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Adult Food Security and Depressive Symptoms in NHANES 2021-2023

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Abstract. This analysis evaluated whether the degree of food security among U.S. adults corresponded to depressive symptom severity and the probability of a positive depression screen in the August 2021-August 2023 National Health and Nutrition Examination Survey (NHANES). The descriptive sample included 4,884 participants aged 20 years or older, and all survey-weighted models were fitted in 4,578 participants with complete exposure, outcome, and covariate information. The Patient Health Questionnaire-9 (PHQ-9) was treated both as a 0-27 score and as an indicator defined by a score of at least 10. The fully adjusted specification included family income-to-poverty ratio, educational attainment, marital or cohabitation status, age, sex, and race and ethnicity. Survey-weighted positive-screen prevalence ranged from 8.1% in the fully food-secure group to 37.5% in the very-low-security group. Covariate-standardized mean scores for the four categories were 3.44, 4.33, 5.27, and 7.45. Relative to full security, very low security corresponded to an adjusted mean difference of 4.01 points (95% confidence interval [CI], 3.09 to 4.94), an odds ratio of 4.34 (95% CI, 2.87 to 6.57), and a standardized prevalence difference of 19.9 percentage points (95% CI, 12.1 to 27.7). Global design-based Wald tests yielded $p < 0.001$ for both endpoints. Square-root and logarithmic transformations of the score led to the same substantive conclusion. By combining score-based and threshold-based analyses with standardized absolute contrasts, this study updates earlier NHANES evidence on food security and depression.

Keywords: Food insecurity, Depressive symptoms, PHQ-9, NHANES, Survey-weighted regression

1. Introduction

Food security concerns whether households can reliably obtain enough food of adequate quality to support health and daily activity [1]. The U.S. Department of Agriculture estimated that 13.5% of U.S. households encountered food insecurity during 2023 [2]. The burden was not uniform: rates were higher in lower-income households and in non-Hispanic Black and Hispanic households [2]. Limited income is central, but disruptions such as job loss, medical or housing bills, and other unplanned costs can also constrain food purchases. When resources are scarce, adults may substitute cheaper, nutritionally poorer foods or postpone care; prior National Health and Nutrition

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Examination Survey (NHANES) research has also linked food insecurity with chronic disease [3]. These consequences make household food access a relevant public health exposure.

Depressive illness accounts for substantial disability internationally [4]. Epidemiologic surveys often quantify recent symptoms with the nine-item Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 is validated and produces a summary score from 0 to 27 [5]; values of 10 or more are commonly interpreted as a positive screen rather than a diagnosis. Several mechanisms could connect food insecurity with depression. Difficulty affording food may produce sustained worry, and constraints on food choice may reduce diet quality. The reverse direction is also plausible because depressive symptoms can disrupt work, budgeting, shopping, or meal preparation. Socioeconomic characteristics, particularly income, may influence both conditions and must therefore be addressed in the analysis.

Existing research generally reports worse mental health among people with insecure food access. Leung et al. observed a higher prevalence of depressive symptoms among low-income U.S. adults with food insecurity even after accounting for sociodemographic differences [6]. During the COVID-19 period, food hardship was likewise related to depression, anxiety, and perceived stress [7, 8]. In an analysis of 28,448 NHANES participants aged at least 20 years from 2005 through 2016, Reeder et al. estimated adjusted depression odds ratios of 1.60, 1.88, and 3.50 for marginal, low, and very low security, respectively, using full security as the referent [9]. Thus, greater food hardship corresponded to progressively greater odds. Another NHANES study associated food insecurity with having seen a mental-health professional during the previous year, showing that clinical mental-health services may be one point at which food needs can be recognized [10].

The Reeder et al. study treated depression as a dichotomous PHQ-9 measure and covered data through 2016 [9]. The August 2021-August 2023 NHANES release permits an updated assessment and supports two complementary outcome formulations. Using the full PHQ-9 score preserves information on symptom severity below and above a fixed cutoff. For the threshold outcome, standardized probabilities and prevalence differences describe absolute burden and are easier to compare directly than odds ratios alone. This cycle supplies an adult food-security classification from the established questionnaire [11, 12], the depression-screener responses needed to construct PHQ-9 outcomes [13], and the weights and design variables required for population inference [14, 15].

