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# Severity of Household Food Insecurity Is Positively Associated with Mental Disorders among Children and Adolescents in the United States[1–4]

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## Abstract

**Background:** Household food insecurity and mental disorders are both prevalent conditions among children and adolescents (i.e., youth) in the United States. Although some research has examined the association between the 2 conditions, it is not known whether more severe food insecurity is differently associated with mental disorders in youth.

**Objective:** We investigated the association between severity of household food insecurity and mental disorders among children (aged 4–11 y) and adolescents (aged 12–17 y) using valid and reliable measures of both household food security status and mental disorders.

**Methods:** We analyzed cross-sectional data on 16,918 children and 14,143 adolescents whose families participated in the 2011–2014 National Health Interview Survey. The brief Strengths and Difficulties Questionnaire and the 10-item USDA Household Food Security Survey Module were used to measure mental disorders and food security status, respectively. Multinomial logistic regressions were used to test the association between household food security status and mental disorders in youth.

**Results:** There was a significant linear trend in ORs, such that as severity of household food insecurity increased so did the odds of youth having a mental disorder ($P < 0.001$). Other selected results included the following: compared with food-secure households, youth in marginally food-secure households had higher odds of having a mental disorder with impairment [child OR: 1.26 (95% CI: 1.05, 1.52); adolescent OR: 1.33 (95% CI: 1.05, 1.68)]. In addition, compared with food-secure households, youth in very-low-food-secure households had higher odds of having a mental disorder with severe impairment [child OR: 2.55 (95% CI: 1.90, 3.43); adolescent OR: 3.44 (95% CI: 2.50, 4.75)].

**Conclusions:** The severity of household food insecurity is positively associated with mental disorders among both children and adolescents in the United States. These results suggest that improving household food security status has the potential to reduce mental disorders among US youth. *J Nutr* 2016;146:2019–26.

**Keywords:** food insecurity, mental disorder, children, adolescents, National Health Interview Survey, NHIS

## Introduction

Food insecurity is one of the most prevalent nutrition-related problems that children and adolescents (i.e., youth) experience in the United States. Household food insecurity is defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (1). Food insecurity ranges in severity. A household has low food security if its members experience food shortages and reductions in food quality attributable to a lack of household resources or access and has very low food security if its members also experience reductions in food intake and disrupted eating patterns (2). In 2014, 13.2% and 6.0% of youth in the United States lived in a household with low food security or very low food security, respectively (2). Furthermore, 12.1% of US youth lived in a household with marginal food security, which means there are reports of food insecurity but they are not severe enough to classify the household

[1] A preliminary version of this analysis was presented at Experimental Biology, Boston, MA, 28 Mar–1 Apr 2015. The abstract was published at: Burke M, Martini L, Çayır E, Hartline-Grafton H, Meade R. Low and very low food security are associated with differences in emotional and behavioral problems among children and adolescents in the US. FASEB J 2015;29:261.4 (abstr).

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as being low or very low food secure (2). Households with very low food security are of special concern because they are those in which hunger is most likely to occur among household members.

Mental disorders also are a pressing public health concern, with nearly 13–20% of youth experiencing a mental disorder in a given year (3–5). Mental disorders are described as "serious deviations from expected cognitive, social, and emotional development" (6). Youth is a critical time for mental disorders, because age of first onset is usually during this time (7). Mental disorders are a concern in part because they pose barriers to optimal academic and social development in youth (5, 8–11). Attention to mental disorders also is needed because suicide is the third leading cause of death among adolescents aged 10–14 y and the second among those aged 14–24 y (12) and is often the result of mental disorders (13). In addition, mental disorders pose substantial economic and emotional burdens on the health care system and families (14).

Food insecurity is associated with mental disorders and behavior problems in young children (15–17) and with a wide range of mental disorders in US adolescents (18). Although food insecurity is measured at the household level and reported by a caregiver, youth are aware of and react to food insecurity (19, 20). Experiencing household food insecurity is a source of stress, anxiety, and shame (21), and it is possible that those experiences contribute to or exacerbate mental disorders. Other work has shown that youth react to stressful family events, often with negative consequences to health and well-being (22).

