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Association of Food Insecurity and Food Addiction Symptoms: A Secondary Analysis of Two Samples of Low-Income Female Adults

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Abstract

Background—Household food insecurity persists in the United States and has important implications for health and well-being. Food insecurity in female-identified caregivers is particularly concerning given its association with their mental health and adverse health outcomes for their children. Food insecurity is associated with disordered eating, but no prior studies have examined an association between food insecurity and food addiction.

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Objective—To examine whether food insecurity is associated with higher food addiction symptom endorsement in low-income female adults.

Design—Secondary analysis of baseline data from a quasi-experimental study of a mindfulness-based intervention on gestational weight gain among low-income pregnant individuals and an observational study of low-income families.

Participants/setting—Participants in Study 1 (n = 208) were English-speaking, low-income pregnant individuals with overweight or obesity, recruited in California from 2011 to 2013. Participants in Study 2 (n = 181) were English-speaking, low-income female caregivers for children between 8 and 10 years old, recruited in Michigan from 2018 to 2019. Both studies recruited participants from community health clinics, social service agencies, and online advertisements.

Main Outcome Measures—The primary outcome measure was food addiction symptoms, assessed by the Yale Food Addiction Scale.

Statistical Analysis—Multivariate Poisson regression was used to examine the association between household food insecurity and food addiction symptoms in each sample, adjusted for sociodemographic characteristics.

Results—In Study 1, pregnant individuals in food-insecure households reported 21% higher food addiction symptoms than pregnant individuals in food-secure households (IRR 1.21, 95% CI 1.00, 1.47, *P=.047*). In Study 2, caregivers in food-insecure households had 56% higher food addiction symptoms than caregivers in food-secure households (IRR 1.56, 95% CI 1.01, 2.40, *P=.045*).

Conclusions—These findings provide preliminary support for a relationship between household food insecurity and food addiction. Future research should examine potential mechanisms and whether interventions to reduce food insecurity lower risk of food addiction.

Keywords

food insecurity; food addiction; low-income; maternal health

Introduction

Household food insecurity, which refers to the lack of access to sufficient food to meet the nutritional needs of all household members, was estimated to affect 10.5% of U.S. households in 2019.[1] Food insecurity disproportionately affects households with children and single-parent households.[1] Food insecurity is particularly concerning for low-income female-identified caregivers, who are often responsible for feeding children and other household members due to gender norms and expectations.[2] Mothers who experience food insecurity report elevated levels of depression, anxiety, and other psychopathology,[3,4] which may impact parenting and increase children's risk for developmental delays and psychopathology.[5,6] In economically developed countries, food insecurity is associated with greater body mass index (BMI).[7,8] Although the role of gender in the relationship between food insecurity and BMI is not fully understood, several studies suggest women in food-insecure households are at greater risk for obesity than men in food insecure households.[7] For children in food-insecure households, BMI in the "overweight "and "obese" ranges

is associated with increased health risks, some of which may track into adulthood, even after adequate access to food is restored.[9] Food insecurity is associated with overall eating disorder pathology,[10,11] increased incidence of diagnosable eating disorders including bulimia nervosa,[12,13] binge eating disorder,[14] as well as dysfunctional eating symptoms, including dietary restraint,[4,10,11,15] and loss of control eating.[16,17] During pregnancy, food insecurity is associated with disordered eating and food insecurity coupled with dietary restraint is associated with greater gestational weight gain.[18]

Families experiencing food insecurity often have limited access to nutrient-rich foods like fruits, vegetables, and lean proteins, and relatively greater access to less expensive, highly processed foods, which are high in refined carbohydrates (i.e., white flour and sugar) and fat.[19] Highly processed foods are much more effective than naturally-occurring foods at activating neural reward responses[20] and are associated with behavioral patterns that mirror substance use disorders.[21,22] Food addiction is measured by the Yale Food Addiction Scale (YFAS), which assesses symptoms of substance use disorder (e.g., compulsive use, unsuccessful attempts to cut down, tolerance, withdrawal) in the context of highly processed foods.[22,23] In parallel to substance use disorder diagnosis, individuals are considered to have a food addiction “diagnosis” if they endorse at least two symptoms and clinically significant impairment or distress.[22] Approximately 15% of adults in community samples report symptoms that met the criteria for diagnosable food addiction.[24] Meeting the diagnostic definition of food addiction is associated with adverse health outcomes, including diet-related disease (e.g., hypercholesteremia), depression, and poor quality of life.[25-28] Furthermore, higher endorsement of food addiction symptoms is a strong psychosocial predictor of weight gain and attrition during weight loss treatment.[29] Food insecurity is associated with outcomes that are also associated with food addiction symptoms, including increased BMI and disordered eating.[10,11,14] However, no prior studies have examined whether food insecurity is associated specifically with food addiction symptoms.

Findings regarding the relationship between food addiction and measures of socio-economic status (SES) have been mixed.[24,30,31] Findings may vary because prior studies have used relatively high SES samples where relatively few participants were experiencing food insecurity. This highlights the need for research examining these relationships specifically in low-income samples that are adequately powered to detect relationships between food addiction, food insecurity, along with SES measures. In low-income samples, at equally low levels of income there is a range of levels of food insecurity. Examining food insecurity and food addiction among low-income samples is one way to test these relationships.

