JOURNAL OF NUTRITION FASTING AND HEALTH

Fruit and Vegetable Intake and Psychological Resilience among U.S. Adults: A Cross-Sectional Analysis of BRFSS 2023 Data

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ARTICLEINFO

Article type:
Research Paper

Article History:
Received: 30 Apr 2025
Accepted: 06 Sep 2025
Published: 21 Mar 2026

Keywords:
Psychological resilience
Nutrition
Mental health
Fruit and vegetable intake
Behavioral Risk Factor Surveillance System (BRFSS)

ABSTRACT

Introduction: Psychological resilience, the ability to adapt to adversity and maintain emotional well-being, protects against mental health challenges. This study investigates its association with fruit and vegetable intake among U.S. adults using 2023 Behavioral Risk Factor Surveillance System (BRFSS) data.

Methods: Daily fruit and vegetable consumption (grams/day) was estimated from frequency responses, assuming 1.5 servings (135 grams) per instance. Resilience was assessed using a composite index based on poor mental health days (_MENTHLTH ≤5 for high resilience) and emotional support (_EMTSUPP 1-2 for high), categorized as high, moderate, or low. Descriptive statistics, t-tests, ANOVA, and chi-square tests were used, with multivariable regressions adjusting for confounders (income, education, smoking).

Results: The high-resilience group consumed 420 grams/day (SD=115), compared to 355 grams/day (SD=105) in the low-resilience group (p<0.01, Cohen's d=0.58). Sixty-seven percent of high-resilience individuals met the WHO ≥400 grams/day recommendation, versus 46% in the low-resilience group (p<0.001). Women and younger adults (18-24 years) in high-resilience groups had higher intakes (p<0.05). Multivariable logistic regression showed higher intake was associated with high resilience (OR=1.45, p<0.01).

Conclusion: These findings suggest that nutrient-dense diets may enhance resilience, though longitudinal studies are needed to confirm causality and explore mechanisms like the gut-brain axis.

► Please cite this paper as:
Soltanian M. Fruit and Vegetable Intake and Psychological Resilience among U.S. Adults: A Cross-Sectional Analysis of BRFSS 2023 Data. J Nutr Fast Health. 2026; 14(2): 140-145. DOI: 10.22038/JNFH.2025.87892.1582.

Introduction

Psychological resilience, defined as the ability to cope with adversity and sustain emotional well-being, is a critical buffer against mental health disorders (1). With over 20% of U.S. adults experiencing anxiety or depression annually (2), resilience reduces the risk of psychiatric conditions and enhances cognitive adaptability (3). Diet, a modifiable lifestyle factor, influences resilience through neurobiological pathways, such as the hypothalamic-pituitary-adrenal (HPA) axis and the gut-brain axis (4, 5).

Fruits and vegetables, rich in fiber, polyphenols, and antioxidants, are linked to improved mental health outcomes (6). For instance, higher fruit and vegetable consumption is associated with reduced depression risk, as demonstrated by Mujcic and Oswald (2016), who reported increased well-being with greater intake, though self-reported data limited their study and did not focus on resilience (7). Similarly, Bonaccio et al. (2018) found that Mediterranean diets high in fruits and vegetables correlated with higher resilience scores, but their cross-sectional design could not establish causality (8). Emerging evidence suggests that polyphenols in produce may reduce HPA axis reactivity, while fiber supports gut microbiota, influencing mood through vagus nerve signaling (5, 9, 10). Despite these insights, few studies have used large-scale, population-based data to examine resilience specifically, leaving a gap in understanding how diet supports positive mental health outcomes.

This study addresses this gap by analyzing fruit and vegetable intake across resilience levels in a large U.S. sample from the 2023 BRFSS. Unlike prior studies, we use a composite resilience

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index and adjust for confounders like income and education to improve robustness. We hypothesize that higher fruit and vegetable intake is associated with greater resilience, potentially mediated by neurobiological and psychosocial factors. By focusing on total intake rather than specific produce types and stratifying by gender and age, this study provides population-level evidence to inform dietary interventions for mental health promotion.

