RESEARCH NOTE

Relationship between household food insecurity and food and nutrition literacy among children of 9–12 years of age: a cross-sectional study in a city of Iran

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Abstract

Objective: The aim of this study was to assess the relationship between household food insecurity (HFI) with food and nutrition literacy (FNLIT) in a sample of Iranian children. This cross sectional study was performed on 315 children aged 9 to 12 years recruited from the primary schools throughout Mashhad, Iran. The Household Food Insecurity Access Scale (HFIAS) was used to assess the HFI. Also, overall FNLIT score and its sub-categories were evaluated using a validated 40-item questionnaire.

Results: The prevalence of HFI in the total sample was about 56%. Also, almost 14% of students had a low FNLIT score. Food insecure children had significantly lower levels of FNLT and some subscales including nutrition knowledge, food choice literacy, and food label literacy than the food-secure subjects, moreover, they had a higher likelihood of having low FNLIT score (OR = 2.89, CI 1.03–8.09; p = 0.04). In conclusion, there is a negative association between HFI and FNLIT in children. Further studies to confirm this finding are needed.

Keywords: Food and nutrition literacy, Food insecurity, Children

Introduction

Household food insecurity (HFI), which is defined as the limited access to nutritionally adequate and safe food or inability to acquire foods in socially acceptable ways, has become a major public health concern throughout the world. HFI is shown to be positively related to the several adverse health outcomes in children including infectious diseases, anemia, psychological distresses, and growth disorders [1]. Besides the socio-economic, there are some non-financial factors in determining food access at the household level, which are proposed that might influence access to healthy foods in low-income or food-insecure individuals [2, 3]. One of the factors that have been recently gained attention is food and nutrition literacy (FNLIT).

The FNLIT is a relatively new term that reflects the technical, cultural and ethical aspects of the foods beyond just a source of satisfying the caloric requirements [4]. Studies have revealed that food literacy/nutrition literacy can play a critical role in shaping children's dietary behaviors [5, 6] and enabling them to make healthy food choices that can be sustained later in life [7–9]. Low FNLIT is associated with nutritional inadequacy in school-age children and it seems to be a barrier for them to assess information when choosing foods, comprehend

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food labels, and apply dietary recommendations [10]. Therefore, identifying the factors that could affect food literacy in children is a necessary approach to promote healthy eating patterns and subsequently, to reduce the burden of diet-related diseases in the long-term.

There is a dual relationship between food security and food literacy whereby inadequate food literacy may contribute to food insecurity and being food insecure may limit the ability to use food literacy skills to achieve adequate diet quality [11]. Some findings have shown that development of food and nutrition literacy components among children including learning about traditional food practices from elders, parents and families members, new food exposure, learning about seasonality and local foods, and food preparation skills as well as food and drink purchasing skills through improving reading and using traffic light and food labels, students grocery store/supermarket tours make meaningful improve to children food choices. This contributes to food utilization as a key dimension of food security [10, 12].

Findings from some recent studies have shown that in comparison to the food-secure households, those with food insecurity had lower FNLIT mainly characterized by unfavorable food choices and purchasing decisions as well as poor food preparation skills [13–16]. However, this evidence was limited to the adult population living in high-income and developed countries; thus, it is unknown whether these findings are generalizable to the children and adolescents particularly in the low-income and developing nations. To our knowledge, no study has examined the relationship between HFI and food literacy in children yet. With this regard, the present study aimed to assess the association of HFI with FNLIT and its subcategories in a sample of Iranian children.

Main text

Methods

A total of 315 children aged 9 to 12 years-old were recruited from the primary schools throughout the city of Mashhad, north-east of Iran. Data were collected from December 2018 to March 2019. Study subjects were chosen using a multi-stage random cluster sampling method. Children in the fourth, fifth and sixth grades who had not any chronic or acute diseases, were eligible to participate in the study.

Sociodemographic data including child's age, birth order, parents' age, parental education was obtained through interviews with students and verified by their mothers or caregivers by experienced interviewers.

Anthropometric measurements were performed by a trained dietitian using the calibrated equipment. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meter. The BMI Z-score

for age and sex was calculated based on the World Health Organization Child Growth Standards software (Anthro-Plus, World Health Organization, Geneva, Switzerland, 2007). The weight status of children was reported in four categories including underweight (z-score < 2 standard deviation (SD), normal (z-score ≥ − 2 SD and ≤ 1 SD), overweight (z-score > 1 SD and ≤ 2 SD), and obese (z-score > 2 SD).

