Nutrition and Food Sciences Research Vol 8, No 3, Jul-Sep 2021, pages: 37-47

Original Article

Food and Nutrition Literacy (FNLIT) is Associated to Healthy Eating Behaviors in Children

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Received: October 2020 **Accepted:** January 2021

ABSTRACT

Background and Objectives: The objective of the current study was to investigate associations between food and nutrition literacy (FNLIT) and eating behaviors of elementary school children in Tehran, Iran.

Materials and Methods: In this cross-sectional study, 803 students aged 10–12 years were participated from 44 primary schools in Tehran, Iran. A valid, reliable self-administered questionnaire was used to investigate participants' food and nutrition literacy. A research-made questionnaire was used to assess eating behaviors of the students. Furthermore, the multinomial adjusted odds ratios of food and nutrition literacy for eating behaviors were analyzed.

Results: Food and nutrition literacy cognitive domain included understanding food and nutrition information and nutritional health knowledge. Food and nutrition literacy skill domain included functional, interactive, critical food and nutrition literacy, food choice and food label literacy. High levels of food and nutrition literacy scores in the cognitive domain were negatively associated to irregular breakfast intakes compared to everyday eating breakfast (1–2 times a week, OR = 0.32, CI = 0.17–0.60), irregular lunch intakes compared to everyday eating lunch (never/1–2 times a week, OR = 0.40, CI = 0.17–0.93; 3–6 times a week, OR = 0.45, CI = 0.25–0.80) and irregular dinner intakes compared to everyday eating dinner (never/1–2 times a week, OR = 0.32, CI = 0.17–0.68). High food and nutrition literacy scores in the cognitive domain were attributed to never eating sausage/hamburger (OR = 2.20, CI = 1.01–4.83) and eating salty snacks 3–4 times a week (OR = 2.58, CI = 1.09–6.13). The FNLIT scores in the skill domain were negatively associated to irregular breakfast intakes compared to everyday eating breakfast (3-6 times a week, OR = 0.33, CI = 0.13–0.78). Food and nutrition literacy scores in the skill domain were positively associated to never eating sweet snacks (OR = 4.19, CI = 1.39–12.62).

Conclusions: The current manuscript highlights the necessity of continuous improvements in health education curriculum of schools in Iran, particularly highlighting the importance of greater attention needs to practical and skill-based lessons rather than theoretical lessens. Further studies with long-term follow-up plans are needed to understand associations between food and nutrition literacy and eating behaviors more comprehensively.

Keywords: Food and Nutrition literacy, Eating behaviors, School-age children, Iran

Introduction

Urbanization and development have resulted in major lifestyle changes, including dietary behaviors and physical activities in developed and developing countries. Poor dietary habits have been associated to diet-related chronic diseases (DRCD), including obesity and diabetes (1, 2). As a country experiencing nutrition transition, Iran witnesses major behaver changes in adults and children. High-risk nutritional behaviors such as meal skipping, unhealthy dietary habits and low physical activities increase in the country (3–5). Childhood provides opportunities for health promotion to lead the adoption of healthy behaviors, preventing health problems in adulthood (6). Health

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[DOR: 20.1001.1.23830441.2021.8.3.6.8]
[DOI: 10.52547/nfsr.8.3.37]

literacy is reported as one of the most important personal skills to enable individuals to control health determinants (7). Evidence suggest needs of emphasizing specific areas of health literacy, including food literacy/nutrition literacy, due to the wide scopes of health issues. Food and nutrition literacies have recently emerged concepts, which address knowledge and skills of food and nutrition (8, 9). Overall, transition from knowledge to practice is described as a vital component of either food or nutrition literacy (10).

Current studies have shown that food and nutrition literacy is one of the key factors in forming eating behaviors of children and adolescents (11–13). Food skills such as cutting fruits and vegetables, following recipes, measuring ingredients and preparing foods are shown to be associated to increased consumption of fruits and vegetables in adolescents (14). Food and nutrition literacy such as health literacy can be conceptualized as an asset (15) or enabler to healthy eating (9). Clarifying magnitude and nature of the relationships between food and nutrition literacy and children dietary behaviors is important to develop effective strategies for intervention in this group. In addition, it may help predict effects of interventions that focus on improving food literacy to improve children dietary habits. Therefore, the aim of this study was to assess relationships between food and nutrition literacy and dietary habits in primary school children in the metropolitan city of Tehran, Iran.

Materials and Methods

Study design and participants

This study was a population-based cross-sectional survey using multistage random cluster sampling design. Study sample included 803 primary school students of 419 boys and 384 girls aged 10–12 years (power study, 88%; response rate, 89.2%) from various socioeconomic districts of Tehran, Iran. Students and their parents were provided with written informed consents before beginning of the survey. Data collection was carried out at schools by trained research assistants. The STROBE study on food and nutrition literacy (FNLIT) and dietary habits in children is outlined in Fig. 1.

Measurements

Food and nutrition literacy assessment

A valid self-administered questionnaire was used for the assessment of FNLIT. The process of developing questionnaire and assessing its interface, content and construct validity has previously been described (16). The FNLIT questionnaire included 46 items in the cognitive and skill domains. The cognitive domain included two sub-scales of understanding food and nutrition information (ten items) and nutritional health knowledge (five items). The skill domain included four subscales of functional food and nutrition literacy (ten items), interactive food and nutrition literacy (seven items), food choice (six items) and critical food and nutrition literacy (four items). Food label literacy was assessed by four true-false items. The FNLIT status was categorized into three levels of low (≤ 51), medium (> 51 to < 74) and high (≥ 74) categories (17), where the FNLIT score ranged 25.8–96.8.

