idea, to determine if disordered eating endures in the individuals once the adolescent is in a different life stage and independent of family and able to secure their own food. Our understanding of disordered eating as a life-long struggle may not fit this population.

"Hunger is not an issue of charity. It is an issue of justice." ~ Jacques Diouf

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Appendices

Appendix A: Example search terms for systematic review

(Adolescen* OR Teen* OR Youth* OR Young adult OR Student OR "High school" OR University) AND (Eat* OR "Eating pathology" OR "Eating disorder" OR "Eating behavior" OR Anorexia OR Bulimia OR Binge* OR Restrict* OR Diet OR Purge OR Obes* OR "Emotional eating" OR "Body dissatisfaction") AND ("Food poverty" OR Hung* OR "Food insecurity" OR "Food insecur*" OR "Food security" OR "Low income" OR "Household food insecurity" OR Povert*)

Appendix B: Standard Quality Assessment Criteria for Reviewing Quantitative Studies and Rating Table

Kmet, Lee, & Cook (2004) *Standard Quality Assessment Criteria for Evaluating Primary Research Papers from a Variety of Fields*. Alberta: Alberta Heritage Foundation for Medical Research.

Criteria		YES (2)	PARTIAL (1)	NO (0)	N/A
1	Question / objective sufficiently described?				
2	Study design evident and appropriate?				
3	Method of subject/comparison group selection or source of information/input variables described and appropriate?				
4	Subject (and comparison group, if applicable) characteristics sufficiently described?				
5	If interventional and random allocation was possible, was it described?				
6	If interventional and blinding of investigators was possible, was it reported?				
7	If interventional and blinding of subjects was possible, was it reported?				
8	Outcome and (if applicable) exposure measure(s) well defined and robust to measurement / misclassification bias? Means of assessment reported?				
9	Sample size appropriate?				
10	Analytic methods described/justified and appropriate?				
11	Some estimate of variance is reported for the main results?				
12	Controlled for confounding?				
13	Results reported in sufficient detail?				
14	Conclusions supported by the results?				

To score:

Yes = 2, Partial = 1, No = 0.

Items not applicable to a particular study design marked "n/a" and excluded from calculation of summary score.

Summary score calculated by summing total score obtained across relevant items and dividing by the total possible score (total score / no. of items x 2).

	Item														Total /22
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Barry et al (2021)	2	1	2	2	n/a	n/a	n/a	1	2	2	1	2	2	2	19
Bruening et al (2017);	2	1	1	1	n/a	n/a	n/a	1	0	1	2	2	2	2	15
Christensen et al. (2021);	2	1	1	2	n/a	n/a	n/a	2	2	2	2	2	2	2	20
El Zein, et al. 2019	2	2	2	2	n/a	n/a	n/a	2	2	2	2	2	2	2	22
Frank et al. (2021);	2	2	2	1	n/a	n/a	n/a	2	1	2	2	1	2	2	19
Hazzard, et al. (2022);	2	2	2	1	n/a	n/a	n/a	2	2	2	1	2	1	2	19
Hooper, et al 2022;	2	2	2	2	n/a	n/a	n/a	2	2	1	1	2	1	2	19
Hooper et al, 2020;	2	2	2	2	n/a	n/a	n/a	2	2	2	2	2	2	2	22
Kim et al. (2021);	2	2	2	2	n/a	n/a	n/a	2	0	2	2	0	2	2	18
Linsenmeyer et al, 2021	2	2	2	1	n/a	n/a	n/a	2	1	2	2	0	2	2	18
Poll et al. (2020);	1	1	2	1	n/a	n/a	n/a	1	1	1	2	0	2	1	13
Royer et al (2021)	2	2	2	2	n/a	n/a	n/a	2	2	1	1	2	2	2	20
Shankar-Krishnan et al. (2021);	2	2	2	2	n/a	n/a	n/a	2	2	2	2	2	2	2	22
West et al 2021,	2	1	2	1	n/a	n/a	n/a	2	0	1	1	2	2	2	16
West et al 2019;	2	1	2	2	n/a	n/a	n/a	2	2	1	2	2	2	2	20

Appendix C: Ethical Approval for Study

UCL RESEARCH ETHICS COMMITTEE
OFFICE FOR THE VICE PROVOST RESEARCH

18th June 2022

Professor Lucy Serpell
Clinical, Educational and Health Psychology
UCL

Cc: Katherine Smith

Dear Professor Serpell

Notification of Ethics Approval with Provisos
Project ID/Title: 22355/001: Investigating the impact of food insecurity on eating pathology in adolescents in the UK and exploring the impact on the COVID-19 lockdowns on this.