Current research into the association between household food insecurity and mental health in youth has several limitations (15–18, 23–26). First, it is not known whether more severe food insecurity is associated with a higher incidence of mental disorders. Most research that examined the association between food insecurity and mental disorders in youth treated food-insecure households as a single, homogenous group. That is, the distinction between households with marginal, low, and very low food security was not made. Moreover, authors often combined food-secure and marginally food-secure households into 1 category and placed food-insecure with low- and very-low-food-secure households into a second category. Such a classification ignores gradients of severity and potentially masks differential associations on the basis of severity of food security status. Second, instruments used to measure food insecurity and mental disorders vary widely between studies. For example, some studies did not use the widely used and validated USDA Household Food Security Survey Module (HFSSM)[11] but instead used scales developed for their particular study or a subset of the HFSSM items. Although most studies did use validated measures of mental disorders in youth, they were often not paired with the HFSSM or were only used within a limited age range. In sum, it is currently difficult to make valid inferences to the general population of US youth related to severity of household food insecurity and mental disorders.

Household food insecurity and mental disorders are pressing nutrition- and health-related problems for youth in the United States. The US Department of Health and Human Services has called for the end of or a reduction in both food insecurity and mental disorders by 2020 (27). The purpose of this study was to investigate the association between the severity of household food insecurity and mental disorders in youth in the United States. To achieve this purpose, we used a nationally representative sample of youth, as well as reliable and valid measures of household food insecurity and mental disorders. We hypothesized that more severe household food insecurity would be associated with higher reports of mental disorders in children and adolescents.

## Methods

### Data source

Data were from the 2011–2014 National Health Interview Survey (NHIS). The NHIS is an ongoing, annual, nationwide cross-sectional survey of the civilian, noninstitutionalized US population conducted by the National Center for Health Statistics and the Census Bureau. A multistage probability-sample strategy was used to select households for inclusion in the NHIS. Data were collected in person at the homes of participants by using a computer-assisted personal interview, with telephone follow-up when necessary. All adult members of the family who were present at the time of the survey were eligible to participate in the general survey, which covered a range of health, well-being, and social topics. In families with youth, a single child or adolescent (0–17 y) was randomly selected to participate, with a knowledgeable adult reporting on behalf of the child or adolescent. In >98% of cases, this was the parent of the youth, but it could also be a grandparent, legal guardian, or other adult. More detailed information on the NHIS can be found elsewhere (28).

### Study population

NHIS interviews were completed in 2011, 2012, 2013, and 2014 with 40,496, 43,345, 42,321, and 45,597 families and with unconditional response rates of 81.3%, 76.8%, 74.9%, and 73.1%, respectively. We restricted the sample in a number of ways. First, only the randomly selected child (aged 4–11 y) or adolescent (aged 12–17 y) with a caregiver proxy was included in the analysis. These age groups are suggested for use with the Strengths and Difficulties Questionnaire (SDQ) (29). Second, youth with mental retardation (i.e., intellectual disability), developmental delays, autism, or Down syndrome were not included in the analysis. Finally, families, adults, or youth with missing information on variables of interest to this analysis were not included. These restrictions resulted in an analytical sample size of 16,918 children and 14,143 adolescents.

### Measures

*Outcome variable.* Mental disorders among children and adolescents were measured by using the 6-item SDQ. The SDQ uses 5 Likert-type items to screen for anxiety, mood, oppositional defiant disorder, attention-deficit hyperactivity disorder, and conduct disorders in the previous 6 mo. An example item is "he or she is often unhappy, depressed, or tearful," with response options of "not true," "somewhat true," and "certainly true" and which are coded 0–2, respectively. One Likert-type "impact" item assesses functional impairment. The impact item is "overall, do you think that [child] has difficulties in any of the following areas: emotions, concentration, behavior, or being able to get along with other people?" and has response options of "no," "minor," "definite," or "severe" difficulties, which are coded 0–3, respectively. The SDQ can be completed by a caregiver proxy (30). Briefly, the 5 items are scored, summed, and matched with the score on the impact item for a combined score. Then, the combined score is matched with the age of the respondent to best predict mental disorders. Detailed information on the SDQ and its scoring can be found elsewhere (29, 31, 32). On the basis of age and combined score, respondents are classified as having "no disorder," "mental disorder with impairment" (MDI), or "mental disorder with severe impairment" (MDSI). MDI indicates the presence of a disorder with at least partial or severe impairment. MDSI indicates the presence of a disorder with ≥1 severe impairments. Partial impairment "refers to a notable reduction of function," and severe impairment "refers to complete, or almost complete, inability to function in a particular area" (29). The SDQ is not able to distinguish between individual mental disorders, only whether an overall mental disorder is present. The 6-item SDQ included in the NHIS

[11] Abbreviations used: GED, General Education Development; HFSSM, Household Food Security Survey Module; MDI, mental disorder with impairment; MDSI, mental disorder with severe impairment; NHIS, National Health Interview Survey; SDQ, Strengths and Difficulties Questionnaire.

was validated in a subsample of youth who also received a clinical interview. The SDQ was shown to have moderate concordance with clinical diagnosis (AUC range: 0.72–0.79) and small to moderate bias in predicting mental disorders and can be used to accurately estimate and screen for mental disorders in youth in the NHIS (29).

