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Original Article

# Socioeconomic and Demographic Determinants of Malnutrition and Food Insecurity among Elementary School Girl Students in Larestan, Fars Province, Iran

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## Abstract

**Background:** Malnutrition and food insecurity pose serious threats to children's health worldwide. The present study aimed to investigate the prevalence of malnutrition and food insecurity and their associated socioeconomic and demographic factors among elementary school girls aged 7–12 years in Larestan, Fars Province, Iran.

**Methods:** In this cross-sectional study conducted from February 2022 to June 2023, we included 736 female students from public elementary schools in Larestan, Fars Province, Iran. Nutritional status (wasting, stunting, overweight, obesity) was assessed using WHO's AnthroPlus software based on anthropometric measurements. Food insecurity at the individual level was measured using the validated Food Insecurity Experience Scale (FIES). The associations among the variables of the study were examined using chi-square tests and multivariable logistic regression. FIES uses 9 questions that directly capture a person's own experiences of constrained access to food, such as worrying about running out of food, reducing meal sizes, or missing entire meals due to a lack of money or other resources. By focusing on personal experiences, FIES classifies individuals into categories of mild, moderate, or severe food insecurity.

**Results**: Based on our results, the prevalence rates were 10.3% for wasting, 13.3% for stunting, 18.5% for overweight, and 9.8% for obesity. Notably, 82.6% of students consumed sugary snacks daily, while only 25.7% consumed vegetables daily. Severe food insecurity was prevalent in 21.1% of the participants. Food insecurity showed significant associations with father's education ($P<0.001$), mother's education ($P=0.001$), household expenditure ($P<0.001$), and physical activity level ($P=0.043$).

**Conclusions**: Girls from families with lower parental education and income are at a higher risk of malnutrition and food insecurity. These findings underscore the urgent need for targeted public health interventions and policies addressing the underlying socioeconomic determinants to improve nutritional outcomes and food security among school-aged girls in socioeconomically disadvantaged regions like Larestan, Fars Province, Iran.

***Keywords***: Food Insecurity, Child Nutrition Disorders, Growth Disorders, Overweight, Wasting, Stunting, School, Female, Iran

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## 1. Introduction

Children constitute a substantial proportion of the global population, and ensuring their optimal growth, development, and well-being is fundamental to building a healthy future society. For school-aged children, nutrition directly impacts physical and cognitive health, as well as academic performance (1, 2). Malnutrition, resulting from inadequate nutrient intake, and food insecurity, characterized by limited or uncertain access to sufficient and nutritious food, are two interrelated issues that pose significant threats to the health of schoolchildren, particularly girls (3).

The high prevalence of malnutrition, notably stunting and impaired growth, remains a major public health challenge in developing countries. This is especially critical for elementary school girls, who are at a pivotal stage of physical and cognitive development. Proper nutrition during this period is essential for healthy growth, academic achievement, and long-term well-being (4). Despite global progress, the double burden of malnutrition—where undernutrition (stunting, wasting) coexists with overnutrition (overweight, obesity)—is increasingly common, especially in transitioning economies (5).

The etiology of malnutrition and food insecurity is multifaceted. Poverty is a primary driver, limiting families' financial capacity to secure adequate

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food. Limited access to healthcare and nutrition education further exacerbates the problem (6, 7). Cultural and social norms, including gender-based disparities in food allocation, can also place girls at disproportionate risk (6, 7).

Globally, socioeconomic and demographic factors strongly predict nutritional outcomes. A study by Farah and colleagues found low parental education and household income were key predictors of concurrent stunting and overweight in schoolchildren (8). Similarly, a study by Ali and co-workers emphasized maternal education and family size as crucial determinants (9).

In Iran, studies like CASPIAN-V report significant regional disparities in adolescent food insecurity and thinness, closely linked to socioeconomic status (10). Similarly, a study conducted by Esfandiari and co-workers identified low parental education and socioeconomic status as critical contributors to food insecurity among primary school students (11).

