

Assessing food security among U.S. post-secondary level students

by

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Abstract

The prevalence of food insecurity among college and university students in the United States ranges from 19% to 52%, which is significantly greater than the national average. In this context, this study aims to determine the prevalence of food insecurity among students from higher education and examine if sociodemographic factors such as income, race, sex, marital status, and parental status significantly predict levels of food security. This study used data from the Current Population Survey (CPS), administered by the U.S. Census Bureau, comprising 22,686 students from 2019–2023 across the United States. This investigation used the Food Security Index using the 10-item U.S. Adult Food Security Survey Module developed by the United States Department of Agriculture (USDA).

Furthermore, a generalized linear model was employed to examine the relationship between multiple demographic factors and food security, with model selection based on Akaike's Information Criterion (AIC). The best-fit model included all predictor variables: income, race, age, sex, marital status, and parental status. However, the model demonstrated moderate predictive power ($R^2 = 0.07$).

Contrary to much of the existing literature, 12% of college students in our sample experienced food insecurity. Multiethnic and Black students reported greater levels of food insecurity compared to White and Asian students, with Multiethnic students nearly being two times more food insecure than their White peers. Students with parental responsibilities are approximately 1.55 times more likely to experience food insecurity than their peers without children. Female and older students also experienced higher levels of food insecurity, whereas greater household income was associated with increased food security. Married and never-

married students exhibited lower levels of food insecurity than those whose marital status is separated, widowed, or divorced.

Given that a sizable proportion of the variance remains unexplained, further research is needed to identify additional factors influencing food security in this population. Nonetheless, this study provides a valuable benchmark for future research investigating more fine-grained demographic questions related to food security among post-secondary level students across the U.S.

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Dedication

I dedicate this work to my family, whose love and support have carried me through every challenge. To my mother, for always showing me through her example the meaning of hard work and dedication, and to my father, for his unconditional support and caring, their love and guidance were the foundation of my journey. I am also deeply grateful to my mentors, who encouraged me and guided me throughout this process, and to my aunt, who was always there to listen and offer me reassurance. And to all those who face obstacles yet continue to pursue knowledge.

Preface

This journey has not been easy. Along the way, I faced unexpected challenges, both personal and academic, compounded by political changes that made progress difficult at times. I began my graduate research exploring *hügelkultur* and sustainable soil practices; however, as my work evolved, I felt compelled to shift my focus toward a more social and human-centered issue: food insecurity.

Eating lies at the epicenter of all our functions. It sustains not only our bodies but also our capacity to think, learn, and grow. Yet, too many students today face the uncertainty of whether they will have access to a healthy meal. No student should have to carry that burden while pursuing their education.

This thesis represents not only my academic effort but also my deep belief that addressing food insecurity is essential to creating equitable and thriving learning environments for all.

Chapter 1 - Literature Review

1.1. Conceptualizing Food Security

Food security is a complex concept with varying definitions shaped by disciplinary frameworks, contextual guidelines, and methodological approaches. The World Food Summit (1996) established a widely acknowledged definition, remarking that individuals are food secure when they have consistent physical and economic access to sufficient, safe, and nutritious food that aligns with their cultural dietary preferences, enabling them to maintain an active and nourishing life (Abou-Rizk, 2023; Shaw, 2007). For this analysis, an active lifestyle involves energy expenditure through repetitive muscle contractions, which stress the muscles, joints, and heart while enhancing their natural functions (World Health Organization 2007; World Health Organization, 2019). This connotation suggests that individuals with equivalent access to food, but distinct food selections might display distinct levels of food security. Preferences refer to foods that are socially and culturally acceptable and consistent with religious and ethical values rather than broader interpretations (Pinstrup-Andersen, 2009; Drewnowski & Almiron-Roig, 2010). Additionally, nutrition security at the organism level refers to the human body's cells, tissues, and organs obtaining adequate nourishment to perform optimally.

Any divergence from the globally recognized standards set by the World Food Summit (1996) including restricted access, financial limitations, inadequate nutritional quality, or fluctuations in food availability; constitutes food insecurity (Shaw, 2007). This socioeconomic condition manifests in various forms, from persistent hunger and malnutrition to short-term disruptions in food access resulting from economic instability, social disparities, or environmental challenges (Foley et al., 2011; Tilman et al., 2002). Ultimately, these factors can impede an individual's capacity to sustain a healthy and active lifestyle.

These aspects of food and nutrition security are shaped by dynamic food systems at local, regional, and national levels, each contributing to varying levels of access to food, particularly for vulnerable groups such as students (Friel & Ford, 2015; Leroy et al., 2015; Manikas et al., 2023).

Food insecurity encompasses four interrelated dimensions: food availability, food access, food utilization, and stability (Guiné, 2021; Ivers, 2015; Fathelrahman et al., 2021). It is also intrinsically linked to broader structural challenges, affecting individuals across social, biological, environmental, and financial domains (Guiné, 2021; Gustafson et al., 2016; Béné et al., 2019). Similarly, the Food and Agriculture Organization (FAO) defines food insecurity as the lack of access to safe and nutritious food for normal growth and development for an active and healthy life (Adeshina, 2020).

Food insecurity is strongly correlated with poverty, particularly among lower-income households, which are at heightened risk. Prior to the COVID-19 pandemic, food insecurity (10.9%) closely mirrored the poverty rate (10.5%) in the U.S. (Coleman-Jensen et al., 2020; Semega et al., 2020). However, poverty and food insecurity are not synonymous; while many low-income households remain food secure, some higher-income households also face food insecurity (Gundersen et al., 2017). Moreover, food insecurity is often intermittent, with many households cycling in and out of insecurity rather than experiencing it consistently (Richard et al., 2020).

Certain demographic groups are more vulnerable to food insecurity. Households with children, female-headed households, Black, Latinx, and Native American households, and those with members who have disabilities are at greater risk (Blue Bird Jernigan et al., 2017; Coleman-Jensen et al., 2020,21,22). Immigrant households, particularly those headed by recent or

noncitizen immigrants, also face increased risk (Chilton et al., 2009; Ghaffar, 2020).

Additionally, research reveals that LGBTQ+ individuals, contrary to stereotypes of affluence, are more likely to experience food insecurity, being 1.62 times more likely to report limited money to buy food than their peers (Brown et al., 2016).

While it is well-established that food insecurity disproportionately affects low-income populations, studies tend to focus on prevalence rates rather than unpacking how different economic, social, and policy-related factors intersect to perpetuate this vulnerability. For instance, low-income households, primarily those with children, elderly members, or individuals with disabilities, are more likely to face higher food insecurity risks because these groups often rely on transfer income, which can be insufficient to meet their needs (Berkowitz et al., 2024).

Expanding on this framework, the present research explores food insecurity as a complex and multifaceted issue, particularly its effects on underserved post-secondary student populations across the United States.

1.1.1. Theoretical Framework

Historically, food insecurity has been analyzed through a four-dimensional framework, focusing on food availability, access, utilization, and stability (Guiné, 2021; Ivers, 2015; Fathelrahman et al., 2021). Recent studies regard food insecurity as a sixth multidimensional concern. This framework adds agency and sustainability to the conventional four-pillar approach, as key components to inform policy and laws surrounding the food system. This updated framework was introduced in the 15th report of the High-Level Panel of Experts on Food Security and Nutrition (HLPE), titled *Food Security and Nutrition: Building a Global Narrative Towards 2030* (HLPE, 2020). Incorporating these dimensions, aims to establish clearer guidelines for global policymaking (Clapp et al., 2022; Béné, 2020).

Based on this framework, the intersectionality of race, ethnicity, and food insecurity displays structural disparities that perpetuate inequitable food access. The prevalence of social and economic disadvantages among historically underserved communities significantly contributes to greater rates of food insecurity. Numerous studies have demonstrated that systemic inequities, particularly racial and financial disparities, not only exacerbate food insecurity but also reinforce long-term cycles of poverty and increase the burden of diet-related chronic diseases in the United States (Camanzi et al., 2014; Gundersen & Ziliak, 2015; Lofton et al., 2025).

The prevalence of food insecurity increased for Black, non-Hispanic householders, from 19.1% in 2019 to 21.7 % in 2020 (Coleman-Jensen et al., 2021). This statistic reflects the systemic inequities outlined in the six-dimensional framework, where marginalized communities face more significant challenges accessing resources and opportunities. Moreover, food insecurity was greater in 2020 for households in the South, a region historically impacted by racial and economic disparities (Chappell, 2018; Collins, 2022; Coleman-Jensen et al., 2021; Rocha, 2007).

Longitudinal studies continue to demonstrate the enduring nature of these disparities. For instance, Berkowitz et al. (2024) show that food insecurity risks remain high for marginalized groups, driven by persistent economic instability and inadequate social support systems. Similarly, Gundersen et al. (2017) found that while some households experience intermittent food insecurity, the problem remains entrenched, particularly in communities of color and among low-income families, including those in the South.

As a response to these structural barriers, social movements have emerged to challenge the structural injustices within the food system and reclaim control over the historical

dispossession faced by many small farmers (Morales et al., 2021). One of the prominent movements in the U.S. has been focused on reconnecting Indigenous communities with traditional food systems, with an emphasis on promoting food sovereignty to ensure access to healthy, regionally produced foods (Anderson et al., 2019; Morales et al., 2021; Wittman et al., 2010). The concept of food sovereignty has evolved over time, but its core principles remain focused on affirming the right of people to control their own food systems, protect their livelihoods, and reconnect with ancestral practices to guarantee access to culturally appropriate foods (Clapp, 2022; Wald & Hill, 2016).

Numerous authors argue that food sovereignty differs from food security, as the latter does little to address questions of agency and rights (Wald & Hill, 2016; Patel, 2009). However, social movements have increasingly emphasized that food sovereignty is a prerequisite for achieving food security (Patel, 2009; Clapp, 2014). While food security primarily addresses access to sufficient nutritious food, food sovereignty extends this notion to include the rights of individuals and communities to control their food systems, ensuring sustainability, cultural relevance, and autonomy. While some tension exists between these concepts, they are more complementary than opposition (Clapp, 2014; Jarosz, 2014). Correspondingly, incorporating agency and sustainability into the discourse would fundamentally reshape the narrative, shifting the focus from mere access to food toward autonomy, self-determination, and long-term resilience (Gitz & Meybeck, 2016; FAO, 2014).

In this context, Sen (1982), in his seminal work *Poverty and Famines*, emphasized that famines arise not solely from a lack of food, but from inequities in access. Building on these insights, Clapp et al. (2022) consolidate these concepts of Amartya Sen's approach, which emphasizes the intangible aspects of development, defined as the expansion of individuals'

capabilities, the substantive freedoms that enable people to pursue lives they have reason to value (Sen, 1982). In this sense, development encompasses not only economic growth but also the removal of social, political, and structural barriers that constrain choice and opportunity. This perspective provides the foundation for incorporating agency and sustainability into food system analyses and policies (Clapp et al., 2022; Toboso, 2011; Béné et al., 2019).