Accordingly, the analysis assessed whether adult food-security category was related to depressive symptoms among U.S. residents aged 20 years or older in the August 2021-August 2023 NHANES cycle. Outcomes were the total PHQ-9 score and a positive screen defined as a score of at least 10. Before analysis, a graded pattern was expected, with the three lower-food-security categories showing successively higher symptom scores and screening probabilities than the fully secure category, including after control for family income-to-poverty ratio (PIR), education, marital or cohabitation status, age, sex, and race and ethnicity.

2. Materials and methods

2.1. Study population

NHANES uses a cross-sectional, nationally representative design to describe health and nutrition in the U.S. civilian population living outside institutions. Participants are chosen with a stratified multistage probability sample. Information is collected through interviews in the home and standardized examinations in mobile centers [14, 15].

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The August 2021-August 2023 Demographics file (DEMO_L) served as the starting data set. Using SEQN, adult exposure data from FSQ_L and depression items from DPQ_L were merged. The resulting data set held 11,933 participant records. Sequential eligibility criteria retained 7,809 adults aged 20 years or older, 5,210 with all information needed for a valid PHQ-9 total, and 4,884 with an adult food-security category. Complete information on adjustment variables was available for 4,578 participants, who formed the regression sample. The underlying survey operated under ethical review by the National Center for Health Statistics, and NHANES obtained consent from its participants.

Descriptive estimates were based on all 4,884 participants with valid exposure and PHQ-9 information; each primary model used the identical 4,578-person complete-case subset (Figure 1). The 2,599 participants excluded before PHQ-9 eligibility comprised 1,745 without mobile examination center participation or a positive examination weight, 791 missing every PHQ-9 item, and 63 with an incomplete set of item responses. Covariate missingness then removed 306 members of the descriptive sample: 300 without PIR, two without education, and four without marital status. Consequently, the modeling sample represented 93.7% of descriptive participants and 93.6% of their weighted population total. PHQ-9 was not scored when any of its nine responses was unavailable, and incomplete covariate records were not used in regression. Implications of these exclusions are addressed later.

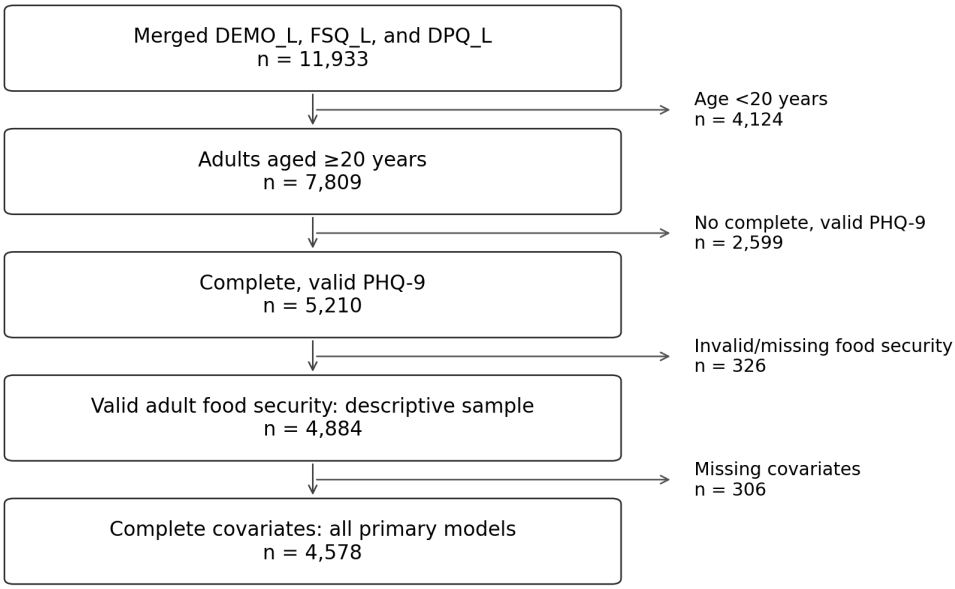


Figure 1. Derivation of the analysis samples (picture credit: original)

2.2. Food security

Exposure was defined from the 10 adult/basic questions of the federal household food-security instrument [11, 12]. During the household interview, a designated adult respondent reported food-access conditions and related experiences for the household and its adult members. Unlike earlier cycles, the August 2021-August 2023 questionnaire did not administer the eight child-focused items. NHANES nevertheless continued to publish the adult category derived from the retained 10 questions [12].

