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Associations between food security status and suicidal ideation: a comprehensive analysis of NHANES 2007-2016

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Abstract

Suicidal ideation not only indicates severe psychological distress but also significantly raises the risk of suicide, whereas food insecurity may further increase this risk. To examine the relationship between food insecurity and suicidal ideation, we used the NHANES (National Health and Nutrition Examination Survey) data from 2007 to 2016. The association between the risk of suicidal ideation and food security status was examined using multivariate logistic regression models. To ensure the robustness of our findings, we also conducted subgroup and sensitivity analyses, which were crucial for assessing the consistency and precision of the research findings. This study included 22,098 participants, of whom 50.30% were female and 49.70% were male. In the comprehensive analysis of the population, after full adjustment, the odds ratios were 1.14 (95% CI: 0.89, 1.46) for marginal food security, 1.40 (95% CI: 1.12, 1.76) for low food security, and 1.59 (95% CI: 1.27, 1.99) for very low food security. In the subgroup analysis, we identified a significant interaction between depression and food security (P = 0.004). Additionally, the results of the sensitivity analysis were consistent with previous findings. Our study revealed that food insecurity significantly increased the risk of suicidal ideation, emphasizing the importance of addressing food security to improve mental health. These findings support the need for national food assistance programs integrated with mental health services. More longitudinal studies are needed to validate the long-term impact of food insecurity on suicidal ideation to optimize intervention measures and policy adjustments.

Keywords: Food insecurity, Suicidal ideation, NHANES, Cross-sectional study, Suicide prevention

1 Introduction

Suicide is a significant global public health issue, responsible for approximately 800000 deaths annually and having a profound impact on individuals, families, and society. Suicidal ideation, characterized by persistent thoughts or plans regarding suicide, acts as a warning signal for potential suicidal behavior [(1)]. Global studies have suggested that the lifetime prevalence of suicidal ideation exhibits considerable variability across countries and regions, typically ranging from 3% to 9% [(2)]. Suicidal ideation is not merely a manifestation of psychological distress but also serves as a robust predictor of future suicide attempts and behavior. Research has demonstrated that individuals who experience suicidal ideation are more likely to engage in suicidal behavior than those without such thoughts [(3)]. Additionally, early identification and targeted intervention for suicidal ideation are critical to preventing suicidal behavior, necessitating comprehensive mental health services, robust social support, and effective psychotherapies, such as cognitive-behavioral therapy and dialectical behavior therapy [(4)]. Social and economic factors, including food security, can also potentially impact suicidal ideation [(5)].

Access to enough safe, nourishing food that satisfies dietary requirements and preferences for an active and healthy life at all times is a prerequisite for food security [(6)]. However, food security remains a significant global issue, particularly in low- and middle-income countries. In 2019, approximately 690 million people were afflicted with hunger, and nearly 2.49 billion lacked regular access to safe, nutritious, and sufficient food [(7)]. Although absolute hunger is uncommon in developed countries, food insecurity persists among low-income households. Food insecurity contributes to malnutrition, an increased risk of chronic diseases, and mental health issues [(8; 9)]. Consequently, food security transcends a mere nutritional issue and constitutes a comprehensive public health concern.

Extensive research has shown that food insecurity raises levels of psychological stress and anxiety, which in turn elevates the incidence of suicidal ideation [(10; 11; 12)]. Interventions aimed at addressing food insecurity may reduce the incidence and mortality linked to suicide [(13)]. Studies have revealed that adults experiencing food insecurity exhibit a significantly higher proportion of suicidal ideation than those who are food secure [(14)]. Food insecurity among veterans was linked to an increase in depressive symptoms and suicidal tendencies, with the correlation becoming

more pronounced as the level of food insecurity worsened [15]. Nonetheless, a recent systematic review has found that suicide attempts are less frequently reported among individuals facing food insecurity [16], highlighting the complexity and multifactorial nature of the issue.

In light of these findings, the study aimed to further explore the relationship between food insecurity and suicidal ideation, seeking to clarify this connection through extensive data analysis. It was anticipated that the study would furnish policymakers and public health professionals with novel insights and robust evidence to inform the implementation of more effective measures for preventing suicidal behavior and enhancing the mental health of the population.

2 Methods

2.1 Study design and study population

The National Health and Nutrition Examination Survey (NHANES) constitutes a comprehensive nationwide survey that assesses both the health and nutritional status of children and adults across the United States. The NHANES employs a complex multistage probability sampling design to ensure that the selected sample is representative of the U.S. population. This design process randomly selects geographic areas nationwide, followed by the random selection of households and individuals within each area. This method ensures the randomness and diversity of the sample, allowing the research results to reflect the health status of different communities and populations more accurately. The NHANES questionnaire incorporates demographic, dietary, examination, laboratory, and questionnaire data. The Centers for Disease Control and Prevention (CDC) website, https://www.cdc.gov/nchs/nhanes, has all of the statistics that are accessible to the general public. Every participant gave their informed consent, and the National Center for Health Statistics (NCHS) Institutional Review Board authorized the study.