This secondary analysis examined the association between food insecurity and food addiction symptoms in two low-income vulnerable populations: pregnant individuals and female caregivers of school-aged children. The study had two aims: 1) to determine whether a relationship exists between food insecurity and food addiction, and 2) if so, to determine whether the relationship can be replicated across two samples of low-income female adults. The study tested the hypotheses that food insecurity would be associated with greater endorsement of food addiction symptoms in both samples, and this relationship would be observed independent of other measures of SES.

Methods

Participants

This analysis included baseline data from two cohort studies of low-income female adults: the Maternal Adiposity, Metabolism, and Stress (MAMAS) study and the Family Food Study (FFS).

Detailed methodology for the MAMAS study has been previously reported.[32] Briefly, the MAMAS study was a quasi-experimental study of an eight-week mindfulness-based intervention on gestational weight gain in low-income pregnant individuals with overweight or obesity. MAMAS study participants were recruited from hospital-based and community-based clinics, offices for federally funded nutrition benefits, organizations providing services to pregnant individuals, and online advertisements in the San Francisco Bay area between August 2011 and June 2013. Participants (n = 208) were English-speaking pregnant individuals aged 18-45 at 12-19 weeks of a singleton pregnancy at the time of assessment. Participants had a pre-pregnancy BMI of 25-41 kg/m^2 and a household income <500% of the US federal poverty line. Data for the present study comes from the baseline survey completed prior to the initiation of the intervention. All study procedures were approved by the University of California San Francisco, California Pacific Medical Center, University of California Berkeley, and Contra Costa Regional Medical Center and Health Centers Institutional Review Boards. All participants provided written informed consent prior to enrollment.

FFS was a follow-up study of low-income families recruited from Southeast Michigan that aimed to assess associations between food insecurity, child weight gain, and maternal weight gain. Participants in the FFS (n = 181) were English-speaking adult female-identified caregivers aged 27-57, with children between 8 and 10 years old, and a household income less than or equal to 200% of the US federal poverty line. Families were recruited from community health clinics, social service agencies, and UMhealthresearch.org, an online database where community members find opportunities to participate in ongoing clinical and behavioral studies. Data for the present study comes from the baseline survey completed by FFS participants from September 2018 to December 2019. All study procedures were approved by the University of Michigan Institutional Review Board Health Sciences and Behavioral Sciences. All participants provided written informed consent prior to enrollment.

Measures

Food Security.—The US Household Food Security Module is an 18-item scale designed to examine a family's level of household food security in the last 12 months.[33] The first 10 questions assess adult respondents' experiences (the U.S. Adult Food Security Module), and the remaining eight questions assess experiences of respondents' children. The MAMAS study used the U.S. Adult Food Security Module and the FFS used the full module. The first three questions of each module assess for frequency of food insecurity experiences (e.g., worrying whether food would run out until they got money to buy more). The remaining questions assess other experiences of food insecurity (e.g., cutting the size of meals or skipping meals because there wasn't enough money for food). Participants were categorized

as “food-insecure” when they answered affirmatively to three or more questions (“often true,” or “sometimes true,” to the first three questions, or “yes” to questions with binary response options). All other participants were categorized as “food-secure.”

Yale Food Addiction Scale (YFAS).—The YFAS was developed to assess food addiction symptoms. The questions are based on the substance use disorder criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM), adapted to the context of highly processed food. Each study used a different YFAS version, based on the current version at the time of data collection. The MAMAS study used the original YFAS, which consists of 27 questions and assesses the seven substance use disorder symptoms from DSM-IV.[23] The FFS used the Modified YFAS, Version 2.0 (mYFAS 2.0), which consists of 13 questions and assesses for the 11 substance use disorder symptoms from DSM-5.[22] Participants reported the frequency of each symptom over the last 12 months, from “never,” to “every day.” Each symptom has a different frequency threshold that must be met to meet criteria for that symptom. For example, on the YFAS, in order to meet criteria for the symptom “substance taken in larger amount and for longer period than intended,” participants must report that they “found that when they started eating certain foods, they ended up eating much more than planned” at least four times per week. Participant symptom endorsement was scored as 0 or 1 for each symptom based on thresholds for each YFAS version. The number of symptoms each participant endorsed were added to create a symptom count score. A symptom count of 2 is the current estimated threshold for a clinical level of addictive eating.[22] A symptom count was used rather than a dichotomous diagnostic score because continuous dimensional measures are more sensitive for detecting food addiction symptoms in community samples.[34]

Sociodemographic covariates.—Participants in both studies reported their age, race/ethnicity, level of educational attainment, and household income. These variables were selected as potential confounders, as they have each been associated with food insecurity and/or food addiction symptoms.[24,35] Gender and sex were not included as covariates, as all participants identified their sex as female, and data on gender identity was not collected in either study. Female sex was assumed in the MAMAS study, as all participants were pregnant during participation as an aim of the study was to evaluate the effectiveness of a mindfulness intervention during pregnancy on birth outcomes. The FFS was limited to caregivers of school-aged children who self-identified as female, as female caregivers are more likely to take responsibility for children’s nutritional needs.[2]

Statistical Analysis

All statistical analyses were performed using SAS software, Version 9.3 (SAS Institute Inc., Cary, NC). Statistical significance was set at $P<.05$, two-tailed. First, means and distributions in sociodemographic covariates were compared by food security status using univariate linear regression (for age) and chi-squared tests (for categorical variables).