Recognizing agency as a dimension of food security would not only bridge the gap between these two concepts but also align food security more closely with the principles of food sovereignty. Correspondingly, sustainability emphasizes the interconnectedness of ecological, social, political, and economic systems in maintaining food security for future generations (Clapp, 2022). Food systems are broadly defined as encompassing all components and actions related to food production, processing, distribution, preparation, and consumption, along with these activities' socioeconomic and environmental outcomes (Mehta et al., 2014).

Literature differentiates stability from sustainability in food security. Stability is often considered in the context of short-term disruptions, such as market fluctuations and natural disasters, which may temporarily undermine food security (Godfray et al., 2010). These disruptions can reduce food availability or access but do not threaten the long-term function of food systems. In contrast, sustainability accounts for the long-term resilience of food systems, aiming to ensure that food production and availability are maintained over time while minimizing environmental and social impacts (Godfray et al., 2010). Food security emerges from the interactions within complex food systems that intersect with ecological, health, economic, political, and socio-cultural dimensions, collectively shaping broader food and nutrition outcomes. The sustainability of food systems depends on maintaining ecological integrity, addressing health and nutritional needs, supporting economic viability, and fostering political

stability. Additionally, cultural factors and social systems influence both food security outcomes and adaptability (Gitz & Meybeck, 2016).

The long-term viability of food systems, therefore, depends on the sustained health and functionality of these interconnected systems (Béné, 2020; Béné et al., 2019; Berry et al., 2015; Ericksen, 2008; Ingram, 2011; Schipanski et al., 2016). Ecological systems provide the material foundation for food production and dietary diversity. However, the dominant industrialized food production has proven to be environmentally unsustainable. Over the years, numerous technological advancements have emerged but have exacerbated ecological degradation rather than mitigate it. For instance, the widespread use of synthetic fertilizers and pesticides has led to soil degradation, water pollution, and biodiversity loss (Tilman et al., 2002).

While increasing efficiency, mechanized farming practices have contributed to deforestation and greenhouse gas emissions (Foley et al., 2011). Additionally, genetically modified organisms (GMOs) have raised concerns about long-term ecological impacts and the reduction of crop genetic diversity (Altieri, 2009). While initially intended to boost productivity, these technological innovations often damage ecological systems' resilience and threaten food production's sustainability.

1.2. Food Insecurity Among Native American and Alaskan Natives

Food insecurity among Tribal communities cannot be divorced from their historical land dispossession through federal policies that systematically dismantled their holistic food systems. For thousands of years, Native food systems nourished and provided vitality to their community. These diverse and nutritious gastronomic traditions were shaped by the topography and local resources of the lands where Tribal nations settled (Chaparro et al., 2022).

However, nationwide policies enabled settler colonialism, land appropriation, and the displacement of Native. The implementation of these discriminatory policies disrupted Indigenous food systems and well-being (Lemke & Delormier, 2017; Wilson et al., 2021; Dunbar-Ortiz, 2021).

A significant example of the U.S. government's disruption of tribal lands is the Dawes Act of 1887, which fragmented communal landholding systems by appropriating and redistributing tribal lands into individual plots (Hanning, 2010). This policy, which applied to reservations in the Indian Territory (Cherokee, Creek, Choctaw, Chickasaw, Seminole, Miami, and Peoria tribes), the Oklahoma Territory (Osage and Sac and Fox tribes), New York (Seneca Nation), Nebraska (Sioux Nation), and the Badlands (Oglala Lakota tribe) led to the widespread loss of tribal territories to non-Native settlers (Hanning, 2010). Between the 1880s and 1934, approximately 90 million acres of land were transferred from Native to non-Native ownership. Had this legislation not been enacted, Native lands would today account for around 7.8% of U.S. land, or approximately 190 million acres, nearly double their current holdings (Merjian, 2010).

Subsequent federal policy persisted in discriminating against Tribes' land rights. The Burke Act of 1906 authorized the Secretary of the Interior to tax their land regardless of the allottee's consent or awareness. Thus, many parcels of land were lost to tax foreclosure, as allottees were either unfamiliar with the tax system or financially unable to meet tax obligations (Rusco, 2000).

Furthermore, economically, and agriculturally valuable lands were frequently expropriated from Native ownership and allocated to white settlers, directly contributing to today's food insecurity and inadequate health outcomes among the Indigenous community (Rusco, 2000).

From 2000 to 2010, 25 % of Native Americans and Alaska Natives (AIAN) were food insecure, which is significantly greater than the nationwide estimate of 10.5% in 2019. These statistics persisted from 2010 to 2020, when AIAN food insecurity was roughly double or even triple the levels encountered by white Americans (Nelson et al., 2024). Moreover, the COVID-19 pandemic exacerbated this issue. An investigation by the Native American Agriculture Fund found that approximately 50% of survey respondents experienced food insecurity by February 2021, with 31% facing very low food security (Bruening et al., 2017). More recent studies continue to confirm the disproportionate burden of food insecurity among AI/AN populations, highlighting persistent systemic inequities in access to nutritious and culturally appropriate foods (Nguyen et al., 2023; Nelson et al., 2024).

1.3. Food Insecurity Among Multiethnic and Black Communities

In recent years, there has been rising recognition that racism is a primary driver of racial health inequities. These disparities are profoundly embedded in structural racism, which is defined as the systemic paths in which societies perpetuate racial discrimination by enabling inequitable systems that reinforce discriminatory beliefs, values, and the unequal allotment of resources (Odoms-Young & Bruce, 2018)

Food insecurity represents an immediate outcome of these structural inequities, surfacing primarily from economic constraints and disproportionately impacting Black and Hispanic populations. The burden of food insecurity is not distributed equally, with racial and ethnic underserved groups bearing a significantly heightened share (Odoms-Young et al., 2023, 2024).

Long-standing wealth gaps between Multiethnic and White Americans have further exacerbated these disparities. Research indicates that Black and Hispanic individuals are more likely to experience chronic poverty and downward income mobility than their White

counterparts. These income inequalities are rooted in structural racism, which has historically restricted intergenerational wealth accumulation and limited access to education and employment opportunities (Odoms-Young et al., 2023, 2024).

Despite economic recovery by 2018, food insecurity rates remained disproportionately high among Black (21.2%) and Hispanic (16.2%) households, compared to the national average of 11.1% (USDA, 2019). By 2020, food insecurity among Black households increased to 21.7%, triple the rate of White households at 7.1% (Coleman-Jensen et al., 2021). While the COVID-19 pandemic exacerbated food insecurity, these persistent disparities highlight ongoing vulnerabilities in underserved communities. Although research has expanded, significant gaps remain in understanding how food insecurity and neighborhood environments contribute to racial, ethnic, socioeconomic health disparities, and in identifying effective interventions to reduce these inequities (Seligman & Schillinger, 2010; Walker et al., 2010).

National Trends and Disparities in Food Insecurity Rates

For decades, food insecurity has remained a critical public health concern. In 2021, an alarming 13.5 million U.S. households were classified as food insecure, with heightened prevalence among single-parent households and those led by Black, Hispanic, Alaska Natives, and Native American individuals (Coleman-Jensen et al., 2023, 2022).

Food insecurity rates were significantly greater among households with children led by a single female (24.3%) or a single male (16.2%). Similarly, Black (19.8%) and Hispanic (16.2%) homes faced notable disparities compared to the national average (Coleman-Jensen et al., 2022). Contrastingly, 25% of Native American and Alaska Native households were consistently food insecure, making them twice as susceptible to experiencing food insecurity compared to the white population (Blue Bird Jernigan et al., 2017).

1.4. Food Insecurity Among College and University Students

Food insecurity is a complex, multidimensional phenomenon intrinsically tied to a confluence of socioeconomic, cultural, and structural factors. Its impact is disproportionate, particularly affecting historically marginalized groups. Bowen et al., (2021) claim that racism is a fundamental structural cause of food insecurity, highlighting how it perpetuates disparities in access to resources and opportunities. Particularly for students from underserved groups, food insecurity is not simply a matter of economic hardship but a direct consequence of entrenched societal inequalities. Previous studies have documented that the intersectionality of overlapping identities, such as race, gender, and socioeconomic status, compounds material hardships, amplifying the vulnerability of students to food insecurity, housing instability, and poor academic performance (Joachin, 2025; Silva et al., 2015). This study, therefore, builds on these theoretical frameworks to explore how food insecurity manifests differently across diverse marginalized populations in higher education.

Food insecurity is not a standalone issue; it is deeply interwoven with other forms of material hardship. Structural inequities, such as discrimination, limited access to financial resources, and institutional barriers, contribute to a broader environment of insecurity and instability for these students (Bowen et al., 2021). These hardships are further exacerbated by a lack of culturally relevant resources or the ability to afford nutritious food (Alleman et al., 2024).

The consequences of food insecurity on students' cognitive function, academic performance, and overall well-being are profound and far-reaching. Previous studies have demonstrated that food insecurity impairs cognitive abilities and academic outcomes, particularly among children and adolescents. Jyoti et al. (2005) and Jansen et al. (2017) found that food insecurity disrupts focus, lowers academic achievement, and contributes to behavioral issues due

to inadequate nutrient intake. For college students, food insecurity similarly increases stress, anxiety, and fatigue, which in turn hinder their ability to concentrate, retain information, and perform academically (Bruening et al., 2017; Nazmi et al., 2019).

On the other hand, elementary and post-secondary students are frequently disregarded in food security discourse (Coleman-Jensen et al., 2016). Nevertheless, findings indicate that student populations face food insecurity at rates significantly higher than the general population (Broton et al., 2014). Previous investigations on U.S. college campuses reported that food insecurity rates range from 43.5% (Nazmi et al., 2019; Bruening et al., 2017) to nearly 52% of the student population (Broton & Goldrick-Rab, 2018; Dubick et al., 2016). Considering these findings, this present study seeks to address the following guiding research questions:

1. What is the prevalence of food insecurity among post-secondary students in the U.S. during 2019-2023?
2. To what extent do demographic factors, including race/ethnicity, income, sex, parental status, age, and marital status, predict the risk of food insecurity among college and university students in the U.S.?

By addressing these questions, this study aims to illuminate the often-overlooked burden of food insecurity among post-secondary students and generate evidence to inform targeted interventions and policy responses designed to support this vulnerable population.

