**Introduction**

Food insecurity, or the state of having insufficient dietary resources to maintain a healthy, active lifestyle, affects approximately 10 to 15% of United States households (~14.3 million) annually (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2018). Minority households and those that are headed by a single parent are more likely to experience food insecurity, although these associations may be partially confounded by household income and education (Gundersen & Ziliak, 2018). Food insecurity can include a variety of behaviors such as skipping meals or repeatedly eating the same foods due to lack of dietary resources, but the most common experiences of food insecurity reported in the U.S. are worry over ability to afford food and not being able to make food purchases last (Coleman-Jensen et al., 2018). Consistent with these experiences, dietary intake within food insecure households often follows a cyclical pattern mirroring availability of Supplemental Nutrition Assistance Program (SNAP) benefits, with larger purchases and consumption early in the month followed by a decline in purchases and intake until funds are again available (Castellari, Cotti, Gordanier, & Ozturk, 2017; Wilde & Ranney, 2000). This cycle may contribute to increased odds of overweight and obesity among individuals with food insecurity, potentially through physiological and metabolic changes (Dinour, Bergen, & Yeh, 2007) or increased compensatory eating, especially in combination with consumption of lower cost, energy dense foods (Drewnowski, 2004). However, there appears to be effect modification by sex, as several studies have observed an association between food insecurity and overweight/obesity in adult women only (Franklin et al., 2012; Gooding, Walls, & Richmond, 2012; Hernandez, Reesor, & Murillo, 2017; Martin & Lippert, 2012).

A growing body of literature suggests that food insecurity may be associated with eating disorders (EDs) such as bulimia nervosa (BN), binge eating disorder (BED) and disordered eating behaviors. Whereas the lifetime prevalences of BN and BED in the general U.S. population are estimated to be approximately 1% and 3%, respectively (Hudson, Hiripi, Pope, & Kessler, 2007), internet and community-based samples drawn from food-insecure populations have found prevalences of clinically significant ED ranging from 6 – 17% (Becker, Middlemass, Gomez, & Martinez-Abrego, 2019; Becker, Middlemass, Taylor, Johnson, & Gomez, 2017; Lydecker & Grilo, 2019; Rasmusson, Lydecker, Coffino, White, & Grilo, 2019). The mechanism underlying the association between food insecurity and EDs is not well understood, but may be partially confounded by traumatic event exposure and associated comorbid psychopathology (e.g. depression) (Becker et al., 2018; Leung, Epel, Willett, Rimm, & Laraia, 2015), or a physiological response to hunger, deprivation, and food scarcity (Carr, 2011).

Alternatively, high levels of weight stigmatization and overvaluation of weight and shape among food insecure populations may underpin disordered eating behaviors (Becker et al., 2017). In general, individuals with overweight and obesity face significant amounts of psychological distress associated with weight gain and lack of perceived control over eating and food choices, particularly in conjunction with experiences of weight discrimination (Tomiyama, 2014). Weight discrimination is more pernicious when combined with other forms of discrimination, such as sexism, racism, and classism (Ciciurkaite & Perry, 2018), and given the associations between food insecurity, sex, minority status, and income, individuals with food insecurity may be especially vulnerable to this type of multiplicative discrimination. Associations between discriminatory experiences, psychological distress, disordered eating, and weight gain appear to be mediated by internalization of weight stigma and negative weight self-labelling (Mensinger, Calogero, & Tylka, 2016; O’Brien et al., 2016); it is therefore possible that self-perceptions of weight differ by food insecurity status and contribute to the high rates of disordered eating and obesity in this population. However, other research suggests that the perception of being overweight is more common among White individuals and those with higher incomes compared to minority and lower income individuals, respectively, irrespective of actual weight (Dorsey, Eberhardt, & Ogden, 2009; Paeratakul, White, Williamson, Ryan, & Bray, 2002), which suggests that those experiencing food insecurity would be less likely to perceive themselves as overweight and internalize negative weight messages. Given these contradictory observations, a better understanding of how weight perception varies by food insecurity might provide functional insights into the high prevalence of disordered eating among those who are food insecure. The objective of the current study was to investigate whether beliefs about weight, weight perception, and current weight control behaviors vary as a function of food insecurity in a representative sample of the U.S. population.