Previous studies in Iran also highlighted significant regional disparities. Data from a national systematic review conducted in 2014 showed a higher prevalence of malnutrition in southern regions of Iran; specifically, the prevalence of stunting, wasting, and underweight in Sistan and Baluchestan Province, Iran was 25.1%, 6.8%, and 17.3%, respectively. These reported rates are considerably higher than the national averages of 4.7%, 3.7%, and 5.3%, indicating a higher burden of malnutrition in children in these deprived regions (12). Given that nutrition and its various dimensions are particularly essential for children, especially girls aged 7 to 12 who are on the brink of adolescence, addressing these issues requires comprehensive, multi-sectoral approaches that target the root causes of malnutrition and food insecurity (13).

Larestan, located in southern Iran, is a socioeconomically disadvantaged region. Challenges such as water scarcity, economic instability, and distinct cultural practices may create a unique risk profile for nutritional problems. National health policies are often based on data from other regions. However, a notable research gap persists, as few studies have specifically examined the socioeconomic and demographic factors simultaneously associated with both malnutrition and food insecurity among elementary school girls in this unique sociocultural and economic context. Therefore, this study aimed to investigate the prevalence of malnutrition and food insecurity and their associated socioeconomic and demographic factors among female elementary school students in Larestan, Fars Province, Iran.

## 2. Method

### *2.1. Design*

This cross-sectional study was conducted between February 2022 and June 2023 in girls' primary schools in Larestan, Fars Province, Iran.

### *2.2. Selection and Description of Participants*

The local education department provided a complete list of all female students aged 7–12 years (grades 1–6), totaling approximately 1,500 eligible students. We employed a census-based sampling approach**,** meaning all eligible students were invited to participate. The inclusion criteria were being a female student aged 7 to 12 years, residing in Larestan, Iran, and providing informed consent to participate. Students with diagnosed chronic illnesses (e.g., diabetes, chronic diarrhea), physical/developmental disorders, or weight abnormalities due to underlying medical, metabolic, and genetic causes were excluded from the study. Ultimately, 736 students completed the study protocol and were included in the final analysis.

### *2.3. Sample Size Determination*

Based on the list provided by the local education department, approximately 1,500 female students aged 7–12 years were identified as the target population in Larestan, Fars Province, Iran. Due to the limited size of the target population and to increase the precision of the findings, a census-based sampling method was employed, and all eligible students were invited to participate. Of these, 736 students (response rate of ~49%) completed the study protocol and were included in the final analysis.

### *2.4. Data Collection and Measurements*

#### *2.4.1. Anthropometric Assessment:*

Nutritional status indices, including height-

for-age Z-score (HAZ) and body-mass-index-for-age Z-score (BAZ), were calculated using WHO AnthroPlus software (Version 3.2.2, 2011), which applies the WHO 2007 growth reference for school-aged children (14). Students were classified as follows:

- Stunted: HAZ< -2 SD
- Wasted: BAZ< -2 SD
- Overweight: BAZ> +1 SD
- Obese: BAZ> +2 SD

*2.4.2. Food Insecurity Experience Scale (FIES):*

Individual food insecurity was measured using the 8-item Food Insecurity Experience Scale (FIES), developed by the Food and Agriculture Organization (FAO) (15). This questionnaire directly captures an individual's experiences of constrained access to food during the previous 30 days. The FIES has been globally validated with demonstrated high reliability (15). While the Household Food Insecurity Access Scale (HFIAS) has been previously validated in Iran (16), the FIES was used in the Iranian National database in 2017 (16). According to the standard FAO methodology, the raw scores were classified into three mutually exclusive categories: Food Secure (FS: raw score of 0-1), Moderate Food Insecurity (MFI: raw score of 2-4), and Severe Food Insecurity (SFI: raw score of 5-8)."

*2.4.3. Sociodemographic and Behavioral Questionnaire:*

A researcher-developed online questionnaire was used which consisted of three main sections: (1) a sociodemographic and behavioral checklist, (2) the 8-item Food Insecurity Experience Scale (FIES) (15) to assess the students' food insecurity status, and (3) items regarding physical activity and dietary habits. This questionnaire was applied to collect data on parents' job and education, household expenditure, family size, the child's physical activity level (categorized as sedentary, moderate, or vigorous based on reported activities), and dietary habits (frequency of consuming fruits, vegetables, dairy, sugary snacks, fast food). To assess food insecurity, the standard 8-item Food Insecurity Experience Scale (FIES) developed by the Food and Agriculture Organization (FAO) was incorporated into the questionnaire (15).