Multivariate Poisson regression was used to examine the association between food insecurity and food addiction symptom count. For each sample, the report includes an initial unadjusted model, a second model adjusted for age, and a final model adjusted for all

other sociodemographic covariates (race/ethnicity, educational attainment, and household income). The incidence rate ratio (IRR) was interpreted as the difference in food addiction symptoms endorsed by food-insecure participants as compared to food-secure participants. Cohen's *d* was calculated as a measure of standardized effect size for each multivariate model.[36] Effects were considered small at $|d| > .2$, medium at $|d| > .5$ and large at $|d| > .8$.[37]

Results

Comparisons of demographic characteristics by food security status revealed no significant differences between participants in food-secure and food-insecure households in either sample. Table 1 details characteristics of MAMAS study participants by household food security status. In the MAMAS sample, 41.8% of pregnant individuals were food-insecure. 20.2% of pregnant individuals had low food security and 21.6% had very low food security. On average, MAMAS participants met criteria for 2.1 food addiction symptoms. Food-secure and food-insecure MAMAS participants did not differ by age, race/ethnicity, educational attainment, or household income.

Table 2 details characteristics of FFS participants by household food security status. In the FFS sample, 60.1% of caregivers were food-insecure. 27.8% of caregivers had low food security and 32.4% had very low food security. On average, FFS participants met criteria for 0.6 food addiction symptoms. Similar to MAMAS, food-secure and food-insecure FFS participants did not differ by age, race/ethnicity, educational attainment, or household income.

Multivariate Poisson regression revealed that participants in food-insecure households in both samples reported significantly more food addiction symptoms compared to participants in food-secure households. Table 3 shows the multivariate-adjusted associations between food insecurity and food addiction symptoms. In MAMAS, pregnant individuals in food-insecure households had 21% higher food addiction symptoms than pregnant individuals from food-secure households, after adjusting for sociodemographic variables (IRR 1.21, 95% CI 1.00, 1.47, $P = .047$). Cohen's effect size value ($d = .39$) suggested a small effect. In FFS, caregivers in food-insecure households had 56% higher food addiction symptoms than caregivers from food-secure households, after adjusting for sociodemographic variables (IRR 1.56, 95% CI 1.01, 2.40, $P = .045$). Cohen's effect size value ($d = .29$) suggested a small effect. Note that MAMAS and FFS studies used different versions of the YFAS as the outcome measure. Thus, these results cannot necessarily be meaningfully compared across samples.

Discussion

This study examined the association between food insecurity and food addiction symptoms in two samples of low-income female adults. Consistent with hypotheses, food insecurity was associated with higher food addiction symptom endorsement when controlling for sociodemographic characteristics, in both samples. This is the first study to identify an association between food security status and endorsement of food addiction symptoms. The magnitude of the observed associations were small, which is likely due to multiple

biopsychosocial factors that contribute to food addiction.[38] However, these findings suggest food insecurity is a relevant overlooked factor related to food addiction. Given that food addiction is associated with poorer mental and physical health,[25-27] food addiction may contribute to negative outcomes for low-income female individuals experiencing food insecurity. These findings represent an important step toward advancing scientific understanding of the detrimental health impacts of food insecurity and point to several mechanisms that may serve as intervention targets to reduce food addiction among low-income female adults.

These findings are consistent with prior studies that show that food insecurity is associated with increased binge eating disorder and loss of control eating.[14,16,17] Although binge eating disorder and food addiction show some overlap in symptomatology, they are considered distinct constructs that account for unique variance in clinical impairment.[39-41] Three interrelated key mechanisms of addiction may contribute to increased food addiction symptoms in the food insecurity context. First, food insecurity is associated with low/poor diet quality.[42] The current food environment is dominated by highly processed foods, which are cheaper and more convenient than minimally processed foods.[43] Individuals experiencing food insecurity may be particularly vulnerable to the effects of the food environment due to targeted marketing and other food industry tactics (e.g., manipulating shelf space in supermarkets in low-income areas).[44,45] Given these factors, it is not surprising that people with food insecurity are more likely to consume highly processed foods, including high-fat dairy products, salty snacks, and sugar-sweetened beverages.[46] Food addiction theory posits that the refined ingredients in these highly processed foods parallel the process of distilling active ingredients in other addictive agents in order to make them more addictive (e.g., processing the coca leaf, which has little addictive potential, into powder cocaine, which has a higher addictive potential).[21] There is currently scientific controversy about whether highly processed foods are truly capable of triggering an addictive response.[47] However, evidence from basic science shows diets composed of refined carbohydrates and fats can cause changes in the brain that drive forward addictive eating behavior.[48] This is consistent with human studies, which show that individuals almost exclusively exhibit signs of addictive intake with highly processed foods, but not with minimally processed foods.[21] Thus, individuals experiencing food insecurity may be particularly vulnerable to food addiction due to the dominance of potentially addictive highly processed foods in their food environment.[43,49,50] An important area of future study is to investigate how availability and access to highly processed foods shape eating behavior in food-insecure samples. It will be important to investigate whether the pattern of only addictively eating highly processed foods generalizes to food-insecure samples, or whether patterns of deprivation and availability of all food may lead to addictive patterns of consumption that occur regardless of food type.