**Methods**

*Study Sample*

For this secondary analysis, we used data from the publicly available National Health and Nutrition Examination Survey (NHANES). The methods and design of NHANES have been described in detail elsewhere (Curtin et al., 2013; Johnson, Dohrmann, Burt, & Mohadjer, 2014). Briefly, NHANES is a nationally representative multi-stage probability sample conducted every two years by the National Center for Health Statistics and Centers for Disease Control and Prevention. In order to ensure representativeness, NHANES oversamples minority, low-income, and older individuals, although individuals of all ages are eligible to participate. The cross-sectional survey assesses a wide variety of health topics, including weight control behaviors, mental health, drug and alcohol use, and functional limitations, although specific questions vary according to participant age and year of interview. Surveys are completed in-person at NHANES mobile examination centers using audio computer-assisted self-interview systems. Additionally, trained NHANES staff conduct physical examinations of respondents, obtaining in-person measurements of weight, height, and waist circumference, among other biometrics.

In the present study, we restricted our analyses to respondents age 18 and over in the 2005 (*n* = 3,285) , 2007 (*n* = 4,625), 2009 (*n* = 5,001), 2011 (*n* = 4,796), and 2013 (*n* = 5,057) waves of NHANES. Although data for later waves (2015 – 2016) are available, the structure of the questionnaire assessing weight perception changed between 2013 and 2015 such that respondents in later years were asked only about weight loss behaviors rather than both weight loss behaviors and behaviors to not gain weight. Because we were interested in both types of weight control behaviors, we focused on earlier waves of data. Response rates for the selected years ranged from 72 – 79%.

**Measures**

*Food Insecurity*

Household food insecurity was assessed using the 18-item U.S. Food Security Survey Module (Bickel, Mark, Cristofer, William, & John, 2000). Participants were asked a series of questions regarding worry about affording and obtaining food, behaviors to stretch food supply (e.g. skipping meals and fasting), and consequences of not being able to afford food (e.g. hunger and weight loss). Depending on the question, responses were given as binary (yes = 1/no = 0) or ordinal (never = 0/sometimes = 1/often = 2) answers, and composite scores were derived by summing all scale items. Scores ranged from 0 to 18. We dichotomized food insecurity as completely food secure (a score of 0 at the household level) or food insecure (a score of 1 or greater at the household level).

*Weight Perception and Desired Weight*

After self-reporting their current weight, participants were asked two questions regarding weight perception: “Do you consider yourself now to be overweight, underweight, or about the right weight?” and “Would you like to weigh more, less, or about the same?” We operationalized two weight perception variables, weight consideration and desired weight, respectively, from responses to these questions.

Participants also self-reported their weight a year prior to the interview, and, if their previous weight was more than 10 pounds greater than their current weight, were asked if the change was intentional. Those who had not lost weight or had done so unintentionally were also asked if they had tried to lose weight or to not gain weight at any point in the past year and, if so, what methods they used to accomplish this (e.g. used laxatives, dieted, exercised). Due to a skip pattern in the survey, questions about weight control methods were not asked of participants who had lost weight unintentionally, had not tried to lose weight, or had not tried to not gain weight in the past year. We dummy coded a five-level weight action variable based on responses to weight control questions as lost weight intentionally, lost weight unintentionally, tried to lose weight (but did not), tried to not gain weight, and none of the above. Because no questions were asked about attempts to gain weight, individuals in the ‘none of the above’ category include individuals who did not try to control their weight and those who tried to gain weight.