*Predictor variable of interest.* Household food security was measured by using the reliable and validated USDA 10-item adult HFSSM (2). The HFSSM uses a 30-d recall period and 10 Likert-type items to assess the frequency with which adults report food insecurity because of a lack of resources; disruptions in the quality, quantity, and patterns of the household food supply; as well as anxiety related to running out of food. The items are scored and summed for a range of 0–10. Households with high food security have an HFSSM score of 0, households with marginal food security have a score of 1–2, households with low food security have a score of 3–5, and households with very low food security have a score of 6–10. Households with high food security do not indicate any food-related anxiety, shortages, or reduced quality. Households with marginal food security typically indicate anxiety over food sufficiency or a shortage of food in the house but have little or no indication of changes in diet or food intake. Households with low food security typically indicate reduced quality, variety, or desirability of the household food supply but little or no indication of reduced food intake. Households with very low food security indicate reduced quality, variety, and desirability of food intake, as well as reduced intake and disrupted eating patterns. Because child and adolescent food security was not measured directly, we report that youth live in food-secure or food-insecure households rather than that the youth themselves have food security or insecurity. A large body of research shows associations with negative health and social outcomes among children and adolescents who live in food-insecure households (33).

### Covariates

We controlled for socioeconomic and demographic variables that could confound the association between household food security and mental disorders in youth. At the youth level, we adjusted for sex (male, female) and age in years. At the caregiver-proxy level, we adjusted for age in years, sex (male, female), race and ethnicity (white, non-Hispanic; black, non-Hispanic; other, non-Hispanic; Hispanic), education [bachelor's degree or higher, high school degree, General Education Development (GED) or vocational degree, less than high school], and perceived health status (excellent or very good, good, fair, or poor). At the family level, we adjusted for family structure (2 caregivers compared with 1 caregiver) and ratio of family income to federal poverty threshold (categorical variable treated as continuous with a range of 1–14, with each category representing a threshold; thresholds ranged from <0.50 to >5). We also adjusted for year of survey (2011, 2012, 2013, or 2014).

### Statistical analysis

Analyses were conducted by using Stata software (version 14.1; StataCorp). All of the statistics incorporated survey weights provided by the NHIS at the youth level to be representative of the US civilian, noninstitutionalized youth population. We divided the weights by 4 to obtain youth-level weights for the pooled data years, as recommended in the NHIS documentation (32). Stata survey procedures were used to account for the complex survey design and weights.

Because of emotional and cognitive differences between children and adolescents, all of the analyses were stratified by age (34). Children aged 4–11 y comprised the first stratum, and adolescents aged 12–17 y comprised the second. We first used descriptive statistics (percentages or means ± SEs) to make comparisons between our outcome, predictor of interest, and covariates on the basis of food security status. We then tested these comparisons by using chi-squared tests for categorical variables or *F* tests for continuous variables. Next we used multinomial logistic regression to test the association between mental disorder and household food security status, adjusting for covariates. Multinomial models were used rather than ordinal logistic regression because *1*) the parallel odds assumption was violated and *2*) it cannot be assumed that differences in severity between food security categories are equal. For the multivariable models, we also used contrasts of marginal linear predictions to test for a dose-response association between food security status and mental disorder. Finally, predicted marginal proportions were calculated by using the results of the multinomial logistic regressions. Two-sided *t* tests were used and were considered significant at an $\alpha$ of 0.05.

## Results

Among children aged 4–11 y, 79.5% had an SDQ score indicative of no mental disorder, 15.3% had a score indicative of an MDI, and 5.2% had a score indicative of an MDSI. Weighted proportions and means of socioeconomic and demographic characteristics for children and their caregiver proxy overall and by food security status are provided in **Table 1**. The majority of caregivers were female (71%); had a high school education, GED, or vocational degree (54%); were white, non-Hispanic (58%); perceived their health to be excellent or very good (66%); and were, on average, aged 37 y. The majority of children were male (51%) and were, on average, aged 7 y. The majority of families had 2 caregivers (82%) and had an income-to–federal poverty threshold ratio of 2.00–2.50.

