

Household Food Insecurity Is Positively Associated with Depression among Low-Income Supplemental Nutrition Assistance Program Participants and Income-Eligible Nonparticipants^{1–3}

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Abstract

Background: Food insecurity is associated with adverse mental health outcomes. Given that federal food assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP), aim to alleviate food insecurity, there may be heterogeneity in the association between food insecurity and depression by SNAP participation status.

Objective: With the use of data from the 2005–2010 NHANES, we examined the associations between household food security and depression and whether these differed by SNAP participation.

Methods: The study population was restricted to 3518 adults with household incomes $\leq 130\%$ of the federal poverty level. Food insecurity was assessed with the 18-item US Household Food Security Survey Module; a score of ≥ 3 was considered food insecure. Depression was assessed with the 9-item Patient Health Questionnaire and was defined as a score of ≥ 10 . Multivariate logistic regression models examined the associations between food insecurity and depression, adjusting for sociodemographic and health characteristics.

Results: The overall prevalence of depression was 9.3%, ranging from 6.7% among SNAP nonparticipants to 12.8% among SNAP participants. For every depressive symptom, there was a dose-response relation, such that a higher prevalence was observed with worsening food insecurity. After multivariate adjustment, food insecurity was positively associated with depression (P -trend < 0.0001), but SNAP participation modified this relation (P -interaction = 0.03). Among low-income, eligible nonparticipants, very low food security was significantly associated with higher odds of depression (OR: 5.10; 95% CI: 3.09, 8.41). Among SNAP participants, very low food security was also associated with higher odds of depression but at a lower magnitude (OR: 2.21; 95% CI: 1.54, 3.17).

Conclusion: The complex relation between food insecurity and mental health may vary on the basis of SNAP participation status. Programmatic efforts to address the risk of depression among their beneficiaries may positively affect the mental health of low-income adults. *J Nutr* 2015;145:622–7.

Keywords: depression, food insecurity, food stamps, Supplemental Nutrition Assistance Program, National Health and Nutrition Examination Surveys

Introduction

Food insecurity, defined as a lack of consistent access to food for all members of the household, has persisted at high levels in the

United States throughout the past decade (1). In 2013, it was estimated that 14.3% of households, or ~ 1 in 7 Americans, experienced food insecurity at some point during the past year. Food insecurity is associated with poorer health consequences among adults, including obesity, systemic inflammation, and diabetes, and it is considered a serious public health challenge (2–8).

Food insecurity is also associated with adverse mental health outcomes, particularly higher rates of anxiety and depressive symptoms among women (9–16). These associations are not

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extensively studied among men or investigated for the role of federal nutrition assistance programs. Supplemental Nutrition Assistance Program (SNAP)⁹ is currently the largest of 15 federal nutrition assistance programs, serving 1 in 7 Americans (17). SNAP aims to reduce food insecurity and to improve the health of low-income individuals through the provision of benefits used to purchase food. Given the strong evidence that SNAP participation leads to improvements in food insecurity (18–24), there may be a differential relation between food insecurity and depression between SNAP participants and low-income nonparticipants.

The relations between food insecurity, SNAP participation, and adult mental health have been explored in few studies with mixed results. Heflin and Ziliak (25) examined food insufficiency, an older measure of food insecurity, Food Stamp Program participation, and mental distress in the Panel Study of Income Dynamics. Their findings suggested that the relation between food insufficiency and emotional distress was heightened among Food Stamp recipients (25). Kim and Frongillo (12) observed a positive association between food insecurity and depression among SNAP nonparticipants in a cross-sectional analysis of the Health and Retirement Study. No association was found among SNAP participants. However, this interaction was not observed when the data were examined longitudinally or in a sample of elderly adults from the Asset and Health Dynamics Among the Oldest Old study. The investigators used a modified measure of food insecurity, which may have underestimated the prevalence of food insecurity, leading to an attenuation of the true effects.

The objective of this study was to examine the association between household food security and depression and whether these differed by SNAP participation status among low-income adults. Because previous studies have focused on women, we also examined potential effect modification by sex on these associations. Our study builds on the previous research in this area and attempts to bring clarity to the mixed findings by using a recent and nationally representative sample of low-income men and women eligible for SNAP benefits, examining validated measures of household food security and depression, and adjusting for sociodemographic and health characteristics hypothesized to influence these associations.