Second, people experiencing food insecurity may have uncertain or intermittent patterns of food availability (e.g., food resources are abundant at the beginning of a month, but scarce at the end of the month once resources have been exhausted).[51] Animal research shows intermittent access to addictive drugs facilitates addictive patterns of consumption, even when animals are exposed to a relatively small amount of the drug.[52] This pattern mirrors drug use patterns that contribute to addiction in humans.[53] Animal research has replicated

this effect with food; mice subjected to intermittent periods of fasting and food availability display more binge behavior than mice that fast and eat at predictable intervals.[54] However, this pattern only emerges in rats given intermittent access to sugar, but not intermittent access to chow, suggesting a combination of intermittency and highly processed food may be necessary to facilitate addictive eating.[55] Food insecurity may replicate these conditions by causing individuals to access potentially addictive highly processed foods in intermittent patterns that further increase risk for addictive eating.

Third, individuals experiencing food insecurity report higher stress levels, which are associated with greater food insecurity severity.[56] Chronic stress is an important risk factor for the development and maintenance of addiction.[57] Chronic stress is a common mechanism between addiction and obesity, as it alters the reward system in ways that potentiate overconsumption of both addictive drugs and highly processed foods.[58,59] A recent study found food insecurity was indirectly associated with higher body weight via increased distress and eating to cope.[60] Thus, the stress associated with food insecurity may increase individuals' risk for food addiction.

The samples were an important strength of this study, in that they comprised low-income female adults with a large proportion of participants experiencing food insecurity; the distribution increased power to detect differences by food security status. Having samples that represent distinct groups of low-income female adults from different geographic regions, with data collected from non-overlapping time periods, and representing different stages of parenthood/caregiving point to the robustness of the findings. Although the incidence rate ratios between the two samples differ in magnitude, overlapping confidence intervals indicate similar associations between food insecurity and food addiction between samples, despite differences in participant characteristics. Participants in the MAMAS study were pregnant individuals who may or may not have had other children, while participants in the FFS were caregivers for at least one 8 to 10-year-old child. The studies also differed in the required income threshold for participation. There may be aspects of pregnancy or being a female caregiver of a school-aged child that account for potential differences in food addiction symptom endorsement and the association between food insecurity and food addiction symptoms. Future research may examine whether income level, pregnancy status, age of children, or number of children in the household impact food addiction symptom endorsement or moderate the relationship between food insecurity and food addiction.

This study was subject to several limitations to consider when interpreting the findings. First, this study was cross-sectional and cannot prove causation. Longitudinal studies may illuminate temporal relationships between food insecurity and food addiction and potential explanatory mechanisms over time. Third, this study analyzed baseline data from studies with different primary aims. The MAMAS study was an intervention study that required participants to commit to attending 8 weekly mindfulness-based intervention sessions, plus two booster telephone sessions and one postpartum group session with parents and infants. Participant characteristics may have been influenced by participants' motivation and availability to attend the intervention. For example, participants with greater eating pathology/food addiction symptomology may have been drawn to a study that offered training in mindful eating. In contrast, the FFS was an observational study that did not offer

any potential benefit regarding managing eating. The replication of the observed association between food insecurity and food addiction across samples suggests the findings were not unique to an intervention-seeking sample. Future research should investigate whether the association between food insecurity and food addiction and generalize to non-parents and children. An additional limitation of these samples is that sex and gender identity were not assessed as distinct constructs. Future studies should assess both constructs and consider the impact of biological mechanisms (e.g., reproductive hormones) and societal gender roles on the association between food addiction and food insecurity.

Measurement error may have been introduced by the scales used in this study. The Food Security Module asks participants to report whether they have experienced indicators of food insecurity within the last 12 months. Thus, participants may have experienced food insecurity up to 12 months prior to the study but were no longer experiencing it at the time of study participation. The YFAS also asks participants to report their food addiction symptoms in the last 12 months, which poses the same limitation. Longitudinal studies with larger sample sizes are needed to determine the temporal relationship between experiences of food insecurity and food addiction and to examine how the severity of food insecurity affects the risk of subsequent food addiction. Additionally, the FFS used the mYFAS 2.0, which is an abbreviated version of the YFAS 2.0. There is evidence that the mYFAS 2.0 is less sensitive at detecting food addiction symptoms compared the full version of the scale.[61] Thus, this study may have underestimated food addiction symptoms in the FFS sample.

