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Associations between depressive symptomatology, diet, and BMI among participants in the Supplemental Nutrition Assistance Program

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Abstract

Background—Participation in the Supplemental Nutrition Assistance Program (SNAP) has been shown to increase food security, or access to adequate food; however, SNAP participation has also been associated with obesity among certain demographic groups (e.g., women, but not men and children), possibly due to poorer dietary quality. Depressive symptomatology is an understudied factor, which is associated with obesity across the lifespan.

Objective—This study examined the relationship between depressive symptomatology, dietary quality, and body weight among a sample of SNAP participants (N= 639).

Design—The analysis was cross-sectional; survey data was collected in May–December 2011 by trained data collectors.

Participants/setting—Adults who self-identified as the primary food shopper of the household in two predominantly low-income African-American neighborhoods characterized as “food deserts” in Pittsburgh, PA were recruited to participate in this study.

Measures—Dietary quality was calculated using the US Department of Agriculture Healthy Eating Index (HEI)-2005. Body Mass Index (BMI) was based on objective measurements taken by the interviewer and derived from the standard formula of weight (kg) divided by height squared (m²). Current depressive symptomatology was assessed by a trained interviewer using the Patient Health Questionnaire-2.

Statistical analyses performed—Descriptive statistics (means and percentages); two multivariate OLS regression analyses predicting BMI and dietary quality from depressive symptomatology while controlling for sociodemographic factors and food insecurity were performed.

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Conflict of Interest Disclosure

There are no conflicts of interest for any of the authors.

Results—Depression was a strong and statistically significant predictor of both dietary quality and BMI: higher score in depressive symptomatology was associated with lower scores in dietary quality ($\beta=-1.26$, $p<0.0001$). A higher score in depressive symptomatology was associated with higher BMI ($\beta=.63$, $p=0.0031$).

Conclusions—These findings show that depressive symptomatology is significantly associated with weight-related outcomes and suggests that understanding the risk of depression among SNAP participants could be important to understanding the relationship among SNAP participation, diet, and weight. The association between depressive symptomatology, elevated BMI and lower dietary quality among low-income, primarily African American residents living in a food desert suggests the potential for mental health interventions to have broader benefits in this population. However, the directionality of this association is unclear and improving diet and reducing weight may also improve mental health symptoms. Further longitudinal studies should assess these possibilities.

Keywords

Supplemental Nutrition Assistance Program; depressive symptomatology; dietary quality; obesity; low-income populations

Introduction

While more than two-thirds (34.9%) of U.S. adults are obese,¹ disparities exist in the prevalence of obesity across socioeconomic status (SES).^{2–4} For example, 42% of women living in low-income households (i.e., below 130% of the poverty line) are obese compared to 29% of women living in households well above the poverty line,⁵ and the rate of weight gain among those who are already overweight is fastest among those with the lowest income.³ Other SES-related indicators including low wages⁶ and economic hardship (e.g., having less than enough money for one's needs)⁷ are also associated with BMI and higher risk for obesity.

Interestingly, participation in SNAP, formerly known as the Food Stamp Program, has been associated with obesity among women.⁸ SNAP participation is an indicator of SES since it is based on gross and net income (for families with at least one elderly or disabled member, just net income). Participation in SNAP has been shown to increase food security, or access to enough food for all members at all times of the year.^{9,10} Yet in a recent literature review, DeBono and colleagues suggest there is growing evidence for a positive association between SNAP participation and obesity for women, especially those who are long time program participants, although the data fall short of what is needed for causal inference.⁸ Data across a number of studies suggest that SNAP participants consume more sugar-sweetened beverages, less fruit, more total fat and added sugars, and more excess calories than nonparticipants.^{11–14}

An intriguing but understudied factor may be the role of depression as a possible contributing factor to obesity among SNAP participants given research documenting a link between low socioeconomic status (SES) to depression over the lifecourse^{15,16} For example, in a meta-regression analysis that looked across SES groups, low-SES individuals had almost twice the odds of being depressed compared to their high-SES counterparts (OR,

1.81; 95% CI, 1.57–2.10; $p < 0.001$).¹⁶ This study also showed that depression increased the odds for developing obesity by almost 60% (OR, 1.58; 95% CI, 1.33–1.87; $P < 0.001$).¹⁶