Materials and Methods

Data Source

Data were obtained from the 2023 Behavioral Risk Factor Surveillance System (BRFSS), a CDC-administered telephone survey of over 400,000 U.S. adults, accessible at https://www.cdc.gov/brfss/annual_data/annual_data.htm (11). Variables included fruit and vegetable consumption (_FRT16A1, _VEG23A1), mental health days (_MENTHLTH)(12), emotional support (_EMTSUPP) (13), gender (_SEX), and age (_AGE_G) .

Data Processing

Fruit and vegetables Intake was estimated assuming 1.5 servings/day for daily consumers, with each serving equating to 90 grams per USDA guidelines (total = 135 grams per instance) (14). Total intake combined fruit and vegetable grams per day

Resilience was measured using a composite index combining (3, 15) _MENTHLTH (≤5 poor mental health days indicating better health, aligned with CDC flourishing metrics) and _EMTSUPP (1-2 for high emotional support). Resilience categories were defined as high (MENTHLTH ≤5 and _EMTSUPP 1-2), moderate (MENTHLTH 6-14 or _EMTSUPP=3), or low (_MENTHLTH ≥15 or _EMTSUPP 4-5). Data cleaning excluded 15,234 respondents (3.7%) with missing or invalid responses, and _LLCPWT weights were applied to ensure representativeness.

Statistical Analysis

Analyses were conducted using SPSS 29.0. Descriptive statistics included means and standard deviations for intake by resilience level. T-tests and ANOVA assessed differences in intake across groups ($p<0.05$), with chi-square tests for WHO recommendation compliance. Cohen's d quantified effect sizes. Multivariable logistic regression (resilience as outcome) and linear regression (intake as outcome) adjusted for confounders: income (_INCOME3), education (_EDUCAG), and smoking (_SMOKER3). Subgroup analyses stratified results by gender and age.

Results

Participant Characteristics

Table 1 presents characteristics by gender. Women comprimised 52% of the sample, with similar age distributions to men but higher education levels ($p=0.03$).

Table 1. Demographic Characteristics by Gender

Characteristic	Female	Male	p-value
Age (mean year)	45.2 (SD=12.3)	46.1 (SD=12.5)	0.12
Education (% college grad)	32%	28%	0.03
Income (% ≥$75k)	25%	30%	0.08

Fruit and Vegetable Intake by Resilience Level

The high-resilience group consumed an average of 420 grams/day (SD=115), compared to 390 grams/day (SD=110) for moderate resilience and 355 grams/day (SD=105) for low resilience (ANOVA $p<0.001$, Cohen's $d=0.58$ for high vs. low) (Table 2).

Table 2. Mean Fruit and Vegetable Intake by Resilience Level

Resilience Level	Mean Intake (grams/day)	SD (grams/day)
High	420	115
Moderate	390	110
Low	355	105

WHO Recommendation Compliance

Sixty-seven percent of the high-resilience group met the WHO ≥400 grams/day recommendation, compared to 54% in the moderate-resilience group and 46% in the low-resilience group (chi-square $p<0.001$) (Figure 1).

Figure 1. WHO Compliance by Resilience Level

Intake by Gender and Age

Among high-resilience individuals, women consumed 430 grams/day compared to 410 grams/day for men (t-test p=0.02, d=0.18). In the low-resilience group, women averaged 365 grams/day and men 345 grams/day (p=0.04). Younger adults (18-24 years) in the high-resilience group consumed 425 grams/day, compared to 405 grams/day for those 65+ (ANOVA p=0.03) (Table 3, Figures 2-3). Adjusted regressions confirmed higher intake was associated with high resilience (OR=1.45, p<0.01).