As shown in Fig.1, the initial dataset consisted of 50588 participants who participated in five NHANES cycles conducted between 2007 and 2016. To refine the analytic sample, we used a series of exclusion criteria. Participants under the age of 20 were excluded. Additionally, those who were pregnant were excluded due to the potential impact of pregnancy on food safety and mental health outcomes that could confound results. Participants who lacked complete information on food security status or suicidal ideation were also excluded. Finally, participants

with missing data on covariates, including key demographic, socioeconomic, and health-related factors, were also excluded. After these exclusions, 22098 participants were included in the final analysis.

2.2 Assessment of Suicidal Ideation

The Patient Health Questionnaire-9 (PHQ-9) is a nine-item instrument used to assess depressive symptoms experienced over the past two weeks and is recognized as an effective screening tool for depression [(17)]. The presence of suicidal ideation was evaluated through the ninth item of the PHQ-9, which posed the question: "Over the last 2 weeks, how often have you been bothered by the following problem: thoughts that you would be better off dead, or of hurting yourself in some way?" Participants responded on a scale ranging from 0 (not at all) to 3 (nearly every day), with intermediate scores of 1 (several days) and 2 (more than half the days). In the context of this study, a response of 0 indicated the absence of suicidal ideation, whereas responses of 1 to 3 suggested the presence of suicidal ideation [(18; 19)].

2.3 Food Security

During household interviews, an adult participant responded to the questions posed by the U.S. Food Security Survey Module (US FSSM). Households with children under 18 completed 18 items, while households without children addressed 10 items. These questions were pertinent to all household members, not solely to the NHANES participants. In this study, the adult food security survey module, which consists of 10 items, was utilized as the criterion for assessing food security in households without children, resulting in four categories of food security status: adults with full food security (no affirmative responses), adults with moderate food security (one or two affirmative responses), adults with low food security (three to five affirmative responses), and adults with very low food security (six to ten affirmative responses) [(20; 21)].

2.4 Covariates

Based on prior research, the subsequent covariates were included in our analysis. Demographic variables comprised sex, age, race, education level, marital status, and the poverty income ratio (PIR). Sex was classified as either female or male; race as Mexican American, non-Hispanic

Black, non-Hispanic White, other Hispanic, or other; education level as less than high school, high school or equivalent, or college and above; and marital status as married/living with partner, widowed/divorced/separated, or never married. PIR levels were divided into three categories: 'Low' (<1), 'Medium' (1-2.99), and 'High' (≥3).

Body Mass Index (BMI) was derived from examination data and categorized into three levels: 'Underweight/Normal' (≤24.99), 'Overweight' (25-29.99), and 'Obese' (≥30). Smoking status was determined based on whether an individual had smoked at least 100 cigarettes in their lifetime, alcohol consumption was quantified by the consumption of 12 or more drinks in any given year, and diagnosed chronic somatic disease (including hypertension, diabetes, arthritis, congestive heart failure, coronary heart disease, heart attack, stroke, and cancer) [22], were ascertained from questionnaire responses. Having smoked at least 100 cigarettes during one's lifetime was considered smoking, and alcohol consumption was defined as having had 12 or more drinks in any year. Depression was determined by a PHQ-9 score of 10 or above [23; 24]. Sleep parameters included average duration and reported sleep disorders. Physical activity was characterized by a minimum of 10 minutes of continuous moderate to vigorous activity, excluding work or commuting, and classified as either active or inactive [25].

2.5 Statistical analysis

The mean ± standard deviation (SD) was used to represent continuous variables with a normal distribution, while the median (interquartile range) was used to represent continuous variables with a non-normal distribution. Frequency and percentage were used to express categorical variables. To compare differences in continuous variables between groups, we used independent sample t-tests and Mann-Whitney U tests and employed chi-square tests for differences in categorical variables.

Using individuals with "full food security" as the reference category, we employed multivariable logistic regression to examine the association between levels of food security and suicidal ideation. The regression models estimated odds ratios (ORs) with corresponding 95% confidence intervals (CIs). An unadjusted model (crude model) was first developed to provide a baseline association without considering confounders. In Model 1, adjustments were made for

basic demographic factors, including age, sex, and race. Model 2 further incorporated additional covariates to account for potential confounding effects, including education level, marital status, PIR, BMI, smoking, alcohol consumption, chronic somatic disease, depression, sleep duration, sleep disorder, health insurance, and physical activity.