There is also robust evidence that individuals experiencing food insecurity have higher rates of depression compared to their food-secure counterparts.^{17–24} Although a number of studies of SNAP participants have posited stress and depression as important to diet and weight,^{25–27} no study, to our knowledge, has tested associations between depression and weight outcome while controlling for food insecurity among SNAP participants. Almost all studies to date that have looked at associations between depression and diet have examined whether consumption of specific nutrients predicts risk of depression (e.g., n-3 fatty acids are associated with lower risk of depression among adults).^{28–30} Only one study among a low-income cohort suggested that higher dietary quality was associated with reduced symptoms of depression.³¹ Others have tested the relationship between dietary patterns and obesity and shown that certain dietary patterns (e.g., high intakes of fruit, vegetables, fish, and whole grains) are associated with a reduced depression risk.^{32–34} However, a plethora of laboratory studies also suggest that depression is associated with increased consumption of palatable food rich in fat and sugar given that these foods have an anxiolytic effect.^{35–37} This study builds on prior work by testing the hypothesis that depressive symptomatology will be associated with two weight-related outcomes among SNAP participants. Specifically, it examines dietary quality as measured by the Healthy Eating Index-2005 (i.e., an indicator that assesses conformance to the 2005 Dietary Guidelines for Americans), and measured body mass index (BMI), or kg/m^2 . To our knowledge, this is the first study to examine these relationships among SNAP participants, and hence we begin to address a key gap in the literature by examining weight-related outcomes in low-income populations. Because SNAP participants are a group that can be identified and accessed, these analyses might shed light on potential avenues for intervention.

Methods

Study design and sample

The Pittsburgh Hill/Homewood Research on Eating, Shopping and Health (PHRESH) is a five-year study of a cohort of 1,372 residents living in “food deserts.” These food deserts are approximately 4 miles from one another in the City of Pittsburgh and have poor access to healthy food options.^{38,39} Both neighborhoods consist of populations that are predominantly low-income and African-American. Baseline data was collected May through December 2011 from households that were randomly selected from a complete list of addresses obtained from the Pittsburgh Neighborhood and Community Information System (PNCIS), which houses neighborhood-level data for the City of Pittsburgh. Parcel data were merged with Allegheny County Office of Property Investment data to identify residential addresses, which were then cross-referenced with postal service data to remove vacant properties. A random selection of 2,900 households was chosen from these data.

Eighteen trained data collectors who themselves were neighborhood residents went door-to-door to enroll households following local publicity in church bulletins, community-based organizations and groups, posters in businesses, and postcards that were mailed to each of the randomly selected addresses. Data collectors were able to speak with an adult and

identify the address as a residence for 1,956 households (67% of all selected addresses). Of those households, 1,649 were eligible to participate, (i.e., the primary food shopper was 18 years or older and available) and 1,434 (87%) agreed to participate in the study. Of those households who participated, surveys with large amounts of missing data (greater than 20%) were considered unusable $n=4\%$.

Data collectors interviewed the main food shopper of the household who was 18 years or older using a computer-assisted personal interviewing (CAPI) method. For sensitive questions, including annual household income and participation in federal assistance programs, participants were given the option of using self-administered interviewing methods instead. Specifically, interviewers provided two example questions as a means of “training” the respondent and then turned the screen toward the respondent. When the questions were complete, the respondent turned the computer back to the interviewer. Interviewers also measured height and weight of the main food shopper at the conclusion of the interview and administered a 24-hour dietary recall. Approximately one week later, data collectors administered a dietary recall a second time via telephone. The original study protocol specified that dietary data would be collected during one weekend and one weekday. However, scheduling proved to be too difficult and only 32% of the sample completed the dietary recall according to this schedule. Most of the sample completed both recalls during weekdays (60%), and 8% during weekends. All study protocols were approved by the RAND Human Subjects Protection Committee. Further, all study participants were adults (i.e., 18 years and older) and provided oral informed consent prior to the interview.

Measures

SNAP participation—Participation was measured with a single question (Did any member of your household receive food stamps – such as SNAP, Access card, or Electronic Benefit Transfer (EBT) — in any of the last 12 months?).

Current depressive symptomatology—Depressed mood and anhedonia was captured with the Patient Health Questionnaire-2 (PHQ-2),⁴⁰ which has performed well in various large clinic samples and in an ethnically diverse population sample that included African-American adults⁴¹. Respondents were asked to estimate how often they have encountered the following problems over the last 2 weeks: (1) “little interest or pleasure in doing things”, and (2) “feeling down, depressed, or hopeless.” Raw scores were summed and ranged from 0–6, with higher scores indicating greater current depressive symptomatology. The question about depressed mood has a sensitivity of 85% to 90% when compared to longer tools designed to measure major depression, and adding the anhedonia item increases the sensitivity to 95%.⁴⁰ In our sample, the scale exhibited acceptable reliability for a two-item scale (Cronbach’s $\alpha=0.54$).