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FSDAD, the NHANES-derived adult measure, groups households according to the number of affirmative answers on those 10 questions [12]. A count of zero defines full security. One or two affirmative responses define marginal security, three to five define low security, and six to ten define very low security. The same household classification appears on the record of each participating member. In the regression models, FSDAD was entered as a four-level factor with full security as the referent. This parameterization estimates a separate contrast for every lower-security category and does not assume equally spaced or linear effects.

2.3. Depression

Recent depressive symptoms were recorded with the PHQ-9. Respondents indicated how often each of nine symptoms had occurred during the prior 14 days [5, 13]. The four response choices were coded 0, 1, 2, or 3, so a complete nine-item sum could vary from 0 to 27.

The total score was first retained to represent symptom severity on its original scale. A binary endpoint was then created by assigning scores of 10 or more to a positive-screen category and lower scores to a negative-screen category. This cutoff supports screening comparisons but does not establish a clinical diagnosis.

2.4. Covariates

Adjustment variables were identified before inspection of outcome results by selecting characteristics that could be related to both food access and depressive symptoms. The fully adjusted model contained age, sex, race and ethnicity, schooling, marital or cohabitation status, and family PIR.

Age entered the model in decades after subtracting 50 years. Male served as the reference for the female/male variable. The race and ethnicity factor comprised non-Hispanic White (reference), non-Hispanic Black, Hispanic, and a combined Other/Multiracial/Asian group. Educational attainment was grouped as below high school, high school or General Educational Development (GED) credential, and at least some college; the last group was the referent. Marital status contrasted participants who were married or cohabiting with everyone else. PIR was centered at 2.5, and its association was estimated per one-unit difference.

2.5. Statistical analysis

Every estimate used the mobile examination center weight WTMEC2YR together with the masked stratum code SDMVSTRA and primary sampling unit code SDMVPSU. This design was specified on the full eligible data before analysis subpopulations were defined. Taylor linearization supplied variance estimates, and the stratum-by-cluster structure left 15 design degrees of freedom.

Participant counts are reported without weights; summaries intended to represent the U.S. population use survey weights. To test heterogeneity across food-security levels in Table 1, survey-weighted linear models were fitted for continuous characteristics and design-adjusted Wald F statistics were used; categorical characteristics were compared with Rao-Scott F-adjusted chi-square procedures. Each endpoint was analyzed twice on the same 4,578 complete cases. The first specification contained only the four-level exposure, whereas the second also included all prespecified demographic and socioeconomic covariates.

For the score endpoint, a survey-weighted Gaussian generalized linear model with an identity link was fitted; exposure coefficients are interpreted as point differences from the fully secure group.

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For the score-at-least-10 endpoint, a quasibinomial logit model was used, and exponentiating coefficients yielded odds ratios. A joint design-based Wald F test of the three nonreference exposure terms provided the overall test of food-security status in each model.

Predictive margins averaged model-based outcomes over the weighted covariate distribution. These margins yielded covariate-standardized PHQ-9 means and positive-screen prevalences. Continuous contrasts were summarized as differences in adjusted means, and the binary endpoint was summarized with both odds ratios and prevalence differences expressed in percentage points, always relative to full security. Robustness of the adjusted score analysis was examined by refitting it after applying the square-root transformation, sqrt(PHQ-9), and the logarithmic transformation, log(PHQ-9 + 1).

Several in-sample indices were also calculated as descriptive checks rather than primary inferential results. Gaussian-model summaries comprised mean absolute error (MAE), root mean squared error (RMSE), and weighted R-squared. For the logit models, log loss, Brier score, and the weighted area under the receiver operating characteristic curve (AUC) were recorded. Residuals plotted against fitted scores were used to decide whether transformed-outcome checks were warranted. All indices came from the same observations used to estimate their models. Computation used R 4.4.3 and survey 4.5. Statistical tests were two-sided and used a 0.05 significance level.