To better understand the robustness of our findings, we conducted subgroup analyses by stratifying participants according to key factors, including sex, age, race, educational level, marital status, PIR, BMI, smoking, alcohol consumption, chronic somatic disease, depression, sleep duration, sleep disorder, health insurance, and physical activity levels. This approach allowed us to assess whether the relationship between food security and suicidal ideation differed across these strata.

In addition, sensitivity analyses were performed to test the consistency of our results. Specifically, we redefined the reference category by combining "full food security" and "marginal food security" into one group and compared it against the "low/very low food security" category.

All statistical analyses were performed using SPSS 25.0 and R 4.3.2, with $P<0.05$ considered statistically significant. Based on a power analysis conducted using SPSS, with an effect size of 0.5, an alpha level of 0.05, and a desired power of 0.80, a minimum sample size of 4632 participants was determined to be required. Our study includes 22098 participants, which exceeds this minimum requirement, ensuring sufficient power to detect meaningful effects.

3 Results

3.1 Baseline characteristics of the study populations

Table 1 illustrates that our study included 22098 participants, comprising 50.30% females and 49.70% males, with a median age of 49. Of these, 21267 participants were without suicidal ideation, while 831 were identified with suicidal ideation. Significant differences were noted between participants with and without suicidal ideation across variables including gender, age, race, education level, marital status, PIR, BMI, smoking status, chronic diseases, depression, sleep patterns, insurance status, physical activity, and food security ($P<0.05$). Participants with suicidal ideation tended to be female, identify as other Hispanic, be unmarried, have obesity,

smoke, lack health insurance, and have diagnoses of chronic somatic disease, depression, and sleep disorders. Additionally, they typically had lower education levels, lower PIR, shorter sleep durations, less physical activity, and lower levels of food security.

3.2 Relationship between food security and suicidal ideation

Table 2 indicates that in the unadjusted model, participants with marginal, low, and very low food security had significantly higher odds of suicidal ideation compared to those with full food security, with ORs of 1.76 (95% CI: 1.42, 2.18), 2.78 (95% CI: 2.29, 3.37), and 4.51 (95% CI: 3.76, 5.41), respectively. In the fully adjusted Model 2, the ORs for suicidal ideation were 1.14 (95% CI: 0.89, 1.46) for marginal food security, 1.40 (95% CI: 1.12, 1.76) for low food security, and 1.59 (95% CI: 1.27, 1.99) for very low food security, compared to full food security. These results highlight the importance of food security as a potential factor associated with mental health outcomes, particularly for individuals experiencing low or very low food security.

3.3 Subgroup and sensitivity analyses

Table 3 presents the findings from subgroup analyses and interaction tests. Subgroup analyses, stratified by various demographic and health factors, consistently demonstrated a significant association between food security and suicidal ideation. Notably, a significant interaction between food security and depression was identified (P=0.004). In the sensitivity analysis, which compared full and marginal food security as reference groups, the stratified analysis results were consistent with those using full food security alone (Table 4).

4 Discussion

In our cross-sectional study, we explored the link between food security and suicidal ideation. Our research indicated that people who were food insecure were more likely to have suicidal ideation. This relationship persisted across various demographic and health-related subgroups. The robustness of these findings was further validated through sensitivity analysis, emphasizing the reliability of our observations.

Food insecurity's link to an increased likelihood of suicidal ideation can be attributed to various factors. Firstly, chronic psychological stress and life difficulties brought on by food

insecurity act as significant triggers for such ideation [26]. Notably, when psychological symptoms are most severe, they are typically accompanied by the most severe food shortages[27], indicating that there may be a bidirectional relationship between the two. Elevated levels of individual psychological stress and anxiety due to food insecurity can lead to heightened feelings of depression and hopelessness, which may, in turn, lead to suicidal ideation [28]. Secondly, food insecurity often goes hand in hand with low socioeconomic status, which can exacerbate mental health struggles [29]. The difficulty in acquiring sufficient food due to low income and economic instability may also contribute to feelings of social isolation and a perceived lack of support, both of which are substantial risk factors for suicidal ideation [30; 31; 32]. Furthermore, negative impacts on physical health due to food insecurity, such as malnutrition and chronic health issues, which are more common among those experiencing food insecurity, are closely linked with depression and suicidal ideation [33]. Food insecurity negatively affects health, while deteriorating health conditions increase medical costs and economic burdens, further impacting food insecurity. Our study revealed that individuals with low food security were at a 1.40 times higher risk of suicidal ideation compared to those with adequate food security, and this risk increased to 1.59 times for individuals with very low food security, emphasizing the substantial impact of food security on mental health. However, studies presented conflicting evidence, such as one that reported a negative correlation between food insecurity and suicide attempts (OR=0.622, 95% CI: 0.617-0.627) [16], suggesting that the characteristics of the study sample and methodological approaches could significantly influence outcomes. This highlights the importance of further research to gain a more comprehensive understanding of the impact of food insecurity on mental health.