Dietary quality—Data were derived from the average of two 24-hour recalls administered by data collectors using the online Automated Self-Administered 24-hour recall (ASA-24), which uses a modified version of the USDA’s Automated Multiple-Pass Method.⁴² The ASA-24 was designed to be self-administered; however, there was concern that most

respondents would only have internet access through a mobile device and would not have access to high-speed internet connections or computers at home. The recall data was then used to derive Healthy Eating Index-2005 scores.^{43,44} The HEI-2005 includes 12 components, five of which represent the major food groups found in the USDA's MyPyramid, (i.e., total fruit, total vegetables, total grains, milk, and meat and beans). A maximum score in the HEI is 100; higher scores indicate greater adherence to federal dietary guidelines (i.e., 2005 Dietary Guidelines for Americans).⁴⁵

BMI—Body Mass Index (BMI) was based on objective measurements taken by the interviewer and derived from the standard formula of weight (kg) divided by height squared (m^2). Interviewers were trained in these specific procedures^{46,47} and measured height using a carpenter's square (triangle) and an 8-ft folding wooden ruler marked in inches. Height was recorded to the nearest one-eighth of an inch. Interviewers entered adjustments to the height—e.g., for shoes or hair ornaments that the respondent chose not to remove. Respondent weight was measured using the SECA Robusta 813 digital scale, which was capable of weighing respondents up to 400 pounds. If the respondent weighed more than 400 pounds, self-reported weight was used. Interviewers recorded weight as it appeared on the scale's LCD display, to the nearest one-tenth of a pound.

Food security—The 18-item U.S. Household Food Security Survey Module was used to measure food security (secure, low food security, or very low food security in the last 12 months). This instrument has been used in diverse samples and is the measure used to report national food insecurity prevalence experienced by households since 1995.⁴⁸ Low and very low food security levels were combined and food security was used as the reference category.

Sociodemographic characteristics—Sociodemographic characteristics that were hypothesized to be directly related to diet or body mass index were included in the models. These included sex, age (measured as a continuous variable in years), and a count of all children in the household (children defined as ≥ 18). Education was originally assessed with a six level variable: elementary school, some high school, high school, some college/technical school, college degree, and graduate school, which was then coded as <High School, High School, some college, and college or higher. Further, for the multivariate models, the first three levels were combined to be the reference category. Employment was coded as employed full or part time, and unemployed as retired, looking for work, disabled and other. The last four levels were combined to be the reference category because all of those point estimates were of similar magnitude and of the same direction. Income was measured with a single question ("What was your total household income in the past year? Household income means the combined income of everyone who lives in the house and who shares expenses and earnings."); missing values were imputed with the software IVEWare in SAS macros (version 0.2, 2009, Software Survey Methodology Program at the University of Michigan's Survey Research Center, Institute for Social Research, Ann Arbor).

Statistical Analyses

From the initial cohort of 1,372 shoppers this study focuses only on SNAP participants (n=703). Women who reported being pregnant, or women who reported having a live birth in the 12 months prior to the day of the household survey (n=56) were excluded given their unique dietary needs and pregnancy-related weight. In addition, participants who refused to answer the SNAP question or did not know whether they received SNAP benefits in the past 12 months (n=8) were excluded, for a final sample size of N=639 of main household food shoppers.

Descriptive statistics (means and percentages) were calculated to examine the distribution of sociodemographic factors, food insecurity, diet-related variables, and depression symptomatology. Two separate multivariate OLS regressions were modeled for depressive symptomatology for each of the weight-related outcomes, while controlling for sociodemographic factors. The decision to model dietary quality and BMI separately derived from the additional analysis that showed a non-significant correlation between HEI-2005 scores and BMI (0.021, $p=0.44$). Food security was also included in the models to test for associations between depression and weight or dietary quality independent of any role that food security might play. Finally, this study explored the possibility that food security and sex might be acting as possible moderators in the relationship between depressive symptomatology and the two outcomes of interests; however, the interaction terms were non-significant for all models in this sample (results not shown).