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Chapter 2-Assessing Food Security Among U.S. Post-Secondary Level Students

2.1. Introduction

Food insecurity is recognized as a multidimensional and persistent global concern affecting millions of people worldwide (Baspakova et al., 2024). The USDA Economic Research Service estimated that 1.3 billion people experienced food insecurity in 2022, underscoring the necessity to quickly address this global challenge (U.S. Department of Agriculture, Economic Research Service, 2022). Furthermore, American citizens are not immune to this international crisis, with approximately 13.5% of U.S. households experiencing food insecurity in 2023 (U.S. Department of Agriculture, Economic Research Service, 2023). Additionally, a recent study found that students in U.S. higher education institutions experience food insecurity at a three times higher rate compared to the national average (Nazmi et al., 2018, 2019). The discourse on food insecurity reveals that the prevalence among university students ranges from 19% to 52% across U.S. campuses (Hagedorn et al., 2019; Soldavini et al., 2019; Camelo & Elliott, 2019; Hagedorn-Hatfield et al., 2023).

This study is grounded on the theoretical framework of the pillars of food security: availability, access, utilization, and stability, acknowledging that these dimensions manifest differently across populations. Specifically, among students, these variations often reflect differences in financial resources, institutional support, and social contexts (Pérez-Escamilla, 2017, 2024). Conceptualizations of food security extend beyond mere food presence to encompass nutritional quality, cultural appropriateness, safety, emotional well-being, socially

acceptable acquisition methods, and the ability to make informed, autonomous choices regarding food. By integrating these perspectives, this study situates food insecurity within both structural and individual contexts, providing a comprehensive lens to interpret disparities and challenges in higher education settings (Pérez-Escamilla & Segall-Corrêa, 2008; Change, 2016).

This complex issue may be explained by unique vulnerabilities among college students, including limited income, higher tuition costs, and limited time availability, all of which exacerbate their risk of experiencing food insecurity (Bruening et al., 2017). These challenges are compounded by the often temporary and part-time employment status of many students, which may not be sufficient to cover both living expenses and academic-related costs (Bruening et al., 2017). Furthermore, food insecurity is especially severe for students, as this condition is linked not only to poor dietary outcomes but also to heightened mental health risks. Bruening et al. (2017) conducted an extensive study among college students and found that food insecurity was strongly associated with poorer psychosocial health outcomes, including elevated stress and increased depressive symptoms. Food-insecure students were more likely to report mental health challenges such as anxiety, depression, and lower self-esteem. Similarly, previous studies documented that food insecurity was significantly associated with chronic health conditions, including type 2 diabetes, hypertension, and higher rates of attention disorders. (Shakya et al., 2025; El Zein et al., 2019).

Individuals experiencing greater levels of food insecurity are less likely to engage in regular physical activity and often develop a pattern of overeating when food becomes available (Robaina & Martin, 2013; To et al., 2014). Contrastingly, another study revealed more complex results: food-insecure adults were more physically active than their food-secure counterparts; however, they were less likely to follow the recommendations of the Physical Activity

Guidelines for Americans (PAGA), which suggests at least 150 minutes of moderate-intensity aerobic activity per week combined with muscle-strengthening activities on two or more days (Leung et al., 2015; Bushman, 2019). As a primary institutional response, many universities and colleges have established campus food pantries to mitigate the negative effects of food insecurity among student populations. Frequent use of campus food pantries has been associated with improved student health outcomes, including reduced depressive symptoms, better self-perceived health, and greater sleep sufficiency (Martinez et al., 2022).

Nonetheless, university food pantries have a limited supply of fresh vegetables and foods that are culturally relevant for a diverse student population (Patton-Lopez et al., 2014). To transform this discourse, some universities have established community gardens to supply fresh produce to campus food pantries. Multiple benefits are associated with this approach, including increased vegetable consumption, improved social connection and sense of belonging, ultimately leading to improved mental and physical health (Djan, 2023; Barnidge et al., 2013; Litt et al., 2011). However, the success of this strategy is strongly dependent on environmental and socio-economic factors.

To examine the structural disparities among U.S. college and university students, this study uses the 10-item USDA Household Food Security Module, a widely recognized and validated instrument for assessing household food insecurity in the United States (Blumberg et al., 1999). This measure is well-established and has been applied consistently for decades (Habicht & Meyers, 1991); however, it primarily captures the experience of food insufficiency and does not fully address other dimensions, such as utilization or agency. Previous research has noted similar limitations in specialized populations, including older adults, where measurement tools may not fully capture key contributors to food insecurity, such as physical limitations or

community-level food access barriers (Wolfe et al., 1996). Additionally, the 10-item module may not account for structural contributors to food insecurity, including limited availability of nutritious foods, cultural or religious restrictions on acceptable foods, or logistical barriers such as mobility or transportation challenges (Wolfe et al., 1996). Despite these limitations, the module provides a practical and reliable approach for assessing food security.

Given this context, it has become clear that we need a better understanding of how demographic factors affect food security issues in post-secondary level students. This study uses nationally representative survey dataset from the Current Population Survey (CPS), to address two critical research questions: What is the prevalence of food insecurity among U.S. postsecondary students? And to what extent do Income, Race/Ethnicity, Age, Sex, Marital Status, and Parental Status serve as significant predictors of food security outcomes among U.S. post-secondary level students?

2.2. Methodology

2.2.1 Data Collection

This study uses publicly accessible data from the Current Population Survey (CPS), specifically the Household Food Security Supplement (HFSS) administered by the U.S. Department of Labor and the U.S. Census Bureau (U.S. Census Bureau, n.d.). The HFSS serves as the primary federal instrument for measuring household food security in the United States. The analytical dataset comprises five years of CPS data (2019–2023) (U.S. Census Bureau, n.d.). Although the CPS samples the entire U.S. population, this study restricted the analytic sample to respondents who indicated current enrollment in a university or college at the time of the survey. All students included those enrolled in community colleges, trade schools, and 4-year colleges or universities, at both undergraduate and graduate levels. The CPS and HFSS achieved an average

response rate of approximately 72% over the 2019–2023 period (U.S. Census Bureau, n.d.). The final sample consists of 22,686 students aged 16 to 54, representing all 50 states and the District of Columbia. State-level representation ranged from smaller samples in Maine (n=118) and Vermont (n=208) to larger samples in California (n=2,524), Texas (n=1,495), New York (n=1,024), and Florida (n=886) (Figure 1). This index was estimated using the following equation, where greater scores indicate food insecurity (Fiagbor et al., 2025):

$$FSI = \sum_{i=1}^n x_i \quad \text{Eq.1}$$

Where i = each of the 10 survey questions, X_i = coded response for that question.

The HFSS module evaluates access to adequate and nutritious food by asking whether respondents worried about food running out, experienced insufficient resources to buy balanced meals, or adults in the household cut or skipped meals due to financial constraints. Additional items assessed whether respondents ate less than they felt they should, went hungry, lost weight, or went an entire day without food in a 12-month period. Affirmative responses, including “yes,” “often,” “sometimes,” were coded as 1, and all other responses were coded as 0, according to current USDA guidelines to generate the FSI (United States Department of Agriculture, 2025).

To assess the relationship between food security and student sociodemographic characteristics, this investigation included the following predictors in the model: Household Income, Race/Ethnicity, Age, Sex, Marital Status, and Parental Status. All variables were recoded and consolidated as needed to improve interpretability and ensure statistical robustness (Table 1). This framework guided the construction of the models, underscoring how household structure, social roles, and available resources may influence students' food access and security (Story et al., 2008). Model selection involved constructing 13 different models, including a null

model. Redundant models were automatically flagged using RStudio diagnostics, and statistically meaningful models were retained for analysis (R Core Team, 2016).

Guided by the study's analytical approach, the author intentionally uses the terms "mother" and "father" to denote social roles rather than biological or gendered identities; this usage appears in the Results and Discussion sections to examine traditional social frameworks and their association with food security.

2.2.2. Data Analysis

Generalized linear models (GLMs) with a log-link function were used to assess the relationship between individual Food Security Index (FSI) and sociodemographic characteristics among postsecondary students. A total of 13 models were fit using FSI as the response variable, including single-predictor models, additive covariate models, and a null model. In this study, correlated variables ($r > 0.50$) were not included within the same model to reduce multicollinearity (Mamun & Paul, 2023).

Model performance was systematically evaluated using Akaike's Information Criterion corrected for small sample sizes (AICc), with models having $\Delta\text{AICc} \leq 2.00$ considered to have substantial empirical support (Burnham & Anderson, 2002; Mamun & Paul, 2023). All model selection and comparison procedures were conducted using the AICcmodavg package in R, allowing assessment of the relative importance of predictors included in this study. McFadden's pseudo- R^2 was calculated for each model using the pscl package as a measure of goodness-of-fit.

Predicted FSI scores were generated from the models using the ggeffects package, back-transformed from the log scale, and rescaled to a 0–10 scale for interpretability. When working with log-transformed variables in regression models, it is standard practice to back-transform the predictions using the exponential function, especially for count or continuous data (Winkelmann,

2008). Visualizations, including violin plots, scatter plots, and confidence intervals, were produced for each covariate to illustrate the relationships between student sociodemographic characteristics and food security outcomes.

2.3. Results

2.3.1. Sample Characteristics

This dataset sample included 22,686 postsecondary students from all 50 U.S. states and the District of Columbia (Fig.1). Participants were 44.4% men and 55.6% women. Most students identified as White (74.5%), followed by Black (12.5%), Asian (9.8%), and Multiethnic (3.2%). The majority reported not having children (87.15%), whereas 12.85% were parents. Most participants were unmarried (79.4%), while 16.6% were married, 0.3% widowed, 0.9% separated, and 2.8% divorced. Participant ages ranged from 16 to 54 years, with a mean of 24 (SD = 7.66). Across the full sample, 12% of students reported experiencing food insecurity.

2.3.2. Model Fit and Predictive Strength

The global model, which was the most competitive, included the additive effects of Income ($\beta = -0.31$, SE = 0.02, 95% CI [-0.35, -0.27]), Race ($\beta = 0.28-0.32$, SE = 0.03-0.04, 95% CI [0.21, 0.39]), Age ($\beta = 0.11$, SE = 0.02, 95% CI [0.07, 0.15]), Sex ($\beta = 0.08$, SE = 0.01, 95% CI [0.06, 0.10]), Marital Status ($\beta = 0.05-0.14$, SE = 0.03-0.08), and Parental Status ($\beta = 0.10$, SE = 0.02, 95% CI [0.06, 0.14]).

The most-supported model accounted for only 7% of the variance in Food Security Index, indicating that the sociodemographic factors included in the analysis explain a limited portion of students' food security. This result suggests that these variables may not fully capture the complexity of food insecurity among postsecondary students, and that additional unmeasured

factors likely exert a stronger influence on food security outcomes in this population. ($R^2 = 0.07$; Table 2).