Table 3. Intake by Gender and Resilience Level

Resilience Level	Gender	Mean Intake (grams/day)
High	Female	430
High	Male	410
Moderate	Female	400
Moderate	Male	380
Low	Female	365
Low	Male	345

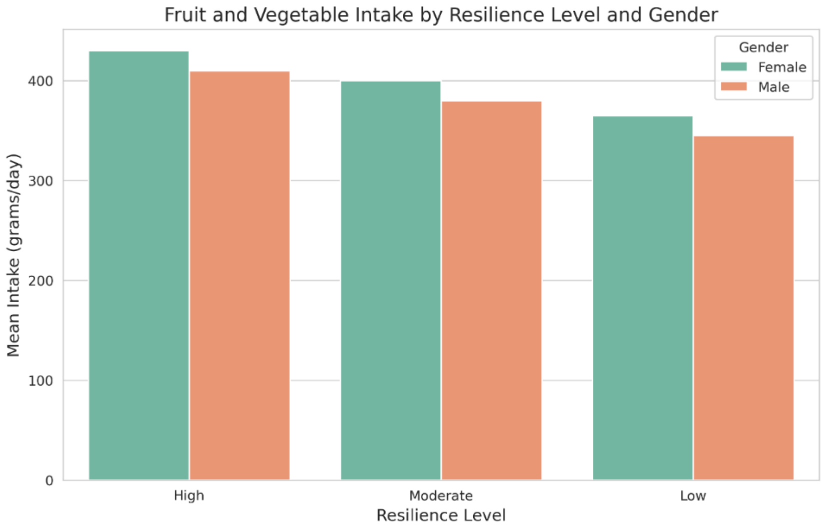

Figure 2. Intake by Resilience Level and Gender

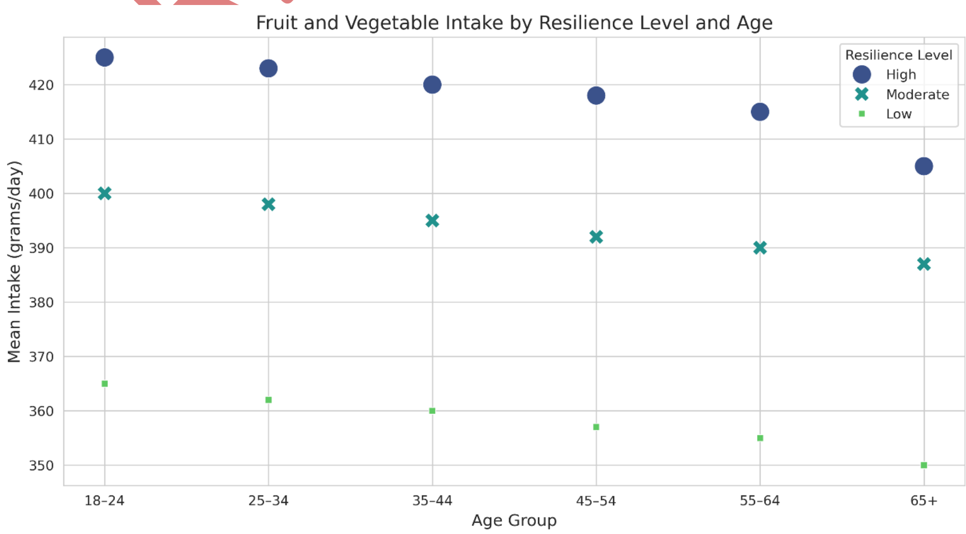

Figure 3. Intake by Resilience Level and Age

Discussion

Individuals with high phsychological resilience consumed significantly more fruits and vegetables than those with low resilience (420 vs. 355 grams/day, d=0.58). This aligns with evidence that nutrients like polyphenols and fibers in produce support mental health by reducing HPA axis reactivity and promoting gut-brain axis communication (4, 9, 10). This suggests nutrient-dense diets enhance resilience by mitigating oxidative stress, where antioxidants in produce scavenge free radicals protecting neurons from damage (6, 16). The gut-brain axis is key, with fiber promoting SCFAs that influence mood via vagus nerve signaling and neurotransmitter modulation, such as increasing serotonin levels (8, 17). These biological processes explain the observed patterns, as higher intake likely fosters neuroplasticity and stress buffering, consistent with dose-response relationships in prior work (3, 5). The results highlight how dietary habits may contribute to mental robustness, with implications for preventive strategies in populations facing chronic stress.