*Covariates*

We used weight and height measured in the NHANES mobile clinics to calculate BMI using the formula weight in kilograms divided by height in meterssquared, and coded BMI category as follows: < 18.5kg/m2 as underweight, 18.5 – < 25 kg/m2 as normal weight, 25 – < 30 kg/m2 as overweight, 30 – < 35 kg/m2 as obesity, class I, 35 – 40 kg/m2 as obesity, class II, and ≥ 40 kg/m2 as obesity, class III. Race/ethnicity was coded according as a four-level dummy variable (Non-Hispanic White, Non-Hispanic Black, Hispanic/Latino, or other), and education was coded as high school degree or less, some college, and college degree or higher. Current depressive symptoms was assessed using the nine-item Patient Health Questionnaire (PHQ-9) (Kroenke, Spitzer, & Williams, 2001). PHQ-9 scores range from zero to 27, with higher scores representing greater depression severity. Per scoring guidelines, we operationalized depression as a score of 11 or greater, which roughly corresponds to moderate to severe depression (Kroenke et al., 2001). To accommodate potential nonlinearity in the associations between age and weight perception, we also categorized age as 18 – 29, 30 – 39, 40 – 49, and 50 – 59, and 60 years or older.

**Statistical Analyses**

We first compared baseline covariates between individuals with and without food insecurity using Chi-square and t-tests for categorical and continuous variables, respectively. Then, to determine the strengths of association among weight consideration, desired weight, weight control, food insecurity, and BMI category, we constructed a matrix of pairwise polychoric correlations between the five variables. We then computed unadjusted associations between food insecurity and weight consideration, desired weight, and weight control using three individual multinomial logistic regressions with thinking ones’ weight was about right, wanting to weigh the same amount, and not doing anything about ones’ weight as the reference outcomes (Model 1). In Model 2, we adjusted for age category, education, race, and sex, then further adjusted for BMI category (Model 3) and depression (Model 4). We tested for interactions by race and sex to accommodate potential effect modification, and decomposed significant interactions by calculating Average Marginal Effects (AMEs). Specifically, holding all covariates other than race or sex and food insecurity at their observed values, we calculated the response probability for each outcome in the multinomial logistic regression at all possible combinations of the interacting variables (e.g. female with food insecurity, White individual without food insecurity). Given the complex sampling methodology of NHANES, all analyses were adjusted for survey design. Data were managed in R, version 3.6.1 (R Core Team, 2019) using the RNHANES (Susmann, 2016), dplyr (Wickham, Francois, Henry, & Müller, 2015), and survey packages (Lumley, 2004), and analyzed in Stata, version 15 (StataCorp, 2017).

**Results**

*Descriptive Statistics*

A total of 7,234 respondents (23.4%) had experienced food insecurity in the year prior to interview. Individuals with food insecurity were more likely to have BMIs in the obese or underweight ranges and were more likely to be young, female, and non-White than respondents with complete food security (Table 1). Irrespective of food insecurity status, most individuals believed themselves to be overweight (56.5% of food secure and 54.6% of food insecure), wanted to weigh less (67.6% of food secure and 62.3% of food insecure), and were either trying to lose weight or not taking action to change their weight. However, a greater percentage of those with food insecurity perceived themselves to be underweight, wanted to weigh more, or had lost weight unintentionally than those with complete food security. Food insecurity, BMI category, weight perception, desired weight, and weight action were all significantly correlated with one another (Table 2). In most cases, associations were weak, although strong associations were observed between weight perception and desired weight (ρ = -0.897, *p* < 0.001), weight perception and BMI category (ρ = 0.756, *p* < 0.001), and desired weight and BMI category (ρ = -0.712, *p* < 0.001).

*Food Insecurity and Weight Perception*

In unadjusted models, food insecurity was significantly associated with individuals’ perceptions of their weight (Table 3). Those experiencing food insecurity had a higher risk of perceiving themselves as underweight versus about right compared to those without food insecurity (RRR = 1.93, 95% CI = 1.62 – 2.29), and this association persisted after adjustment for potential confounders including actual BMI category. In contrast, food insecurity was associated with significantly lower relative risk of overweight perception only after adjustment for all potential confounders (Table 3). There was not strong evidence of effect modification by race (*p*interaction = 0.435) or sex (*p*interaction = 0.075).