The Household Food Insecurity Access Scale (HFIAS) was used to assess HFI in the study sample. The validity of the Persian version of questionnaire in the Iranian population was confirmed by Salarkia et al. [17]. The questionnaire consists of 9 items investigating a wide range of food-related behaviors, experiences, and conditions due to the financial limitation over a recall period of past month. Based on the total score, households were categorized as food secure (0–1 point), mild (2–7 points), moderate (8–14 points), and severe food insecure (15–27 points). In this study, mothers or caregivers were interviewed to fill out HFIAS questionnaire. We also have merged the mild, moderate and severe category to the food insecure group as a separate group.

The FNLIT was measured using a developed questionnaire. The questionnaire examining FNLIT in two distinctive domains with seven subscales, including (1) cognition domain: understanding food and nutrition information and nutritional health knowledge; (2) skills domain: functional FNLIT, interactive FNLIT, food choice literacy, critical FNLIT and food label literacy, respectively [18]. We confirmed the validity and reliability of FNLIT in this population. Content Validity Ratio (CVR) and Content Validity Index (CVI) of the 40-item questionnaire were at acceptable levels of 0.87 and 0.99. The internal consistency and test–retest reliability were assessed using Cronbach α (subscale-specific, range: 0.68–0.8) and intra-class correlation coefficients (ICC: 0.97, CI 0.94–98), respectively. FNLIT scores were ranked into three categories as low FNLIT (≤ 58), medium FNLIT (> 58–< 81) and high FNLIT (≥ 81).

Statistical analysis

Statistical analysis was performed using SPSS version 25 (SPSS Inc., Chicago, Illinois, USA). Independent-samples t test and Chi-square test was used to compare the variables between the food-secure and food-insecure subjects. Also, to determine the odds of having low FNLIT score in food insecure subjects in comparison to the food secure one, the crude and adjusted multiple regression models were used. The covariates included in the adjusted analyses were sex, grade, BMI, birth order, as well as parental age and education which were stated as the most important socioeconomic predictors of FNLIT in children [19]. Categorical variables were presented as frequency and

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percentage, while the numerical data were reported as mean, standard deviation (SD), odds ratio (OR), and 95% confidence interval (CI). Significance level was considered as a p-value less than 0.05.

Results

A total of 315 students (51% males) participated in the study. The mean age of study participants was 10.55 ± 1.007 years. The prevalence of mild, moderate, and severe HFI in the total sample were 30.5%, 20.3%, and 5.7%, respectively. Also, about 14% of the students had a low FNLIT score, while the percentages of moderate and high FNLIT scores in the total study sample were 62.7% and 23.2%, respectively. As it is shown in Table 1, the distribution of BMI, birth order and parental education were significantly different between the food-secure and food-insecure subjects ($p < 0.05$). Although, there were no significant differences between

Table 1 General characteristics of study participants

Variable	HFI status		p-value[a]
	Food-secure (n = 137)	Food-insecure (n = 178)	
Age (year)	10.49 ± 1.02[b]	10.58 ± 0.98	0.44[c]
Sex			
Male	73 (45.1)[c]	89 (54.9)	0.56
Female	64 (41.8)	89 (58.2)	
Grade			
Fourth	50 (46.3)	58 (53.7)	0.73
Fifth	43 (41.0)	62 (59.0)	
Sixth	44 (43.1)	58 (56.9)	
BMI z-score			
Underweight	8 (40.0)	12 (60.0)	0.02*
Normal	76 (42.0)	105 (58.0)	
Overweight	20 (33.3)	40 (66.7)	
Obese	33 (61.1)	21 (38.9)	
Birth order			
1	81 (54.0)	69 (46.0)	< 0.001*
≥ 2	56 (33.9)	109 (66.1)	
Father age tertile (year)			
30–37	31 (40.8)	45 (59.2)	0.15
38–44	69 (49.6)	70 (50.4)	
≥ 45	36 (37.5)	60 (62.5)	
Mother age tertile (year)			
23–34	43 (45.7)	51 (54.3)	0.56
35–39	57 (46.0)	67 (54.0)	
≥ 40	37 (39.4)	57 (60.6)	
Father education			
≤ 5 years education	2 (4.9)	39 (95.1)	< 0.001*
6 to 9 years or diploma	37 (26.4)	103 (73.6)	
Associate's degree and higher	97 (75.2)	32 (24.8)	
Mother education			
≤ 5 years education	1 (3.4)	28 (96.6)	< 0.001*
6–9 years or diploma	38 (23.3)	125 (76.7)	
Associate's degree and higher	98 (81.7)	22 (18.3)	

HFI household food insecurity, *BMI* body mass index

*Significant at the level of $p < 0.05$

[a] p-values obtained from Chi-square test unless indicated

[b] Data are shown as Mean ± standard deviation

[c] p-value obtained from Independent-samples t test

[c] Data are shown as frequency (percentage)

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the two groups in terms of age, sex, grade and parental age.