3. Results

3.1. Study sample and participant characteristics

Descriptive estimates included 4,884 adults. Weighted shares across full, marginal, low, and very low security were 71.5%, 11.3%, 9.5%, and 7.7%. Table 1 shows evidence of differences across the four groups in all listed characteristics and both depression measures. The weakest evidence concerned sex (overall p = 0.038); for age, race and ethnicity, education, PIR, marital or cohabitation status, mean PHQ-9, and positive-screen prevalence, each overall p-value was below 0.001.

As food security worsened, the sample profile shifted toward younger age and greater socioeconomic disadvantage. The weighted mean age was 50.6 years in the full-security group and 43.0 years in the very-low-security group. Across the same endpoints, the share with some college or more fell from 75.1% to 43.8%, average PIR from 3.61 to 1.52, and the married or cohabiting share from 65.9% to 35.7%. Depression measures showed a similar ordering in the opposite direction: mean PHQ-9 was 3.24 versus 8.09, and the proportion scoring at least 10 was 8.1% versus 37.5%. Regression estimates exclude 306 descriptive-sample participants with incomplete adjustment variables, leaving n = 4,578 (Table 1).

Table 1. Survey-weighted characteristics by adult food-security category in NHANES August 2021-August 2023 (descriptive sample, n = 4,884)

Characteristic	Full food security(n = 3,459)	SE	Marginal food security(n = 534)	SE	Low food security(n = 486)	SE	Very low food security(n = 405)	SE	p
Age, y	50.6	0.7	45.9	1.4	45.6	1.1	43.0	0.9	<0.001
Sex									0.038
Male	50.4	1.1	47.6	2.1	46.2	2.2	39.7	3.5	
Female	49.6	1.1	52.4	2.1	53.8	2.2	60.3	3.5	

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Table 1. (continued)

Race/ethnicity									<0.001
Non-Hispanic White	70.6	1.6	44.5	4.4	43.3	3.6	48.0	3.5	
Non-Hispanic Black	7.7	0.9	15.6	3.3	16.2	3.1	18.5	3.9	
Hispanic	11.2	2.3	28.7	5.2	27.6	4.7	20.2	3.1	
Other/Multiracial/Asian	10.5	0.8	11.2	1.9	12.9	1.9	13.3	1.9	
Education									<0.001
Less than high school	4.0	0.5	18.8	1.9	20.1	2.8	18.6	2.6	
High school/GED	20.9	2.0	36.3	3.0	39.0	2.4	37.7	3.9	
Some college or above	75.1	2.3	44.8	2.8	40.9	2.9	43.8	3.9	
Family income-to-poverty ratio	3.61	0.09	2.10	0.10	1.78	0.09	1.52	0.08	<0.001
Marital/partner status									<0.001
Married/Living with partner	65.9	1.3	50.4	3.0	48.1	2.2	35.7	4.0	
Not married/not living with partner	34.1	1.3	49.6	3.0	51.9	2.2	64.3	4.0	
PHQ-9 score, mean	3.24	0.09	4.48	0.32	5.60	0.32	8.09	0.39	<0.001
Positive depression screen									<0.001
PHQ-9 score ≥10	8.1	0.6	14.1	2.7	21.4	2.1	37.5	3.8	

Entries for age, PIR, and PHQ-9 are weighted means; categorical entries are weighted percentages. SE means standard error, and sample counts in headers are unweighted. Estimates for education, marital or cohabitation status, and PIR use available records within the descriptive sample. The final column gives a four-group omnibus comparison. Design-based Wald F statistics were used for continuous measures and Rao-Scott F-adjusted chi-square statistics for categorical measures.

3.2. Food security and continuous PHQ-9 scores

Continuous scores increased stepwise as food security declined (Table 2). Before covariate adjustment, the marginal-, low-, and very-low-security groups averaged 1.37, 2.37, and 4.86 PHQ-9 points above the full-security group. The corresponding survey-weighted group means in the common regression sample were 3.27, 4.63, 5.64, and 8.13.