Our findings suggested a comorbidity of suicidal ideation and food insecurity, with the risk of suicidal ideation escalating in parallel with the severity of food insecurity. These findings corroborated similar conclusions from other studies, suggesting a dose-response relationship between food insecurity and suicidal ideation. A study utilizing NHANES data demonstrated that, compared to veterans who were food secure, those with low food security exhibited a 115% increased likelihood of experiencing suicidal thoughts, while those with very low food security displayed a 384% increased likelihood [15]. Poor food security was strongly correlated with the occurrence of suicidal ideation in a nationally representative sample of adult Americans (prevalence ratios = 2.21, 95% CI: 1.32-3.70), and very low food security had an even stronger

association (prevalence ratios = 6.99, 95% CI: 2.71-10.83) [34]. The dose-response relationship between food insecurity and suicidal ideation was further confirmed by another study that demonstrated a 32% and 77% increase in the risk of moderate food insecurity and severe food insecurity, respectively [5].

Previous research has established that the severity of depression correlates with suicidal ideation [35], and individuals with mental disorders exhibit a higher risk of suicide [36]. In our subgroup analysis, we identified a significant interaction between depression and food security influencing suicidal ideation. Specifically, the influence of food security on suicidal ideation was more pronounced among individuals without depression. Although low food security still heightened the risk of suicidal ideation among individuals with depression, this elevation was not statistically significant. This might be explained by the fact that these people already have a great deal of psychological stress, subsequently, the extra weight of food insecurity has no effect. However, this does not imply that food security issues should be ignored, as they still adversely affect overall health and quality of life. In contrast, the correlation between low food security and suicidal ideation was more robust among non-depressed individuals. This may be due to non-depressed individuals lacking the coping mechanisms and experience to manage the stress of food insecurity, rendering them more vulnerable to suicidal ideation.

This study has several limitations. Firstly, being a cross-sectional study, it precludes the determination of a causal relationship between food security and suicidal ideation. Secondly, despite adjusting for potential confounders, the presence of unknown covariates may still impact the validity of the results. Lastly, considering that the study's data came from the American public, the results might not apply to other nations or areas.

5 Conclusions

Our findings suggest that individuals experiencing food insecurity are at an elevated risk of developing suicidal ideation, reinforcing the critical role of food security as a social determinant of mental health and behavior. Public policies should therefore prioritize food security as an integral component of mental health strategies. Specific policy recommendations include expanding access to the Supplemental Nutrition Assistance Program (SNAP), implementing food voucher programs, and providing nutritional subsidies, particularly for vulnerable populations.

These measures should be integrated into existing mental health services to ensure access to adequate nutrition as part of a comprehensive approach to care. To address the intertwined challenges of food insecurity and mental health, it is essential to increase public awareness through media outreach and community-based activities. Advocates and non-governmental organizations can play a vital role in driving policy change and fostering public discourse on this issue. Moreover, community-based support systems that combine food assistance with mental health resources may help mitigate the psychological impacts of food insecurity. Future research should involve larger and more diverse populations across countries and regions to further validate and generalize our findings.

6 Conflict of interest statement

The authors declare that there are no conflicts of interest related to this study. We have no direct or indirect financial, personal, or professional relationships that could be perceived to influence the validity of our findings.

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7 Author contributions

The authors' responsibilities were as follows - WWZ: involved in data cleaning, statistical analysis and interpretation, and writing the manuscript; XLY: took primary responsibility for the final content and was involved in assisting and guiding the interpretation of the study data and revising the manuscript; all authors: read and approved the final manuscript.

8 Funding

The authors have no funding to report.

9 Data availability

The data in our study are publicly available online from the NHANES (https://www.cdc.gov/nchs/nhanes/index.htm).

10 Ethical approval

The study was conducted according to the guidelines of the Declaration of Helsinki. All study participants gave informed consent following the Institutional Review Board and study ethics guidelines at the Centers for Disease Control and Prevention.