Methods

Study population. NHANES is an ongoing, multistage cross-sectional survey administered by the National Center for Health Statistics. NHANES is designed to be representative of the civilian, noninstitutionalized US population and collects information on demographics, dietary intake, mental health, and health-related behaviors.

This analysis combined data from the 2005–2010 surveys, representing 17,132 adults 20 y and older. The analytic sample was restricted to households whose incomes fell at or below 130% of the federal poverty level (FPL) to include individuals financially eligible to receive SNAP benefits. The analytic sample comprised adults aged 20–65 y with complete data on household food security (missing $n = 136$), SNAP participation (missing $n = 137$), and depression (missing $n = 714$) and excluded pregnant women ($n = 185$) and NHANES participants with a sampling weight of zero ($n = 131$). The final sample comprised 3518 adults.

Depression. The 9-item Patient Health Questionnaire (PHQ-9) was added to the NHANES mobile examination centers beginning in 2005.

⁹ Abbreviations used: FPL, federal poverty level; PHQ-9, 9-item Patient Health Questionnaire; SNAP, Supplemental Nutrition Assistance Program.

The PHQ-9 asks respondents to self-report the frequency of 9 DSM-IV signs for depression over the past 2 wk, ranging from “little interest or pleasure in doing things” to “thoughts that you would be better off dead or of hurting yourself in some way.” Responses were self-reported and scored from 0 (not at all) to 3 (nearly every day). The sum of the responses was calculated, and a score of ≥ 10 was used to identify individuals with depression (26). The PHQ-9 is validated as a tool to screen, measure, and diagnose the severity of depression in clinical and general populations (26, 27).

Household food security and SNAP participation. Food insecurity was measured with the 18-item US Food Security Survey Module (28). Questions are ordered by severity and attribute-related experiences or behaviors to insufficient resources to buy food over the past 12 mo. A raw score was created by summing the affirmative responses of the 18 questions, with a higher score reflecting higher levels of food insecurity. Categories were then assigned on the basis of guidelines from the USDA: 0, full food security; 1–2, marginal food security; 3–5 (households without children) or 3–7 (households with children), low food security; and 6–10 (households without children) or 8–18 (households with children), very low food security. Food insecurity refers to households reporting low or very low food security.

SNAP participation was assessed with the question, “In the last 12 mo, did you or any members of your household receive Food Stamp benefits?” Both food insecurity and SNAP participation are measured at the household level.

Study covariates. Sociodemographic covariates included age (in 10-y increments), sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other or multiple race/ethnicities), education level (<12 y, high school graduate or general educational development equivalent, some college, college graduate), marital status (married or living with partner, never married, widowed/ divorced/ separated), and poverty income ratio (0–25% FPL, 25.1–50% FPL, 50.1–75% FPL, 75.1–100% FPL, 100.1–130% FPL). Health indicators included smoking status (never smoker, former smoker, current smoker) and standard BMI categories from measured height and weight (kg/m^2 ; <18.5 , 18.5–24.9, 25–29.9, ≥ 30). Sociodemographic and health covariates were included in multivariate regression analyses because they were conceived as common determinants of food insecurity and depressive symptoms.

Statistical analysis. Complex survey weights were used to account for different sampling probabilities and participation rates for the various stages of NHANES and to obtain effect estimates and standard errors representative of the US population. Weights for the mobile examination centers were used for all models and were recalculated to reflect the probability of being sampled in the 6-y period.

First, sociodemographic and health characteristics were compared with food insecurity levels by using chi-squared tests and univariate linear regression models. Next, we evaluated associations between household food security and depression by fitting logistic regression models. The first model adjusted for age and sex. The multivariate model included all sociodemographic covariates and health characteristics. Trend tests were conducted by running multivariate logistic regression models for the outcome of depression by testing household food security as an ordinal variable. Next, we examined whether the associations between household food security and depression were modified by SNAP participation over the past 12 mo and sex. When statistical interaction was found, results were stratified by subgroups of interest.

All statistical tests were two-sided, and significance was considered at $P < 0.05$ for all tests. Statistical analyses were performed with SAS 9.3 (SAS Institute Inc.).

Results

In our nationally representative sample of adults at or below 130% FPL between 2005 and 2010, 16.1% of low-income adults reported their households were marginally food secure, 23.5% reported their households had low food security, and

13.8% reported their households had very low food security. Approximately 42% of low-income adults received SNAP benefits in the past 12 mo. Sociodemographic and health characteristics of study participants by household food security status are shown in **Table 1**. Compared with food-secure adults, food-insecure adults were generally more likely to be nonwhite, have lower educational attainment, be a current smoker, and participate in SNAP.