Adjustment reduced these contrasts but left their ordering intact. Relative to full security, Model 2 estimated differences of 0.89 points for marginal security (95% confidence interval [CI], 0.20 to 1.59; $p = 0.016$), 1.83 for low security (95% CI, 0.95 to 2.72; $p < 0.001$), and 4.01 for very low security (95% CI, 3.09 to 4.94; $p < 0.001$). Averaging predictions over the covariate distribution gave adjusted means of 3.44, 4.33, 5.27, and 7.45 from full through very low security. The three exposure coefficients were jointly different from zero (Wald $F(3,15) = 33.92$; $p < 0.001$).

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Table 2. PHQ-9 mean-score contrasts and standardized means across food-security categories (regression sample, n = 4,578)

Food security	Model 1, β (95% CI)	Model 2, β (95% CI)	Model 2 adjusted mean (95% CI)	Model 2 p
Full	Reference	Reference	3.44 (3.21–3.66)	—
Marginal	1.37 (0.65–2.08)	0.89 (0.20–1.59)	4.33 (3.59–5.07)	0.016
Low	2.37 (1.59–3.14)	1.83 (0.95–2.72)	5.27 (4.49–6.04)	<0.001
Very low	4.86 (4.07–5.66)	4.01 (3.09–4.94)	7.45 (6.58–8.32)	<0.001

Beta is the expected PHQ-9 point difference from the full-security referent. Model 1 contains only the exposure apart from the complex survey design. Model 2 adds PIR, education, marital or cohabitation status, age, sex, and race and ethnicity. Adjusted means were obtained by averaging model predictions over the weighted covariate distribution. CI indicates confidence interval.

3.3. Food security and positive depression screens

Positive-screen odds rose as food security declined (Table 3). With no covariate adjustment, the odds ratio was 6.78 for very low security, 3.03 for low security, and 2.08 for marginal security, each relative to the full-security group. In ascending severity, the Model 2 values were 1.58 (95% CI, 0.95 to 2.65; $p = 0.077$), 2.22 (95% CI, 1.59 to 3.11; $p < 0.001$), and 4.34 (95% CI, 2.87 to 6.57; $p < 0.001$). The omnibus adjusted test was significant (Wald $F(3,15) = 19.69$; $p < 0.001$). Unlike the two more severe categories, the marginal contrast had a confidence interval that included the null.

After standardization, predicted positive-screen prevalence was 9.0% under full security, followed by 13.4%, 17.6%, and 28.9% under marginal, low, and very low security. Subtracting the full-security estimate gave absolute differences of 4.4 percentage points (95% CI, -1.2 to 10.0), 8.7 percentage points (95% CI, 4.5 to 12.9), and 19.9 percentage points (95% CI, 12.1 to 27.7), respectively. Thus, the largest category contrast amounted to about 20 additional positive screens per 100 adults on the standardized scale.

Table 3. Odds ratios, standardized prevalences, and prevalence differences for PHQ-9 scores of at least 10 by food-security category (n = 4,578)

Food security	Model 1, OR (95% CI)	Model 2, OR (95% CI)	Standardized prevalence, % (95% CI)	Prevalence difference, pp (95% CI)	Model 2 p
Full	Reference	Reference	9.0 (7.7–10.3)	Reference	—
Marginal	2.08 (1.25–3.46)	1.58 (0.95–2.65)	13.4 (7.9–18.8)	4.4 (-1.2–10.0)	0.077
Low	3.03 (2.15–4.28)	2.22 (1.59–3.11)	17.6 (13.8–21.4)	8.7 (4.5–12.9)	<0.001
Very low	6.78 (4.85–9.48)	4.34 (2.87–6.57)	28.9 (21.2–36.6)	19.9 (12.1–27.7)	<0.001

CI denotes confidence interval, OR denotes odds ratio, and pp denotes percentage points. All contrasts use full security as the referent. Model 1 is exposure-only apart from the complex survey design; Model 2 includes PIR, education, marital or cohabitation status, age, sex, and race and ethnicity. Standardized prevalence and its absolute contrasts were obtained by averaging predictions over the weighted covariate distribution.