*Food Insecurity and Desired Weight*

Closely paralleling the results for weight consideration, food insecurity was associated with higher risk of wanting to weigh more compared to wanting to weigh the same amount both before (RRR = 1.93, 95% CI =1.65 - 2.25) and after (RRR = 1.58, 95% CI = 1.32 - 1.90; Table 3) adjustment. While wanting to weigh less was not significantly associated with food insecurity, the magnitudes of estimates were virtually identical to those for self-perception of overweight, reflecting the strong correlation between these variables. As a whole, the interactions between race and weight perception were not significant (*p*interaction = 0.232), but there was effect modification by sex (*p*interaction < 0.001). In stratified fully adjusted models, food insecurity was associated with significantly lower risk of wanting to weigh less compared to weighing the same in women but not men (female RRR = 0.82, 95% CI = 0.70 – 0.98; male RRR = 0.99, 95% CI = 0.84 – 1.17) and with higher risk of wanting to weigh more in both women and men, although the association was stronger in women (female RRR = 1.94, 95% CI = 1.43 – 2.67; male RRR = 1.60, 95% CI = 1.34 – 1.91). Women experiencing food insecurity were 2.7% more likely to want to weigh more than those who were food secure, while men were 2.8% more likely to want to weigh more when experiencing food insecurity. Similarly, the average marginal effect of food insecurity on wanting to weigh less was -3.9% for women and – 2.2% for men (Figure 1).

*Food Insecurity and Weight Action*

Individuals with food insecurity had 2.12 times higher relative risk of losing weight unintentionally versus doing nothing about their weight compared to those without food insecurity in unadjusted models (95% CI = 1.86 – 2.42; Table 3). Food insecurity was not associated with intentional weight loss but was associated with lower risk of unsuccessfully trying to lose weight and of trying to not gain weight. Again, associations were generally robust against adjustment for confounders, although the association between food insecurity and trying not to gain weight was reduced to nonsignificance in the final model (Table 3). There was a significant interaction between food insecurity and race on what an individual was doing about their weight (*p* < 0.05), but not significant interaction by sex (*p* = 0.425). White or Hispanic individuals displayed the same patterns in weight behavior, becoming more likely to do nothing about their weight or to lose unintentionally and less likely to be trying to not gain weight or to lose weight intentionally when experiencing food insecurity relative to food security. Black individuals and individuals reporting other races had a higher probability of reporting intentionally losing weight, unintentionally losing weight, or trying to not gain weight and lower probability of doing nothing about their weight or have an unsuccessful weight loss attempt when food insecure (Figure 2). Attempting to lose weight was the most common weight behavior for all racial groups except Blacks, for whom doing nothing about weight was most common.

**Discussion**

Generally, we found that food insecurity was positively associated with perceptions of weight and weight control behaviors consistent with a desire to gain weight. Individuals experiencing food insecurity were more likely to have lost weight without intending to, to want to weigh more, and to consider themselves as too thin than were individuals without food insecurity. The strength of these associations was reduced, though not entirely eliminated, after controlling for actual BMI, indicating that differences in perception are not an artifact of body size alone. Additionally, the effect of food insecurity on how individuals attempted to manipulate their weight varied by race, with Black individuals and other individuals being more likely, and White or Hispanic individuals being less likely, to take no action against or try not to gain weight when food insecure versus secure.

Regarding the implications of these findings for addressing obesity and overweight among food insecure populations, there remains debate about whether increasing body size awareness or “correcting” weight underperception is either necessary or effective for weight reduction and health promotion. For instance, several longitudinal studies have shown that although the perception of being overweight is associated with increased attempts to lose weight, it is not associated with weight loss and, for those not clinically overweight, may actually lead to weight gain (Feng & Wilson, 2019; Haynes, Kersbergen, Sutin, Daly, & Robinson, 2018).

Whether weight perception While it is therefore possible that previously observed associations between obesity and food insecurity may be partially accounted for by intentions of gaining weight for certain subpopulations and lack of intentional weight manipulation for others, the absolute effect of food insecurity on these perceptions and behaviors was small (~3-5% difference in predicted probabilities for all outcomes), suggesting that other factors play a larger role both in determining weight perceptions and behaviors and, by extension, actual body weight.