*2.5. Procedure*

After obtaining the necessary administrative approvals from the local education department and the university's ethics committee, the list of eligible female students was prepared. Formal consent forms were distributed to the parents, and only students with signed informed consent were included. Data collection was conducted in two phases. In the first phase, a researcher-developed online questionnaire was sent to parents via a link, which was completed by the students' mothers with the assistance of a trained nutritionist. In the second phase, trained personnel measured the students' height (in cm) and weight (in kg) using calibrated instruments, and age was recorded in months. A trained nutritionist was present at the schools to explain the study objectives and assist mothers in completing the online questionnaire. The questionnaire link was provided to the parents, and they were given a specific timeframe to complete it. Simultaneously, a trained anthropometric team visited the schools to measure the students' height and weight using standardized equipment. All data were securely recorded and checked for accuracy before being entered into the analytical software.

*2.6. Data Analysis*

Data were analyzed using SPSS version 22. Descriptive statistics are presented as mean ± standard deviation (SD) for continuous variables and frequency (percentage) for categorical variables. The Shapiro-Wilk test assessed normality. Univariate associations between independent variables (sociodemographic factors) and dependent variables (wasting, stunting, BMI-for-age categories, food insecurity) were examined using independent sample t-tests or chi-square tests, as appropriate. Variables with a P value<0.2 in univariate analysis were included as candidates in separate multivariable binary logistic regression models for each outcome. The Enter method was used for variable selection. Adjusted Odds Ratios (AORs) with 95% Confidence Intervals (CIs) are reported. A P value <0.05 was considered to be statistically significant.

## 3. Results

*3.1. Sociodemographic Characteristics*

The sociodemographic characteristics of the 736

participants are summarized in Table 1. The mean household size (total number of family members) was 4.21 (±0.99). Most mothers were housekeepers (84.7%), while most fathers were employed or self-employed (93.0%). Regarding household expenditure, a majority of families (67.5%) reported that their total monthly expenditure exceeded their income. Only 28.8% of fathers and 35.1% of mothers had a university education (Table 1). Furthermore, as shown in Table 1, 5.6% of the study population suffered from the co-existence of both stunting and wasting, highlighting a distinct subgroup within the student population experiencing a complex nutritional deficit.

### *3.2. Nutritional Status and Dietary Habits*

The prevalence of malnutrition indicators was as follows: wasting 10.3% (n=76), stunting 13.3%

**Table 1:** Socioeconomic and demographic characteristics of school girls

| **Characteristic** | **N (%)** |
|---|---|
| Child's Grades: | |
| 1 | 124 (16.9) |
| 2 | 121 (16.5) |
| 3 | 133 (18.1) |
| 4 | 137 (18.6) |
| 5 | 106 (14.4) |
| 6 | 114 (15.5) |
| Father's Job | |
| Employed | 153 (20.8) |
| Self-employed | 531 (72.2) |
| Retired | 29 (3.9) |
| Un-employed | 22 (3.0) |
| Mother's Job | |
| Housewife | 623 (84.7) |
| Employed | 65 (8.8) |
| Self-employed | 35 (4.8) |
| Retired | 7 (1.0) |
| Un-employed | 5 (0.7) |
| Father's Education | |
| High School Diploma or Below | 523 (71.2) |
| University Education | 212 (28.8) |
| Mother's Education | |
| High School Diploma or Below | 477 (64.9) |
| University Education | 258 (35.1) |
| Household economic status | |
| Expenditure Equal to Income | 224 (30.5) |
| Expenditure Exceeds Income | 496 (67.5) |
| Income Exceeds Expenditure | 15 (2.0) |
| Number of Family Members, Mean (SD) | 4.21 (0.99) |
| Child's Weight, Mean (SD) kg | 31.12 (10.94) |
| Child's Height, Mean (SD) cm | 133.31 (16.12) |
| Physical Activity | |
| Sedentary | 220 (29.90) |
| Moderate | 162 (22.0) |
| Vigorous | 23 (3.1) |
| Weight Status | |
| Wasting n | 76 (10.3) |
| Normal | 659 (89.7) |
| BMI for Age | |
| Overweight | 136 (18.5) |
| Obese | 72 (9.8) |
| Height Status | |
| Stunting | 98 (13.3) |
| Normal | 637 (86.7) |
| Double Burden of Disease | |
| Wasting and Stunting | 41 (5.6) |
| Overweight and Stunting | 35 (4.8) |