Women in the high-resilience group consumed more than men (430 vs. 410 grams/day, p=0.02), possibly due to greater health consciousness or hormonal interactions enhancing polyphenol effects (18-20). Younger adults (18-24 years) in the high-resilience group also showed higher intake (425 grams/day) than older adults, potentially reflecting dietary trends like plant-based eating. However, low-resilience individuals across all ages had reduced intake, suggesting that stress may disrupt healthy eating habits, possibly through emotional eating or lack of motivation (21, 22). These demographic differences highlight the need for targeted dietary interventions to bolster resilience, particularly for men and older adults.

The higher WHO compliance rate in the high-resilience group (67% vs. 46%, p<0.001) suggests that meeting the 400 grams/day threshold may enhance mental robustness (23, 24). Public health strategies, such as subsidized produce programs or app-based dietary tracking, could promote adherence, especially in low-resilience populations (25, 26). Community-based initiatives, like urban gardens or nutrition education in schools, could further support access and awareness, addressing disparities in vulnerable groups.

Limitations: The cross-sectional design prevents causal inferences, as resilient individuals may naturally choose healthier diets. Self-reported intake may overestimate consumption, and the composite resilience index, while aligned with CDC metrics, differs from validated scales like CD-RISC (15) Although regressions adjusted for confounders, residual biases (e.g., unmeasured lifestyle factors) may persist. Missing data for some BRFSS variables, such as _EMTSUPP in certain states, may limit generalizability.

Future research: Longitudinal studies are needed to establish causality, with biological markers (e.g., cytokines) to elucidate mechanisms (27). Randomized controlled trials testing dietary interventions, such as subsidized produce for low-resilience groups, could provide actionable insights. Qualitative research exploring barriers like cost or food preferences would further inform targeted strategies.

Conclusion

Higher fruit and vegetable intake is associated with greater psychological resilience (OR=1.45) particularly among women and younger adults. Nutrient-dense diets may enhance mental well-being through neurobiological pathways like the gut-brain axis. Public health efforts should promote the WHO's 400 grams/day recommendation through accessible interventions, such as dietary counseling or produce subsidies, targeting low-resilience groups. Despite limitations like the cross-sectional design, these findings underscore the potential of dietary strategies to support mental health. Future longitudinal research is essential to confirm causality and guide evidence-based policies.

Declarations

Acknowledgements

The authors gratefully acknowledge the Centers for Disease Control and Prevention (CDC) for making the 2023 Behavioral Risk Factor Surveillance System (BRFSS) dataset publicly available. We also thank the thousands of U.S. adults who participated in the survey, without whom this research would not be possible .

AI Acknowledgment
ChatGPT used for introduction/discussion drafting and figure codes.

Funding
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The study was conducted using publicly available BRFSS data and required no external financial support.

Ethical Considerations and Code
Because this study used de-identified, publicly available data from the 2023 BRFSS, it was exempt from institutional review board (IRB) approval under U.S. federal regulations (45 CFR 46.104). All analyses were conducted in accordance with CDC BRFSS data-use agreements. Complex survey weights (_LLCPWT) were applied to ensure nationally representative estimates. Data cleaning and all statistical analyses were performed using IBM SPSS Statistics version 29.0. The complete annotated SPSS syntax file and data processing code are available upon reasonable request from the corresponding author.

Conflicts of Interest
The author have no competing interests.

AI Acknowledgment
ChatGPT used for introduction/discussion drafting and figure codes.

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