2.3.3. Sociodemographic Factors Associated With Food Insecurity

Income

Analyses examining the relationship between household income and food insecurity revealed a pronounced inverse association. Students from the lowest-income households exhibited the greatest predicted food insecurity scores (9–10), with scores declining as household income increased. Students in the mid-income range (\$60,000– \$80,000) demonstrated predicted scores near 3, indicating a reduction of 2/3 compared to those in the lowest-income bracket. Among students with household incomes exceeding \$120,000, predicted food insecurity scores approached zero, representing an approximate tenfold decrease relative to the lowest-income group. These findings highlight that students from lower-income households experience greater food insecurity (Fig.2).

Race

Racial differences in food insecurity were observed, with Black and Multiethnic students reporting greater levels of food insecurity than White and Asian students. Specifically, the food security index for Black students was around 0.5, indicating greater food insecurity compared to White students, who had a lower food security index of 0.3. Multiethnic students had the greatest food insecurity index at about 0.6, which was not only greater than both White (0.3) and Asian students (0.2), but also nearly twice the food security index of White students. These findings suggest that Multiethnic students experience food insecurity at a level approximately two times greater than their White counterparts, and that Black and Multiethnic students face significantly greater challenges related to food security compared to their White and Asian peers (Fig. 3).

Age

Food insecurity scores increased with age. Older students consistently reported higher food insecurity scores than younger students, following an approximately linear trend. The fitted regression line suggests that food insecurity rose by about one unit for every five-year increase in age (Fig. 4).

Sex

In terms of sex, female students experienced food insecurity at a rate 10% greater than male students, with the food security index for females at 0.35 compared to 0.25 for males, reflecting a 0.10 greater level of food insecurity (Fig. 5).

Marital Status

Analyses of marital status revealed that students who were married or never married reported slightly lower levels of food insecurity, yet still significantly lower, compared to those who were separated, widowed, or divorced. Specifically, the food security index for married students was approximately 0.1, which was 0.2 lower than that of widowed students (0.3), 0.3 lower than divorced students (0.4), and 0.4 lower than separated students (0.5). Separated students experienced food insecurity that was five times greater than married students and approximately 2.5 times greater than never married students (0.2). While these differences may appear modest, they are still statistically significant, students who are separated face the most severe levels of food insecurity, with their food insecurity index being five times greater than married students (Fig. 6).

Parental Status

Students without children reported greater food security than those with children, with an average Food Security Index (FSI) of 0.33 compared to 0.51 for students with children. This

indicates that students with parental responsibilities are approximately 1.55 times more likely to experience food insecurity than their peers without children (Fig. 7).

2.4. Discussion

Food insecurity remains a persistent and multifaceted challenge in the United States, disproportionately affecting individuals and households with limited financial, social, and structural resources. Since the establishment of the USDA's Food Security Measure in 1995, scholars have extensively examined food insecurity across a range of underserved populations, including elderly adults, those with disabilities and students (Pak & Kim, 2020; Gundersen, et al., 2017).

The COVID-19 pandemic further intensified food insecurity across the United States. Among college students, disruptions to on-campus resources, including employment, housing, dining services, and food pantries, significantly reduced their ability to access and afford nutritious meals. These structural and logistical challenges were compounded by heightened psychological distress, contributing to increased levels of anxiety, depressive symptoms, and broader psychosocial strain among students (Bruening et al., 2017; Shakya et al., 2025).

2.4.1. Variations in Prevalence Across Studies and Data Sources

These pandemic-related challenges help contextualize previous reports, conducted prior to the pandemic, which reported that food insecurity among college students can reach rates as high as 52%, (Bruening et al., 2017; Broton & Goldrick-Rab et al., 2018), whereas the present study, utilizing nationally representative data from the Current Population Survey (CPS), identified a considerably lower prevalence of 12% (Coleman-Jensen et al., 2021). On average, college and university students accounted for 3–4% of all CPS respondents, thereby limiting the representation of higher education students in the dataset. Participants were distributed across

multiple states, with sample sizes ranging from 118 students in Maine to 2,524 in California (Fig. 1). Taken together, these structural and regional variations, in conjunction with differences in institutional resources and public policies across states, may contribute to the discrepancy between the prevalence observed in this study and the higher rates documented in prior research (Broton & Goldrick-Rab, 2018; Wolfson et al., 2022).

Socioeconomic and Geographic Determinants of Food Insecurity

Furthermore, state-level poverty rates exhibited substantial variability, from less than 10% in Utah and New Hampshire to more than 17% in Mississippi and Louisiana (U.S. Census Bureau, 2025), and directly influenced both access to essential resources and the overall risk of food insecurity. Geographic context further compounds these disparities; rural regions often experience higher poverty rates and reduced access to affordable, nutritious foods than their urban counterparts (Gundersen et al., 2017). Future research should prioritize the development of survey methodologies capable of capturing such structural and contextual variations with greater precision, ensuring that reported prevalence rates reflect the complex realities of food insecurity across diverse higher education populations.

2.4.2. Economic Constraints and Survey Methodological Considerations

Food insecurity is a complex and multifaceted issue that extends beyond economic limitations, encompassing psychological and structural barriers that influence individual outcomes (Hagedorn, et al., 2019). In this study, household income was inversely associated with food insecurity; students from greater-income households reported greater food security, reflecting the role of financial resources in mitigating food-related stress (Fig. 2).

Indeed, food insecurity among individuals is directly dependent on multiple levels of social and structural barriers, from individual factors to institutional and political contexts

(Bruening et al., 2017; Broton & Goldrick-Rab et al., 2018). Similarly, previous analyses reported that in-person food insecurity surveys promote greater trust and more honest disclosure, which usually leads to reporting higher food insecurity levels compared to national phone surveys, which usually standardize people's circumstances (Bruening et al., 2017; Coleman-Jensen et al., 2021; Rafferty et al., 2023).

2.4.3. Structural Racism and Racialized Patterns of Food Insecurity

Race was a significant predictor of food insecurity, with Black and Multiethnic students reporting greater levels of food insecurity compared to White and Asian peers (Fig. 3). This pattern reflects historical marginalization and systemic discrimination, as structural inequities in access to healthy foods, culturally appropriate programs, and institutional decision-making continue to shape disparities in food security (Tanner et al., 2015; Rafferty et al., 2023; Leslie et al., 2015).

Scholarly literature documents that food security and urban agriculture initiatives often reproduce racial inequalities when not designed with equity-centered approaches; projects led by white, nonresident actors may exclude Black and Hispanic communities, while efforts initiated by communities of color frequently encounter systemic barriers, that undermine their capacity to strengthen local food governance (Tanner et al., 2015; Rafferty et al., 2023; Moore et al., 2015). Other analyses highlight the need for culturally appropriate and participatory interventions to avoid policies and programs that consolidate racial privilege within food systems (Leslie et al., 2015; Passidomo, 2013; Lunsford, 2022).

This exclusion from institutional decision-making processes collectively shapes the food choices of multiracial and Black populations. Specifically, in low-income neighborhoods, the increased prevalence of fast-food chains and convenience outlets create food deserts that

exacerbate both food insecurity and health disparities (Carrillo-Álvarez et al., 2024; Campbell et al., 2021).

2.4.5. Age-Related Vulnerabilities and Nontraditional Student Populations

A relationship has been identified between food insecurity (FI), particularly severe forms, and malnutrition, as well as between FI, especially mild forms, and overweight or obesity, highlighting a dual burden of nutritional outcomes among older adults (Pereira et al., 2022). In the college-student context, prior research indicates that FI disproportionately affects older or non-traditional students. For example, Wolfson et al. (2022) found higher levels of FI among older students, while a nationally representative survey reported that approximately 23 % of undergraduates experienced FI in 2020, with students aged 24 or older disproportionately impacted (U.S. Government Accountability Office [GAO], 2024). Similarly, a multi-institutional study of first-year U.S. college students found a 19 % prevalence of FI, with older and non-traditional students at elevated risk (El Zein et al., 2019).

Consistent with these findings, the present study found that age influenced FI, with older students reporting higher levels than younger students (Fig. 4). This pattern may reflect increased financial obligations, greater academic pressures, and reduced access to familial or institutional support networks among older students (Maroto et al., 2015; Payne-Sturges et al., 2018). Collectively, these results underscore the importance of considering age as a key sociodemographic factor in postsecondary food-security interventions, particularly for older and non-traditional student populations (Pérez-Escamilla, 2008, 2017, 2024).

2.4.6. Gendered Dimensions of Food Insecurity Among College Students

This study found college students who reported as women experienced higher levels of food insecurity than their male counterparts. In this context, the food security discourse reports

that women face disproportionate and unique socioeconomic barriers. Financially, women have limited economic stability due to persistent wage gaps and occupational segregation (Bruening et al., 2017; Coleman-Jensen et al., 2020, 2021; Wolfson et al., 2022). Particularly, women who are mothers often assume primary caregiving roles, which constrains their employment options and time availability, and prioritize feeding their children before themselves (Broton & Goldrick-Rab, 2018; Bruening et al., 2017; Patton-López et al., 2014; Wolfson et al., 2022). While this study did not investigate potential interactions between sex and parental status among college students, largely due to limitations in the dataset and measurement structure, future research should examine disparities in food insecurity among college students who are also parents to better understand these intersecting vulnerabilities (Gao et al., 2022).

2.4.7. Marital Status, Parental Responsibilities, and Intersecting Stressors

Married students, especially in dual-income households, often have greater economic stability, whereas divorced or separated students may face single-parent responsibilities with limited resources (Huang et al., 2016; Springer, 2023; Nazmi et al., 2019). Previous investigations highlight that marital dissolution is associated with greater economic vulnerability and reduced access to stable food resources (Huang et al., 2016; Bowen et al., 2021). Married individuals, particularly those in dual-income households, are often better positioned to allocate resources toward food expenditures (Springer, 2023).

Similarly, single students are more likely to rely on financial support through their families and higher institutions. Contrastingly, divorced and separated students are more likely to assume single-parent roles with limited financial aid (Nazmi et al., 2019; Ghaffar, 2020).

Finally, college students who were also parents were exposed to greater food insecurity issues (Fig. 7). Parental responsibilities, particularly for mothers, amplify both financial and

psychological stress, as society often shapes parents' decisions by placing a disproportionate burden on mothers in child-rearing (Dunn et al., 2015). Similarly, findings from previous studies indicated that mothers in financial hardship reported heightened psychological distress when restricting their children's preferred foods (Fram et al., 2011; Campbell, 2015; Goldrick-Rab, 2020).

In the same context, men who function as primary breadwinners may experience additional stressors, including long work hours, reduced time for caregiving, and sleep deprivation (Rudolph et al., 2018; Walzer, 2025). These financial pressures, combined with academic demands, can further restrict the time and resources needed to prepare nutritious meals (Goldrick-Rab, 2020; Nazmi et al., 2019). In this study, an interaction between sex, parental status, and race was not investigated because the data were too coarse to allow for meaningful analysis of these interactions. Future research should seek to identify potential disparities between male and female college students who are also parents, with attention to race, as this could provide valuable insights into how parental responsibilities may differently affect students of different sexes and racial backgrounds.