**Table 2:** Frequency of food consumption among school girls

| Intakes | Never | Rare | Weekly | Daily |
|---|---|---|---|---|
| Sugary Snacks | 3 (0.4) | 70 (9.5) | 55 (7.5) | 607 (82.6) |
| Salty Snacks | 13 (1.8) | 276 (37.6) | 359 (48.8) | 87 (11.8) |
| Sugar-sweetened Beverages | 66 (9.0) | 357 (48.6) | 274 (37.3) | 38 (5.2) |
| Artificially Sweetened Beverages | 527 (71.7) | 174 (23.7) | 24 (3.3) | 10 (1.4) |
| Fruits (fresh & dried) | 43 (5.9) | 175 (23.8) | 237 (32.2) | 280 (39.1) |
| Fresh Fruit Juices | 62 (8.4) | 331 (45.0) | 265 (36.1) | 77 (10.5) |
| Packaged Fruit Juice | 74 (10.1) | 397 (54.0) | 208 (28.3) | 56 (7.6) |
| Vegetables (Fresh & Cooked) | 39 (5.3) | 174 (23.7) | 333 (45.3) | 189 (25.7) |
| Milk | 37 (5.0) | 165 (22.4) | 315 (42.9) | 218 (29.7) |
| Yogurt | 17 (2.3) | 132 (18.0) | 384 (52.2) | 202 (27.5) |
| Cheese | 17 (2.3) | 93 (12.7) | 335 (45.6) | 290 (39.5) |
| Fast-food | 91 (12.4) | 394 (53.6) | 240 (32.7) | 10 (1.4) |
| Tea | 134 (18.2) | 264 (35.9) | 183 (24.9) | 154 (21.0) |
| Sugar/Sugar Cube added to Tea | 153 (47.8) | 251 (34.1) | 175 (23.8) | 156 (21.2) |

(n=98), overweight 18.5% (n=136), and obesity 9.8% (n=72). Alarmingly, 5.6% (n=41) of students suffered from the double burden of both wasting and stunting. Dietary patterns were concerning: 82.6% reported daily consumption of sugary snacks, while daily intake of vegetables, fruits, and milk was only 25.7%, 39.1%, and 29.7%, respectively (Tables 1 and 2).

### *3.3. Food Insecurity Status*

The mean FIES score was 3.41. Based on FIES classification, 44.1% (n=324) of households were food secure, 34.9% (n=256) had moderate food insecurity, and 21.1% (n=155) experienced severe food insecurity (Table 3).

### *3.4. Household Food Insecurity Experiences*

The most frequently reported conditions of food insecurity during the previous four weeks were worrying about not having enough food (32.6%), inability to eat preferred foods due to lack of resources (39.0%), having to eat a limited variety of foods (39.0%), and consuming foods they did not want to eat due to resource constraints (38.6%). More severe experiences were also reported, including eating smaller meals than needed (22.2%), eating fewer meals per day (19.0%), having no food of any kind in the household (17.1%), going to sleep hungry (14.0%), and going a whole day and night without eating (5.4%). The most frequently reported conditions were worrying about food (32.6%) and inability to eat preferred foods due to resource constraints (39.0%).

### *3.5. Associations among Variables*

Univariate analysis (Table 4) identified several candidate variables for multivariate modeling. The multivariable logistic regression models (Table 5) revealed that food insecurity was significantly associated with lower father's education and lower physical activity. Regarding stunting, the model showed a borderline significant positive association with food insecurity (AOR=1.056, P=0.068) after adjustment. Additionally, stunting was significantly associated with lower maternal education, higher household expenditure pressures, and lower physical activity. In contrast, wasting and BMI-for-age showed no statistically significant independent association with food insecurity scores in the adjusted models. Finally, BMI-for-age was found to be significantly associated with father's education and physical activity levels.