I am pleased to confirm in my capacity as Chair of the UCL Research Ethics Committee (REC) that your study has been ethically approved by the UCL REC until **1st September 2023.**

Approval is subject to the following conditions:

Notification of Amendments to the Research
You must seek Chair's approval for proposed amendments (to include extensions to the duration of the project) to the research for which this approval has been given. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing an 'Amendment Approval Request Form' https://www.ucl.ac.uk/research-ethics/responsibilities-after-approval

Adverse Event Reporting – Serious and Non-Serious
It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator (ethics@ucl.ac.uk) immediately the incident occurs. Where the adverse incident is unexpected and serious, the Joint Chairs will decide whether the study should be terminated pending the opinion of an independent expert. For non-serious adverse events the Joint Chairs of the Ethics Committee should again be notified via the Ethics Committee Administrator within ten days of the incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Joint Chairs will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Office of the Vice Provost Research, 2 Taviton Street
University College London
Tel: +44 (0)20 7679 8717
Email: ethics@ucl.ac.uk
http://ethics.grad.ucl.ac.uk/

Final Report
At the end of the data collection element of your research we ask that you submit a very brief report (1-2 paragraphs will suffice) which includes in particular issues relating to the ethical implications of the research i.e. issues obtaining consent, participants withdrawing from the research, confidentiality, protection of participants from physical and mental harm etc.

In addition, please:

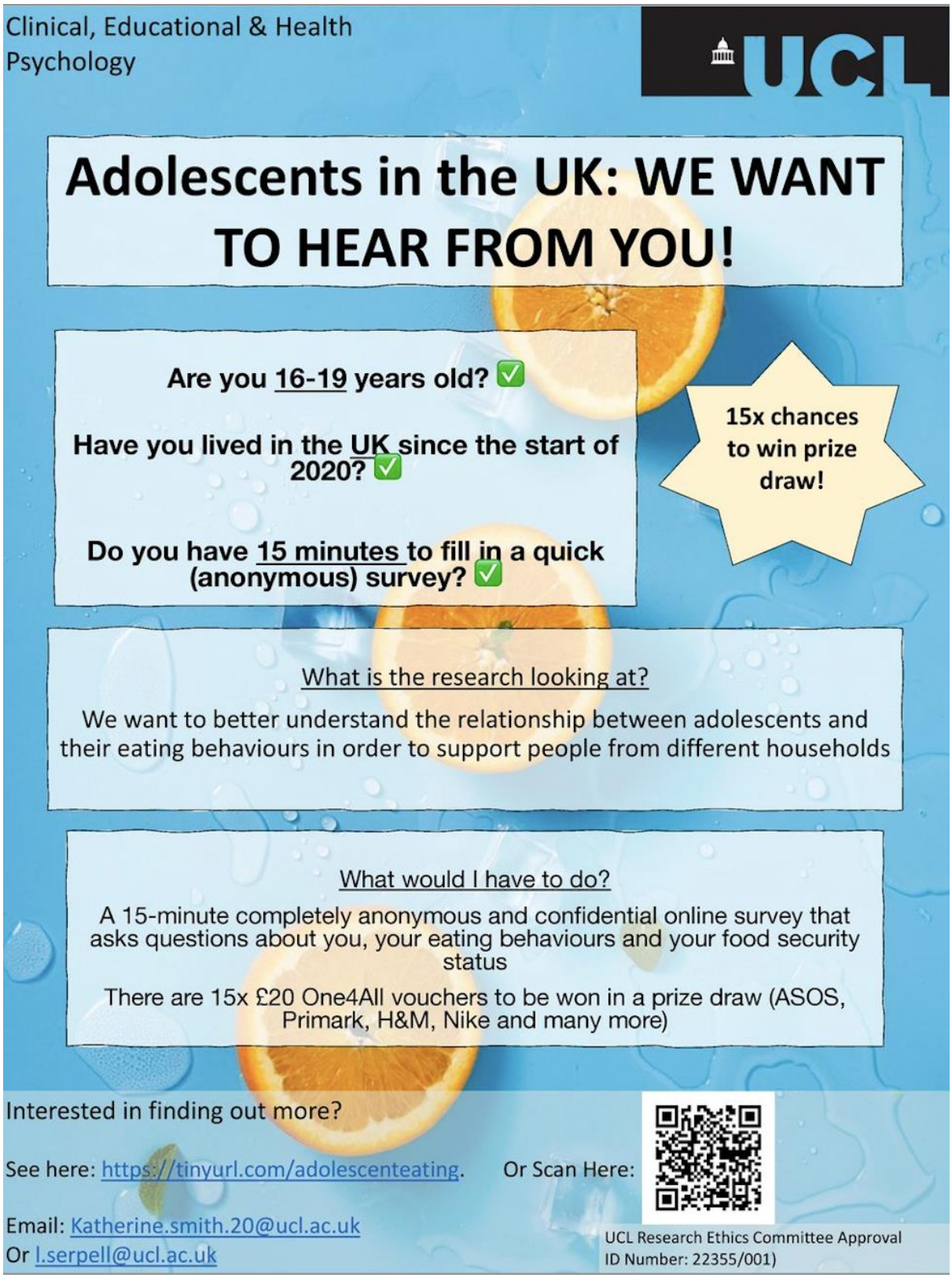
- ensure that you follow all relevant guidance as laid out in UCL's Code of Conduct for Research;
- note that you are required to adhere to all research data/records management and storage procedures agreed as part of your application. This will be expected even after completion of the study.