A series of residual diagnostics were conducted to check for model assumptions (e.g., normality, linearity, and homoscedasticity explicitly). The process for choosing covariates included using a conceptual model and previous study results. Statistical significance was set at $p < .05$, and analyses were conducted using SAS statistical analysis software (version 9.2, 2006, SAS Institute Inc.). Results were sufficiently robust to employ cluster-corrected standard errors.

Results

Characteristics of study participants

As shown in Table 1, the study sample was composed of older adults, with only one-third (33%) of participants between the ages of 18–44. Most of the sample was women (76.7%) and nearly half were educated beyond high school (40.8%). Approximately 80% of the sample was not currently employed and one-third (33%) of participants had at least one child living in the household. Mean annual household income was less than \$10,000, and only 6% of the study sample reporting an annual household income of \$20,000 or more. Despite receiving SNAP benefits, over 40% were food-insecure (e.g., food runs out before there is money to buy more; couldn't afford to eat balanced meals). Mean score on the HEI was 47.3, which is low (i.e., less than half the maximum score).^{43,44} Average BMI for the sample was 31.1. A BMI of 30 or greater is considered obese according to the CDC guidelines;⁴⁹ 26.3% percent of the sample was overweight and 48.6% were obese.

Predictors of dietary quality and BMI

Depression was a strong and statistically significant predictor of both dietary quality and BMI (see Tables 2 and 3). Specifically, higher score in depressive symptomatology was associated with lower scores in dietary quality ($\beta=-1.26$, $p<0.0001$). A higher score in depressive symptomatology was associated with higher BMI scores ($\beta=0.63$, $p<0.01$), after controlling for other individual factors.

In terms of sociodemographic predictors, only age and college education or higher were significantly associated with dietary quality. Specifically, age ($\beta=0.09$, $p<0.01$) and college education or higher ($\beta=3.57$, $p=0.01$) were positively associated with dietary quality after adjusting for other factors. Sex and having a child in the household were the only demographic factors significantly associated with BMI. Specifically, being male was associated with lower BMI ($\beta=-2.65$, $p<0.001$), whereas having a child in the household was associated with higher BMI ($\beta=2.01$, $p<0.05$). Food insecurity was unrelated to dietary quality, but was associated with higher BMI ($\beta=1.46$, $p=0.0239$). The estimates provided for the socio-demographic characteristics in Tables 2 and 3 are direct effects, rather than total effects.⁵⁰

Discussion

These findings confirm previous studies that suggest depressive symptomatology is significantly associated with weight-related outcomes, including a study of a low-income cohort.³¹ Yet these analyses take the findings of previous studies one step further as this study was able to link depressive symptomatology with both dietary quality and BMI in a low-income cohort. While this study found that depressive symptomatology was negatively associated with dietary quality, it also found that depressive symptomatology was positively associated with body mass index. These findings call to light the potential importance of depressive symptomatology and weight-related outcomes (e.g., BMI, dietary quality), particularly among SNAP participants. However, this is a cross-sectional association and a number of studies have investigated the opposite association given the plausibility that obesity can lead to depression.^{51–53} Research on dietary intake also suggests high intakes of fruits, vegetables, fish, and whole grains are associated with reduced depression risk among adults³². Further research is needed to elucidate the direction of this relationship.

For example, future studies might focus on the specific role of mental distress given the studies that have found greater emotional distress among SNAP participants.⁵⁴ Recent qualitative research among SNAP households with children also highlights the harsh economic circumstances of families, and the fundamental reality that expenses often outstrip income. Specifically, “SNAP families build their monthly budgets around SNAP, allocating their cash resources towards bills and other, often urgent, financial needs triggered by loss of income or increase expenditures.”⁵⁵ SNAP participants also used a complex set of decision-making strategies that were employed throughout the month (e.g., changing the types of food bought towards the end of the month to cheaper foodstuff such as Top Ramen and potatoes) or restricting food intake when families experienced budget shortfalls.⁵⁵ Such trade-offs in the context of poverty have been shown to cause decision fatigue, which refers to the deteriorating quality of decisions made by an individual after a long session of

decision-making. This situation in turn results in a significant depletion in behavioral control (i.e., loss of “will-power, or self-control”).⁵⁶ Sub-optimal nutritional choices may be further influenced by depressive mood, given the studies that have found depression influences the severity of cravings such as snack foods high in carbohydrates (e.g., potato chips or pastries).⁵⁷ Further studies focusing on decision fatigue and its relation to health may be particularly promising to further understand the intersection between mental health, diet, and weight among the most vulnerable.