In the low-income study population, the overall prevalence of depression was 9.3%; 6.7% among SNAP-eligible nonparticipants and 12.8% among SNAP participants (data not shown). Among all low-income adults, the most commonly reported depressive symptoms by low and very low food-secure adults were 1) feeling tired or having little energy; 2) trouble sleeping or sleeping too much; and 3) feeling down, depressed, or hopeless (**Supplemental Figure 1**). For every depressive symptom, there was a dose-response relation, such that a higher prevalence was

observed with worsening food insecurity. After adjustment for sociodemographic and health characteristics, the odds of depression were 3-fold higher for very low food-secure adults than for food-secure adults (OR: 3.42; 95% CI: 2.61, 4.49) (**Table 2**).

A significant heterogeneity was found in the association between household food security and depression by SNAP participation (P -interaction = 0.03). After adjustment for sociodemographic and health differences, very low food security was associated with 5-fold higher odds of depression (OR: 5.10; 95% CI: 3.09, 8.41) among low-income, SNAP-eligible nonparticipants (**Table 3**). Low food security was marginally associated with higher odds of depression (OR: 1.64; 95% CI: 0.93, 2.92; P = 0.09). Among SNAP participants, low food security (OR: 2.12; 95% CI: 1.31, 3.42) and very low food security (OR: 2.21; 95% CI: 1.54, 3.17) were each associated with higher odds of depression, albeit weaker than SNAP-eligible

TABLE 1 Characteristics of 3518 low-income NHANES participants by household food security status¹

	Full food security (<i>n</i> = 1499)	Marginal food security (<i>n</i> = 596)	Low food security (<i>n</i> = 896)	Very low food security (<i>n</i> = 527)	<i>P</i> ²
Age, y	38.5 ± 0.7 ³	38.3 ± 0.5	36.7 ± 0.5	39.7 ± 0.7	0.002
Household size, <i>n</i>	3.5 ± 0.1	3.8 ± 0.1	4.2 ± 0.1	3.4 ± 0.2	<0.0001
Female	797 (53.5) ⁴	331 (56.5)	481 (53.3)	287 (53.8)	0.63
Race/ethnicity					<0.0001
Non-Hispanic white	622 (56.9)	196 (44.5)	268 (37.0)	193 (43.1)	
Non-Hispanic black	309 (15.4)	97 (15.7)	175 (18.3)	120 (22.2)	
Hispanic	483 (20.9)	284 (35.4)	406 (36.0)	187 (26.9)	
Other	85 (6.9)	19 (4.4)	47 (6.0)	27 (7.8)	
Education level					<0.0001
<12 y	579 (32.3)	262 (38.2)	479 (48.5)	238 (40.4)	
High school graduate	386 (27.0)	160 (31.0)	214 (25.6)	138 (28.0)	
Some college	395 (29.2)	122 (22.0)	172 (22.2)	137 (28.9)	
College graduate or higher	137 (11.6)	51 (8.8)	31 (3.7)	14 (2.7)	
Marital status					0.16
Single	402 (30.5)	143 (26.6)	208 (25.6)	134 (28.5)	
Married or living with partner	742 (49.0)	328 (51.3)	495 (54.3)	246 (45.5)	
Widowed, divorced, or separated	354 (20.5)	125 (22.1)	193 (20.1)	147 (26.0)	
Poverty income ratio					0.26
0–25% FPL	152 (11.5)	40 (7.9)	99 (11.5)	61 (11.5)	
>25–50% FPL	160 (10.2)	67 (10.5)	128 (14.0)	75 (16.3)	
>50–75% FPL	301 (20.8)	138 (24.2)	201 (22.8)	122 (21.0)	
>75–100% FPL	388 (24.9)	164 (26.2)	237 (25.3)	124 (23.0)	
>100–130% FPL	498 (32.5)	187 (31.2)	231 (26.4)	145 (28.2)	
Smoking status					0.0007
Never smoker	743 (47.6)	307 (49.4)	403 (43.2)	204 (38.1)	
Former smoker	252 (17.0)	92 (14.6)	142 (13.6)	69 (11.9)	
Current smoker	503 (35.4)	197 (36.0)	349 (43.2)	254 (50.0)	
BMI category					0.61
Underweight	46 (3.8)	13 (2.3)	18 (2.1)	14 (3.2)	
Normal weight	403 (29.7)	157 (29.4)	214 (27.5)	132 (26.6)	
Overweight	478 (31.7)	198 (30.8)	281 (31.5)	167 (31.2)	
Obese	547 (34.8)	220 (37.5)	376 (38.8)	205 (39.0)	
SNAP participation	534 (33.3)	256 (44.8)	453 (50.8)	279 (53.9)	<0.0001