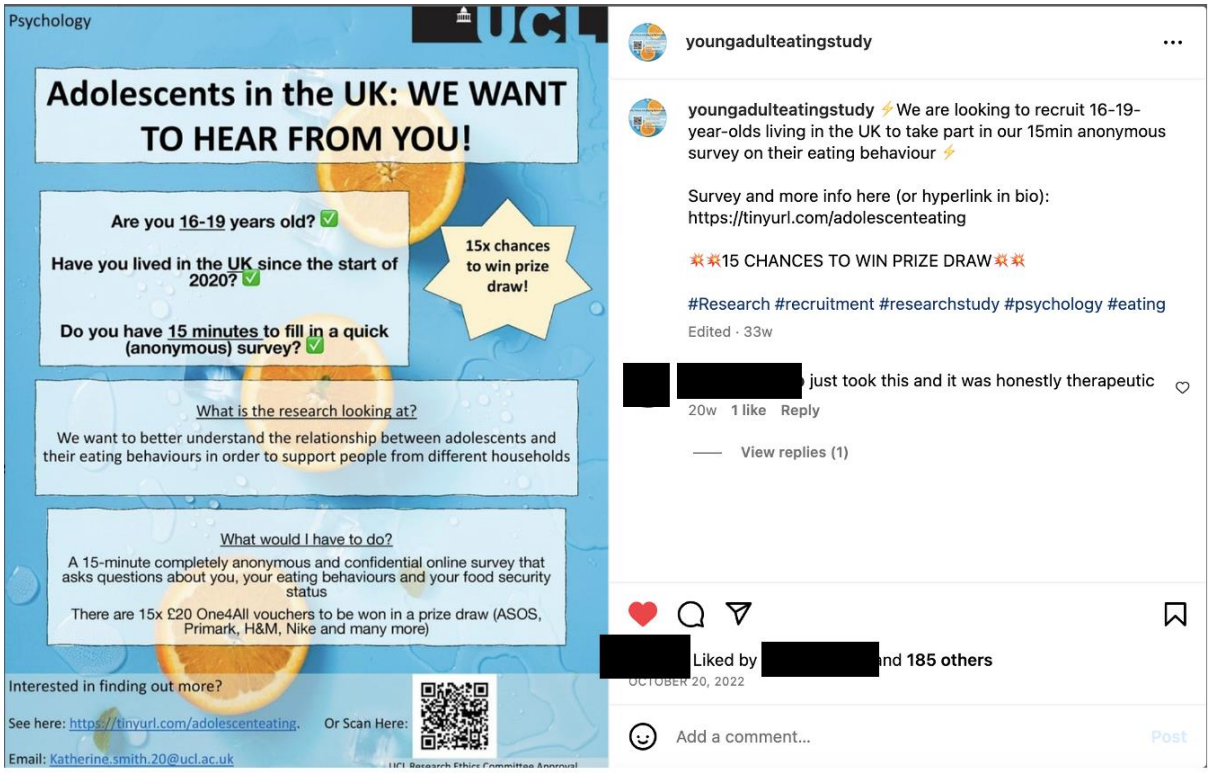
With best wishes for the research.