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Table 1. Characteristics of study participants

Variables	All (N=22098)	Non-suicidal ideation (N=21267)	Suicidal ideation (N=831)	*P* value
Sex, n (%)				0.002
Female	11115(50.30)	10654(50.10)	461(55.48)	
Male	10983(49.70)	10613(49.90)	370(44.52)	
Age (years), median (IQR)	49(34,63)	49(34,63)	50(36,61)	0.586
Race, n (%)				<0.001
Mexican American	3229(14.61)	3092(14.54)	137(16.49)	
Other Hispanic	2246(10.16)	2114(9.94)	132(15.88)	
Non-Hispanic White	9806(44.38)	9461(44.49)	345(41.52)	
Non-Hispanic Black	4590(20.77)	4436(20.86)	154(18.53)	
Other Race	2227(10.08)	2164(10.17)	63(7.58)	
Education level, n (%)				<0.001
Less than high school	2089(9.45)	1958(9.21)	131(15.76)	
High school or equivalent	8165(36.95)	7801(36.68)	364(43.80)	
College or above	11844(53.60)	11508(54.11)	336(40.44)	
Marital status, n (%)				<0.001
Married/Living with Partner	13127(59.40)	6132(28.83)	231(27.80)	
Widowed/Divorced/Separated	4899(22.17)	7037(33.09)	228(27.44)	
Never married	4072(18.43)	8098(38.08)	372(44.76)	
PIR, n (%)				<0.001
Low	4767(21.57)	444(20.90)	323(38.87)	
Medium	9249(41.86)	8886(41.78)	363(43.68)	
High	8082(36.57)	7937(37.32)	145(17.45)	
BMI, n (%)				<0.001
Underweight/Normal	6363(28.79)	6132(28.83)	231(27.80)	
Overweight	7265(32.88)	7037(33.09)	228(27.44)	
Obese	8470(38.33)	8098(38.08)	372(44.76)	
Smoking, n (%)				<0.001

No	12079(54.66)	11718(55.10)	361(43.44)	
Yes	10019(45.34)	9549(44.90)	470(56.56)	
Alcohol consumption, n (%)				0.973
No	6101(27.61)	5872(27.61)	229(27.56)	
Yes	15997(72.39)	15395(72.39)	602(72.44)	
Chronic somatic disease, n (%)				<0.001
No	10652(48.20)	10335(48.60)	317(38.15)	
Yes	11446(51.80)	10932(51.40)	514(61.85)	
Depression, n (%)				<0.001
No	20100(90.96)	19822(93.21)	278(33.45)	
Yes	1998(9.04)	1445(6.79)	553(66.55)	
Sleep duration (hours), mean (SD)	6.99±1.48	7.00±1.46	6.86±1.91	0.035
Sleep disorder, n (%)				<0.001
No	16360(74.03)	15934(74.92)	426(51.26)	
Yes	5738(26.97)	5333(25.08)	405(48.74)	
Health insurance, n (%)				<0.001
No	4835(21.88)	4593(21.60)	242(29.12)	
Yes	17263(78.12)	16674(78.40)	589(70.88)	
Physical activity, n (%)				<0.001
Inactive	11348(51.35)	10793(50.75)	555(66.79)	
Active	10750(48.65)	10474(49.25)	276(33.21)	
Food security, n (%)				<0.001
Full food security	15215(68.85)	14842(69.79)	373(44.89)	
Marginal food security	2640(11.95)	2528(11.89)	112(13.48)	
Low food security	2368(10.72)	2213(10.40)	155(18.65)	
Very low food security	1875(8.48)	1684(7.92)	191(22.98)	

Abbreviations: IQR, interquartile range; PIR, poverty income ratio; BMI, body mass index; SD, standard deviation.

Continuous variables are presented as mean ± SD or median ± IQR, while categorical variables are expressed as n (%).

P<0.05 is statistically significant.

Table 2. Association between food security and suicidal ideation

	Participants	Crude Model		Model 1		Model 2	
	N	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Full food security	15215	1.00(Ref.)		1.00(Ref.)		1.00(Ref.)	
Marginal food security	2640	1.76(1.42,2.18)	**<0.001**	1.78(1.43,2.22)	**<0.001**	1.14(0.89,1.46)	0.275
Low food security	2368	2.78(2.29,3.37)	**<0.001**	2.77(2.27,3.38)	**<0.001**	1.40(1.12,1.76)	**0.003**
Very low food security	1875	4.51(3.76,5.41)	**<0.001**	4.58(3.80,5.52)	**<0.001**	1.59(1.27,1.99)	**<0.001**

The crude model did not adjust for any potential confounders;

Model 1 adjusted for age, sex, and race;

Model 2 further adjusted for education level, marital status, PIR, BMI, smoking, alcohol consumption, chronic somatic disease, depression, sleep duration, sleep disorder, health insurance, and physical activity.

Bold numbers indicate statistical significance ($P < 0.05$).