¹ Assessed with the 18-item US Household Food Security Survey Module. Households were categorized as full food security with 0 affirmative responses, marginal food security with 1–2 affirmative responses, low food security with 3–5 affirmative responses (or 3–7 affirmative responses in households with children), and very low food security with 6–10 affirmative responses (or 8–18 affirmative responses in households with children). FPL, federal poverty level; SNAP, Supplemental Nutrition Assistance Program.

² Comparisons with food insecurity were analyzed with univariate linear regression models (for continuous variables) and chi-squared tests (for categorical variables).

³ Means ± SEs (all such values).

⁴ *n* (percentage) (all such values).

TABLE 2 Results of multivariate logistic regression models for the association between household food security and depression among 3518 low-income adults

	Depression, ¹ <i>n</i> (%)	Age- and sex-adjusted OR (95% CI)	Multivariate-adjusted ² OR (95% CI)
Full food security	93 (5.8)	Referent	Referent
Marginal food security	42 (7.7)	1.32 (0.81, 2.15)	1.24 (0.76, 2.04)
Low food security	98 (11.1)	2.09 (1.43, 3.05)	2.10 (1.46, 3.02)
Very low food security	95 (19.6)	3.83 (2.85, 5.15)	3.42 (2.61, 4.49)

¹ Unadjusted prevalence of depression by household food security status.

² Multivariate logistic regression model adjusted for age, sex, race/ethnicity, education, marital status, household size, poverty level, smoking status, and BMI categories.

nonparticipants. The predicted probabilities of depression by household food security and SNAP participation, using estimates from the same multivariate model, is shown in Figure 1. Among food-secure, marginally food-secure and low food-secure adults, SNAP participants had higher predicted probabilities of depression than eligible nonparticipants. Food-secure, SNAP nonparticipants had the lowest probability of depression (4.5%). The highest probabilities of depression were reported among very low food-secure SNAP participants (18.8%) and SNAP-eligible nonparticipants (20.9%). No evidence of effect modification by sex was found in the associations between food insecurity and depression (*P*-interaction > 0.20).

Discussion

The consequences of food insecurity go beyond physical health outcomes and can affect mental well-being. Our results showed a dose-response relation between the level of food insecurity and the prevalence of all depressive symptoms, with most very low food-secure adults experiencing lethargy, trouble sleeping, and feelings of depression or hopelessness. This suggests the experience of food insecurity affects multiple depressive symptoms, including depressive feelings, thoughts, and behaviors. After adjustment for sociodemographic and health characteristics, food insecurity was positively associated with depression in this nationally representative sample of low-income adults. These findings are similar to previous studies of female welfare recipients, which documented an association between food insufficiency, an older measure of food insecurity, and the risk of major depression or mental distress (10, 29, 30). Laraia et al. (13) found that food insecurity was not only positively associated with depressive symptoms but also with perceived stress,

trait anxiety, and a stronger belief in chance affecting one's life and inversely associated with self-esteem and mastery among pregnant women. Dean et al. (31) observed that food-insecure elderly adults were more likely to perceive themselves as worse off and to report lower social capital than their food-secure peers. We found no differences by sex on any of the examined associations, similar to a study conducted in New Zealand of food insecurity and psychological distress among adult men and women (32).

The associations between household food security and depression differed significantly by SNAP participation. Although food-insecure SNAP participants were more likely to report depression than their food-secure counterparts, the magnitude of the association was noticeably smaller compared with food-insecure, SNAP-eligible nonparticipants. This is likely attributed to a higher probability of depression among food-secure SNAP participants (8.6%) than among food-secure nonparticipants (4.5%), the reference groups for the stratified analyses. The results from a previous study found that the relation between food insufficiency and emotional distress was higher among Food Stamp/SNAP participants than eligible nonparticipants (25), which the investigators speculate is because of the potential stigma or feelings of dependency associated with the program. Our results also demonstrated that SNAP participants had higher probabilities of depression at every level of household food security, with the exception of very low food-secure adults. The previous study used a 1-item, dichotomous measure of food insufficiency, rather than the current 18-item measure, which describes ranges of household food security, a measurement difference that might help to explain the discrepancy between the studies.