Yours sincerely

Professor Michael Heinrich
Joint Chair, UCL Research Ethics Committee

Appendix D: Participant Recruitment Advertisements




Psychology
UCL
Adolescents in the UK: WE WANT TO HEAR FROM YOU!
Are you 16-19 years old?
Have you lived in the UK since the start of 2020?
Do you have 15 minutes to fill in a quick (anonymous) survey?
15x chances to win prize draw!
What is the research looking at?
We want to better understand the relationship between adolescents and their eating behaviours in order to support people from different households
What would I have to do?
A 15-minute completely anonymous and confidential online survey that asks questions about you, your eating behaviours and your food security status
There are 15x £20 One4All vouchers to be won in a prize draw (ASOS, Primark, H&M, Nike and many more)
Interested in finding out more?
See here: https://tinyurl.com/adolescenteating.
Or Scan Here:
Email: Katherine.smith.20@ucl.ac.uk
UCL Research Ethics Committee Approval
youngadulteatingstudy
youngadulteatingstudy ⚡We are looking to recruit 16-19-year-olds living in the UK to take part in our 15min anonymous survey on their eating behaviour ⚡
Survey and more info here (or hyperlink in bio): https://tinyurl.com/adolescenteating
💥💥15 CHANCES TO WIN PRIZE DRAW💥💥
#Research #recruitment #researchstudy #psychology #eating
Edited · 33w
[redacted] just took this and it was honestly therapeutic
20w 1 like Reply
View replies (1)
[redacted] Liked by [redacted] and 185 others
OCTOBER 20, 2022
Add a comment...
Post

Appendix E: Participant Information Sheet

RESEARCH DEPARTMENT OF CLINICAL, EDUCATIONAL AND HEALTH PSYCHOLOGY

UCL

Participant Information Sheet

Research Ethics Committee Approval ID Number: **22355/001**

To download the participant information sheet please click here

Who is this questionnaire for?
Adolescents aged 16-19 living in the UK.

What is the study about?
This study seeks to understand the impact of food insecurity on eating behaviour amongst adolescents in the UK.

Food insecurity is defined as "when an individual or household is unable to acquire nutritionally adequate, safe, and culturally appropriate foods in socially acceptable ways". The primary aim is to explore the relationship between self-reported food insecurity and eating behaviour.

What happens during the study?
The study involves filling in the following anonymous questionnaire which should take no more than 15 minutes. You will be asked to answer questions about...

- Demographics including your age, gender, ethnicity, religion and occupation
- Your level of food security
- Your eating behaviour including times when you might have restricted your food intake or eaten what you feel is an excessive amount of food. You can still take part even if you would prefer not to complete this information.
- You will also be asked about how the COVID-19 lockdowns impacted your eating behaviour.

At the end of the questionnaire, you can download a copy of this participant information sheet, the consent form you signed and your answers.

Please be aware that as your response is anonymous, we would not be able to provide you with a copy of your questionnaire at a later date.

Due to the anonymous nature of the study, you are encouraged to contact the researchers if you wish to obtain a copy of the final report:
- Dr Lucy Serpell (Principal Researcher) l.serpell@ucl.ac.uk
- Katie Smith (Trainee Clinical Psychologist) Katherine.smith.20@ucl.ac.uk

Do I have to take part?
No. You do not have to take part if you don't want to. If you change your mind during the study and decide you no longer want to take part, that is fine too, simply exit this tab on your browser. Questions are optional and it is also fine for

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University College London Gower Street London WC1E 6BT
General Enquiries Tel: +44 (0)20 7679 1897
http://www.ucl.ac.uk/clinical-psychology

you to only answer the questions you feel comfortable to.