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3.4. Sensitivity analyses and model assessment

Transforming PHQ-9 did not alter the substantive result for the continuous endpoint. Under Model 2, coefficients for each of the three lower-security categories remained above zero for both the square-root and log(PHQ-9 + 1) specifications, and their ordering matched the original-score model (Table 4). The omnibus statistics were $F = 33.92$ on the raw scale, $F = 75.32$ after square-root transformation, and $F = 88.38$ after logarithmic transformation; all had $p < 0.001$. Evidence for a graded association therefore did not depend on the chosen scale.

Adjustment produced modest gains in the descriptive fit measures. In continuous-score models, MAE fell from 3.275 to 3.166 and RMSE from 4.378 to 4.276, while weighted R-squared rose from 0.095 to 0.137. For the positive-screen models, log loss declined from 0.3495 to 0.3387 and the Brier score from 0.1018 to 0.0996; weighted AUC increased from 0.660 to 0.724. Residual plots displayed horizontal bands because PHQ-9 is an integer score bounded below by zero, together with increasing right-side dispersion; these features prompted the transformed-score analyses. Because every metric was computed in the estimation sample, these indices are used only to describe fit and discrimination, not to replace the population-association results.

Table 4. Adjusted food-security coefficients after alternative transformations of PHQ-9 (n = 4,578)

Food security	Original PHQ-9, β (95% CI)	Sqrt (PHQ-9), β (95% CI)	Log (PHQ-9 + 1), β (95% CI)
Marginal	0.89 (0.20–1.59)	0.25 (0.06–0.44)	0.18 (0.04–0.32)
Low	1.83 (0.95–2.72)	0.48 (0.25–0.71)	0.36 (0.19–0.53)
Very low	4.01 (3.09–4.94)	0.96 (0.78–1.13)	0.69 (0.57–0.81)
Overall Wald F	33.92	75.32	88.38
p	<0.001	<0.001	<0.001

Full security is the reference in every column, and all models use the Model 2 adjustment set. Because coefficients belong to different scales, comparison should focus on sign, ordering, confidence intervals, and omnibus evidence rather than coefficient magnitude.

4. Discussion

The survey-weighted findings show that lower food security coincided with a less advantaged socioeconomic profile: participants were younger, had lower education and PIR values, and were less often married or cohabiting. Both depression measures also increased sharply across categories. At the descriptive extremes, mean PHQ-9 was 3.24 under full security and 8.09 under very low security, and positive-screen prevalence was 8.1% and 37.5%. Adjustment narrowed but did not erase this ordering. Very low security remained associated with a 4.01-point adjusted score difference, an odds ratio of 4.34 for a score of at least 10, and a standardized prevalence difference of 19.9 percentage points. The greatest symptom burden therefore appeared among adults reporting the most severe food hardship.

The estimates can be compared cautiously with Reeder et al.'s NHANES 2005-2016 results [9]. That study reported fully adjusted odds ratios of 1.60, 1.88, and 3.50 across marginal, low, and very low security; the corresponding estimates in the present analysis were 1.58, 2.22, and 4.34. Both analyses show the same order, consistent also with findings from low-income samples and data collected during the pandemic [6-8]. Exact values need not agree because the survey periods, sample sizes, coding decisions, and covariate sets differ. Reeder et al. included smoking and body mass

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index (BMI) and classified several variables differently. In addition, the 2021-2023 food-security questionnaire removed eight child items used in prior cycles, although FSDAD continued to rely on the 10 adult/basic questions [12]. The present analysis adds information beyond an updated odds ratio by examining the entire PHQ-9 scale and reporting standardized prevalences and prevalence differences for the binary screen.

The group differences also show why income adjustment does not make food security redundant. Lower-security categories had lower PIR and educational attainment and fewer married or cohabiting adults; women also constituted a larger proportion of the very-low-security group than of the full-security group. Similar clustering of social conditions has been documented previously [6-9], and controlling for these factors reduced the exposure coefficients. PIR locates family income relative to the federal poverty threshold. By contrast, the food-security module records concrete experiences of uncertain access, compromised food quality, and reduced intake. The two variables overlap conceptually but represent different aspects of material hardship.