The relations between household food security, SNAP participation, and depression are undoubtedly complex, and further research, particularly from longitudinal studies, is needed to investigate whether a causal mechanism exists for SNAP in alleviating depressive symptoms. Although our present study cannot determine causality, our results suggest that SNAP-eligible nonparticipants with very low food security have the highest risks of depression. To the extent that nutrition assistance might be able to alleviate depressive symptoms through the provision of resources for food, enrollment in SNAP among this group is imperative. Future programmatic efforts might also include incorporating screening procedures or providing resources for counseling or modules within the SNAP education program to help address the high risk of depression in their targeted population.

Our study is strengthened by the use of a representative sample of low-income adults surveyed over a recent time period. Household food security was measured with the 18-item US Household Food Security Survey Module, currently regarded as

TABLE 3 Results of multivariate logistic regression models for the association between household food security and depression according to SNAP participation among 3518 low-income adults¹

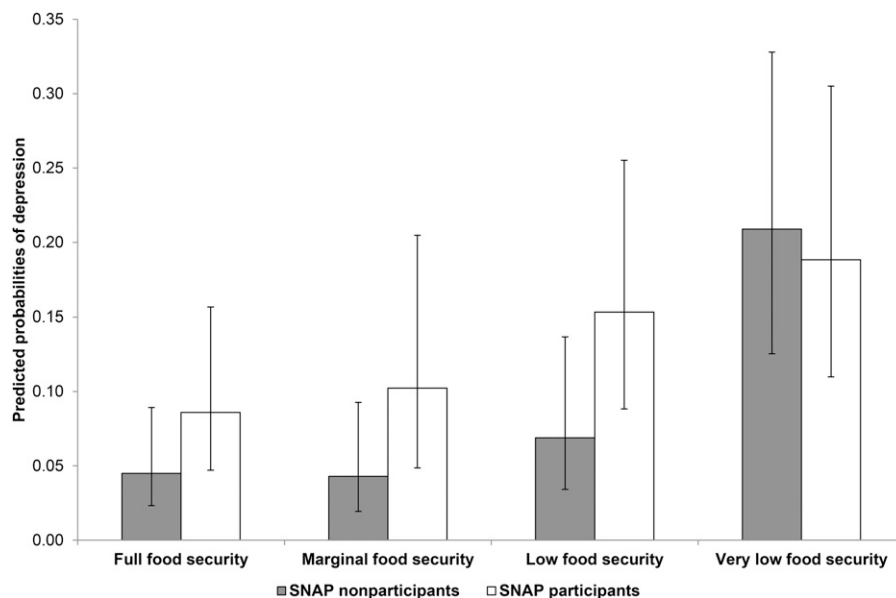
	SNAP nonparticipants		SNAP participants	
	% ²	OR (95% CI) ³	% ²	OR (95% CI) ³
Full food security	4.5	Referent	8.6	Referent
Marginal food security	4.3	0.98 (0.50, 1.92)	10.2	1.22 (0.64, 2.34)
Low food security	6.9	1.64 (0.93, 2.92)	15.3	2.12 (1.31, 3.42)
Very low food security	20.9	5.10 (3.09, 8.41)	18.8	2.21 (1.54, 3.17)

¹ SNAP, Supplemental Nutrition Assistance Program.

² Predicted probabilities of depression by household food security status from multivariate logistic regression model.

³ Multivariate logistic regression model adjusted for age, sex, race/ethnicity, education, marital status, household size, poverty level, smoking status, and BMI categories.

FIGURE 1 Predicted probabilities of depression from multivariate logistic regression models by household food security and SNAP participation among 3518 low-income adults. Values are predicted probabilities and the ranges are the 95% CIs. SNAP, Supplemental Nutrition Assistance Program.



the gold standard of food security measurement (33). Both measures of household food security and depression are validated for use in the general population. The response rates for the entire NHANES are considerably high, ranging from 68% to 78% in the examined sample (34–36). Although a high response rate can help to ensure the generalizability of our findings, we acknowledge that the specific response rate for our analytic sample is unknown.