2.4.8. Implications for Equity-Centered Interventions in Higher Education

Collectively, these findings underscore the need for targeted interventions that address not only economic constraints but also structural and social inequities across demographic groups. Addressing disparities in food security requires equity-centered approaches that consider income, race, age, sex, marital status, and parental responsibilities simultaneously.

Long-standing structural and socioeconomic inequities continue to drive food insecurity among college students, with policy changes in the late 2010s, such as reductions in the Policy shifts during the late 2010s, including retrenchment in the Supplemental Nutrition Assistance

Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), exacerbating vulnerabilities for low-income populations (Miller et al., 2020). While these programs play an essential role in alleviating hunger and poverty, they remain insufficient to eliminate food insecurity, particularly among students who face unique barriers to access. Strict SNAP eligibility rules, particularly those tied to income and college enrollment status, have historically limited participation among college students (Kelchen & Stedrak, 2016; Darby et al., 2023), and even temporary expansions of eligibility during the COVID-19 pandemic did not necessarily lead to higher utilization among students. In addition to structural barriers, cultural stigma significantly impedes engagement with available resources. Many students avoid campus food pantries and other forms of assistance due to embarrassment, shame, or fear of negative perceptions, often believing that financial struggles are simply part of the college experience (El Zein et al., 2019).

Food insecurity among students also varies by institution type. State-administered community colleges disproportionately serve low-income populations and exhibit higher rates of food insecurity, while private institutions and historically Black colleges and universities (HBCUs) remain underexamined (Blagg et al., 2017; Dickinson, 2022; Kornbluh et al., 2022). Long-term consequences of food insecurity, including learning deficits, lower graduation rates, poor dietary behaviors, and mental health challenges, underscore the urgency of addressing this issue (Hagedorn-Hatfield et al., 2022; Darby et al., 2023). To mitigate these disparities, universities can adopt a multi-pronged approach: integrating campus-based food security initiatives such as food pantries, meal-sharing programs, and subsidized grocery resources; reducing the stigma associated with using these services through awareness campaigns and inclusive messaging; expanding partnerships with local food banks and federal assistance

programs; and tailoring interventions to the specific demographics and institutional contexts of their student populations (Budowle et al., 2023). By addressing both structural barriers and cultural perceptions, higher education institutions can develop equitable, sustainable strategies to improve food security and support student success.

In this regard, Amartya Sen's framework emphasizes the need for policies that foster both equity and human well-being (Archard, 1995; Sen, 1982). Within this framework, compassion is not merely a benevolent attitude but a responsibility of governments and institutions to ensure that individuals can achieve food security without compromising other aspects of their well-being. Bridging the gap between national measurement tools and the lived experiences of students will be a crucial step toward developing more inclusive, effective, and equitable food security interventions (Miller et al., 2020; Ikejiaku, 2024).

Similarly, this work advocates adding another critical pillar: reliance. It is imperative to recognize that, particularly within the context of higher education, students cannot fully exercise their agency or effectively utilize available resources without the reliance necessary to disclose their current circumstances and to depend on their institutions to provide meaningful support. Research on collegiate food insecurity reveals that students navigate complex campus environments, where trust, peer networks, and social connections play crucial roles in determining whether and how they access resources (Campbell et al., 2021; Warne et al., 2023). During the roundtable committee defense, the importance of student advocacy emerged as a key recommendation: students experiencing food insecurity should be able to rely on peers to offer guidance, share resources, and provide relevant contacts. Literature further suggests that students are more likely to engage with assistance when the source reflects their own identity or lived experience (Budowle et al., 2023). Fostering reliance is therefore essential to making students

active participants, rather than passive recipients, in the policies and interventions intended to support them. This aligns with emerging evidence that peer-led, student-driven initiatives can strengthen engagement, increase utilization of available resources, and reduce stigma (OoNorasak et al., 2022; Duong et al., 2024).

In contrast, while the standard 10-item USDA food security survey focuses primarily on food availability and economic access, it fails to capture the full spectrum of food security challenges. The narrow lens of this instrument overlooks dimensions such as agency, utilization, culturally or religiously informed dietary practices, and the newly proposed pillar of reliance, all of which shape students' ability to achieve meaningful food security (Budowle et al., 2023). Several scholars highlight that conventional U.S. measures have conceptual limitations, including inconsistent thresholds, limited cultural sensitivity, and an emphasis on economic access at the expense of lived experience (Arteaga, & Wilde, 2023; Jones et al., 2013; Pérez-Escamilla, 2024).

Frameworks like the Food Insecurity Experience Scale (FIES), therefore, offer a more nuanced, multidimensional alternative by assessing the severity of food insecurity through individuals' lived experiences (Saint Ville et al., 2019). The FIES framework accounts for psychological and behavioral adaptations, including worry about food access, rationing behaviors, and coping strategies, which align closely with campus-based studies documenting emotional stress, shame, and hidden coping mechanisms among college students (Chrisman et al., 2024; Rafferty et al., 2023).

A capability-based approach situates food security within the broader context of human development, emphasizing the fundamental freedoms students must choose what, when, and how they eat (Burchi & De Muro, 2012). By incorporating dimensions of agency and empowerment,

this framework highlights that access alone does not guarantee meaningful food security. Structural and institutional factors, including stigma, financial constraints, limited culturally appropriate options, and variable campus food environments, may constrain students' ability to fully utilize available resources, as documented in several recent college-focused studies (Campbell et al., 2021; Warne et al., 2023).

Food insecurity among college students has received widespread attention, yet consensus on its magnitude remains limited (Laska et al., 2020; Laska et al., 2021; U.S. Government Accountability Office [GAO], 2024). Most studies rely on convenience samples, though a few have leveraged nationally representative surveys, including the Current Population Survey and the Panel Study of Income Dynamics, to estimate more accurate prevalence rates (Gundersen et al., 2017; Nikolaus et al., 2020; Wolfson et al., 2022). The 2019–2020 National Postsecondary Student Aid Study (NPSAS) was the first nationally representative survey of undergraduate and graduate students to include food-security measures, reporting that 23% of undergraduates and 12% of graduate students experienced food insecurity (Irwin et al., 2023). These rates exceed prior estimates for both college students and the general adult population, highlighting unique vulnerabilities among college students (Coleman-Jensen et al., 2022; Gundersen et al., 2017).

Inconsistencies in measurement further complicate comparisons. Variations in survey instruments (6-item vs. 10-item USDA modules) and reference periods (30 days, 12 months, or academic term) influence prevalence estimates (Nikolaus et al., 2020; Ellison et al., 2024). Additionally, college students' diverse financial resources, including employment, family or peer support, scholarships, loans, and meal plans, may affect how they interpret questions about access to food money. Interventions should address these factors, clarify survey terminology, and provide targeted support to meet students' specific needs (Laska et al., 2021; Nowicki, 2018).

2.5. Conclusion

This investigation found that 12% of higher education students experienced food insecurity during the 2019–2023 period, across the United States, a prevalence significantly lower than that reported in previous studies. This difference may be partly explained by sample limitations, as only about 3-4% of the total survey respondents were higher education students who completed the food security supplement. These students represented a diverse range of institutions and states with diverse socioeconomic status factors, which may have reduced the model's explanatory power, accounting for only 7% of the variance in food insecurity. Despite these limitations, the findings suggest that demographic and socioeconomic factors can significantly predict food security levels among college and university students.

A notable observation from this study is the apparent disconnect between the broader national discourse on food insecurity and the levels reported on this survey, which indicates the urgency to acclimate nationwide tools to reflect the realities of students in higher education.

While these instruments provide valuable insights into national trends, they do not fully reflect the circumstances and challenges faced by higher institution students. Developing a specialized or supplemental module within the national survey that applies more contextually relevant and sensitive measures could improve the accuracy of data related to this population.

2.6. Figures and Tables

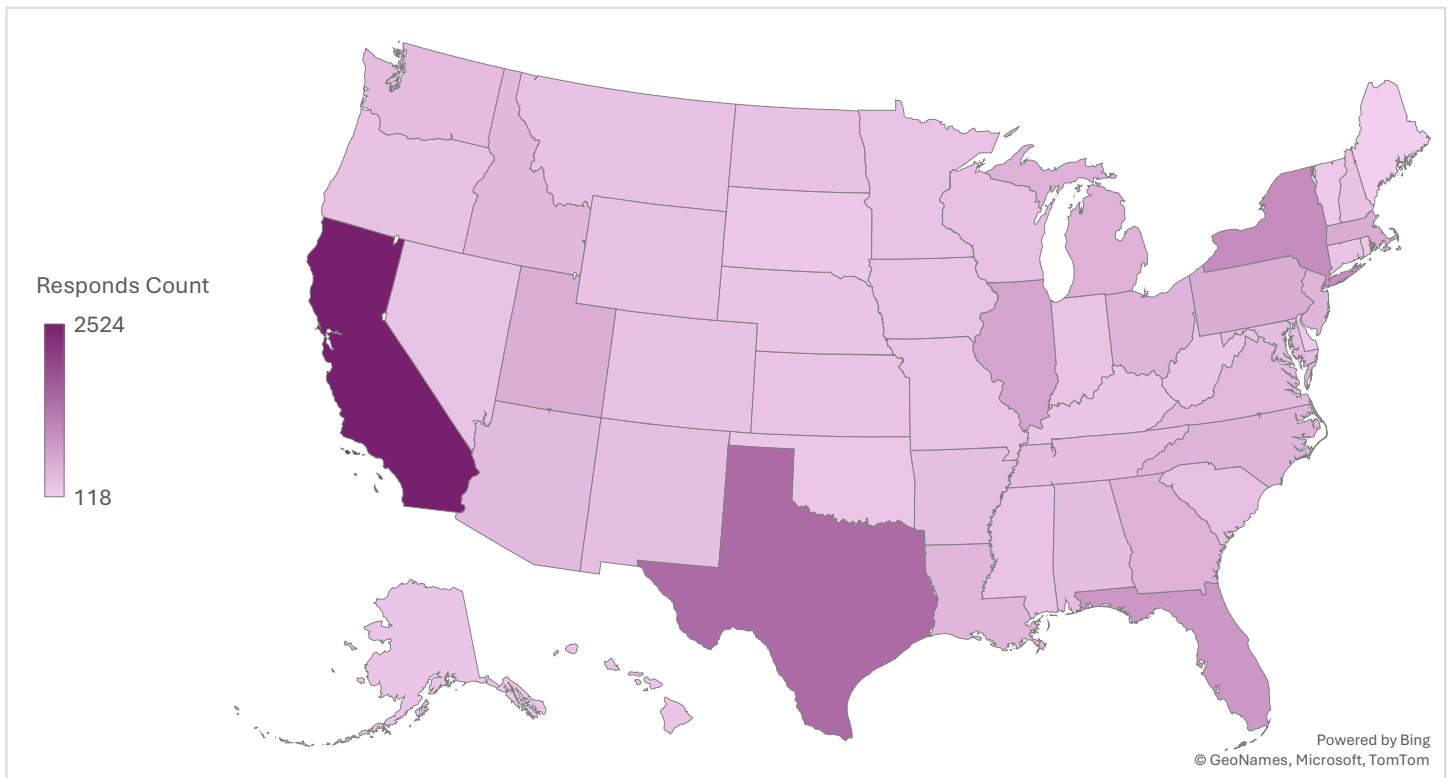


Figure 1. Survey Respondent Distribution Across the U.S. (2019-2023)

The map above illustrates the distribution of respondents across the United States for the study. The color gradient represents the number of respondents in each state, with darker shades indicating higher respondent counts. The data ranges from 118 responses in the least represented states to 2,524 responses in California, highlighting regional differences in participation.