Table 2 compares the total FNLIT scores and its subscales between the food-secure and food-insecure children. In comparison to the food-insecure group, the food-secure subjects had significantly higher scores for total FNLIT (p < 0.001) and some subscales including understanding food and nutrition information (p = 0.01), nutritional health knowledge (p = 0.001) as well as food choice literacy (p = 0.009) and food label literacy (p < 0.001). However, the mean scores of functional, interactive, and critical FNLIT subscales were not significantly different between the two groups.

The results of linear regression models of the influence of HFI on changes in overall FNLIT score and its subcategories are presented in (Additional file 1: Table S1). Based on the results of logistic regression analysis shown in Table 3, the food-insecure group had a higher likelihood of having low FNLIT compared to the food–secure group (OR = 2.86, 95% CI 1.35, 6.05; p = 0.006). Also, this association remained significant after adjusting for potential covariates (OR = 2.89, 95% CI 1.03, 8.09; p = 0.04).

Discussion

To our knowledge, this is the first study investigating the association between HFI and FNLIT in a sample of school-aged children in Iran. We found that children living in the food-insecure households had higher odds of having overall FNLIT compared to the food-secure children. Also, HFI was associated with poor FNLIT behaviors including nutritional knowledge, food choice literacy, and food label literacy.

Table 3 Crude and adjusted odds of having low FNLIT according to the HFI status obtained from logistic regression analysis (n = 315)

	Crude analysis		Adjusted analysis[a]	
	Low FNLIT		Low FNLIT	
	OR (95% CI)	p-value	OR (95% CI)	p-value
HFI status				
Food secure	Reference		Reference	
Food insecure	2.86 (1.35–6.05)	0.006*	2.89 (1.03–8.09)	0.04*

FNLIT food and nutrition literacy, *OR* odds ratio, *CI* confidence interval, *HFI* household food insecurity

*Significant at the level of p < 0.05

[a] Adjusted for sex, grade, BMI, birth order, parental age and education

Findings of the present study are in consistent with the earlier studies, mainly performed in the adults' population. In a study by Begley et al. among a sample of Australian adults, all domains of the Australian food literacy model including planning and management, shopping, preparation, and cooking were independently associated with food insecurity [13]. Also, in another study among college students, it was found that very low food secure students had significantly lower cooking self-efficacy and food preparation scores compared with food secure students [15]. Similarly, Mercille et al. demonstrated that severe household food insecurity was inversely associated with healthy food preparation and self-efficacy among Canadian aboriginal women [20]. Despite the consistent results, there have been a considerable differences between the above-mentioned studies in terms of the type of measurement tools for assessment of food insecurity and different aspects of FNLT. Also, all the previous

Table 2 Comparison of mean scores of total FNLIT and its subscales based on the HFI status

Variable	HFI status		p-value[a]
	Food-secure (n = 137)	Food-insecure (n = 178)	
Total FNLIT (score)	74.09 ± 11.57[b]	68.65 ± 12.83	< 0.001*
FNLIT cognitive domain (score)			
Understanding food and nutrition information	76.95 ± 12.39	73.25 ± 13.91	0.01*
Nutritional health knowledge	88.5 ± 13.49	82.12 ± 20.74	0.001*
FNLIT skill domain (score)			
Functional FNLIT	72.03 ± 13.9	69.41 ± 16.13	0.12
Interactive FNLIT	57.05 ± 26.9	57.11 ± 24.86	0.98
Food choice literacy	75.86 ± 69.94	69.94 ± 21.97	0.009*
Critical FNLIT	67.88 ± 22.16	65.87 ± 23.75	0.43
Food label literacy	72.08 ± 29.7	49.01 ± 35.19	< 0.001*

HFI household food insecurity, *FNLIT* food and nutrition literacy

*Significant at the level of p < 0.05

[a] p-values obtained from Independent-samples t test

[b] Data are shown as Mean ± standard deviation

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studies were conducted in the adults from developed countries that should be considered when the interpretation of the results.