Keeping PHQ-9 in its continuous form revealed shifts that a cutoff can obscure. For marginal food security, Model 2 estimated a 0.89-point mean increase, whereas the odds ratio for crossing the threshold of 10 was 1.58 and comparatively imprecise. Dichotomization discards distinctions among scores on the same side of the cutoff; the original scale retains those smaller movements in symptom severity. Low and very low security were clearly elevated using either definition, and category ordering did not change. Reporting both endpoints therefore distinguishes differences in average burden from differences in the proportion above a clinically useful screening threshold.

The transformed models address the nonnormal features seen in PHQ-9. Despite a zero boundary and right skew, square-root and logarithmic specifications produced positive, ordered food-security coefficients, and each omnibus test had $p < 0.001$. This agreement indicates that the observed gradient was not an artifact of modeling raw scores alone. The added covariates also raised weighted R-squared from 0.095 to 0.137 and weighted AUC from 0.660 to 0.724. These are in-sample summaries and should not be interpreted as external predictive performance; they simply show that the adjustment variables explained additional variation and improved within-sample discrimination.

The population overlap suggests a role for coordinated screening and referral across services. Clinicians treating mental-health concerns could ask whether patients have difficulty obtaining food, while food assistance, community, and nutrition programs could establish routes for further assessment when marked depressive symptoms are recognized. This proposal is consistent with earlier NHANES evidence that food-insecure adults more often reported contact with a mental-health professional [10]. Screening efforts should not focus exclusively on the most severe category: very low security carried the largest burden, but the continuous analysis also identified higher average symptoms at the marginal level.

Several limitations define what can be concluded. Because NHANES is cross-sectional, the analysis cannot establish whether food hardship precedes depressive symptoms, follows them, or participates in a reciprocal process. Timing also differs: FSDAD summarizes the previous 12 months, whereas PHQ-9 covers 14 days [12, 13]. Both variables are self-reported, and FSDAD describes adult conditions at the household level rather than an individual's actual dietary intake. Although models included major demographic and socioeconomic covariates, residual confounding may remain from health conditions, medications, disability, social support, or short-term financial shocks. Complete-case modeling further selected 4,578 participants after exclusions for examination eligibility or weight, PHQ-9 responses, FSDAD, and covariates. Results also pertain to one recent survey cycle. Longitudinal research is needed for temporal direction, while harmonized multi-cycle

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and missing-data analyses could test whether the estimates persist under other sampling periods and assumptions.

5. Conclusion

Analysis of the August 2021-August 2023 NHANES cycle showed a graded relationship between adult food security and depressive symptoms after measured demographic and socioeconomic factors were taken into account. Compared with full security, very low security corresponded to roughly four additional PHQ-9 points and a 19.9-percentage-point increase in standardized positive-screen prevalence. The same ordering was observed across the original PHQ-9 score, the score-at-least-10 indicator, and the square-root and logarithmic sensitivity analyses. The continuous endpoint also detected a difference for marginal security, for which the binary estimate was less precise, illustrating that symptom severity and threshold-based screening capture related but distinct aspects of mental-health burden.

These findings indicate that food-security categories contain information relevant to depressive symptom burden even after adjustment for family income-to-poverty ratio, education, marital or cohabitation status, age, sex, and race and ethnicity. The results also support reporting both relative and absolute contrasts: odds ratios describe the strength of association with a positive screen, whereas standardized prevalence differences quantify the corresponding population burden. From a service-planning perspective, food hardship may therefore be a useful consideration when designing pathways for depression screening, referral, and coordination with food-assistance or community programs.

Interpretation should remain cautious because the cross-sectional design does not establish temporal direction or causality, food security and PHQ-9 refer to different recall periods, and both measures rely on self-report. Complete-case analysis and residual confounding may also affect the estimates, and the findings represent one recent NHANES cycle. Future studies using repeated observations, harmonized multi-cycle data, and explicit missing-data analyses could assess temporal ordering and the stability of these associations. Evaluation of coordinated food-support and mental-health services would further clarify whether identifying food hardship can improve screening, referral, or subsequent care.

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