These findings are consistent with previous work conducted among adolescents living in Trinidad and Tobago which found that adolescents experiencing food insecurity were more likely to want to weigh more and to report being physically inactive, potentially as a means to conserve energy and achieve weight gain (Gulliford, Nunes, & Rocke, 2006). and suggests that associations between obesity and food insecurity may be partially mediated by low weight perception and intentions to gain.

In contrast, food insecurity may also be positively associated with eating disorder pathology, including binge eating, compensatory behaviors, and diagnoses of bulimia nervosa or binge eating disorder (Becker et al., 2019, 2017; Lydecker & Grilo, 2019). These behaviors presumably reflect a desire to lose weight or are a reaction to the restriction and hunger that accompany extreme dieting, especially in combination with negative affect (Stice, 2001), making our findings that food insecurity was negatively associated with overweight perception and a desire to weigh less somewhat perplexing. Although the study populations employed in both Becker and colleagues and Lydecker and Grilo contained higher percentages of Hispanic individuals and females than did the present study, it seems unlikely that the contradictory results are due to participant characteristics alone because the same patterns occurred in stratified results as in collapsed analyses. It is possible that period or cohort effects may

References

Becker, C. B., Middlemass, K., Johnson, C., Taylor, B., Gomez, F., & Sutherland, A. (2018). Traumatic event exposure associated with increased food insecurity and eating disorder pathology. *Public Health Nutrition*, *21*(16), 3058–3066. doi: 10.1017/S1368980018001738

Becker, C. B., Middlemass, K. M., Gomez, F., & Martinez-Abrego, A. (2019). Eating Disorder Pathology Among Individuals Living With Food Insecurity: A Replication Study. *Clinical Psychological Science*, *7*(5), 1144–1158. doi: 10.1177/2167702619851811

Becker, C. B., Middlemass, K., Taylor, B., Johnson, C., & Gomez, F. (2017). Food insecurity and eating disorder pathology. *International Journal of Eating Disorders*, *50*(9), 1031–1040. doi: 10.1002/eat.22735

Bickel, G., Mark, N., Cristofer, P., William, H., & John, C. (2000). *Guide to Measuring Household Food Security, Revised March 2000*.

Carr, K. D. (2011). Food scarcity, neuroadaptations, and the pathogenic potential of dieting in an unnatural ecology: Binge eating and drug abuse. *Physiology & Behavior*, *104*(1), 162–167.

Castellari, E., Cotti, C., Gordanier, J., & Ozturk, O. (2017). Does the Timing of Food Stamp Distribution Matter? A Panel-Data Analysis of Monthly Purchasing Patterns of US Households. *Health Economics*, *26*(11), 1380–1393. doi: 10.1002/hec.3428

Ciciurkaite, G., & Perry, B. L. (2018). Body weight, perceived weight stigma and mental health among women at the intersection of race/ethnicity and socioeconomic status: Insights from the modified labelling approach. *Sociology of Health & Illness*, *40*(1), 18–37. doi: 10.1111/1467-9566.12619

Coleman-Jensen, A., Rabbitt, M. P., Gregory, C., & Singh, A. (2018). *Household Food Security in the United States in 2018*. 47.

Curtin, L. R., Mohadjer, L. K., Dohrmann, S. M., Kruszon-Moran, D., Mirel, L. B., Carroll, M., … Johnson, C. L. (2013). National Health and Nutrition Examination Survey: Sample design, 2007-2010. *Vital and Health Statistics. Series 2, Data Evaluation and Methods Research*, (160), 1–23.

Dinour, L. M., Bergen, D., & Yeh, M.-C. (2007). The Food Insecurity–Obesity Paradox: A Review of the Literature and the Role Food Stamps May Play. *Journal of the American Dietetic Association*, *107*(11), 1952–1961. doi: 10.1016/j.jada.2007.08.006

Dorsey, R. R., Eberhardt, M. S., & Ogden, C. L. (2009). Racial/Ethnic Differences in Weight Perception. *Obesity*, *17*(4), 790–795. doi: 10.1038/oby.2008.603

Drewnowski, A. (2004). Obesity and the food environment: Dietary energy density and diet costs. *American Journal of Preventive Medicine*, *27*(3), 154–162.