Is what I say confidential?
Yes. The information we collect about you in the questionnaire is confidential. Only people involved in the research will be able to read the information you give. The information is anonymous (i.e. we are not recording data that could identify you as you).

What happens to the questionnaire responses?
Questionnaire responses will be stored securely for 10 years after the study has been published – this will contain no identifiable personal information. We will aim to delete these earlier if we have finished the study before then.

Are there any risks or benefits to taking part?
Risks: Being asked to think about financial difficulties and also to think about your relationship with food can be upsetting. Please remember participation is voluntary and it is absolutely fine to not answer certain questions.

Signposting to support will be provided at the end of the questionnaire. This signposting will be provided to everyone, regardless of their answers. This does not mean we think that you have an eating disorder or that you are food insecure. These organisations are being highlighted to you in case you would like any further support. You do not have to complete the questionnaire to go to the end to find the signposting.

Benefits:
- Chance to enter a draw. On the final page of the questionnaire, you will find a link which will take you to a separate form where you can enter your contact details for a chance to be entered in a prize draw to win one of x15 £20 vouchers. You are taken to a separate form so that your responses will not be linked to your contact information in case you win, ensuring that your answers are anonymous. You do not have to complete all of the questions to enter the draw, you can just go to the final page.
- Also, some people can find research questionnaires an interesting experience. We will be asking you about your experiences of food insecurity and its relationship to eating behaviour which will help contribute to new research into an important aspect of eating disorders that has been under-researched. If you would like to find out more about the study or would like a copy of the paper once the study is complete, please contact the researchers via the email addresses above.

Data Protection Privacy Notice
The controller for this project will be University College London (UCL). The UCL Data Protection Officer provides oversight of UCL activities involving the processing of personal data, and can be contacted at data-protection@ucl.ac.uk

This 'local' privacy notice sets out the information that applies to this particular study. Further information on how UCL uses participant information can be found in our 'general' privacy notice: For participants in health and care research studies, click here The information that is required to be provided to participants under data protection legislation (GDPR and DPA 2018) is provided across both the 'local' and 'general' privacy notices.

The lawful basis that will be used to process your personal data are: 'Public task' for personal data and' Research purposes' for special category data. Your personal data will be processed so long as it is required for the research project. If we are able to anonymise or pseudonymise the personal data you provide we will undertake this, and will endeavour to minimise the processing of personal data wherever possible.

If you are concerned about how your personal data is being processed, or if you would like to contact us about your rights, please contact UCL in the first instance at: data-protection@ucl.ac.uk.

See details of your rights at: https://ico.org.uk/your-data-matters/

Appendix F: Consent Form

- **Consent** Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet, please ask the researcher before you decide whether to join in. You will be given the opportunity to download a copy of this Consent Form to keep at the end.

I confirm that I understand that by ticking each box below I am consenting to this element of the study. I understand that it will be assumed that unticked boxes means that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element that I may be deemed ineligible for the study.

C1 I have read the Participant Information Sheet and consent to participate in the study. I have had an opportunity to consider the information and what will be expected of me. I have also had the opportunity to ask questions which have been answered to my satisfaction. *Required*

- ○ Yes (1)
- ○ No (2)

C2 I confirm that I am either 16, 17, 18 or 19 years old and have lived in the UK since at least the start of 2020. *Required*

- ○ Yes (1)
- ○ No (2)

C3 I understand that anonymous data that cannot be traced back to me individually may be used in academic publications and in shared in accordance with open science guidelines. *Required*

- ○ Yes (1)
- ○ No (2)

C4 I understand that I can withdraw at any time from the study before I have submitted my answers, without giving a reason, by closing my browser. *Required*

- ○ Yes (1)
- ○ No (2)

C5 I understand that I can download a copy of my answers at the end of the study but I will not be able to access a copy at a later date due to my data being anonymous. *Required*

- ○ Yes (1)
- ○ No (2)

C6 I understand the potential risks of participating and the support that will be available to me should I become distressed during the course of the research.