Another key limitation of this study is that the YFAS has not been psychometrically validated in samples of pregnant individuals or people experiencing food insecurity. Recent studies with related samples provide preliminary evidence of construct validity for the use of the YFAS in the current study. For example, in an urban, low-income sample, YFAS scores were associated with severity of emotional eating and higher BMI,[62] and in a more well-resourced sample of pregnant women, YFAS scores were associated with eating in the absence of hunger.[63] Further, qualitative research with low-income women found that they identified food addiction as a valid and relevant construct.[64] However, validation studies are needed to account for potential differences in these populations' experiences of addictive eating. Participants in this study may have interpreted the YFAS questions in a way that reflected specific aspects of pregnancy (e.g., increased cravings for specific foods driven by hormonal changes) or food insecurity, rather than an addictive phenotype. Although the YFAS primes participants to consider highly processed foods as they complete the questionnaire, it also allows participants to call to mind "any other foods," they may have eaten in addictive ways. It is possible that endorsement of food addiction symptoms in food-insecure samples reflects increased hedonic urges to eat any available foods, not just highly processed foods typically implicated in food addiction. Psychometric validation of the YFAS for pregnant individuals and people experiencing food insecurity is an important next step.

Conclusions

The current study shows preliminary evidence for an association between food insecurity and food addiction symptoms. This association was replicated in two samples of low-income

female adults: pregnant individuals and female caregivers of school-aged children. These findings expand upon prior research that has found associations between food insecurity and disordered eating patterns by suggesting that food insecurity is also associated with an addictive pattern of eating that resembles substance use disorders. Addictive mechanisms may be valuable avenues for further understanding the relationship between food insecurity and overconsumption of highly processed foods.

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References

1. Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. Household Food Security in the United States in 2019. 2020.
2. Martin MA, Lippert AM. Feeding her children, but risking her health: the intersection of gender, household food insecurity and obesity. Soc Sci Med. 2012;74(11):1754–1764. [PubMed: 22245381]
3. Wu Q, Harwood RL, Feng X. Family socioeconomic status and maternal depressive symptoms: Mediation through household food insecurity across five years. Soc Sci Med. 2018;215:1–6. [PubMed: 30195125]
4. Laraia B, Siega-Riz AM, Gundersen C, Dole N. Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women. J Nutr. 2006;136(1):177–182. [PubMed: 16365079]
5. Gill M, Koleilat M, Whaley SE. The impact of food insecurity on the home emotional environment among low-income mothers of young children. Matern Child Health J. 2018;22(8):1146–1153. [PubMed: 29445981]
6. Pedroso J, Buccini G, Venancio SI, Pérez-Escamilla R, Gubert MB. Maternal mental health modifies the association of food insecurity and early child development. Matern Child Nutr. 2020:e12997. [PubMed: 32351004]
7. Moradi S, Mirzababaei A, Dadfarma A, et al. Food insecurity and adult weight abnormality risk: a systematic review and meta-analysis. Eur J Nutr. 2019;58(1):45–61. [PubMed: 30219965]
8. Myers CA, Mire EF, Katzmarzyk PT. Trends in adiposity and food insecurity among US adults. JAMA Netw Open. 2020;3(8):e2012767–e2012767. [PubMed: 32766803]
9. Weihrauch-Blüher S, Schwarz P, Klusmann J-H. Childhood obesity: increased risk for cardiometabolic disease and cancer in adulthood. Metabolism. 2019;92:147–152. [PubMed: 30529454]
10. Becker CB, Middlemass K, Taylor B, Johnson C, Gomez F. Food insecurity and eating disorder pathology. Int J Eat Disord. 2017;
11. Becker CB, Middlemass KM, Gomez F, Martinez-Abrego A. Eating disorder pathology among individuals living with food insecurity: a replication study. Clin Psychol Sci. 2019;7(5):1144–1158.
12. Lydecker JA, Grilo CM. Food insecurity and bulimia nervosa in the United States. Int J Eat Disord. 2019;52(6):735–739. [PubMed: 30920683]
13. Hazzard VM, Barry MR, Leung CW, Sonneville KR, Wonderlich SA, Crosby RD. Food insecurity and its associations with bulimic-spectrum eating disorders, mood disorders, and anxiety disorders in a nationally representative sample of US adults. Soc Psychiatry Psychiatr Epidemiol. 2021:1–8.
14. Rasmusson G, Lydecker JA, Coffino JA, White MA, Grilo CM. Household food insecurity is associated with binge-eating disorder and obesity. Int J Eat Disord. 2019;52(1):28–35.
15. Middlemass KM, Cruz J, Gamboa A, et al. Food insecurity & dietary restraint in a diverse urban population. Eat Disord. 2020:1–14.