Table 3. Subgroup analysis of the association between food security and suicidal ideation

Variables	Full food security	Marginal food security OR (95% CI)	Low food security OR (95% CI)	Very low food security OR (95% CI)	*P* for interaction
Sex					0.700
Female	1.00(Ref.)	1.17(0.85,1.61)	1.38(1.02,1.86)	1.42(1.04,1.92)	
Male	1.00(Ref.)	1.03(0.70,1.52)	1.39(0.97,1.99)	1.64(1.18.2.29)	
Age					0.624
20-39	1.00(Ref.)	1.14(0.74,1.75)	1.41(0.94,2.12)	1.68(1.14,2.49)	
40-59	1.00(Ref.)	1.37(0.95,1.97)	1.32(0.92,1.90)	1.52(1.08,2.16)	
≥60	1.00(Ref.)	0.79(0.46,1.36)	1.60(1.03,2.48)	1.70(1.07,2.70)	
Race					0.262
Mexican American	1.00(Ref.)	1.68(0.99,2.85)	1.65(0.95,2.85)	1.68(0.95,2.98)	
Other Hispanic	1.00(Ref.)	0.79(0.40,1.56)	1.36(0.78,2.38)	1.09(0.59,2.00)	
Non-Hispanic White	1.00(Ref.)	1.01(0.67,1.53)	1.29(0.88,1.88)	1.35(0.94,1.92)	
Non-Hispanic Black	1.00(Ref.)	1.11(0.62,1.99)	1.77(1.02,3.05)	2.89(1.76,4.76)	
Other Race	1.00(Ref.)	1.25(0.53,2.92)	0.92(0.35,2.37)	1.45(0.55,3.82)	
Education level					0.816
Less than high school	1.00(Ref.)	1.33(0.73,2.42)	1.48(0.85,2.56)	1.85(1.05,3.26)	
High school or equivalent	1.00(Ref.)	1.22(0.85,1.75)	1.44(1.03,1.99)	1.48(1.07,2.05)	
College or above	1.00(Ref.)	0.96(0.64,1.45)	1.32(0.87,1.99)	1.61(1.11,2.34)	
Marital status					0.311
Married/Living with Partner	1.00(Ref.)	1.26(0.88,1.80)	1.29(0.91,1.83)	1.54(1.08,2.20)	
Widowed/Divorced/Separated	1.00(Ref.)	1.23(0.80,1.90)	1.45(0.97,2.17)	1.42(0.97,2.08)	
Never married	1.00(Ref.)	0.78(0.45,1.35)	1.54(0.96,2.45)	1.78(1.13,2.81)	
PIR					0.614
Low	1.00(Ref.)	1.17(0.78,1.73)	1.40(0.98,1.99)	1.58(1.13,2.20)	
Medium	1.00(Ref.)	1.00(0.70,1.43)	1.43(1.03,1.99)	1.71(1.23,2.36)	
High	1.00(Ref.)	1.55(0.80,2.98)	1.00(0.39,2.61)	0.55(0.14,2.05)	
BMI					0.209

Underweight/Normal	1.00(Ref.)	1.51(0.95,2.41)	1.48(0.94,2.35)	1.54(1.00,2.36)	
Overweight	1.00(Ref.)	0.74(0.45,1.23)	1.05(0.66,1.68)	1.77(1.15,2.72)	
Obese	1.00(Ref.)	1.17(0.81,1.68)	1.57(1.13,2.18)	1.48(1.06,2.08)	
Smoking					0.208
No	1.00(Ref.)	0.99(0.68,1.44)	1.28(0.89,1.82)	1.87(1.32,2.63)	
Yes	1.00(Ref.)	1.22(0.88,1.70)	1.55(1.15,2.10)	1.45(1.08,1.95)	
Alcohol consumption					0.292
No	1.00(Ref.)	0.81(0.50,1.30)	1.19(0.78,1.82)	1.17(0.76,1.82)	
Yes	1.00(Ref.)	1.28(0.96,1.70)	1.48(1.12,1.94)	1.72(1.32,2.23)	
Chronic somatic disease					0.728
No	1.00(Ref.)	1.09(0.73,1.62)	1.23(0.84,1.79)	1.63(1.13,2.35)	
Yes	1.00(Ref.)	1.14(0.84,1.56)	1.48(1.11,1.98)	1.51(1.14,2.01)	
Depression					**0.004**
No	1.00(Ref.)	1.48(1.03,2.11)	1.48(1.01,2.15)	2.16(1.48,3.14)	
Yes	1.00(Ref.)	0.90(0.65,1.25)	1.32(0.99,1.76)	1.32(1.01,1.74)	
Sleep duration					0.384
≤ 7 h	1.00(Ref.)	1.20(0.89,1.62)	1.37(1.03,1.83)	1.41(1.06,1.97)	
> 7 h	1.00(Ref.)	0.96(0.63,1.47)	1.45(0.99,2.11)	1.88(1.30,2.73)	
Sleep disorder					0.262
No	1.00(Ref.)	1.28(0.92,1.77)	1.27(0.91,1.76)	1.62(1.18,2.22)	
Yes	1.00(Ref.)	0.95(0.66,1.38)	1.51(1.09,2.09)	1.51(1.10,2.07)	
Health insurance					0.962
No	1.00(Ref.)	1.26(0.81,1.97)	1.40(0.93,2.11)	1.66(1.12,2.48)	
Yes	1.00(Ref.)	1.09(0.81,1.47)	1.38(1.05,1.83)	1.56(1.19,2.05)	
Physical activity					0.079
Inactive	1.00(Ref.)	1.25(0.93,1.67)	1.50(1.14,1.97)	1.44(1.09,1.88)	
Active	1.00(Ref.)	0.82(0.52,1.30)	1.14(0.74,1.74)	1.91(1.28,2.84)	