The primary limitation of this study is the cross-sectional nature of the data, which makes it difficult to infer causation from the observed associations. Although previous longitudinal studies have demonstrated that food insecurity prospectively influences mental health outcomes (10, 12, 37), the potential remains for reverse causation bias in our study such that depression could lead to a change in employment status and income, which could affect household food security. There also exists the possibility of confounding by an unmeasured variable that may influence SNAP participation, food insecurity, and depression levels. In particular, adults who participate in SNAP may be different than adults who do not receive program benefits. Although our analysis included several known socio-demographic and health-related predictors of these associations, it is possible that other important psychosocial or environmental factors were excluded. Similarly, measures of food insecurity, SNAP participation, and depression are derived from self-reported measures, and we cannot exclude the possibility for differential reporting of food insecurity or SNAP participation by a participant's depression level. The mechanisms underlying the associations we observed between food insecurity and depression among SNAP participants and income-eligible non-participants are not well understood and highlight the need for more prospective studies to better understand the possible cyclical nature of food insecurity and depression and the role of SNAP and other federal nutrition assistance programs.

The consequences of food insecurity on physical and mental health outcomes are well documented. Our results show that food insecurity is positively related to depression among low-income adults. However, we found a differential association between food insecurity and depression by SNAP participation, such that the magnitude of the association was less for SNAP participants than for low-income nonparticipants. Although SNAP is a nutrition assistance program, its effects on health could

potentially extend beyond dietary intake. The interactions between SNAP participation, food insecurity, and depression deserve further investigation to help broaden the program's influence on the physical and mental well-being of low-income Americans.

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CWL, ESE, and BAL designed the research; CWL performed statistical analysis and wrote the first draft of the paper; ESE, WCW, EBR, and BAL contributed to the interpretation of the results and made substantial revisions to the content. All authors read and approved the final manuscript.

References

1. Coleman-Jensen A, Gregory C, Singh A. Household Food Security in the United States in 2013. Washington (DC): US Department of Agriculture, Economic Research Service; 2014. (ERR-173).
2. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. *J Nutr* 2010;140:304–10.
3. Gundersen C. Food insecurity is an ongoing national concern. *Adv Nutr* 2013;4:36–41.
4. Kirkpatrick SI, Tarasuk V. Food insecurity is associated with nutrient inadequacies among Canadian adults and adolescents. *J Nutr* 2008;138:604–12.
5. Laraia BA, Siega-Riz AM, Gundersen C. Household food insecurity is associated with self-reported pregravid weight status, gestational weight gain, and pregnancy complications. *J Am Diet Assoc* 2010;110:692–701.
6. Tarasuk VS. Household food insecurity with hunger is associated with women's food intakes, health and household circumstances. *J Nutr* 2001;131:2670–6.
7. Townsend MS, Peerson J, Love B, Achterberg C, Murphy SP. Food insecurity is positively related to overweight in women. *J Nutr* 2001;131:1738–45.
8. Gowda C, Hadley C, Aiello AE. The association between food insecurity and inflammation in the US adult population. *Am J Public Health* 2012;102:1579–86.
9. Hadley C, Patil CL. Food insecurity in rural Tanzania is associated with maternal anxiety and depression. *Am J Hum Biol* 2006;18:359–68.
10. Heflin CM, Siefert K, Williams DR. Food insufficiency and women's mental health: findings from a 3-year panel of welfare recipients. *Soc Sci Med* 2005;61:1971–82.
11. Kaiser L, Baumrind N, Dumbauld S. Who is food-insecure in California? Findings from the California Women's Health Survey, 2004. *Public Health Nutr* 2007;10:574–81.