Feng, X., & Wilson, A. (2019). Does dissatisfaction with, or accurate perception of overweight status help people reduce weight? Longitudinal study of Australian adults. *BMC Public Health*, *19*(1), 619. doi: 10.1186/s12889-019-6938-3

Franklin, B., Jones, A., Love, D., Puckett, S., Macklin, J., & White-Means, S. (2012). EXPLORING MEDIATORS OF FOOD INSECURITY AND OBESITY: A REVIEW OF RECENT LITERATURE. *Journal of Community Health*, *37*(1), 253–264. doi: 10.1007/s10900-011-9420-4

Gooding, H. C., Walls, C. E., & Richmond, T. K. (2012). Food Insecurity and Increased BMI in Young Adult Women. *Obesity*, *20*(9), 1896–1901. doi: 10.1038/oby.2011.233

Gulliford, M. C., Nunes, C., & Rocke, B. (2006). Food insecurity, weight control practices and body mass index in adolescents. *Public Health Nutrition*, *9*(5), 570–574. doi: 10.1079/phn2005886

Gundersen, C., & Ziliak, J. P. (2018). Food Insecurity Research in the United States: Where We Have Been and Where We Need to Go. *Applied Economic Perspectives and Policy*, *40*(1), 119–135. doi: 10.1093/aepp/ppx058

Haynes, A., Kersbergen, I., Sutin, A., Daly, M., & Robinson, E. (2018). A systematic review of the relationship between weight status perceptions and weight loss attempts, strategies, behaviours and outcomes. *Obesity Reviews*, *19*(3), 347–363. doi: 10.1111/obr.12634

Hernandez, D. C., Reesor, L. M., & Murillo, R. (2017). Food insecurity and adult overweight/obesity: Gender and race/ethnic disparities. *Appetite*, *117*, 373–378. doi: 10.1016/j.appet.2017.07.010

Hudson, J. I., Hiripi, E., Pope, H. G., & Kessler, R. C. (2007). The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. *Biological Psychiatry*, *61*(3), 348–358. doi: 10.1016/j.biopsych.2006.03.040

Johnson, C. L., Dohrmann, S. M., Burt, V. L., & Mohadjer, L. K. (2014). *National health and nutrition examination survey: Sample design, 2011-2014*. US Department of Health and Human Services, Centers for Disease Control and ….

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9. *Journal of General Internal Medicine*, *16*(9), 606–613. doi: 10.1046/j.1525-1497.2001.016009606.x

Leung, C. W., Epel, E. S., Willett, W. C., Rimm, E. B., & Laraia, B. A. (2015). Household Food Insecurity Is Positively Associated with Depression among Low-Income Supplemental Nutrition Assistance Program Participants and Income-Eligible Nonparticipants. *The Journal of Nutrition*, *145*(3), 622–627. doi: 10.3945/jn.114.199414

Lumley, T. (2004). Analysis of Complex Survey Samples. *Journal of Statistical Software*, *9*(1), 1–19. doi: 10.18637/jss.v009.i08

Lydecker, J. A., & Grilo, C. M. (2019). Food insecurity and bulimia nervosa in the United States. *International Journal of Eating Disorders*, *52*(6), 735–739. doi: 10.1002/eat.23074

Martin, M. A., & Lippert, A. M. (2012). Feeding her children, but risking her health: The intersection of gender, household food insecurity and obesity. *Social Science & Medicine*, *74*(11), 1754–1764. doi: 10.1016/j.socscimed.2011.11.013

Mensinger, J. L., Calogero, R. M., & Tylka, T. L. (2016). Internalized weight stigma moderates eating behavior outcomes in women with high BMI participating in a healthy living program. *Appetite*, *102*, 32–43. doi: 10.1016/j.appet.2016.01.033

O’Brien, K. S., Latner, J. D., Puhl, R. M., Vartanian, L. R., Giles, C., Griva, K., & Carter, A. (2016). The relationship between weight stigma and eating behavior is explained by weight bias internalization and psychological distress. *Appetite*, *102*, 70–76.