Table 5 also presents the results of binary logistic regression analyses examining the association between food insecurity (measured as a continuous HFIAS score) and three nutritional outcomes: wasting, stunting, and BMI-for-age. Both crude and adjusted odds ratios (ORs) are reported to account for potential confounding variables identified in univariable analysis. In addition, as shown in Table 5, binary logistic regression analyses were performed to examine the association between food insecurity scores and nutritional outcomes (wasting, stunting, and BMI-for-age). The results indicated that food insecurity had the strongest association with stunting; however, after adjusting for potential confounders (mother's education,

**Table 3:** Eating habits, sleep duration, and food security status among school girls

| Eating Habits | N (%) |
|---|---|
| Breakfast / Lunch / Dinner intake on school days | |
| 0 day | 149 (20.3) / 14 (1.9) / 13 (1.8) |
| 1 day | 58 (7.9) / 30 (4.1) / 35 (4.8) |
| 2 days | 74 (10.1) / 34 (4.6) / 22 (3.0) |
| 3 days | 64 (8.7) / 16 (2.2) / 17 (2.3) |
| 4 days | 86 (11.7) / 34 (4.6) / 30 (4.1) |
| 5 days | 156 (21.2) / 235 (32.0) / 219 (29.8) |
| 6 days | 148 (20.1) / 372 (50.6) / 399 (54.3) |
| Intakes on Holidays/ weekends | 574 (78.1) / 735 (99.2) / 726 (98.8) |
| Snacks | |
| Never | 38 (5.2) |
| 1-2 /week | 145 (19.7) |
| 3-4/week | 92 (12.5) |
| 5-6/week | 33 (4.5) |
| Once/ day | 299 (40.7) |
| More than once /day | 128 (17.4) |
| Water/sweetened beverages with meals | |
| Never | 163 (22.2) |
| Up to 1 glass | 458 (62.3) |
| More than one glass | 114 (15.5) |
| Eat out of the house | |
| Never | 172 (23.4) |
| Less than once/month | 309 (42.0) |
| 1 to 3 /month | 138 (18.8) |
| Less than once/week | 45 (6.1) |
| 1-2/week | 63 (8.6) |
| Three and more/ week | 8 (1.1) |
| On a special diet | |
| Yes | 38 (5.2) |
| No | 697 (94.8) |
| Appetite | |
| Low | 129 (17.6) |
| Moderate | 560 (76.2) |
| High | 46 (6.3) |
| Recent Weight changes | |
| Severe weight loss | 1 (0.1) |
| Severe weight gain | 67 (9.1) |
| No change | 665 (90.7) |
| Sleep Hours, Mean (SD) | 8.50 (1.35) |
| Water Intake (glass), Mean (SD) | 5.14 (2.81) |
| Average FIES Score | 3.41 |
| HFIA Category (Prevalence) | |
| Food Secure | 324 (44.1) |
| Mild & Moderate Food Insecure | 256 (34.9) |
| Severely Food Insecure | 155 (21.1) |

HFIA: Household Food Insecurity Access; FIES: Food Insecurity Experience Scale

**Table 4:** Association of malnutrition and food insecurity with socioeconomic and demographic factors

| Variable | Wasting | Stunting | BMI for age | Food insecurity |
|---|---|---|---|---|
| Father's Job | 0.507 | 0.505 | 0.641 | <0.001 |
| Mother's Job | 0.881 | 0.358 | 0.932 | 0.432 |
| Father's Education | 0.411 | 0.372 | 0.179 | <0.001 |
| Mother's Education | 0.220 | 0.132 | 0.350 | 0.001 |
| Number of Family Members | 0.220 | 0.270 | 0.349 | 0.347 |
| Household Expenditure | 0.693 | 0.001 | 0.153 | <0.001 |
| Physical Activity | 0.355 | 0.141 | 0.145 | 0.043 |

Data are presented as n (%). P value<0.05 was considered statistically significant; BMI: Body Mass Index