This is a study of a local sample of SNAP participants and may not generalize to the national population of those enrolled in SNAP. This study was also limited to using a two-item measure of depressive symptomatology given that the primary focus of the PHRESH study is not mental health. Lastly, a model sufficient for estimating the average effect of depression on the outcomes may be insufficient for unbiased estimation of covariate effects (e.g. age, sex) because there may be additional uncontrolled covariates or potential confounders of covariate effects.⁵⁰ As such, only the primary effect depressive symptomatology should be considered as a total effect. Despite these limitations, this study focuses on a group that is of particular importance, low-income, primarily African American, residents of urban food deserts. This group is at particularly high risk of obesity and poor nutrition, and the overall sample descriptives bear this out. Thus, the finding that depression is associated with even *higher* risk within this already high risk group suggests a potential avenue for intervention is a focus on mental health, especially depressive symptomatology.

Conclusions

There is still a large gap in our understanding of the role of depression and diet-related outcomes among vulnerable populations. This analysis has shown that addressing this gap may be critical to efforts to address the obesity epidemic in this country. This issue of bi-directionality reinforces the need for further research on the relationships between these health outcomes among SNAP recipients, given that this program offers nutrition assistance to millions of low-income individuals and continues to function as the largest hunger safety net in the country. The administration of the program also relies on the infrastructure across state agencies and neighborhood organizations to provide nutritional assistance. Leveraging the program’s capacity and resources may be an effective avenue to address mental health issues among the most vulnerable. Our results suggest that in alleviating depressive symptomatology among SNAP participants, we might in turn help improve dietary quality and ultimately health outcomes.

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Table 1

Sociodemographic Characteristics of SNAP Participants living in Pittsburgh, PA (N =639)

	No. (%) or Mean (SD)
Age (in years)	
18–34	119 (18.6%)
35–44	89 (13.9%)
45–54	151 (23.6%)
55–64	137 (21.4%)
65+	143 (22.4%)
Race ^a	
Black	584 (91.8%)
Mixed Black ^b	22 (3.5%)
Non-Black	30 (4.7%)
Sex	
Female	490 (76.7%)
Male	149 (23.3%)
Education	
<High School	116 (18.2%)
High School	262 (41.0%)
Some college	200 (31.3%)
College or higher	61 (9.5%)
Employment status	
Full/Part-Time	134 (21.0%)
Unemployed	505 (79.0%)
Children in household	213 (33.3%)
Adjusted Annual Household Income	
< \$5,000	151 (23.6%)
\$5,000–\$9,999	306 (47.9%)
\$10,000–\$19,999	142 (22.2%)
\$20,000+	40 (6.3%)
Low/Very Low Food security	258 (40.4%)
Healthy Eating Index-2005 ^c	47.3 (10.5)
BMI	31.1 (7.9)
Depression symptomatology ^d	1.38 (1.5)

^aCategories do not add to 100% due to missing values on this variable (n=3)^bIndividuals who considered themselves black and another race.^cScores can range from 0 to 100 with each unit reflecting greater adherence to the 2005 Dietary Guidelines for Americans^dScores can range from 0 to 6 with each unit increase indicating more severe depression symptoms

Table 2

Multivariate Regression Predicting Dietary Quality (HEI-2005) among SNAP Participants living in Pittsburgh, PA (N = 639)

	β	<i>P</i> -value
Intercept	44.4733	
Depressive symptomatology	-1.2554	<0.0001
Sociodemographic Variables		
Age	0.0898	0.0049
Male	-1.4010	0.1591
College education or higher	3.5662	0.0113
Children in household	-0.8412	0.4606
Adjusted Annual Household Income \$10,000	-0.0235	0.6787
Full/Part-Time Employment	0.8675	0.4189
Low/Very Low Food security	0.5967	0.4849

Table 3

Multivariate Regression Predicting Body Mass Index (BMI) among SNAP Participants living in Pittsburgh, PA (N =639)

	β	<i>P</i> -value
Intercept	29.1772	
Depressive symptomatology	0.6291	0.0031
Sociodemographic Variables		
Age	0.0057	0.8114
Male	-2.6465	0.0004
College education or higher	-0.7162	0.5013
Children in household	2.0052	0.0208
Adjusted Annual Household Income \$10,000	-0.0136	0.7599
Full/Part-Time Employment	1.1381	0.1625
Low/Very Low Food security	1.4609	0.0239