Paeratakul, S., White, M. A., Williamson, D. A., Ryan, D. H., & Bray, G. A. (2002). Sex, Race/Ethnicity, Socioeconomic Status, and BMI in Relation to Self-Perception of Overweight. *Obesity Research*, *10*(5), 345–350. doi: 10.1038/oby.2002.48

R Core Team. (2019). R: A language and environment for statistical computing (Version 3.6.1). Retrieved from https://www.R-project.org/

Rasmusson, G., Lydecker, J. A., Coffino, J. A., White, M. A., & Grilo, C. M. (2019). Household food insecurity is associated with binge-eating disorder and obesity. *International Journal of Eating Disorders*, *52*(1), 28–35. doi: 10.1002/eat.22990

StataCorp. (2017). Stata Statistical Software (Version 15). College Station, TX: StataCorp, LLC.

Stice, E. (2001). A prospective test of the dual-pathway model of bulimic pathology: Mediating effects of dieting and negative affect. *Journal of Abnormal Psychology*, *110*(1), 124.

Susmann, H. (2016). RNHANES: Facilitates Analysis of CDC NHANES Data. (Version 1.1.0). Retrieved from https://CRAN.R-project.org/package=RNHANES

Tomiyama, A. J. (2014). Weight stigma is stressful. A review of evidence for the Cyclic Obesity/Weight-Based Stigma model. *Appetite*, *82*, 8–15. doi: 10.1016/j.appet.2014.06.108

Wickham, H., Francois, R., Henry, L., & Müller, K. (2015). dplyr: A grammar of data manipulation. *R Package Version 0.4*, *3*.

Wilde, P. E., & Ranney, C. K. (2000). The Monthly Food Stamp Cycle: Shopping Frequency and Food Intake Decisions in an Endogenous Switching Regression Framework. *American Journal of Agricultural Economics*, *82*(1), 200–213. doi: 10.1111/0002-9092.00016

**Table 1.** Sample demographic characteristics (*N* = 22,764). All numbers indicate survey-weighted percentages and p-values are based on Rao-Scott Chi-square tests.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Food Secure | Food Insecure | *p* |
| Percent of sample | 76.6 | 23.4 | -- |
| BMI category |  |  | < 0.001 |
| Underweight | 1.6 | 2.3 |  |
| Normal Weight | 31.1 | 27.2 |  |
| Overweight | 33.3 | 30.0 |  |
| Obesity (Class I) | 19.6 | 20.8 |  |
| Obesity (Class II) | 8.5 | 10.5 |  |
| Obesity (Class III) | 5.9 | 9.2 |  |
| Male | 49.7 | 47.3 | 0.002 |
| Race |  |  | < 0.001 |
| White | 71.7 | 46.7 |  |
| Black | 9.8 | 19.1 |  |
| Hispanic | 11.0 | 27.5 |  |
| Other | 7.5 | 6.7 |  |
| Education |  |  | < 0.001 |
| High School Degree or Less | 12.0 | 31.3 |  |
| Some College | 20.7 | 27.7 |  |
| College Degree or Higher | 67.3 | 41.0 |  |
| Age Category |  |  | < 0.001 |
| 18 - 29 | 21.1 | 30.8 |  |
| 30 - 39 | 19.9 | 23.2 |  |
| 40 - 49 | 22.8 | 22.1 |  |
| 50 - 59 | 22.5 | 16.5 |  |
| 60 + | 13.7 | 7.3 |  |
| Depression | 5.0 | 15.1 | < 0.001 |
| Weight Consideration |  |  | < 0.001 |
| About Right | 39.7 | 38.2 |  |
| Overweight | 56.5 | 54.6 |  |
| Underweight | 3.8 | 7.2 |  |
| Desired Weight |  |  | < 0.001 |
| Same | 26.6 | 26.7 |  |
| Less | 67.6 | 62.3 |  |
| More | 5.8 | 11.0 |  |
| Weight Action |  |  | < 0.001 |
| Lost Weight Intentionally | 15.6 | 16.2 |  |
| Lost Weight Unintentionally | 3.8 | 8.8 |  |
| Tried to Lose Weight | 37.8 | 33.0 |  |
| Tried to Not Gain Weight | 9.3 | 6.1 |  |
| Not Doing Anything | 33.5 | 35.9 |  |