The findings indicate students experiencing HFI had a lower level of nutritional knowledge and were less able to understand food and nutrition information. Also, the food choice literacy scores was lower in the food-insecure subjects. This result is consistent with many studies demonstrated HFI are associated with unfavorable eating behaviors and consequently low dietary quality, particularly among children [21–24]. Landry et al. reported food insecure children had poor diet quality and lower scores for greens and beans, seafood and plant proteins, and added sugar compared to the food-secure ones [21]. Similarly, in a study conducted on 3790 food-insufficient, low-income families, children consumed fewer calories, total carbohydrates and fruits, but higher cholesterol intake [22].

Moreover, children experiencing different degrees of food insecurity had higher tendency to purchase foods from stores that contain less-healthful foods particularly the convenience ones, and also making unfavorable food choices such as purchasing unhealthy snack foods and sugar sweetened beverages [25, 26]. Although food literacy as a key component of shaping eating behaviors can improve food choices by helping food insecure children to develop their skills, many unmodifiable factors contribute to make poor food choices such as household income level, poor food access and availability and the high prices of healthy food.

The results also suggest that HFI was associated with lower level of food label literacy. Consistent with our observation Butcher et al. found Australian households with low or very low HFI status less tend to find, use or be influenced by nutrition information on food labels when making dietary decisions [14]. Similarly, Gittelsohn et al. reported the lowest food label reading and food knowledge scores among food-insecure households in Baltimore City in the USA [16]. Although there is a growing body of evidence suggested that food label literacy may lead to healthier food purchases [27, 28], the less use of food labels in food-insecure households probably due to families' priorities. In confronting with financial constraints, food purchasing decisions of families are based on price and family food preferences rather than nutrition considerations [29].

Conclusion

In summary, we found that HFI is associated with children's food and nutrition literacy. Food insecure children had lower levels of FNLIT and its subscales including nutrition knowledge, food choice literacy, and food label literacy. We conclude that HFI may be one of the predictors of low FNLIT in primary school children. However, more research is needed to clarify the relationship between food security and food literacy in children to inform Policymaking (Additional file 1: Table S1).

Limitations

There are a few limitations that need to be acknowledged. This is a cross-sectional study that can only establish an association between HFI and food literacy and cannot show causality. Also, the study was conducted in a small group of children aged 9 to 12 years-old in north-east of Iran; therefore, the generalizability of findings to the Iranian populations and different age groups needs to be considered.

Supplementary information

Abbreviations
HFI: Household food insecurity; FNLIT: Food and nutrition literacy; BMI: Body mass index; SD: Standard deviation; HFIAS: Household Food Insecurity Access Scale; CVR: Content Validity Ratio; CVI: Content Validity Index; ICC: Interclass coefficients; OR: Odds ratio; CI: Confidence interval.

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (Approval code was IR.MUMS.fm.REC.1396.732). The objectives of the study were fully explained to the children's parents/guardians. Those who wished to participate in the study signed the written informed consent.

