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Original Article

Food insecurity, socio-economic status, and educational achievement: a cross-sectional study in high school girls, Noshahr, Iran

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Background: Food insecurity has an impact on social-emotional development, school attendance, and academic performance. It is critical to understand the impact of food insecurity on academic standing and its relationship with socio-economic status on adolescent health outcomes. The aim of this study was to investigate the association between food insecurity and socio-economic status, and academic standing among high-school girls in Noshahr, Iran.

Methods: This cross-sectional study was conducted on 525 students. All girls were from private and public high schools in Noshahr from March 2014 to June 2014. Food security was assessed using the United States Department of Agriculture 18-item standard questionnaire. A structured questionnaire was used with a wide range of questions for socioeconomic status (SES) and academic performance.

Results: Food insecurity prevalence was 41%, and 25% of marginal food security. Significant difference was found in grade point average (GPA) between food secure and insecure students $p < 0.001$. The results of logistic regressions showed food secure students are less likely choose technical fields [odds ratio (OR) = 4.902; 95% confidence interval (CI): 1.313-18.304] and more likely have higher GPA, (OR = 0.555; 95% CI: 0.391-0.786), father with secure and higher paid jobs (OR = 5.841; 95% CI: 2.640-12.923), and healthy family members (OR = 1.852; 95% CI: 1.190-2.883).

Conclusion: Food insecurity was a common health problem among students, and SES of parents had main effects on student achievement. The negative impact of food insecurity on student academic performance needs urgent attention. Nutrition education is necessary to improve the quality of lifestyle and empower students to build a successful learning strategy.

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Introduction

Household food security has been described as "Food security means access by all people at all times to enough food for an active, healthy life" [1]. The United States Department of Agriculture (USDA's) new labels describe ranges of food security from high food security to marginal, low, and very low status [1]. Study on children ages 2-4 years revealed no association between food security status, dietary intake patterns, and body mass index percentile [2]. Population study in Paris showed the association between very low food security and obesity in women [3]. High levels of obesity and under nutrition are the coincidence problems of some low and middle-income country [4]. Obesity and undernourishment became more common in Mexico with high prevalence of food insecurity, obesity, and growth retardation [5]. Evidence indicates that low socio-economic status as major determinant of food insecurity is associated to overweight in children [6]. However, the association is inconsistent and may depend on household characteristic within countries [7, 8].

Food insecurity has an impact on social-emotional development, school attendance, and academic performance. Healthy diet in childhood and adolescence is needed for optimum growth and cognitive development. Food insecurity was recognized as a threat to children's well-being [9] and has tremendous negative effects on health status of children and adolescents [8, 9]. Research has revealed associations between poor academic performance, school absenteeism, lower educational interest, and food insecurity among adolescents [10, 11]. Therefore, the results of the studies suggest that food insecurity associated with biologic, psycho emotional, and developmental negative outcomes. Poor academic performance and achievements has important impacts on the quality of future life of young generation and whole-of-society.

The prevalence of food insecurity among American households was estimated 14.3% of the population during 2013 [12]. Results of a population-based study on adolescents in southwestern Ethiopia showed gender difference in food insecurity with high report of food insecurity prevalence among girls [13]. The number of undernourishment by Food and Agriculture Organization (FAO) is estimated 870 million people across the world in 2010-2012 [14]. The majority of these people live in developing regions. The prevalence of food insecurity was assessed at the household level in some parts of Iran: Khoy - 59.4%; Shiraz - 44%; Isfahan - 36.6%; Rey - 50.2%, Dezful - 37.6%, and Tehran - 46.7% [15-19].

We believe that this is the first work that shows the association of food insecurity in adolescents girls with socio-economic status, and academic performance. It is critical to understand the impact of food insecurity on academic standing and its relationship with socio-economic status on adolescent health outcomes. Therefore, the aim of this study was to investigate the association between food insecurity, socio-economic status, and academic standing among high-school girls in Noshahr, Iran.

Methods

A cross-sectional survey was carried out between March 2014 and June 2014 on high school girls, in grades 9-12 at private and public sectors in Noshahr, Iran. The adolescents and their parents were recruited through the school system. The prevalence of food insecurity based on previous research [20], was estimated 20%. Using a two-stage cluster method, 10 high schools selected randomly at the first stage, and students from all grades were chosen randomly with 36% proportionally allocated sample within each selected school at the second stage. The non-eligible participants were 27, with 26 iron deficiency anemia, and 1 case of hyperlipidemia. A total of 525 students were selected with design effect 1.5 with response rate at 92%.