- ○ Yes (1)
- ○ No (2)

Page Break

Appendix G: The Questionnaire

Food Insecurity Experience Scale (FIES)

- During the last 12 months was there a time when, **because of lack of money or other resources**:

	Yes (1)	No (2)	Prefer Not To Say (3)
1. You were worried you would not have enough food to eat? (1)	○	○	○
2. You were unable to eat healthy and nutritious food? (2)	○	○	○
3. You ate only a few kinds of foods? (3)	○	○	○
4. You had to skip a meal? (4)	○	○	○
5. You ate less than you thought you should? (5)	○	○	○
6. Your household ran out of food? (6)	○	○	○
7. You were hungry but did not eat? (7)	○	○	○
8. You went without eating for a whole day? (8)	○	○	○

Eating Disorders Diagnostic Scale DSM-5 (EDDS-5)

Q9-11 Please carefully complete all questions, choosing NO or 0 for questions that do not apply.

Over the past 3 months…

	0- Not at all (1)	1 (2)	2 - Slightly (3)	3 (4)	4- moderately (6)	5 (7)	6- extremely (8)
Have you felt fat? (1)	○	○	○	○	○	○	○
Have you had a definite fear that you might gain weight or become fat? (2)	○	○	○	○	○	○	○
Has your weight or shape influenced how you judge yourself as a person? (3)	○	○	○	○	○	○	○

Q12 During the past 3 months have there been times when you have eaten what other people would regard as an unusually large amount of food (e.g., a large tub of ice cream) given the circumstances? .

○ Yes (1)

○ No (2)

Q39 During the past 3 months have there been times when you felt like you have eaten an unusually large amount of food?

○ Yes (1)

○ No (2)

Q13 During the times when you ate an unusually large amount of food, did you experience a loss of control (e.g., felt you couldn't stop eating or control what or how much you were eating?)

- ○ Yes (1)
- ○ No (2)

Q14 How many times per month on average over the past 3 months have you eaten an unusually large amount of food and experienced a loss of control?

- ○ 0 (1)
- ○ 1 (2)
- ○ 2 (3)
- ○ 3 (4)
- ○ 4 (5)
- ○ 5 (6)
- ○ 6 (7)
- ○ 7 (8)
- ○ 8 (9)
- ○ 9 (10)
- ○ 10 (11)
- ○ 11 (12)
- ○ 12+ (13)

Q15-20 During episodes of overeating with a loss of control, did you…

	Yes (1)	No (2)
Eat much more rapidly than normal? (1)	○	○
Eat until you felt uncomfortably full? (2)	○	○
Eat large amounts of food when you didn't feel physically hungry? (3)	○	○
Eat alone because you were embarrassed by how much you were eating? (4)	○	○
Feel disgusted with yourself, depressed, or very guilty after overeating? (5)	○	○
If you have episodes of uncontrollable overeating, does it make you very upset? (6)	○	○

Q21-24 In order to prevent weight gain or counteract the effects of eating, how many times per month on average over the past 3 months have you:

	0 (1)	1 (13)	2 (14)	3 (15)	4 (16)	5 (17)	6 (18)	7 (19)	8 (20)	9 (21)	10 (22)	11 (23)	12+ (24)
Made yourself vomit (1)	○	○	○	○	○	○	○	○	○	○	○	○	○
Used laxatives or diuretics (2)	○	○	○	○	○	○	○	○	○	○	○	○	○
Fasted (skipped at least 2 meals in a row)? (3)	○	○	○	○	○	○	○	○	○	○	○	○	○
Engaged in more intense exercise specifically to counteract the effects of overeating (4)	○	○	○	○	○	○	○	○	○	○	○	○	○

Q25 How many times per month on average over the past 3 months have you eaten after awakening from sleep or eaten an unusually large amount of food after your evening meal and felt distressed by the night eating?

- ○ 0 (1)
- ○ 1 (2)
- ○ 2 (3)
- ○ 3 (4)
- ○ 4 (5)
- ○ 5 (6)
- ○ 6 (7)
- ○ 7 (8)
- ○ 8 (9)
- ○ 9 (10)
- ○ 10 (11)
- ○ 11 (12)
- ○ 12+ (13)

Q26 -

	0- not at all (1)	1 (2)	2 - slightly (3)	3 (4)	4 - moderately (5)	5 (6)	6 - extremely (7)
How much does any eating or body image problem impact your relationships with friends and family, work performance, and school performance? (1)	○	○	○	○	○	○	○

Q27 How much do you weigh (Pounds -OR- Kilograms)? If uncertain, please give your best estimate

○ Pounds (Lbs) (1) _____

○ Kilograms (KGs) (2) _____

Q28 How tall are you (in feet+ inches -OR- Centimetres)

○ Feet + Inches (1) _____

○ Centimetres (2) _____

Q29 What is your highest weight at your current height? (Pounds -OR- Kilograms)

○ Pounds (Lbs) (1) _____

○ Kilograms (KGs) (2) _____

Clinical Impairment Scale (CIA)

Q29-44 Over the past 28 days (four weeks), to what extent have your:
- eating habits,
- exercising or
- feelings about your eating, shape or weight...