Table 1. Summary of Variables, Coding Procedures, and Descriptive Statistics for CPS-HFSS Postsecondary Student Sample (2019–2023)

Variable	Description	Response Categories	Summary	Notes
Enrollment Status	Are you currently enrolled in college/university?	Enrolled (included in study) / Not enrolled	N = 22,686 (enrolled students)	Only respondents enrolled in higher education
Food Security Index	Food security status measured by USDA 10-item Household Food Security Survey Module	Score ranging from 0 to 10	Count variable; modeled using Poisson GLM	Index based on USDA 10-item scale measuring food security
Race/Ethnicity	What is your race/ethnicity?	White only, Black only, Asian only, Multiracial/Other	White: 74.5%; others combined	Original twenty-six categories consolidated into four groups
Household Income	What is your household income?	Income categories recoded to mean values	Mean income (by category)	Categorical income converted to continuous mean values
Parental Status	Do you have children under eighteen in household?	0 = Not a parent, 1 = Parent	Binary variable	Original categories (child age groups) recoded into binary
Age	How old are you?	Reported in years	Mean: 24.44; Min: 16; Max: 54; SD: 7.66	No respondents over 54 years old
Marital Status	What is your marital status?	Married (spouse present/absent combined), Widowed, Divorced, Separated, Never married	Categories combined	Married categories combined to improve analysis
Sex	What is your sex?	Male, Female		Binary variable

Variables include key sociodemographic and outcome measures. Enrollment Status restricted the sample to currently enrolled students (N = 22,686). Food Security Index (0–10) is based on the USDA 10-item module and modeled as a count variable. Race/Ethnicity consolidates twenty-six categories into four groups. Household Income was recoded from categorical to continuous mean values. Parental Status indicates the presence of children under eighteen. Age is reported in years (16–54). Marital Status categories were combined for analysis. Sex is binary.

Table 2. Competitive models explaining variation in Food Security Index among individuals in the United States.

Model	K	ΔAICc	W_i	-2L
Income + Race + Age + Sex + Marital Status + Parental Status	12	0.00	1.00	-20752.60
Income + Race + Age + Sex + Parental Status	11	105.92	0.00	-20806.56
Income + Race + Age	7	230.64	0.00	-20872.92
Income + Race + Age + Sex	6	336.64	0.00	-20926.92
Income + Race + Age + Sex + Parental Status	5	444.15	0.00	-20981.68
Income	2	968.88	0.00	-21247.04
Race + Age + Sex + Parental Status + Marital Status	11	1831.93	0.00	-21669.56
Race + Age + Sex + Parental Status	4	2365.10	0.00	-21943.15
Race + Age + Sex	5	2729.45	0.00	-22124.33
Race + Age + Sex + Marital Status	2	2758.56	0.00	-22141.88
Race + Sex + Marital Status	2	2849.40	0.00	-22187.30
Race + Sex + Marital Status + Parental Status	2	2870.72	0.00	-22197.96
Intercept Only	1	2996.07	0.00	-22261.64

The table presents model comparison results based on Akaike Information Criterion corrected for small sample sizes (AICc) for various models predicting food security. The number of parameters (K), the difference in AICc from the best model (ΔAICc), model weight (W_i), and the -2 log-likelihood ($-2L$) are provided for each model. The model with the lowest AICc (Income + Race + Age + Sex + Marital Status + Parental Status) is considered the best-fitting model, with a cumulative model weight ($\sum W_i$) ≥ 0.95 for the models shown. The intercept-only model is included for comparison.

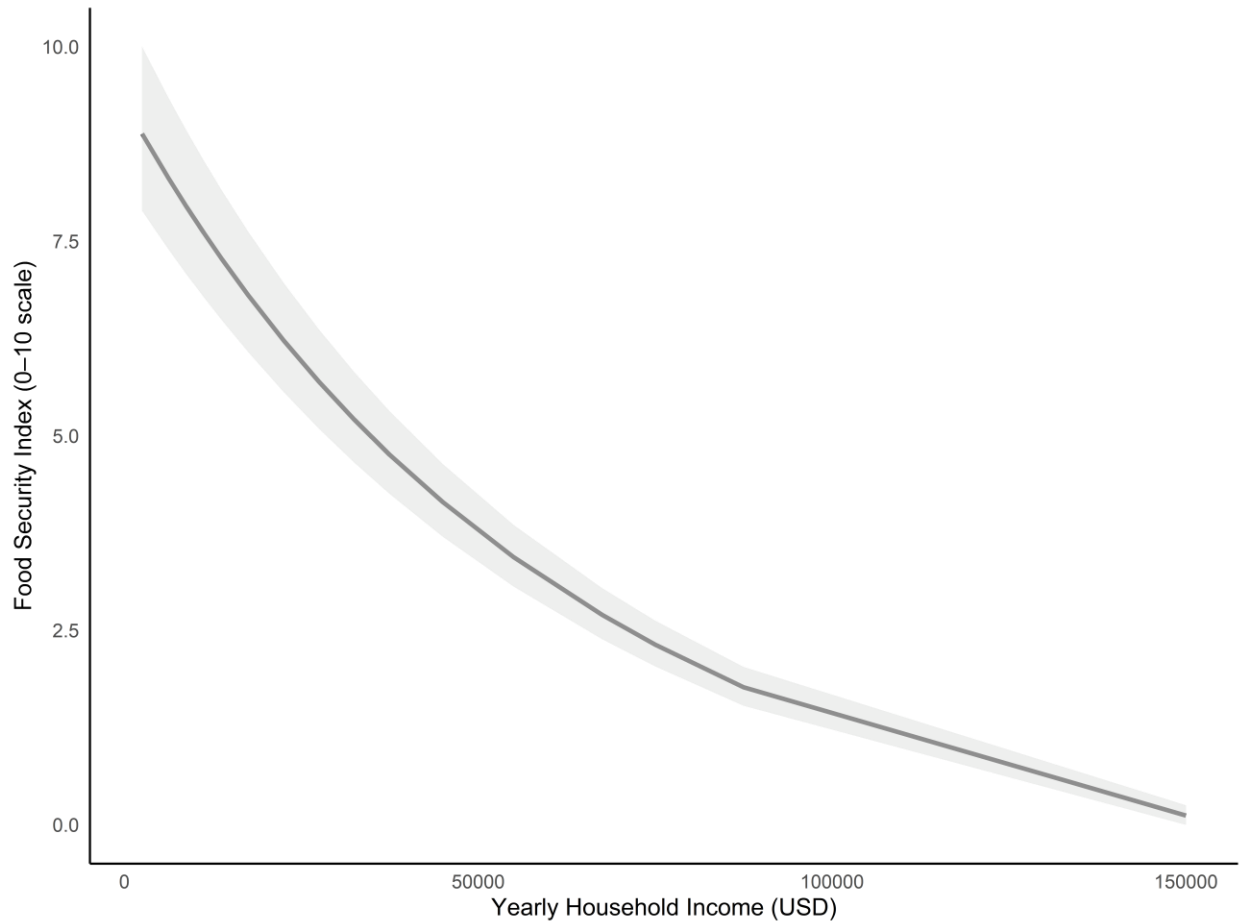


Figure 2. Inverse Relationship Between Yearly Household Income and Food Security Index.

The figure shows a curvilinear inverse association between annual household income and food insecurity, as measured by the Food Security Index (0–10 scale, with greater values indicating food insecurity). As income increases, food security increases significantly. The shaded area represents the 95% confidence interval around the estimated regression line.

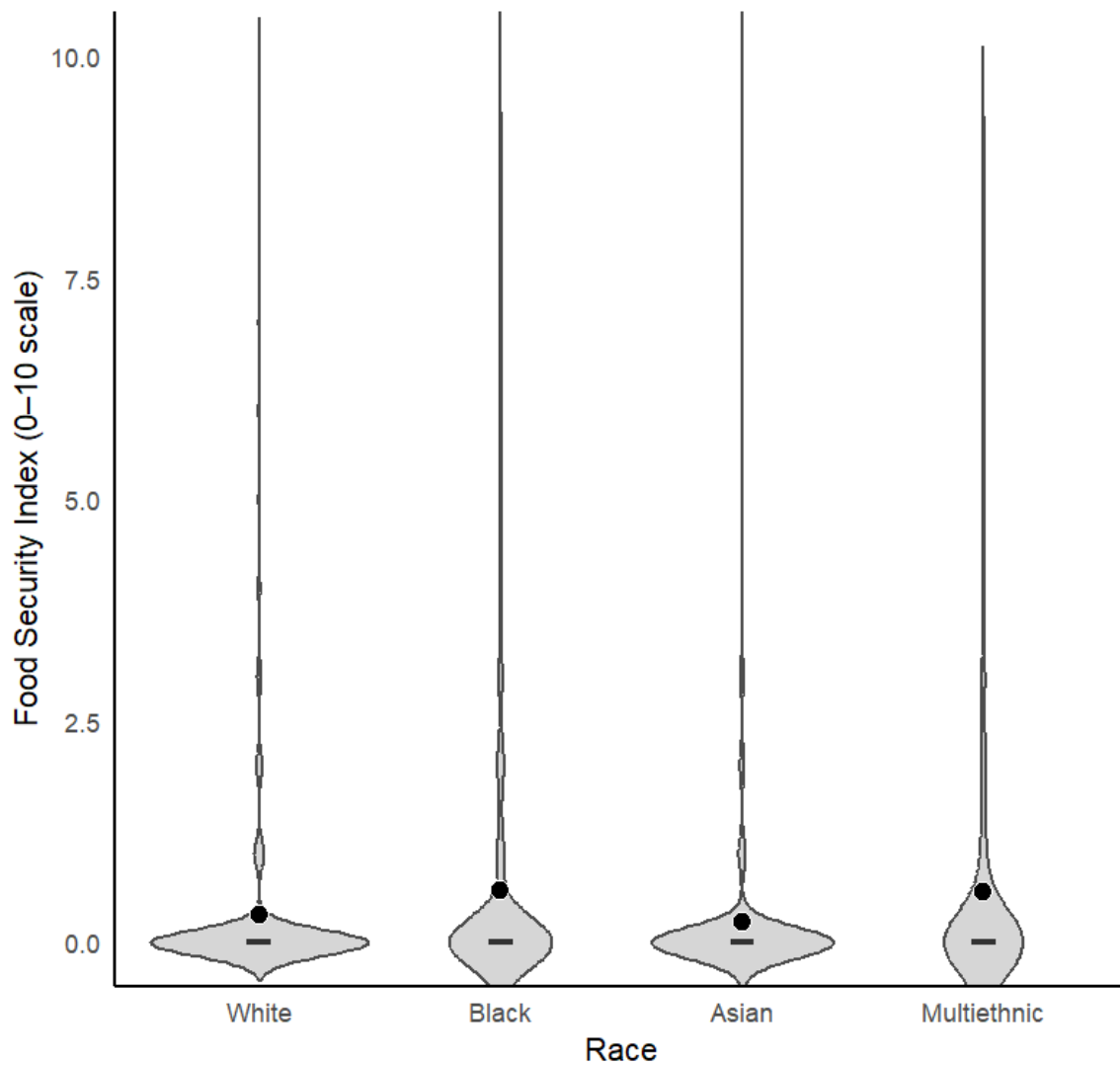


Figure 3. Food Security Index by Race

The figure shows the distribution of Food Security Index scores (on a 0–10 scale, with higher values indicating greater food security) across racial groups. The black dot represents the median score, while the error bars indicate the 95% confidence intervals.