The inclusion criteria were absence of any known chronic or acute disease based on student report. Exclusion criteria were refusal or inability to provide informed consent. A pilot study had been conducted before project implementation on 30 students who were selected randomly to assess the feasibility of the data collection procedures. The protocol carried out according to the declaration of Helsinki of 1975 as revised in 1983 and was approved by Tehran University of Medical Sciences, Ethics Committee Board under number 92/454/d/796. The students were given written materials included a summary of the protocol and contact form. Informed written consent was obtained from all students and their parents. The students and their mothers were interviewed regarding food security, socio-economic status (SES), and academic standing.

A structured questionnaire for the SES was used to collect data. Questionnaire included a

wide range of questions including age, student academic year, marital status, fields of study, school type, income level, parent's occupation and education, family employment rate, residency, food assistance, health care insurance, family health problems, family size, house square meter, age at menarche, sleep duration, and number of children under age 18. Income level was assessed by household assets ownership using an index of nine owned assets: house, car, washer dryers, liquid-crystal-display television, dishwasher, side by side refrigerator, rug, computer/laptop, and microwave. Income status was categorized into three categories: high (7-9 items); medium (4-6 items); and low (≤ 3 items).

Food security was assessed using USDA 18-item standard food security questionnaire (USDA). The questionnaire is referred to as the Household Food Security Survey Module. Food security score was determined by totaling the number of affirmative responses to the questions HH2 through CH7 of the questionnaire.

Academic standing was assessed by using the last annual grade point average (GPA). "GPA was recorded by asking students, what is the last GPA you have earned?" The GPA was double checked with student's record.

Data analysis was performed using SPSS for windows version 16.0 (SPSS Inc., Chicago, IL, USA). Distribution normality of the continuous variables was tested using Kolmogrov–Smirnov test. Non-parametric tests are used for non-normal distributed data. Means and proportions were done using t-test, Mann–Whitney U-test, and chi-square. Pearson's correlation and bivariate analyses were carried out. Multiple logistic regressions with enter method and confounder adjustment were used to evaluate the relationship of food security with socio-demographic variables, and academic standing. $p < 0.050$ was considered significant.

Results

Food security status

Table 1 presents frequency of food security status among students. Food insecurity prevalence was 41% with 25% marginal, 13% low, and 3.5% very low food security status. Marginal food security was one-fourth of food insecure households.

Demographic status

Demographic and educational characteristics of students were shown in table 2. Mean age for food secure students was 16.14 ± 0.06 years, and 16.14 ± 0.07 years for food insecure students. Food insecure students showed the highest rate of engagement compared to food secure group $p = 0.005$. Fields of the study showed significant difference between food secure and insecure students $p = 0.001$. Math or sciences were chosen by 70% of the food secure students. Higher academic standing was achieved by food secure students compared to food insecure ones $p = 0.001$. School's type showed significant difference around 70% of food secure students at non-governmental schools $p = 0.010$. The GPA was significantly different between food secure 88.90 ± 0.09, and insecure students, 84.60 ± 0.14 with $p = 0.001$.

SES

Some socio-economic characteristics of students were shown in table 3. Analyses of income level revealed that majority of the food secure students 90% had higher income family $p < 0.001$. Parents of food secure students had better and secure occupations with more than 75% of fathers with governmental job $p = 0.002$. The education level of both parents was higher in food secure students $p = 0.001$. Higher family employment rate was observed 65% among food secure students compared to food insecure students $p = 0.002$.

Table 1. Frequency of food security status according to the USDA*

Status	Total [n = 525]	(%)	Definition[a]
High food Security	310	59.0	"No reported indications of food-access problems or limitations"
Marginal food security	129	24.6	"One or two reported indications—typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diets or food intake"
Low food security	68	13.0	"Reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake"
Very low food security	18	3.4	"Reports of multiple indications of disrupted eating patterns and reduced food intake"

[a]Definition based on the USDA's current labels. USDA = United States Department of Agriculture

Table 2. Characteristics of the study base at enrolment, Noshahr (Iran), 2014

Characteristics	Food secure (n = 310)	Non-food secure (n = 215)	p value
Mean age (years) (SD)	16.14 (0.9)	16.13 (0.9)	0.970
Range	14.12-18.32	14.27-18.73	
Student academic year %			
1st	62.3	37.7	
2nd	59.3	40.7	0.500
3rd/4th	55.7	44.3	
Marital status %			
Single	59.9	40.1	0.005
Engaged	25.5	75.5	
Fields of study %			
General	63.1	36.9	
Mathematics	71.1	28.9	
Experimental science	69.2	30.8	0.001
Human science	51.9	48.1	
Technician	45.11	54.9	
School type %			
Governmental sector	56.4	43.6	0.010
Non-governmental sector	69.3	37.5	
GPA %			
< 89	38.6	61.4	
80-89	60.5	39.5	0.001
90-100	68.6	31.4	