	Not at all (1)	A little (2)	Quite a bit (3)	A lot (4)
...made it difficult to concentrate? (1)	○	○	○	○
...made you feel critical about yourself? (2)	○	○	○	○
...stopped you going our with others? (3)	○	○	○	○
...affected your work performance (if applicable)? (4)	○	○	○	○
...made you forgetful? (5)	○	○	○	○
...affected your ability to make everyday decisions? (6)	○	○	○	○
...interfered with meals with family and friends? (7)	○	○	○	○
...made you upset? (8)	○	○	○	○
...made you feel ashamed of yourself? (9)	○	○	○	○
...made it difficult to eat out with others? (10)	○	○	○	○
...made you feel guilty? (11)	○	○	○	○
...interfered with you doing things you used to enjoy? (12)	○	○	○	○
...made you absent-minded? (13)	○	○	○	○
...made you feel like. failure? (14)	○	○	○	○
...interfered with your relationships with others? (15)	○	○	○	○
...made you worry? (16)	○	○	○	○

Qualitative Questions

- We will now be asking you two open-ended questions, meaning you can answer as much or as little as you would like.

We would like to take this opportunity to remind you to **not include any identifiable information in these text boxes to ensure your anonymity**. If you do happen to include an identifier, but do not notice until you have submitted, we want to assure you that all responses will be screened and any identifiers will be removed.

Q1 1. Tell us about the impact of the first national lockdown (23rd March 2020-1st June 2020) on your eating. Did you find yourself eating more or less or different types of food? Did the pattern of your eating change?

Q2 2. If there were changes in your eating habits, were these enduring changes? i.e are these changes of habit still with you today? how is your eating now?

Demographics

D1 What is your age?

- ○ 16 (1)
- ○ 17 (2)
- ○ 18 (3)
- ○ 19 (4)

D2 What is your sex? (a question about gender identity will follow later in this questionnaire)

- ○ Male (1)
- ○ Female (2)

D3 Is the gender you identify with the same as your sex registered at birth? (this question is voluntary)

- ○ Yes (1)
- ○ No (2)
- ○ Enter gender identity (3) _____

D4 What best describes your ethnic group or background?

- ○ White (Welsh /English / Scottish/ Northern Irish/ British) (1)
- ○ Irish (2)
- ○ Gypsy or Irish Traveller (3)
- ○ Any other white background (4)
- ○ White and Black Caribbean (5)
- ○ White and Black African (6)
- ○ White and Asian (7)
- ○ Any other mixed/ multiple ethnic background (8)
- ○ Indian (9)
- ○ Pakistani (10)
- ○ Bangladeshi (11)
- ○ Chinese (12)
- ○ African (13)
- ○ Caribbean (14)
- ○ Arab (15)
- ○ Other (please specify) (16)

D5 What is your religion?

- ○ No religion (1)
- ○ Christian (including all christian denominations) (2)
- ○ Buddhist (3)
- ○ Hindu (4)
- ○ Jewish (5)
- ○ Mislim (6)
- ○ Sikh (7)
- ○ Any other religion (8) _____

D6 Are you in full-time education?

- ○ Yes (1)
- ○ No (2)
- ○ Prefer not to say (3)

D7 Are you in full or part time employment?

- ○ Yes (1)
- ○ No (2)
- ○ Prefer not to say (3)

D8 Are you in receipt of any working age benefits (e.g. Universal Credit)?

- Yes (1)
- No (2)
- Prefer not to say (3)

D9 Do you consider yourself to have a disability?

- Yes (1)
- No (2)
- Prefer not to say (3)

D10 Have you ever had a diagnosis of an eating disorder? *optional*

- Yes, currently (1)
- Yes, previously (2)
- No (3)
- Prefer not to say (4)