There were significant differences across all socioeconomic and demographic characteristics in children aged 4–11 y, as shown in Table 1. Notably, children from households with very low food security comprised 15.6% of all children with an MDSI, whereas they comprised only 4.5% of children with no disorder. Another considerable difference was a lower prevalence of children with an MDSI among caregivers who were Hispanic (2.6%) than among those who were white (66.4%), black (15.2%), and other races (15.8%). Children from households with a caregiver in fair or poor health comprised 21.8% of all children with an MDSI, whereas they comprised only 7.3% of children with no disorder. Children with no disorder were more likely to be female (51.0%), whereas children with an MDSI were more likely to be male (63.8%).

Among adolescents aged 12–17 y, 86.4% had an SDQ score indicative of no mental disorder, 7.5% had a score indicative of an MDI, and 6.0% had a score indicative of an MDSI. Weighted proportions and means of socioeconomic and demographic characteristics for adolescents and their caregiver proxy overall and by food security status are provided in **Table 2**. The majority of caregivers were female (69.4%); had a high school education, GED, or vocational degree (56.5%); were white, non-Hispanic (59.9%); perceived their health to be excellent or very good (63%); and were, on average, aged 43 y. Approximately 50% of adolescents were male and were, on average, aged 14 y. The majority of families had 2 caregivers (82%) and had an income-to–federal poverty threshold ratio of 2.00–2.50.

With the exception of adolescent age, there were significant differences across all socioeconomic and demographic characteristics. Similar to children, adolescents from households with very low food security comprised 17.2% of adolescents with an MDSI but only 4.5% of adolescents with no disorder. Another considerable difference was a lower prevalence of adolescents with an MDSI among caregivers who were Hispanic (3.7%) than among those who were white (66.5%), black (15.9%), and other races (13.8%). Adolescents from households with a caregiver in fair or poor health comprised 22.8% of adolescents with an MDSI but only 9.6% of adolescents with no disorder.

Results of the multinomial logistic regression predicting mental disorder as a function of household food security status are provided in **Table 3**. Overall, there was a significant linear trend in ORs, such that as the severity of household food insecurity increased, so did the odds of a child having an MDI ($P < 0.001$). More specifically, compared with children in food-secure households, children in households with marginal, low, or very low

**TABLE 1** Sample characteristics and child mental disorder status in the 2011–2014 NHIS for children aged 4–11 y and their caregiver proxies in the United States[1]

| | Overall ($n$ = 16,918) | No mental disorder ($n$ = 13,398) | Mental disorder with impairment ($n$ = 2647) | Mental disorder with severe impairment ($n$ = 873) | $P$ |
|---|---|---|---|---|---|
| Household food security status, % | | | | | <0.001 |
| Food secure | 75.1 | 77.8 | 66.1 | 60.0 | |
| Marginally food secure | 10.5 | 9.9 | 13.0 | 12.1 | |
| Low food secure | 8.8 | 7.8 | 12.8 | 12.4 | |
| Very low food secure | 5.6 | 4.5 | 8.1 | 15.6 | |
| Caregiver sex, % | | | | | <0.001 |
| Male | 28.7 | 30.2 | 24.6 | 17.8 | |
| Female | 71.3 | 69.8 | 75.4 | 82.3 | |
| Caregiver education, % | | | | | <0.001 |
| Bachelor degree or higher | 30.6 | 33.0 | 22.5 | 18.9 | |
| High school, GED, or vocational degree | 53.8 | 52.5 | 57.1 | 64.6 | |
| Less than high school degree | 15.5 | 14.5 | 20.4 | 16.5 | |
| Caregiver race or ethnicity, % | | | | | <0.001 |
| White, non-Hispanic | 57.5 | 56.8 | 58.1 | 66.4 | |
| Black, non-Hispanic | 13.8 | 13.7 | 13.9 | 15.2 | |
| Other, non-Hispanic | 22.6 | 23.1 | 22.1 | 15.8 | |
| Hispanic | 6.2 | 6.5 | 5.8 | 2.6 | |
| Caregiver health status, % | | | | | <0.001 |
| Excellent or very good | 66.2 | 69.2 | 57.3 | 47.8 | |
| Good | 25.0 | 23.5 | 31.1 | 30.4 | |
| Fair or poor | 8.7 | 7.3 | 11.6 | 21.8 | |
| Family structure, % | | | | | <0.001 |
| 2 caregivers | 82.4 | 83.9 | 78.1 | 72.5 | |
| 1 caregiver | 17.6 | 16.1 | 21.9 | 27.5 | |
| Child sex, % | | | | | <0.001 |
| Male | 50.8 | 49.0 | 56.2 | 63.8 | |
| Female | 49.2 | 51.0 | 43.8 | 36.2 | |
| Child age, y | 7.4 ± 0.0 | 7.4 ± 0.0 | 7.4 ± 0.1 | 8.0 ± 0.1 | <0.001 |
| Caregiver age, y | 37.5 ± 0.1 | 37.7 ± 0.1 | 37.0 ± 0.2 | 37.2 ± 0.4 | <0.01 |
| Income-to–federal poverty threshold ratio[2] | 7.8 ± 0.6 | 8.1 ± 0.1 | 7.0 ± 0.1 | 6.4 ± 0.2 | <0.001 |
| Survey year, % | | | | | <0.01 |
| 2011 | 25.8 | 26.0 | 27.3 | 26.4 | |
| 2012 | 25.3 | 24.6 | 28.4 | 26.7 | |
| 2013 | 23.9 | 24.4 | 21.2 | 24.7 | |
| 2014 | 25.0 | 25.5 | 23.0 | 22.3 | |