**Table 5:** Association between malnutrition and household food insecurity: Logistic Regression Analysis

| Outcome / Predictor | Odds Ratio (OR) | 95% Confidence Interval (CI) | P value |
|---|---|---|---|
| Model 1: Wasting[1] | | | |
| Wasting | 1.024 | 0.32-1.02 | 0.195 |
| Mother's Education | 1.626 | 1.19 – 2.23 | 0.002 |
| Number of Family Member | 1.133 | 0.97 – 1.32 | 0.119 |
| Model 2: Stunting[2] | | | |
| Stunting | 1.056 | 0.99- 1.12 | 0.068 |
| Mother's Education | 1.496 | 0.97 – 2.32 | 0.067 |
| Number of Family Member | 1.134 | 0.90 – 1.42 | 0.288 |
| Physical Activity (1) | 4.053 | 1.31 – 12.52 | 0.012 |
| Physical Activity (2) | 5.181 | 1.66 – 16.14 | 0.004 |
| Household Expenditure (1) | 0.455 | 0.08 – 2.43 | 0.358 |
| Household Expenditure (2) | 1.93 | 0.37 – 10.02 | 0.438 |
| Model 3: BMI-for-Age[3] | | | |
| BMI-for-Age | 1.011 | 0.960-1.065 | 0.221 |
| Physical Activity (1) | 3.737 | 1.27 – 10.99 | 0.017 |
| Physical Activity (1) | 4.758 | 1.57 – 14.43 | 0.005 |
| Household Expenses (1) | 0.429 | 0.08 – 2.30 | 0.327 |
| Household Expenses (2) | 1.805 | 0.35 – 9.39 | 0.489 |
| Father's Job | 1.27 | 0.86 – 1.86 | 0.23 |
| Mothers' Education | 1.22 | 0.77 – 1.94 | 0.39 |
| Father's Education | 0.727 | 0.43 – 1.23 | 0.236 |

[1]Adjusted for Mother's education and family member; [2]Adjusted for mother's education, Family member, costs, physical activity; [3]Adjusted for father's education, father's job, mother' education, expenses and physical activity; BMI: Body Mass Index; CI: Confidence Interval; OR: Odds Ratio

household expenditure, and physical activity), this association became borderline non-significant. In contrast, the crude and adjusted models for wasting and BMI-for-age showed no statistically significant associations with food insecurity scores.

These findings suggest that food insecurity is most strongly associated with stunting, while its relationship with wasting and BMI-for-age appears limited. Additionally, the adjusted models revealed significant correlations between stunting and mother's education, cost of living, and physical activity level. Similarly, BMI-for-age was significantly associated with father's education, cost of living, and physical activity.

## 4. Discussion

### *4.1. Food Insecurity and Socioeconomic Determinants*

The present study revealed a high prevalence of food insecurity among elementary school girls in Larestan, Fars Province, Iran, with 21.1% experiencing severe food insecurity. Our findings demonstrated strong associations between parental education, household expenditure pressure, and food insecurity, which align with the global evidence base (8, 11). Higher parental education likely improves nutritional knowledge, health literacy, and access to resources, serving as a protective factor. Conversely, when a household's total expenditure exceeds its income, families are forced to make difficult trade-offs, often compromising diet quality and quantity—a direct pathway to food insecurity (17, 18). The significant link between lower physical activity and higher food insecurity is also notable. This may reflect a broader pattern of resource deprivation, where constraints on food access are part of a wider limitation on health-promoting activities; alternatively, it is also possible that food insecurity reduces physical activity levels due to fatigue and insufficient energy intake (19).

### *4.2. The Double Burden of Malnutrition (Stunting and Wasting)*

A pivotal finding of this study was the 5.6% prevalence of the concurrent presence of stunting and wasting. This indicates a distinct subgroup suffering from severe and chronic deprivation, facing both acute energy deficiency (wasting) and long-term developmental setbacks (stunting).

This concurrent presence suggests a severe and prolonged deprivation of essential nutrients, likely stemming from persistent food insecurity, recurrent infections, and poor sanitary conditions (20). Stunting is linked to impaired cognitive function and reduced educational attainment, while wasting signifies a current energy deficit and increased vulnerability to morbidity. This synergy likely creates a vicious cycle where past undernutrition weakens the body's resilience, and present undernutrition further hampers recovery and growth potential. Addressing this vulnerable subgroup requires targeted public health interventions that go beyond general nutritional support, including improving household food security, ensuring access to diverse nutrient-rich foods, enhancing maternal and child healthcare, and strengthening water, sanitation, and hygiene (WASH) practices (20, 21).