12. Kim K, Frongillo EA. Participation in food assistance programs modifies the relation of food insecurity with weight and depression in elders. *J Nutr* 2007;137:1005–10.
13. Laraia BA, Siega-Riz AM, Gundersen C, Dole N. Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women. *J Nutr* 2006;136:177–82.
14. Melchior M, Caspi A, Howard LM, Ambler AP, Bolton H, Mountain N, Moffitt TE. Mental health context of food insecurity: a representative cohort of families with young children. *Pediatrics* 2009;124:e564–72.
15. Okechukwu CA, El Ayadi AM, Tamers SL, Sabbath EL, Berkman L. Household food insufficiency, financial strain, work-family spillover, and depressive symptoms in the working class: the Work, Family, and Health Network study. *Am J Public Health* 2012;102:126–33.
16. Ramsey R, Giskes K, Turrell G, Gallegos D. Food insecurity among adults residing in disadvantaged urban areas: potential health and dietary consequences. *Public Health Nutr* 2012;15:227–37.
17. Supplemental Nutrition Assistance Program Participation and Costs; 2014 [cited 2014 Aug 29]. Available from: <http://www.fns.usda.gov/pd/SNAPsummary.htm>.
18. Nord M. How much does the Supplemental Nutrition Assistance Program alleviate food insecurity? Evidence from recent programme leavers. *Public Health Nutr* 2012;15:811–7.
19. Nord M. Effects of changes in SNAP benefits on food security. *Amber Waves*; 2013 [cited 2014 Feb 5]. Available from: <http://www.ers.usda.gov/amber-waves/2013-october/effects-of-changes-in-snap-benefits-on-food-security.aspx#.UvfVtPnFSSh>.
20. Nord M, Golla AM. Does SNAP decrease food insecurity? Untangling the self-selection effect. Washington (DC): Economic Research Service, US Department of Agriculture; 2009. (Report 85).
21. Nord M, Prell M. Food security improved following the 2009 ARRA increase in SNAP benefits (ERR-116); 2011 [cited 2012 Dec 20]. Available from: <http://www.ers.usda.gov/media/127913/err116.pdf>.
22. Ratcliffe C, McKernan S-M. How much does SNAP reduce food insecurity. Washington (DC): The Urban Institute; 2010.
23. Tiehen L, Ver Ploeg M. SNAP benefits alleviate the incidence and intensity of poverty. Washington (DC): Economic Research Service, US Department of Agriculture; 2012.
24. Wilde P, Nord M. The effect of Food Stamps on food security: a panel data approach. *Appl Econ Perspect Pol* 2005;27:425–32.
25. Heflin CM, Ziliak JP. Food insufficiency, Food Stamp participation, and mental health. *Soc Sci Q* 2008;89:706–27.
26. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001;16:606–13.
27. Martin A, Rief W, Klaiberg A, Braehler E. Validity of the Brief Patient Health Questionnaire Mood Scale (PHQ-9) in the general population. *Gen Hosp Psychiatry* 2006;28:71–7.
28. Bickel G, Nord M, Price C, Hamilton W, Cook J. Guide to measuring household food security. Alexandria (VA): Food and Nutrition Service, US Department of Agriculture; 2000.
29. Siefert K, Heflin CM, Corcoran ME, Williams DR. Food insufficiency and the physical and mental health of low-income women. *Women Health* 2001;32:159–77.
30. Siefert K, Heflin CM, Corcoran ME, Williams DR. Food insufficiency and physical and mental health in a longitudinal survey of welfare recipients. *J Health Soc Behav* 2004;45:171–86.
31. Dean WR, Sharkey JR, Johnson CM. Food insecurity is associated with social capital, perceived personal disparity, and partnership status among older and senior adults in a largely rural area of central Texas. *J Nutr Gerontol Geriatr* 2011;30:169–86.
32. Carter KN, Kruse K, Blakely T, Collings S. The association of food security with psychological distress in New Zealand and any gender differences. *Soc Sci Med* 2011;72:1463–71.
33. Cook JT, Black M, Chilton M, Cutts D, Ettinger de Cuba S, Heeren TC, Rose-Jacobs R, Sandel M, Casey PH, Coleman S, et al. Are food insecurity's health impacts underestimated in the U.S. population? Marginal food security also predicts adverse health outcomes in young U.S. children and mothers. *Adv Nutr* 2013;4:51–61.
34. Unweighted Response Rates for NHANES 2005–2006 by Age and Gender. Atlanta: Centers for Disease Control and Prevention. [cited 2014 Jul 23]. Available from: http://www.cdc.gov/nchs/data/nhanes/response_rates_cps/RRT0506ME.pdf.
35. Unweighted Response Rates for NHANES 2007–2008 by Age and Gender. Atlanta: Centers for Disease Control and Prevention. [cited 2014 Jul 23]. Available from: http://www.cdc.gov/nchs/data/nhanes/response_rates_cps/RRT0708ME.pdf.
36. Unweighted Response Rates for NHANES 2009–2010 by Age and Gender. Atlanta: Centers for Disease Control and Prevention. [cited 2014 Jul 23]. Available from: http://www.cdc.gov/nchs/data/nhanes/response_rates_cps/RRT0910.pdf.
37. Polivy J. Psychological consequences of food restriction. *J Am Diet Assoc* 1996;96:589–92.