[1] Values are percentages or means ± SEs. Percentages may not add up to 100 due to rounding. Statistics are weighted at the child level. Chi-squared tests for categorical variables and omnibus $F$ tests for continuous variables were used. All statistics incorporated survey weights provided by the NHIS to be representative of the US civilian, noninstitutionalized child population. GED, General Education Development; NHIS, National Health Interview Survey.
[2] Categorical variable treated as continuous with a range of 1–14, with each category representing a threshold; thresholds ranged from <0.50 to >5.

food security had 1.26 (95% CI: 1.05, 1.52), 1.51 (95% CI: 1.24, 1.83), and 1.59 (95% CI: 1.27, 2.00) times the odds of an MDI, respectively. Findings for MDSI among children differed. Although there was a linear trend in odds ($P$ < 0.001), only children in households with very low food security had significantly higher odds of an MDSI than did children in food-secure households (OR: 2.55; 95% CI: 1.90, 3.43). Furthermore, the odds of an MDSI for children in households with very low food security were considerably higher than the odds of an MDI (2.55 compared with 1.59, respectively), which suggests that very low food security is a stronger predictor of MDSI than MDI.

Findings among adolescents were similar to the findings among children, although most associations were of greater magnitude in adolescents (Table 3). Overall, there was a significant linear trend in ORs, such that as severity of household food insecurity increased, so did the odds of an adolescent having an MDI ($P$ < 0.001). More specifically, compared with adolescents in food-secure households, adolescents in households with marginal, low, or very low food security had 1.33 (95% CI: 1.05, 1.68), 1.82 (95% CI: 1.43, 2.34), and 2.55 (95% CI: 1.83, 3.57) times the odds of an MDI, respectively. Similarly, but with higher magnitude, compared with adolescents in food-secure households, adolescents in households with marginal, low, or very low food security had 1.71 (95% CI: 1.26, 2.31), 1.70 (95% CI: 1.24, 2.34), and 3.44 (95% CI: 2.50, 4.75) times the odds of an MDSI, respectively. Although the ORs of MDSI for adolescents in households with marginal and low food security were similar (1.71 compared with 1.70, respectively), the OR for adolescents in households with very low food security was considerably higher (3.44).

We also calculated predicted marginal proportions of mental disorder by household food security status for children and adolescents (**Figure 1**). The predicted marginal proportion is the proportion of children or adolescents who are expected to have a disorder, adjusting for covariates in the model. For example, among children, ~14%, 17%, 19%, and 19% are expected to

**TABLE 2** Sample characteristics and adolescent mental disorder status in the 2011–2014 NHIS for adolescents aged 12–17 y and their caregiver proxies in the United States[1]