**Table 2.** Polychoric correlation coefficients and standard errors for associations between food insecurity, weight, and weight perception variables.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | BMI Category | Weight Perception | Desired Weight | Weight Action |
| Food Insecurity | 0.080 (0.009)\*\*\* | -0.048 (0.010)\*\*\* | 0.084 (0.010)\*\*\* | -0.021 (0.010)\*\*\* |
| BMI Category | -- | 0.756 (0.004)\*\*\* | -0.712 (0.005)\*\*\* | -0.307 (0.007)\*\*\* |
| Weight Perception | -- | -- | -0.897 (0.002)\*\*\* | -0.354 (0.008)\*\*\* |
| Desired Weight | -- | -- | -- | 0.417 (0.008)\*\*\* |
| *Note:* \*\*\* indicates *p* < 0.001 | | | | |

**Table 3.** Results of survey-weighted multinomial logistic regression predicting weight perception and weight behavior from food insecurity in NHANES participants. All relative risk ratios (RRs) represent the exponentiated coefficient for food insecurity in the model predicting a given category of each outcome.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Model 1 | Model 2 | Model 3 | Model 4 |
| Outcome + Level | RRR (95% CI)1 | RRR (95% CI)2 | RRR (95% CI)3 | RRR (95% CI)4 |
| Weight Consideration |  |  |  |  |
| Too Thin | **1.93 (1.62 - 2.29)** | **1.75 (1.47 - 2.08)** | **1.70 (1.43 - 2.04)** | **1.58 (1.32 - 1.90)** |
| Too Big | 0.99 (0.90 - 1.08) | **1.15 (1.05 - 1.25)** | 0.90 (0.80 - 1.03) | **0.88 (0.78 - 0.99)** |
| Desired Weight |  |  |  |  |
| Less | 0.91 (0.83 - 1.01) | 1.10 (0.99 - 1.21) | 0.90 (0.78 - 1.02) | 0.89 (0.78 - 1.02) |
| More | **1.93 (1.65 - 2.25)** | **1.77 (1.52 - 2.07)** | **1.76 (1.50 - 2.06)** | **1.66 (1.41 - 1.94)** |
| Doing About Weight |  |  |  |  |
| Lost Weight Intentionally | 0.94 (0.84 - 1.06) | 1.14 (1.00 - 1.31) | 1.03 (0.89 - 1.18) | 1.00 (0.86 - 1.15) |
| Lost Weight Unintentionally | **2.12 (1.86 - 2.42)** | **2.14 (1.81 - 2.52)** | **2.16 (1.83 - 2.55)** | **1.93 (1.65 - 2.27)** |
| Tried to Lose Weight | **0.80 (0.72 - 0.89)** | 0.96 (0.85 - 1.08) | **0.86 (0.76 - 0.97)** | **0.86 (0.76 - 0.97)** |
| Tried to Not Gain Weight | **0.61 (0.52 - 0.71)** | **0.84 (0.73 - 0.98)** | **0.86 (0.73 - 0.98)** | * 1. (0.77 - 1.02) |
| 1. Unadjusted; 2. Adjusted for race, sex, education, and age. 3. Model 2 plus BMI category. 4. Model 3 plus depression. | | | | |

A close up of a map

Description automatically generated

**Figure 1.** Predicted probabilities of desired weight by food security status and sex. Predicted probabilities are calculated using average marginal effects in survey-weighted multinomial logistic regression adjusted for age, race, education, BMI category, and depression.

A close up of a map

Description automatically generated

**Figure 2.** Predicted probabilities of weight action by food security status and race. Predicted probabilities are calculated using average marginal effects in survey-weighted multinomial logistic regression adjusted for age, sex, education, BMI category, and depression.