There were significant differences between groups by t-student, χ^2 test. GPA = Grade point average; SD = Standard deviation

Table 3. Characteristics of the socio-economic status of the study base at enrolment, Noshahr (Iran), 2014

Characteristics	Food secure (n = 310)	Food insecure (n = 215)	p value
Income level %			
Low	32.2	67.8	
Medium	59.7	40.3	0.001
High	90.1	9.90	
Mother occupation%			
Self-employed	57.1	42.9	
Employed/retired	81.7	18.3	0.002
Housewife	b	44.1	
Others	80.0	20.0	
Father occupation %			
Self-employed	59.4	40.6	
Governmental	75.8	24.2	0.001
Retired	78.0	22.0	
Others	16.70	83.3	
Education level (mother) %			
Low education (≤ 8 years)	43	57	0.001
High education (> 8 years)	72.4	27.6	
Education level (father) %			
Low education (≤ 8 years)	44.6	55.4	0.001
High education (> 8 years)	70.7	29.3	
Family employment rate %			
≤ 2	55.0	45.0	0.002
> 2	66.7	33.3	
Residency %			
Rural	48.9	57.1	0.001
Urban	65.1	34.9	
Food assistance %			
Yes	30.4	69.6	0.005
No	60.2	39.8	
Healthcare insurance %			
No	45.9	54.1	0.006
Yes	71.6	28.4	

There were significant differences between groups by t-student, χ^2 test

Table 4. OR and 95% CIs for food security status for various sets of variables

Variables	Food secure (n = 310)	Non-food secure (n = 215)	OR	95% CI		p value
				Lower	Upper	
Education level (father)						
Low education (≤ 8 years)	210	190	2.375	1.648	3.423	0.001
High education (>8 years)	100	25	0.656	0.577	0.746	
Family employment rate						
< 2	193	165	1.539	1.190	1.992	0.001
≥ 2	117	50	0.769	0.670	0.883	
GPA						
< 85	73	91	1.615	1.325	1.969	0.001
> 85	237	124	0.678	0.563	0.817	

OR = Odds ratio; CI = Confidence intervals; GPA = Grade point average

Table 5. Logistic regressions enter method (only significant associations are shown)

???	B	SE	Significant	Exp(B)
Fields of study	1.590	0.672	0.018	4.902
GPA	-0.590	0.178	0.001	0.555
Family health problems	0.616	0.226	0.006	1.852
Income level	1.227	0.512	0.017	3.409
Father's occupation	1.765	0.405	0.000	5.841
Constant	0.209	2.647	0.937	1.232

Variables in the equation: School's type, fields of study, GPA, residency, family health history, house square meter, income level, food assistance, healthcare insurance, parent's occupation, and education. GPA = Grade point average, SE = Standard error

A higher percentage of food insecure students had the privilege of the using food assistance p = 0.005. In addition, significant differences was shown in access to healthcare between two groups p = 0.006. Family health problems showed significant difference between two groups p = 0.045. Family size, number of children under age 18, sleep duration, and menarche age, and house square meters showed no significant difference between two groups (data not shown).

Associations between socioeconomic factors, the student's GPA and food security status

Table 4 presents the association between father's education level, family employment rate, the student's GPA level and food security status. Higher education for fathers protects students from food insecurity [odds ratio (OR) = 0.656; 95% confidence interval (CI): 0.577-0.746]. Families with more than two employed person has less chance of food insecurity (OR = 0.769; 95% CI: 0.670-0.883). A lower academic performance was shown in food insecure students compared to food secure students (OR = 1.615; 95% CI: 1.325-1.969).

Table 5 presents logistic regressions with consideration all explanatory variables showed food secure students are less likely choose technical fields (OR = 4.902; 95% CI: 1.313-18.304), and more likely have higher GPA, (OR = 0.555; 95% CI: 0.391-0.786), fathers with secure and higher paid jobs (OR = 5.841; 95% CI: 2.640-12.923), and more healthy families (OR = 1.852; 95% CI: 1.190-2.883).

Discussion

We observed high prevalence 41% of food insecurity among high school girls. 24.6% of students suffered from marginal food security and 3.4% from very low food security. The depth of food insecurity will be meaningful if we take into account the condition of marginal food security as anxiety over food insufficiency. Our findings are consistent with other surveys with high food insecurity prevalence in different parts of Iran [15-19].