| | Overall ($n$ = 14,143) | No mental disorder ($n$ = 12,230) | Mental disorder with impairment ($n$ = 1088) | Mental disorder with severe impairment ($n$ = 825) | $P$ |
|---|---|---|---|---|---|
| Household food security status, % | | | | | <0.001 |
| Food secure | 75.5 | 78.2 | 60.7 | 55.7 | |
| Marginally food secure | 10.1 | 9.6 | 12.1 | 14.2 | |
| Low food secure | 8.6 | 7.8 | 14.4 | 12.9 | |
| Very low food secure | 5.9 | 4.5 | 12.9 | 17.2 | |
| Caregiver sex, % | | | | | <0.001 |
| Male | 30.6 | 32.2 | 21.1 | 19.9 | |
| Female | 69.4 | 67.8 | 78.9 | 80.1 | |
| Caregiver education, % | | | | | <0.001 |
| Bachelor degree or higher | 28.9 | 30.1 | 22.3 | 20.0 | |
| High school, GED, or vocational degree | 56.5 | 55.4 | 61.8 | 65.4 | |
| Less than high school degree | 14.7 | 14.6 | 15.9 | 14.6 | |
| Caregiver race or ethnicity, % | | | | | <0.001 |
| White, non-Hispanic | 59.9 | 59.1 | 63.9 | 66.5 | |
| Black, non-Hispanic | 13.8 | 13.5 | 15.2 | 15.9 | |
| Other, non-Hispanic | 20.6 | 21.4 | 17.4 | 13.8 | |
| Hispanic | 5.7 | 6.0 | 3.5 | 3.7 | |
| Caregiver health status, % | | | | | <0.001 |
| Excellent or very good | 63.0 | 65.4 | 49.3 | 46.1 | |
| Good | 25.9 | 25.0 | 32.1 | 31.1 | |
| Fair or poor | 11.1 | 9.6 | 18.6 | 22.8 | |
| Family structure, % | | | | | <0.001 |
| 2 caregivers | 81.7 | 83.0 | 74.3 | 72.4 | |
| 1 caregiver | 18.3 | 17.0 | 25.8 | 27.6 | |
| Adolescent sex, % | | | | | <0.01 |
| Male | 50.3 | 49.5 | 55.6 | 54.5 | |
| Female | 49.7 | 50.5 | 44.4 | 45.5 | |
| Adolescent age, y | 14.5 ± 0.0 | 14.5 ± 0.0 | 14.4 ± 0.1 | 14.5 ± 0.1 | 0.53 |
| Caregiver age, y | 43.4 ± 0.1 | 43.5 ± 0.1 | 42.4 ± 0.4 | 42.9 ± 0.4 | <0.01 |
| Income-to–federal poverty threshold ratio[2] | 8.4 ± 0.1 | 8.6 ± 0.1 | 7.2 ± 0.2 | 7.0 ± 0.2 | <0.001 |
| Survey year, % | | | | | |
| 2011 | 25.1 | 24.6 | 28.3 | 27.4 | 0.27 |
| 2012 | 25.5 | 25.5 | 24.0 | 26.6 | |
| 2013 | 23.8 | 24.1 | 21.8 | 21.9 | |
| 2014 | 25.7 | 25.7 | 25.9 | 24.1 | |

[1] Values are percentages or means ± SE. Percentages may not add up to 100 due to rounding. Statistics were weighted at the adolescent level. Chi-squared tests for categorical variables and omnibus $F$ tests for continuous variables were used. All statistics incorporated survey weights provided by the NHIS to be representative of the US civilian, noninstitutionalized adolescent population. GED, General Education Development; NHIS, National Health Interview Survey.
[2] Categorical variable treated as continuous with a range of 1–14, with each category representing a threshold; thresholds ranged from <0.50 to >5.

have an MDI in food-secure and marginally, low-, and very-low-food-secure households, respectively.

## Discussion

We examined the association between mental disorders and household food security status with the use of a nationally representative sample of children and adolescents in the United States. We found that the severity of food insecurity was associated with higher odds of both MDI and MDSI in children and adolescents, with the magnitude of association being the highest in households with very low food security. Other research found that 13–20% of youth experienced a mental disorder in a given year between 2005 and 2011 (3–5) and nearly 20% of youth lived in a food-insecure household in 2014 (2). Our findings suggest that these 2 highly prevalent conditions should not be considered independent and that there are heterogeneous associations with mental disorder by food security status.