Abbreviations: PIR, poverty income ratio; BMI, body mass index.

Bold numbers indicate statistical significance ($P < 0.05$).

Table 4. Sensitivity analysis of food security and suicidal ideation

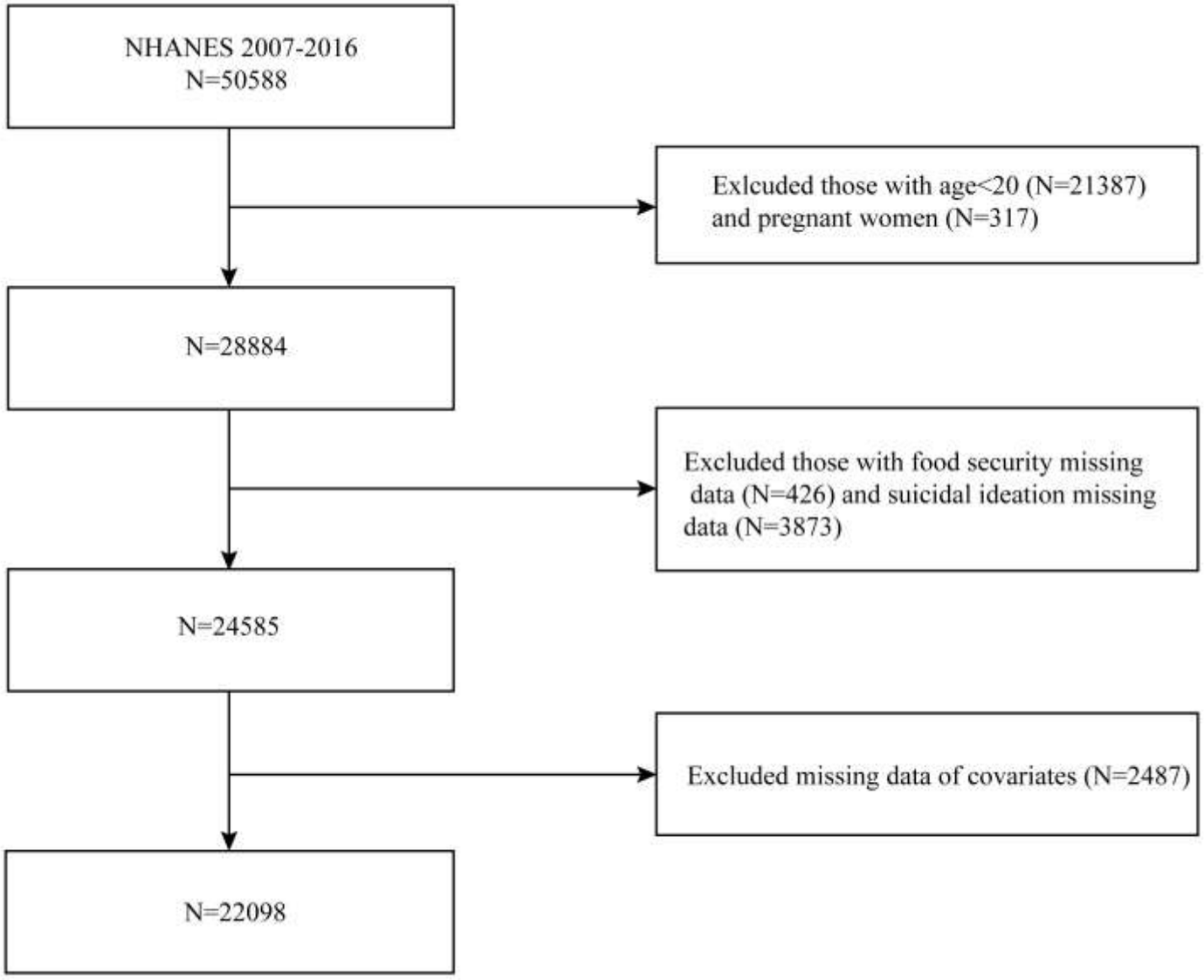
Variables	Full/marginal food security	Low/very low food security	
		OR (95% CI)	*P* value
Sex			
Female	1.00(Ref.)	1.33(1.06,1.67)	**0.014**
Male	1.00(Ref.)	1.51(1.16,1.97)	**0.002**
Age			
20-39	1.00(Ref.)	1.49(1.09,2.02)	**0.010**
40-59	1.00(Ref.)	1.29(0.98,1.68)	0.063
≥60	1.00(Ref.)	1.73(1.22,2.44)	**0.002**
Race			
Mexican American	1.00(Ref.)	1.34(0.88,2.03)	0.161
Other Hispanic	1.00(Ref.)	1.32(0.84,2.07)	0.218
Non-Hispanic White	1.00(Ref.)	1.32(0.99,1.75)	0.054
Non-Hispanic Black	1.00(Ref.)	2.25(1.52,3.33)	**<0.001**
Other Race	1.00(Ref.)	1.05(0.51,2.16)	0.878
Education level			
Less than high school	1.00(Ref.)	1.50(0.99,2.27)	0.051
High school or equivalent	1.00(Ref.)	1.39(1.08,1.78)	**0.009**
College or above	1.00(Ref.)	1.46(1.09,1.97)	**0.011**
Marital status			
Married/Living with Partner	1.00(Ref.)	1.31(1.00,1.71)	**0.046**
Widowed/Divorced/Separated	1.00(Ref.)	1.35(1.00,1.82)	**0.047**
Never married	1.00(Ref.)	1.77(1.24,2.53)	**0.002**
PIR			
Low	1.00(Ref.)	1.41(1.09,1.83)	**0.008**
Medium	1.00(Ref.)	1.56(1.22,2.00)	**<0.001**
High	1.00(Ref.)	0.76(0.34,1.68)	0.503
BMI			
Underweight/Normal	1.00(Ref.)	1.36(0.97,1.90)	0.071
Overweight	1.00(Ref.)	1.50(1.07,2.12)	**0.018**
Obese	1.00(Ref.)	1.45(1.12,1.87)	**0.004**