### *4.3. Dietary Patterns and Nutrition Transition*

The dietary patterns revealed in this study present a significant public health concern. The finding that 82.6% of students consumed sweet snacks daily, coupled with a notably low intake of fruits and vegetables (only 25.7%), points to a critical deterioration in the quality of the adolescent diet. This pattern suggests a high consumption of energy-dense, nutrient-poor foods that are typically rich in sugars, unhealthy fats, and sodium, but deficient in essential micronutrients (9). The nutrition transition in developing countries often drives such poor dietary habits, replacing traditional healthy diets with processed foods (22, 23). Furthermore, these dietary shifts are major contributors to the growing prevalence of childhood obesity and metabolic disorders globally (24). The implications are twofold. Firstly, it directly increases the risk of immediate health issues such as dental caries, obesity, and insulin resistance. Secondly, the low consumption of fruits and vegetables creates a "micronutrient gap," depriving growing adolescents of vital components necessary for immune function and cognitive development. This poor dietary quality, alongside the double burden of malnutrition, paints a clear picture of a nutrition transition, where the student population simultaneously grapples with the legacy of undernutrition and the emerging threat of overnutrition linked to unhealthy food choices.

### *4.4. Association between Food Insecurity and Stunting*

The stronger observed association between food insecurity and stunting compared with wasting or BMI is insightful. Stunting is an indicator of chronic nutritional deprivation, which aligns logically with the sustained stress of household food insecurity. The non-significant association with wasting might be due to its nature as an acute condition, potentially influenced more by recent illness or short-term shocks rather than the 30-day recall period of the FIES. These findings suggest that while food insecurity strongly impacts long-term growth, its relationship with acute malnutrition and overweight may be limited, requiring different intervention strategies for each specific nutritional outcome. Previous literature also highlighted these distinct pathways between food insecurity and different forms of malnutrition (25). Addressing these complex pathways requires comprehensive global actions targeting maternal and child undernutrition simultaneously (26).

### *4.5. Limitations*

This study had several limitations that should be acknowledged. The cross-sectional design of the study precludes establishing causal inferences between food insecurity, malnutrition, and socioeconomic factors. Also, dietary data were self-reported by parents, making them susceptible to recall and social desirability bias. Additionally, the online distribution of the questionnaire resulted in a response rate of approximately 49%, which may limit generalizability and introduces a potential for non-response bias. We lacked data on some potential confounders, such as detailed household income levels, the local food environment, and biomarkers to corroborate dietary intake. The study was conducted in a specific socioeconomically disadvantaged region (Larestan), which may limit the generalizability of the findings to other regions with different contexts.

## 5. Conclusions

This study demonstrated a significant burden of malnutrition and food insecurity among elementary school girls in Larestan, Fars Province, Iran. The coexistence of stunting, wasting, and overweight, along with poor dietary habits and high rates of

severe food insecurity, highlights a complex public health challenge. These issues are strongly shaped by underlying socioeconomic disadvantages, particularly low parental education and high household expenditure pressure. Addressing these intertwined problems requires a multisectoral approach that combines school-based nutritional education with economic support policies for vulnerable families. Future longitudinal studies are needed to establish causality and evaluate the long-term impact of targeted interventions. Additionally, future research should incorporate objective biomarkers and detailed dietary assessments to corroborate self-reported data and further explore the environmental determinants of the double burden of malnutrition in similar socioeconomically disadvantaged contexts.

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**Declaration of AI**

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**Authors' Contribution**

Aboutaleb Modaresi: Contributions to the conception and design of the work; drafting the work. Behnam Honarvar: Contributions to the conception and design of the work; acquisition of data; reviewing the work critically for important intellectual content. Parisa Keshani: Contributions to the analysis and interpretation of data; reviewing the work critically for important intellectual content. Amir Hossein Jalalpoor: Contributions to the interpretation of data; reviewing the work critically for important intellectual content. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work, including questions related to the accuracy or integrity of any part of the work.

**Ethical Approval**

The Ethics Committee of Shiraz University of Medical Sciences, Shiraz, Iran approved the present study with the code of IR.SUMS.REC.1400.026. Also, written informed consent was obtained from the parents of all participants. All data were anonymized and kept confidential.

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