Our study improves on the literature in a number of ways. First, our study used the 10-item HFFSM, which is considered one of 2 standards for measuring household food security status (with the 18-item HFSSM being the other). The 10-item HFSSM allows for standard methods of classifying households as having high, marginal, low, and very low food security, which aids in policy-relevant interpretation and makes comparisons between studies easier. The SDQ is a widely used, reliable, and valid measure of mental disorders in youth (35). The 6-item SDQ correlates well with the 25-item SDQ and was recently validated in a sample of children and adolescents (36). Second, because the NHIS includes survey data on both children and adolescents, it was possible to examine the associations stratified by age. This strengthens the literature by providing nationally representative estimates for both age groups in one study, over the same period of time, and using the same measurement instruments. Third, given the large sample size of the NHIS from 2011 to 2014, it was possible to use all of the USDA classifications of food security

**TABLE 3** Multinomial logistic regression models between mental disorders (outcome variable) and household food security status (predictor of interest) among children ($n$ = 16,918) and adolescents ($n$ = 14,413) in the United States: 2011–2014 NHIS[1]

| | Mental disorder with impairment | | Mental disorder with severe impairment | |
|---|---|---|---|---|
| | OR (95% CI) | *P* | OR (95% CI) | *P* |
| Children[2] | | | | |
| Household food security status | | | | |
| Food secure | Reference | | Reference | |
| Marginally food secure | 1.26 (1.05, 1.52) | <0.01 | 1.16 (0.88, 1.52) | 0.29 |
| Low food secure | 1.51 (1.24, 1.83) | <0.001 | 1.36 (0.99, 1.77) | 0.06 |
| Very low food secure | 1.59 (1.27, 2.00) | <0.001 | 2.55 (1.90, 3.43) | <0.001 |
| Test of marginal linear trend | N/A | <0.001 | N/A | <0.001 |
| Adolescents[3] | | | | |
| Household food security status | | | | |
| Food secure | Reference | | Reference | |
| Marginal food secure | 1.33 (1.05, 1.68) | <0.05 | 1.71 (1.26, 2.31) | <0.01 |
| Low food secure | 1.82 (1.43, 2.34) | <0.001 | 1.70 (1.24, 2.34) | <0.01 |
| Very low food secure | 2.55 (1.83, 3.57) | <0.001 | 3.44 (2.50, 4.75) | <0.001 |
| Test of marginal linear trend | N/A | <0.001 | N/A | <0.001 |

[1] Estimates are adjusted ORs (95% CIs) derived from multinomial logistic regressions. All statistics incorporated survey weights provided by the NHIS to be representative of the US civilian, noninstitutionalized child or adolescent population. N/A, not applicable; NHIS, National Health Interview Survey.
[2] Multinomial logistic regression among children (aged 4–11 y). Estimates were adjusted for child sex and age; caregiver sex, age, race or ethnicity, education, and perceived health status; family structure; family income as a ratio of the federal poverty threshold; and survey year. ''No mental disorder'' is the reference group for the outcome variable.
[3] Multinomial logistic regression among adolescents (aged 12–17 y). Estimates were adjusted for adolescent sex and age; caregiver sex, age, race or ethnicity, education, and perceived health status; family structure; family income as a ratio of the federal poverty threshold; and survey year. ''No mental disorder'' is the reference group for the outcome variable.

and make more precise estimates. This is in contrast to other work in the area that has combined food security categories (33).

Among children, there was a significant linear trend in ORs, such that as severity of household food insecurity increased so did the odds of a child having an MDI or an MDSI. Furthermore, children in households with very low food security had the highest probability of an MDSI. Households with very low food security are markedly more deprived than other food-insecure households and it is within these households that hunger is most likely to exist. Children in these households, at best, are exposed to reduced dietary quality, variety, quantity, and frequency among adult household members and, at worst, might experience some of these reductions themselves. It is possible that such experiences are sufficient to result in mental disorders with severe impairment or exacerbate existing disorders. We did not find that marginal or low food security was independently associated with MDSI in children. Mental disorders with severe impairment are serious conditions, and it may be that mild to moderate disruptions in the household food supply do not elicit a change in mental disorder status for children. With regard to MDI, we found that even with low levels of food insecurity (i.e., marginal food security), the odds of an MDI increased relative to no disorder. This is in line with a large body of research that shows that experiencing any food insecurity is associated with negative health and well-being outcomes in youth (33); our study suggests that this is true for mental disorders as well. Future work should explore possible causal mechanisms between household food insecurity and mental disorders in children.