16. West CE, Darling KE, Ruzicka EB, Sato AF. Household income and loss of control eating in adolescence: Examining the role of food insecurity. Appetite. 2021;165:105291. [PubMed: 33961934]
17. Larson N, Laska MN, Neumark-Sztainer D. Food insecurity, diet quality, home food availability, and health risk behaviors among emerging adults: Findings from the EAT 2010-2018 study. Am J Public Health. 2020;110(9):1422–1428. [PubMed: 32673120]
18. Laraia B, Epel E, Siega-Riz AM. Food insecurity with past experience of restrained eating is a recipe for increased gestational weight gain. Appetite. 2013;65:178–184. [PubMed: 23402720]
19. Drewnowski A The cost of US foods as related to their nutritive value. Am J Clin Nutr. 2010;92(5):1181. [PubMed: 20720258]
20. Small DM, DiFeliceantonio AG. Processed foods and food reward. Science. 2019;363(6425):346–347. [PubMed: 30679360]
21. Schulte EM, Avena NM, Gearhardt AN. Which foods may be addictive? The roles of processing, fat content, and glycemic load. PLoS One. 2015;10(2):e0117959. [PubMed: 25692302]
22. Schulte EM, Gearhardt AN. Development of the modified Yale food addiction scale version 2.0. Eur Eat Disord Rev. 2017;25(4):302–308. [PubMed: 28370722]
23. Gearhardt AN, Corbin WR, Brownell KD. Preliminary validation of the Yale Food Addiction Scale. Appetite. 2009/04/01/ 2009;52(2):430–436. doi:10.1016/j.appet.2008.12.003 [PubMed: 19121351]
24. Schulte EM, Gearhardt AN. Associations of food addiction in a sample recruited to be nationally representative of the United States. Eur Eat Disord Rev. 2018;26(2):112–119. [PubMed: 29266583]
25. Nunes-Neto PR, Köhler CA, Schuch FB, et al. Food addiction: Prevalence, psychopathological correlates and associations with quality of life in a large sample. J Psychiatr Res. 2018;96:145–152. [PubMed: 29049971]
26. Zhao Z, Ma Y, Han Y, et al. Psychosocial correlates of food addiction and its association with quality of life in a non-clinical adolescent sample. Nutrients. 2018;10(7):837. [PubMed: 29958382]
27. Flint AJ, Gearhardt AN, Corbin WR, Brownell KD, Field AE, Rimm EB. Food-addiction scale measurement in 2 cohorts of middle-aged and older women. Am J Clin Nutr. 2014;99(3):578–586. [PubMed: 24452236]
28. Minhas M, Murphy CM, Balodis IM, Samokhvalov AV, MacKillop J. Food addiction in a large community sample of Canadian adults: prevalence and relationship with obesity, body composition, quality of life and impulsivity. Addiction. 2021;
29. Fielding-Singh P, Patel ML, King AC, Gardner CD. Baseline Psychosocial and Demographic Factors Associated with Study Attrition and 12-Month Weight Gain in the DIETFITS Trial. Obesity. 2019;27(12):1997–2004. [PubMed: 31633313]
30. Berenson AB, Laz TH, Pohlmeier AM, Rahman M, Cunningham KA. Prevalence of Food Addiction Among Low-Income Reproductive-Aged Women. J Womens Health. 2015;24(9)
31. Hardy R, Fani N, Jovanovic T, Michopoulos V. Food addiction and substance addiction in women: Common clinical characteristics. Appetite. 2017;120:367–373. [PubMed: 28958901]
32. Epel E, Laraia B, Coleman-Phox K, et al. Effects of a mindfulness-based intervention on distress, weight gain, and glucose control for pregnant low-income women: a quasi-experimental trial using the ORBIT model. Int J Behav Med. 2019;26(5):461–473. [PubMed: 30993601]
33. US Department of Agriculture. U.S. Household Food Security Survey Module. 2012.
34. Meule A, Gearhardt AN. Ten Years of the Yale Food Addiction Scale: a Review of Version 2.0. Curr Addict Rep. 2019:1–11.
35. Myers AM, Painter MA. Food insecurity in the United States of America: an examination of race/ethnicity and nativity. Food Secur. 2017;9(6):1419–1432.
36. Coxe S Effect size for Poisson regression. https://stefany.shinyapps.io/RcountD/
37. Cohen J Statistical power analysis for the behavioral sciences. Routledge; 2013.