Consent to publish
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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References
1. Gundersen C, Ziliak JP. Food insecurity and health outcomes. Health Aff. 2015;34(11):1830–9.
2. Evans A, Banks K, Jennings R, Nehme E, Nemec C, Sharma S, et al. Increasing access to healthful foods: a qualitative study with residents of low-income communities. Int J Behav Nutr Physical Act. 2015;12(1):S5.
3. Ma X, Liese AD, Hibbert J, Bell BA, Wilcox S, Sharpe PA. The association between food security and store-specific and overall food shopping behaviors. J Acad Nutr Diet. 2017;117(12):1931–40.
4. Gartaula H, Patel K, Shukla S, Devkota R. Indigenous knowledge of traditional foods and food literacy among youth: Insights from rural Nepal. J Rural Stud. 2020;73:77–86.
5. Vaitkeviciute R, Ball LE, Harris N. The relationship between food literacy and dietary intake in adolescents: a systematic review. Public Health Nutr. 2015;18(4):649–58.
6. Chung L. Food literacy of adolescents as a predictor of their healthy eating and dietary quality. J Child Adolesc Behav. 2017;5:e117.
7. Vidgen HA, Gallegos D. Defining food literacy and its components. Appetite. 2014;76:50–9.
8. Nutbeam D, Kickbusch I. Advancing health literacy: a global challenge for the 21st century. Health Promot Int. 2000;15(3):183–4.
9. Laska MN, Larson NI, Neumark-Sztainer D, Story M. Does involvement in food preparation track from adolescence to young adulthood and is it associated with better dietary quality? Findings from a 10-year longitudinal study. Public Health Nutr. 2012;15(7):1150–8.
10. Doustmohammadian A, Omidvar N, Keshavarz-Mohammadi N, Eini-Zinab H, Amini M, Abdollahi M, et al. Low food and nutrition literacy (FNLIT): a barrier to dietary diversity and nutrient adequacy in school age children. BMC Res Notes. 2020;13(1):1–8.
11. Palumbo R, Adinolfi P, Annarumma C, Catinello G, Tonelli M, Troiano E, et al. Unravelling the food literacy puzzle: Evidence from Italy. Food Policy. 2019;83:104–15.
12. Topley A. At the table: a case for food literacy coordination. Victoria, BC: Greater Victoria Food Literacy Working Group; 2013.
13. Begley A, Paynter E, Butcher LM, Dhaliwal SS. Examining the association between food literacy and food insecurity. Nutrients. 2019;11(2):445.
14. Butcher LM, Ryan MM, O'Sullivan TA, Lo J, Devine A. Food-insecure household's self-reported perceptions of food labels, product attributes and consumption behaviours. Nutrients. 2019;11(4):828.
15. Knol LL, Robb CA, McKinley EM, Wood M. Very low food security status is related to lower cooking self-efficacy and less frequent food preparation behaviors among college students. J Nutr Educ Behav. 2019;51(3):357–63.
16. Suratkar S, Gittelsohn J, Song H-J, Anliker JA, Sharma S, Mattingly M. Food insecurity is associated with food-related psychosocial factors and behaviors among low-income African American adults in Baltimore City. J Hunger Environ Nutr. 2010;5(1):100–19.
17. Salarkia N, Abdollahi M, Amini M, Eslami AM. Validation and use of the HFIAS questionnaire for measuring household food insecurity in Varamin-2009. Iran J Endocrinol Metab. 2011;13(4):374–83.
18. Doustmohammadian A, Omidvar N, Keshavarz-Mohammadi N, Abdollahi M, Amini M, Eini-Zinab H. Developing and validating a scale to measure Food and Nutrition Literacy (FNLIT) in elementary school children in Iran. PLoS ONE. 2017;12(6):e0179196.
19. Doustmohammadian A, Keshavarz Mohammadi N, Omidvar N, Amini M, Abdollahi M, Eini-Zinab H, et al. Food and nutrition literacy (FNLIT) and its predictors in primary schoolchildren in Iran. Health Promot Int. 2019;34(5):1002–133.
20. Mercille G, Receveur O, Potvin L. Household food insecurity and Canadian aboriginal women's: self-efficacy in food preparation. Can J Diet Pract Res. 2012;73(3):134–40.
21. Landry MJ, van den Berg AE, Asigbee FM, Vandyousefi S, Ghaddar R, Davis JN. Child-report of food insecurity is associated with diet quality in children. Nutrients. 2019;11(7):1574.
22. Casey PH, Szeto K, Lensing S, Bogle M, Weber J. Children in food-insufficient, low-income families: prevalence, health, and nutrition status. Arch Pediatr Adolesc Med. 2001;155(4):508–14.
23. French SA, Tangney CC, Crane MM, Wang Y, Appelhans BM. Nutrition quality of food purchases varies by household income: the SHoPPER study. BMC Public Health. 2019;19(1):231.
24. Bernal J, Frongillo EA, Rivera JA. Food insecurity reported by children, but not by mothers, is associated with lower quality of diet and shifts in foods consumed. Matern Child Nutr. 2016;12(3):546–57.
25. Dennisuk LA, Coutinho AJ, Suratkar S, Surkan PJ, Christiansen K, Riley M, et al. Food expenditures and food purchasing among low-income, urban, African-American youth. Am J Prev Med. 2011;40(6):625–8.
26. Ma X, Liese AD, Bell BA, Martini L, Hibbert J, Draper C, et al. Perceived and geographic food access and food security status among households with children. Public Health Nutr. 2016;19(15):2781–8.
27. Cowburn G, Stockley L. Consumer understanding and use of nutrition labelling: a systematic review. Public Health Nutr. 2005;8(1):21–8.
28. Mhurchu CN, Eyles H, Jiang Y, Blakely T. Do nutrition labels influence healthier food choices? Analysis of label viewing behaviour and subsequent food purchases in a labelling intervention trial. Appetite. 2018;121:360–5.
29. Dachner N, Ricciuto L, Kirkpatrick SI, Tarasuk V. Food purchasing and food insecurity: among low-income families in Toronto. Can J Diet Pract Res. 2010;71(3):e50–e5656.