Similar to children, there was a significant linear trend in ORs among adolescents, such that as severity of household food insecurity increased so did the odds of an adolescent having an MDI or an MDSI, although there are important distinctions between the findings in children and adolescents. First, the magnitudes of association between both MDI and MDSI and food security status were greater among adolescents than among children. It is generally assumed that younger children are more protected against food insecurity (2), and it is plausible that this protection could help reduce the risk of mental disorder in

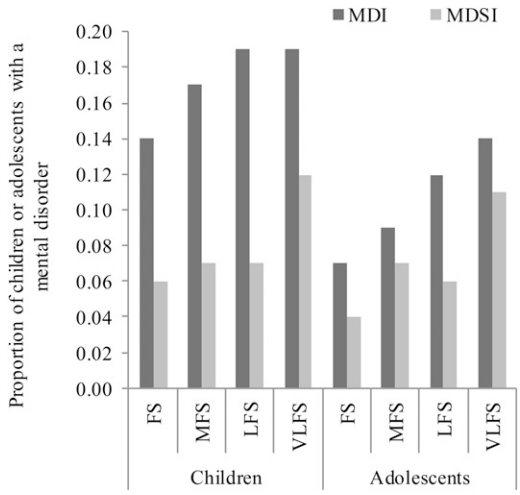


**FIGURE 1** Predicted proportion of children (aged 4–11 y; $n$ = 16,918) and adolescents (aged 12–17 y; $n$ = 14,143) who have a mental disorder by household food security status (2011–2014 National Health Interview Survey). Proportions were adjusted for child or adolescent sex and age; caregiver sex, age, race or ethnicity, education, and perceived health status; family structure; family income as a ratio of the federal poverty threshold; and survey year. FS, food secure; LFS, low food secure; MDI, mental disorder with impairment; MDSI, mental disorder with severe impairment; MFS, marginally food secure; VLFS, very low food secure.

children compared with adolescents. Second, even low levels of food insecurity were associated with an MDSI relative to no disorder in adolescents, although there was not a meaningful difference in the odds between marginal and low food security. It is plausible that negative coping mechanisms in response to marginal and low food security are similar and equally increase the likelihood of MDSI in adolescents. The strongest associations were seen among adolescents in households with very low food security. The adjusted proportion of adolescents in households with very low food security estimated to have an MDSI is 11% compared with 4% in food-secure households. Similar to children, adolescents in households with very low food security are exposed to the most severe range of food insecurity experiences, and it is plausible that they are more aware of and less protected from these experiences, leading to a greater likelihood of MDSI. Future work should explore possible causal mechanisms between household food insecurity and mental disorders in adolescents, especially how they are similar or different from causal mechanisms that might exist in children.

Our study has several notable limitations. First, endogeneity is a concern. It is possible that there are unobserved variables that cause changes in both food security and mental disorder. For example, exposure to violence is associated with food insecurity (37, 38) and mental disorder in youth (39) but is not measured in the NHIS. Previous work has addressed endogenous selection into food security status when estimating the associations between food security and health outcomes in children (40). This work identified a significant impact between food security status, health, and weight status but did not examine mental disorders. Future work should address endogenous selection into food insecurity status when examining the association between mental disorders in children and household food security status. Second, although plausible causal pathways exist between food insecurity and mental disorders in youth, we were not able to estimate causal effects directly, and therefore our results should be viewed as reporting associations only. Third, our models assume that food insecurity predicts mental disorder and not that mental disorder predicts food insecurity. Much research that examined mental disorders and food insecurity also made this assumption, but there is some work that suggests that chronic illnesses and mental disorders could affect food insecurity (41, 42). For example, it is possible that mental disorders with moderate to large medical out-of-pocket expenses create economic distress and thus food insecurity. It is also possible that a mental disorder in a caregiver makes it less likely for a household to receive nutrition assistance because of difficulty navigating the assistance procurement process (43) or a mental disorder in youth makes it less likely for a caregiver to obtain or retain employment due to caregiving responsibilities. It is also possible that food insecurity initially causes or worsens a mental disorder and this, in turn, worsens or extends a food insecurity spell (or vice versa). Issues related to causality or temporality between food insecurity and mental disorders in youth remain important questions for the field that could be addressed by using longitudinal data sets or other types of statistical models. There are also some limitations related to our measures. The 10-item HFSSM does not measure child food security status nor does it measure food security from youth directly. Our measure of mental disorders is only meant to screen for mental disorders and does not necessarily reflect the existence of a disorder. Although the SDQ is efficient and appropriate for population-level studies such as ours, future work would benefit from including youth who have received a clinical diagnosis. Finally, our measure of food security was for the past 30 d, whereas our measure of mental disorders was for the past 6 mo; therefore, it is possible that the 2 conditions did not overlap. For many households, however, food insecurity occurs more than once in the past year (2), so it is likely that in many food-insecure households, these 2 conditions did in fact overlap. Ideally, our measure would cover the same time frame, and future studies should consider this point.


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