38. Wiss DA, Avena N, Gold M. Food addiction and psychosocial adversity: Biological embedding, contextual factors, and public health implications. Nutrients. 2020;12(11):3521. [PubMed: 33207612]
39. Linardon J, Messer M. Assessment of food addiction using the Yale Food Addiction Scale 2.0 in individuals with binge-eating disorder symptomatology: Factor structure, psychometric properties, and clinical significance. Psychiatry Res. 2019;279:216–221. [PubMed: 30862369]
40. Gearhardt AN, White MA, Masheb RM, Morgan PT, Crosby RD, Grilo CM. An examination of the food addiction construct in obese patients with binge eating disorder. Int J Eat Disord. 2012;45(5):657–663. [PubMed: 22684991]
41. Schulte EM, Grilo CM, Gearhardt AN. Shared and unique mechanisms underlying binge eating disorder and addictive disorders. Clin Psychol Rev. 2016;44:125–139. [PubMed: 26879210]
42. Morales ME, Berkowitz SA. The relationship between food insecurity, dietary patterns, and obesity. Curr Nutr Rep. 2016;5(1):54–60. [PubMed: 29955440]
43. Monteiro CA, Moubarac JC, Cannon G, Ng SW, Popkin B. Ultra-processed products are becoming dominant in the global food system. Obes Rev. 2013;14:21–28. [PubMed: 24102801]
44. Stanton RA. Food retailers and obesity. Curr Obes Rep. 2015;4(1):54–59. [PubMed: 26627090]
45. Lucan SC, Maroko AR, Sanon OC, Schechter CB. Unhealthful food-and-beverage advertising in subway stations: targeted marketing, vulnerable groups, dietary intake, and poor health. J Urban Health. 2017;94(2):220–232. [PubMed: 28271237]
46. Leung CW, Epel ES, Ritchie LD, Crawford PB, Laraia B. Food insecurity is inversely associated with diet quality of lower-income adults. J Acad Nutr Diet. 2014;114(12):1943–1953. e2. [PubMed: 25091796]
47. Fletcher PC, Kenny PJ. Food addiction: a valid concept? Neuropsychopharmacology. 2018;43(13):2506–2513. [PubMed: 30188514]
48. Volkow ND, Wise RA, Baler R. The dopamine motive system: implications for drug and food addiction. Nat Rev Neurosci. 2017;18(12):741. [PubMed: 29142296]
49. Hilmers A, Hilmers DC, Dave J. Neighborhood disparities in access to healthy foods and their effects on environmental justice. Am J Public Health. 2012;102(9):1644–1654. [PubMed: 22813465]
50. Zenk SN, Odoms-Young AM, Dallas C, et al. “You have to hunt for the fruits, the vegetables”: environmental barriers and adaptive strategies to acquire food in a low-income African American neighborhood. Health Educ Behav. 2011;38(3):282–292. [PubMed: 21511955]
51. Ludwig DS, Blumenthal SJ, Willett WC. Opportunities to reduce childhood hunger and obesity: restructuring the Supplemental Nutrition Assistance Program (the Food Stamp Program). JAMA. 2012;308(24):2567–2568. [PubMed: 23268513]
52. Kawa AB, Bentzley BS, Robinson TE. Less is more: prolonged intermittent access cocaine self-administration produces incentive-sensitization and addiction-like behavior. Psychopharmacology (Berl). 2016;233(19-20):3587–3602. [PubMed: 27481050]
53. Allain F, Minogianis E-A, Roberts DC, Samaha A-N. How fast and how often: The pharmacokinetics of drug use are decisive in addiction. Neurosci Biobehav Rev. 2015;56:166–179. [PubMed: 26116543]
54. Zhang L-N, Mitchell SE, Hambly C, Morgan DG, Clapham JC, Speakman JR. Physiological and behavioral responses to intermittent starvation in C57BL/6J mice. Physiol Behav. 2012;105(2):376–387. [PubMed: 21907222]
55. Avena NM, Rada P, Hoebel BG. Evidence for sugar addiction: behavioral and neurochemical effects of intermittent, excessive sugar intake. Neurosci Biobehav Rev. 2008;32(1):20–39. [PubMed: 17617461]
56. Martin MS, Maddocks E, Chen Y, Gilman S, Colman I. Food insecurity and mental illness: disproportionate impacts in the context of perceived stress and social isolation. Public Health. 2016;132:86–91. [PubMed: 26795678]
57. Sinha R Chronic stress, drug use, and vulnerability to addiction. Ann N Y Acad Sci. 2008;1141:105. [PubMed: 18991954]
58. Sinha R, Jastreboff AM. Stress as a common risk factor for obesity and addiction. Biol Psychiatry. 2013;73(9):827–835. [PubMed: 23541000]

59. Adam TC, Epel ES. Stress, eating and the reward system. Physiol Behav. 2007;91(4):449–458. [PubMed: 17543357]

60. Keenan GS, Christiansen P, Hardman CA. Household Food Insecurity, Diet Quality, and Obesity: An Explanatory Model. Obesity. 2021;29(1):143–149. [PubMed: 33135388]

61. Brunault P, Berthoz S, Gearhardt AN, et al. The Modified Yale Food Addiction Scale 2.0: Validation among non-clinical and clinical french-speaking samples and comparison with the full Yale Food Addiction Scale 2.0. Front Psychiatry. 2020;11:892.

62. Stojek MM, Wardawy P, Gillespie CF, Stevens JS, Powers A, Michopoulos V. Subjective Social Status Is Associated with Dysregulated Eating Behaviors and Greater Body Mass Index in an Urban Predominantly Black and Low-Income Sample. Nutrients. 2021;13(11):3893. [PubMed: 34836146]

63. Lipsky LM, Burger KS, Faith MS, et al. Pregnant Women Consume a Similar Proportion of Highly vs Minimally Processed Foods in the Absence of Hunger, Leading to Large Differences in Energy Intake. J Acad Nutr Diet. 2021;121(3):446–457. [PubMed: 33109504]

64. Malika NM, Hayman LW Jr, Miller AL, Lee HJ, Lumeng JC. Low-income women's conceptualizations of food craving and food addiction. Eat Behav. 2015;18:25–29. [PubMed: 25867800]

Research Snapshot

Research Question:

Is household food insecurity associated with symptoms of food addiction in low-income female adults?

Key Findings:

Secondary analysis of data from two convenience samples of low-income adult female participants in California and Michigan found that, after adjustment for demographic characteristics, food-insecure participants in both samples were more likely to endorse symptoms of food addiction than food-secure participants.