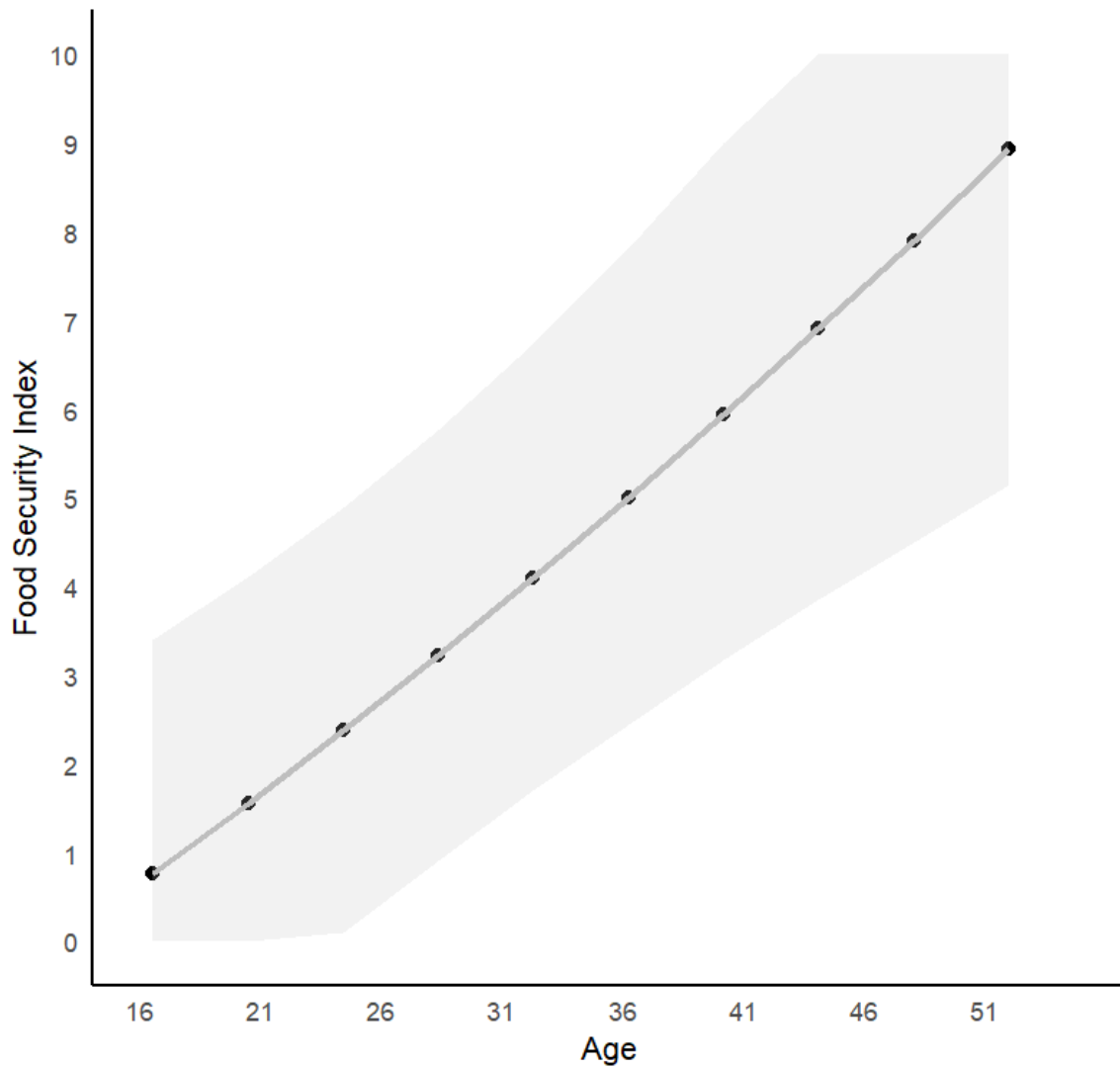


Figure 4. Food Security Index by Age

The figure illustrates the relationship between age and the Food Security Index. The solid line represents the predicted values from a linear regression model, while the shaded region indicates the 95% confidence interval around these predictions. The trend shows that as age increases, the likelihood of being food insecure also increases.

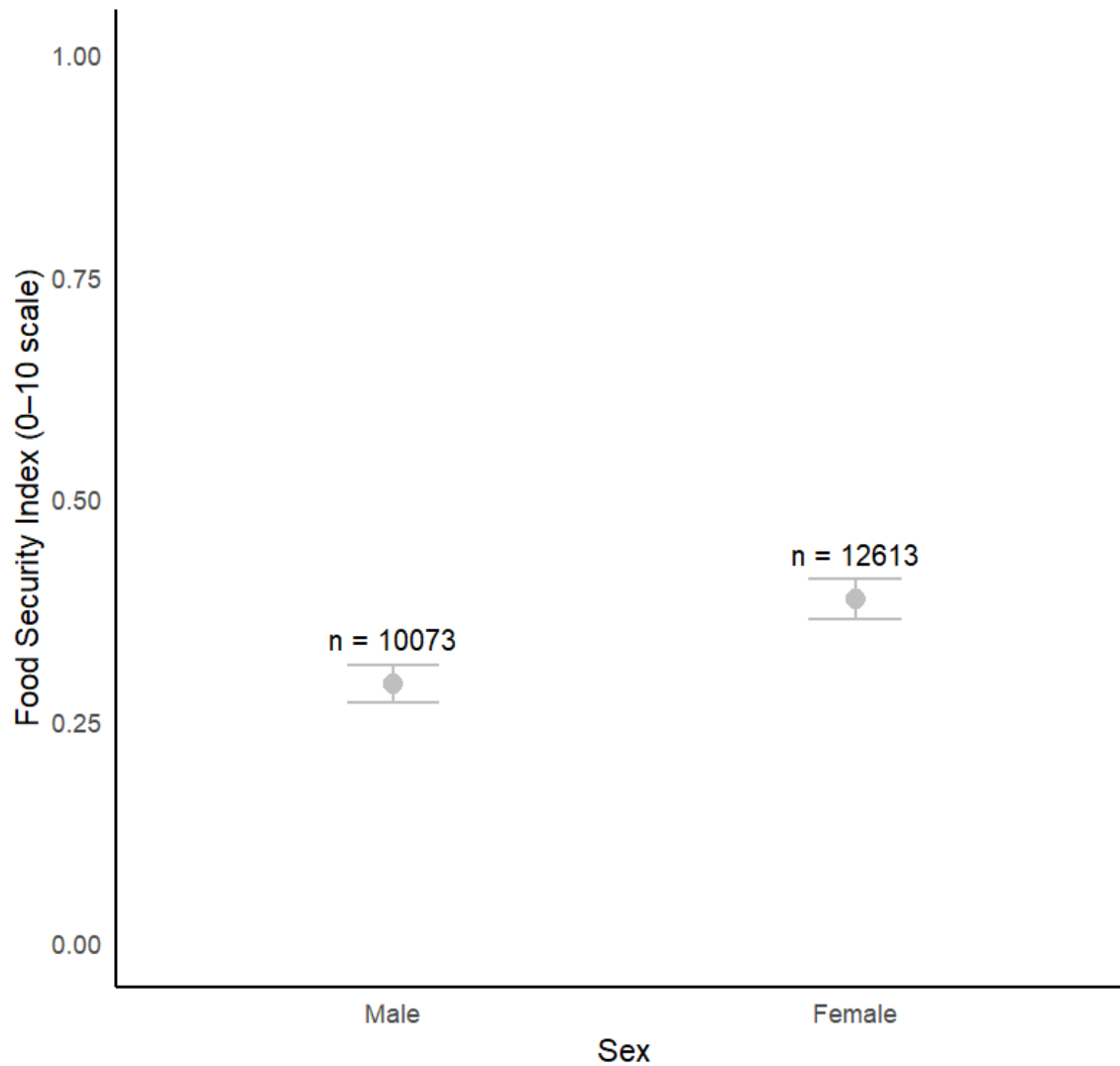


Figure 5. Food Security Index by Sex

Mean Food Security Index scores (measured on a 0–10 scale, with greater values indicating food insecurity) are shown across sex groups. Error bars represent 95% confidence intervals. Sample sizes (n) for each group are indicated above the points.