Smoking			
No	1.00(Ref.)	1.54(1.18,2.01)	**0.001**
Yes	1.00(Ref.)	1.41(1.12,1.77)	**0.002**
Alcohol consumption			
No	1.00(Ref.)	1.25(0.90,1.74)	0.179
Yes	1.00(Ref.)	1.48(1.21,1.82)	**<0.001**
Chronic somatic disease			
No	1.00(Ref.)	1.38(1.04,1.84)	**0.024**
Yes	1.00(Ref.)	1.44(1.15,1.79)	**0.001**
Depression			
No	1.00(Ref.)	1.57(1.18,2.09)	**0.002**
Yes	1.00(Ref.)	1.36(1.10,1.69)	**0.004**
Sleep duration			
≤ 7 h	1.00(Ref.)	1.31(1.05,1.63)	**0.013**
> 7 h	1.00(Ref.)	1.66(1.25,2.22)	**<0.001**
Sleep disorder			
No	1.00(Ref.)	1.33(1.04,1.71)	**0.020**
Yes	1.00(Ref.)	1.53(1.19,1.96)	**<0.001**
Health insurance			
No	1.00(Ref.)	1.42(1.04,1.93)	**0.024**
Yes	1.00(Ref.)	1.43(1.16,1.77)	**<0.001**
Physical activity			
Inactive	1.00(Ref.)	1.37(1.11,1.68)	**0.003**
Active	1.00(Ref.)	1.56(1.14,2.14)	**0.005**

Abbreviations: PIR, poverty income ratio; BMI, body mass index.

Bold numbers indicate statistical significance ($P < 0.05$).

Fig. 1. The flowchart of participants.



Legends: This study utilized data from NHANES 2007–2016, initially including 50588 participants. First, individuals younger than 20 years (21387 individuals) and pregnant individuals (317 individuals) were excluded. Next, participants without information on food security (426 individuals) and those lacking data on suicidal ideation (3873 individuals) were removed. Additionally, 2487 individuals were excluded due to incomplete data on covariates. Ultimately, a total of 22098 adults with complete data were included in the analysis. NHANES, National Health and Nutrition Examination Survey.