The prevalence of food insecurity was reported between 4% and 14% in developed countries [20]. Markwick et al. [21] on their study on the prevalence of food insecurity among more socially and economically disadvantaged area in the Australia showed 20.3% food insecurity after adjusting for confounders. A response to a single question "In the last 12 months, were there any times that you ran out of food and couldn't afford to buy more?" at the national level, revealed 5% food insecurity but high prevalence among the unemployed, low-income households, lone parents, and young people [22].

Bukania et al. [23] showed 86.6% of food insecurity in farmer households in deprived and semiarid zones in Eastern Kenya. Shariff et al.

[24] by using Radimer/Cornell Hunger and food insecurity instrument among low-income women in Malaysia found household food insecure 26.7%; individual food insecure 25.3%, and child hunger 26.4%.

Around 70% of low-income families suffered from food insecurity crisis. Lower income has been associated with food insecurity in previous studies [18, 25]. Higher household income increases purchasing power and improves food security. Similarly, results of this analysis indicated that lower income level and less education were more common in food insecure families [26-28]. Our study showed father's job or households with high-paying job was the most determinant of household food security. "A large body of evidence links education with health, even when other factors like income is taken into account" [29]. Education effects on health status through different ways; health knowledge and behaviors; employment and income; and social and psychological capacity [29]. Parent's education is related to children health status and behavior [29].

Math and experimental science were favorite fields of study in food secure students. Belachew et al. [11] showed household food security has positive association with educational attainment in adolescents. Patton-Lopez et al. [30] showed high prevalence of food insecurity 60% among students from rural university, and revealed inverse association between food insecurity and academic performance GPA $\geq$ 3.1. Food insecurity is an indicator of economic hardship for students, and inadequate food intake may affect student's academic performance [31, 32].

Previous studies have observed significant association between food insecurity and reduced growth and health [33], lower academic performance, social skills, and interaction [31]. Educational achievement is one of the key elements for upward social mobility. Upstream Public Health report 2014, revealed the health outcomes of missing from school on students and community [33]. Hunger, illness, unstable housing, and depression contributed to absenteeism. "In addition, it explores how adults with less education are more likely to smoke, be overweight, have diabetes, and die prematurely of certain chronic conditions" [34]. As stated by FAO "food security is a multi-dimensional phenomenon" and all dimensions should be considered in determining how to approach this issue in health education [35]. We cannot ignore this fact that food insecurity will shape not only the future of students but also the country toward less achievement and competition.

Food insecurity has strong negative impacts on health status of children and prevents them fully engaging in having healthy lifestyles and proper social interaction with peers [35]. Students with food insecurity are more likely suffer from hospitalization, anemia, and poor quality of life. "Therefore chronic food insecurity, which leads to lower educational performance, is a predictor of low lifetime health" [33].

Addressing food insecurity on health outcome should be one of the core subject areas for policy makers. Given the importance of serious health outcomes of food insecurity, health ministry and other health care organizations might consider food insecurity screening at least at the school level as part of standard care. Guerrero et al. [25] have shown the beneficial of using a simple question for identifying food insecurity in urban-rural area in Wisconsin. National strategies, political action, and commitment seem to require identifying multidimensional food insecurity and effective solutions for hunger reduction and alleviate health outcomes in children and teenage groups. Advanced nutrition education approaches should be main component of these strategies and is critical to ensure not only reducing poverty and hunger burden but also prevent further risk of obesity and chronic disease.

Strengths and Limitations

The study was part of the student thesis for a Master Degree in Nutrition and has been supported by Tehran University of Medical Sciences. The sampling was a population representative survey of the high school girls of Noshahr. The cross-sectional design does not permit to study on cause-effect relationship. The mother role was valuable in filling out the questionnaires specially the household food insecurity. Duration of data collection was short from the middle of autumn toward whole winter. Case-control or cohort studies provide the best information about the causation of the problem. The presentation of fourth-grade students was limited due to their tight and busy schedule. In general, this study could enhance our knowledge about food insecurity on health outcomes, particularly in teenage girls.

Recommendations

Further studies are required to evaluate the

effects of food insecurity on body composition, anthropometric measurements, and academic progress. Food security should be our priority in health policy, particularly for children, adolescents. A community-tailored health promotion programs are necessary to reduce food insecurity burden and motivate and engage people towards healthy lifestyle behavior, and better accomplishments.

Conclusion

This cross-sectional study provides enough evidence that food insecurity is a common health problem among high school girls. Food insecurity has strong association with parents' education, and occupation, income level, and academic performance. While the overall prevalence of food insecurity is quite high, but we suggest it may be higher within specific population groups such as those on deprived areas.

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Conflict of interest

None of the authors had any personal or financial conflicts of interest.

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