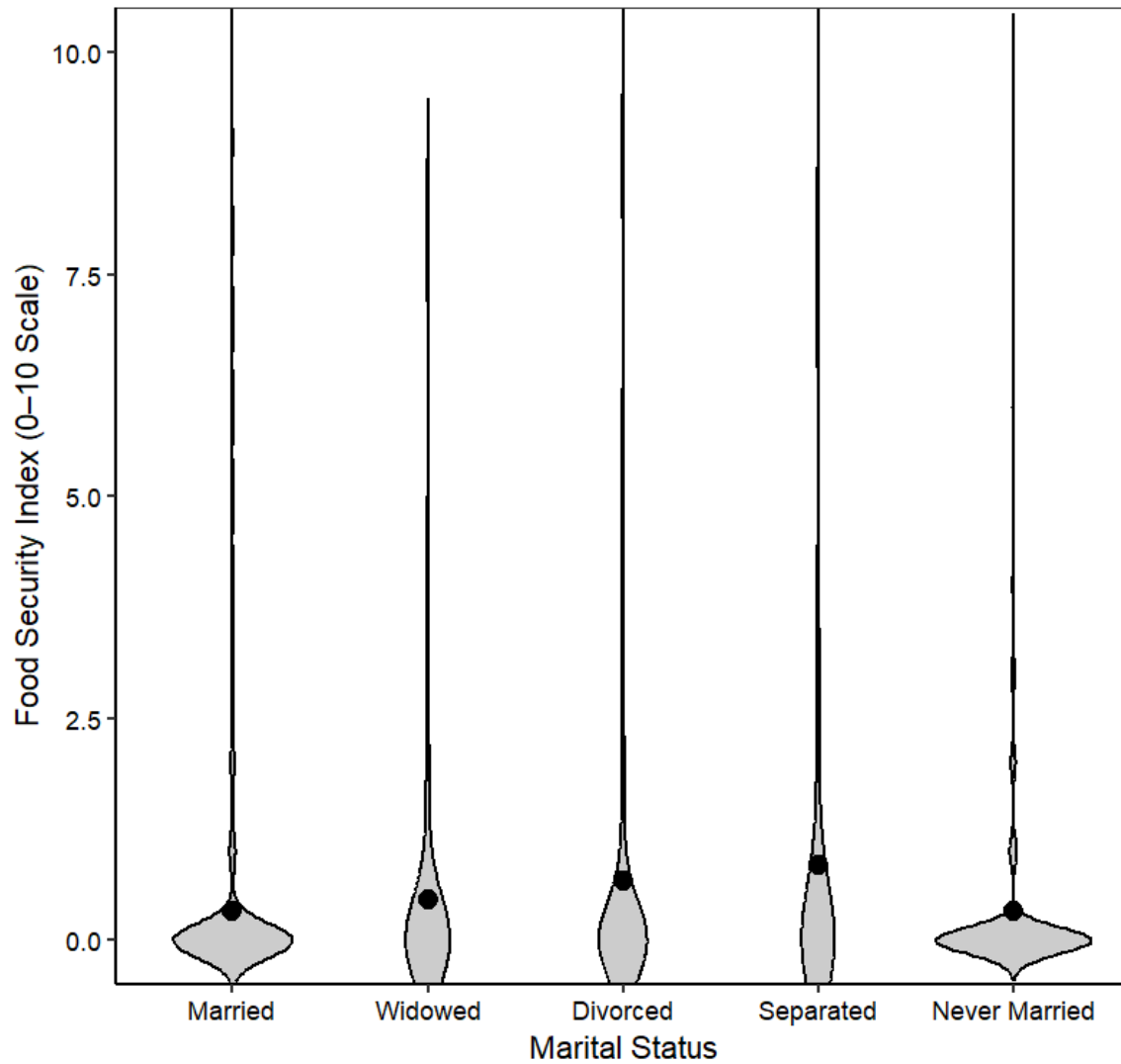


Figure 6. Distribution of Food Security Scores by Marital Status

Violin plots illustrate the distribution and density of food insecurity scores (measured on a 0–10 scale, with greater values indicating food insecurity) across different marital status groups. The width of each violin represents the probability density of the data at different values.

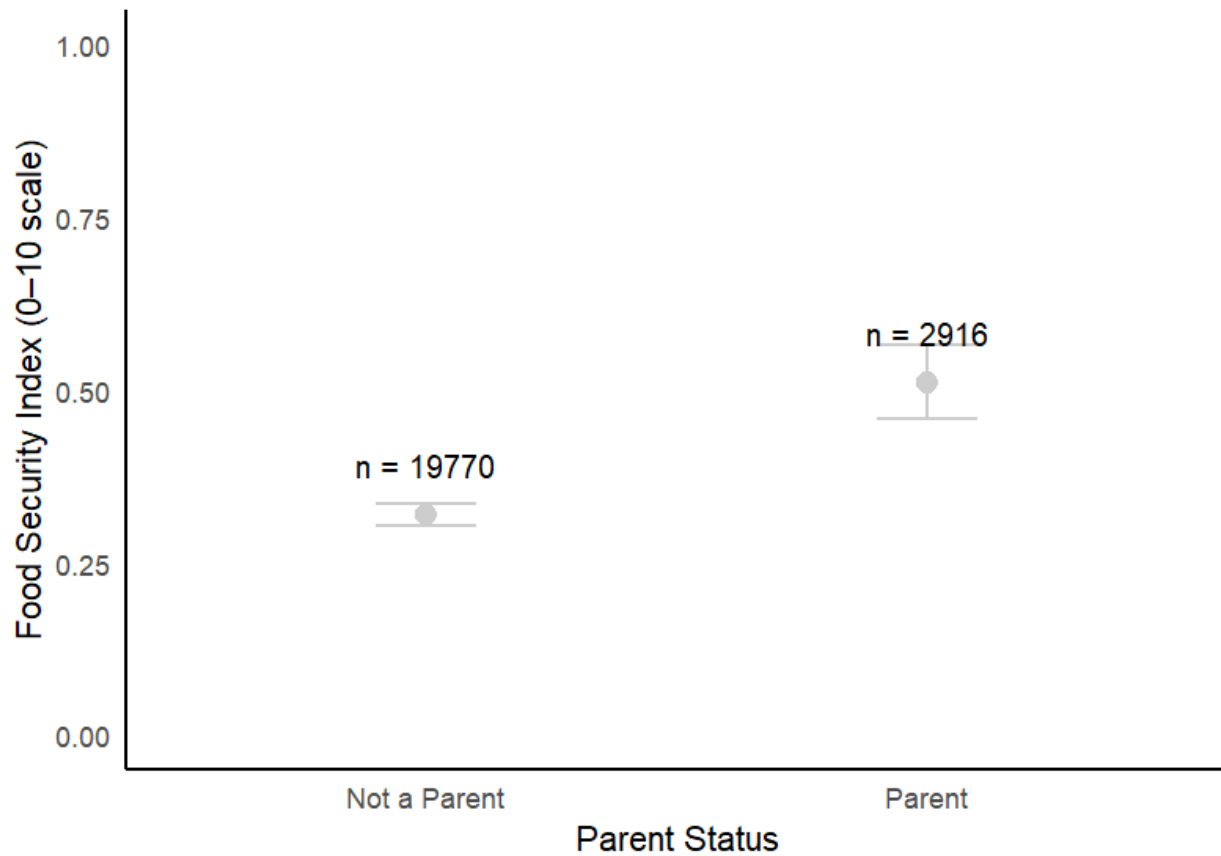


Figure 7. Food Security Index by Parent Status

Mean Food Security Index scores (measured on a 0–10 scale, with greater values indicating food insecurity) are shown for parents and non-parents. Error bars represent 95% confidence intervals. Sample sizes (n) for each group are indicated above the points.

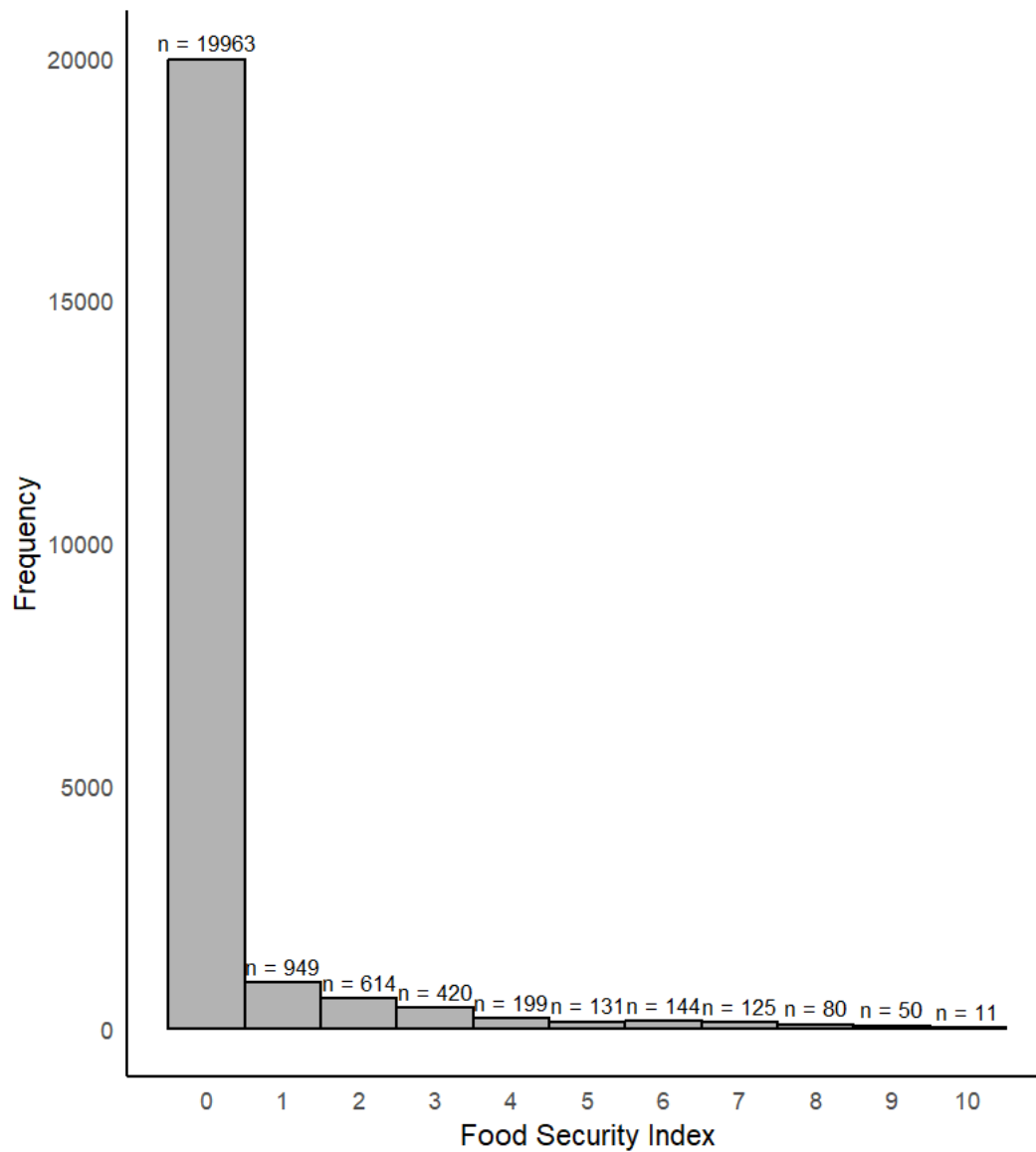


Figure 8. Distribution of Food Security

This figure displays the distribution of the Food Security Index among the study population. The data exhibits a highly skewed pattern characteristic of a Poisson-like distribution, with most respondents clustered at the lower end of the index (i.e., indicating greater food security) and progressively fewer respondents at higher values of the index.

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