Table 1

Characteristics of Maternal Adiposity, Metabolism, and Stress (MAMAS) study participants by food security status

	Total (n=208)	Food-secure[a] (n=121)	Food-insecure (n=87)	*P*
Age (years), mean ± SD	27.9 ± 5.8	28.3 ± 6.0	27.3 ± 5.4	*0.22*
Race/ethnicity, n (%)				*0.44*
White	28 (13.5)	16 (13.2)	12 (13.8)	
African American	81 (38.9)	42 (34.7)	39 (44.8)	
Latino	63 (30.3)	41 (33.9)	22 (25.3)	
Other race	36 (17.3)	22 (18.2)	14 (16.1)	
Educational attainment, n (%)				*0.12*
<High school degree	152 (73.1)	85 (70.3)	67 (77.0)	
High school graduate or more	25 (12.0)	13 (10.7)	12 (13.8)	
Missing	31 (14.9)	23 (19.0)	8 (9.2)	
Household income, n (%)				*0.40*
At or below federal poverty line	98 (47.1)	60 (49.6)	38 (43.7)	
Above federal poverty line	110 (52.9)	61 (50.4)	49 (56.3)	
Total food addiction symptoms[b], mean ± SD	2.1 ± 1.6	1.9 ± 1.5	2.4 ± 1.7	

[a] Food security status was determined by responses on the US Household Food Security Module.[33] Participants were categorized as "food-insecure" when they answered affirmatively to three or more questions. All other participants were categorized as "food-secure."

[b] Food addiction symptoms were determined by responses to the Yale Food Addiction Scale.[23] Participants received a score of 0 or 1 for each symptom based on the frequency threshold for that symptom. The number of symptoms each participant endorsed were added to create a symptom count score. Symptom scores could range from 0 – 7.

Table 2

Characteristics of Family Food Study (FFS) participants by food security status

	Total (n=173)	Food-secure[a] (n=69)	Food-insecure (n=104)	*P*
Age (years), mean ± SD	36.6 ± 6.4	37.7 ± 6.4	35.9 ± 6.3	*0.07*
Race/ethnicity, n (%)				*0.24*
White	102 (59.0)	39 (56.5)	63 (60.6)	
African American	47 (27.2)	23 (33.3)	24 (23.1)	
Other race	24 (13.9)	7 (10.1)	17 (16.4)	
Educational attainment, n (%)				*0.35*
< High school degree	11 (6.4)	6 (8.7)	5 (4.8)	
High school graduate or more	162 (93.6)	63 (91.3)	99 (95.2)	
Household income, n (%)				*0.63*
At or below federal poverty line	74 (42.8)	28 (40.6)	46 (44.2)	
Above federal poverty line	99 (57.2)	41 (59.4)	58 (55.8)	
Total food addiction symptoms[b], mean ± SD	0.6 ± 1.3	0.4 ± 1.0	0.7 ± 1.4	

[a] Food security status was determined by responses on the US Household Food Security Module.[33] Participants were categorized as "food-insecure" when they answered affirmatively to three or more questions. All other participants were categorized as "food-secure."

[b] Food addiction symptoms were determined by responses to the Modified Yale Food Addiction Scale 2.0.[22] Participants received a score of 0 or 1 for each symptom based on the frequency threshold for that symptom. The number of symptoms each participant endorsed were added to create a symptom count score. Symptom scores could range from 0 to 11.

Table 3

Associations between food insecurity and Yale Food Addiction Scale (YFAS)[a] symptom endorsement in Maternal Adiposity, Metabolism, and Stress (MAMAS) study and Family Food Study participants

	MAMAS Study (n = 208)[b]				Family Food Study (n = 181)			
	Rate Ratio	95% CI[c]	*P*	*d* [e]	Rate Ratio	95% CI	*P*	*d*
Unadjusted	1.23	1.02, 1.48	0.03	-	1.64	1.07, 2.50	0.02	-
Age-adjusted	1.22	1.01, 1.48	0.036	-	1.58	1.03, 2.43	0.04	-
Multivariate-adjusted[d]	1.21	1.00, 1.47	0.047	0.39	1.56	1.01, 2.40	0.045	0.29

[a] Food addiction symptoms were determined by responses to the original Yale Food Addiction Scale (YFAS)[23] in the MAMAS Study and the modified Yale Food Addiction Scale 2.0 (mYFAS 2.0)[22] in the Family Food Study. Participants received a score of 0 or 1 for each symptom based on the frequency threshold for that symptom. The number of symptoms each participant endorsed were added to create a symptom count score. Symptom scores could range from 0 – 7 on the YFAS and 0 to 11 on the mYFAS 2.0.

[b] Maternal Adiposity, Metabolism, and Stress Study

[c] Confidence Interval

[d] Multivariate Poisson regression model adjusted for race/ethnicity, educational attainment, and household income

[e] Cohen's *d* was calculated as a measure of standardized effect size for each multivariate-adjusted model.[36] Effects were considered small at $|d| > .2$, medium at $|d| > .5$ and large at $|d| > .8$.[37]