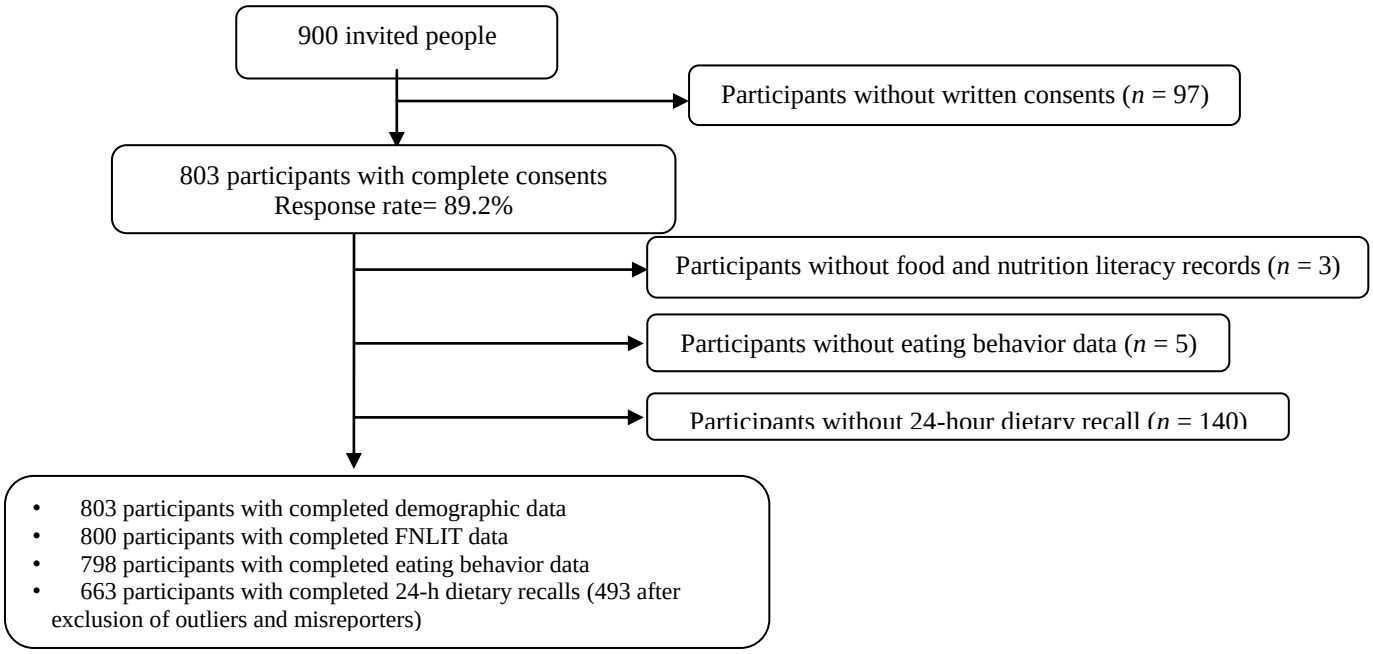

Figure 1. The STROBE study flow chart

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Study covariates

In this study, several baseline covariates were addressed based on the available evidence (8, 23–25). Physical activity was assessed using a locally validated version of the child and adolescent international physical activity questionnaire and interviews by trained research assistants (26, 27). Household food security status was assessed using locally validated 18-item USDA household food security survey module and face-to-face interviews with mothers (28, 29). Calorie intake was assessed using three 24-h recalls (two week days and one holiday) by trained nutritionists. Demographic and socioeconomic characteristics were collected using questionnaires and interviews with students and then verified by their mothers and/or caregivers.

Statistical analysis

Normality of distribution was assessed using Kolmogorov-Smirnov test. Data were presented as frequencies and percentages for categorical variables. Chi-square test was used for the analysis of general characteristics of the participants, eating behaviors categories and FNLIT categories in the cognitive and skill domains. Multinomial logistic regression adjusted for covariates was used to estimate associations between the FNLIT and eating behaviors. Two-tailed tests were used and *p*-values less than 0.05 were considered as statistically significant. All statistical analyses were carried out using SPSS Software v.21.0 (SPSS, Chicago, Illinois, USA).

Results

Characteristics of the study participants

The participants' general characteristics are presented in Tables 1 and 2 based on the FNLIT scores in congnitive and skill domains. Of the total students, 68.8% included high-level cognitive domains. At least one out of four students (25%) included low FNLIT values in the skill domain and a very few students included low scores in the cognitive domain (2.6%). The cognitive domain scores of FNLIT were significantly associated to father age, family size, mother education and student weight status. For example, 10% of students with a small family size (< 4 people) included low cognitive domain scores, compared to those with a family size of 4 (50%) and larger (40%). No significant relationships were seen between the demographic and socioeconomic characteristics and the FNLIT skill domain scores. Due to the low prevalence of FI with moderate and severe hunger, these values were grouped as one. No significant relationships were observed between the household food security status and the FNLIT skill and cognitive domain scores.

Association between FNLIT and eating behaviors

Children eating behaviors are summarized in Table 3. Irregular breakfast intakes were reported in nearly 34% of the students. Based on the results from Tables 4 and 5, high FNLIT scores in cognitive and skill domains were positively associated to eating breakfast, compared to irregular breakfast intake. High FNLIT scores in cognitive domain were positively associated to eating lunch every day compared to less than seven days a week, and to regular dinner intake compared to having dinner less than seven days a week. High FNLIT scores in knowledge domain increased possibilities of eating salty snacks 3–4 times a week, while high FNLIT scores in the skill domain were associated to never eating sweet snacks.

Table 1. General characteristics of the participants based on the food and nutrition literacy scores in congnitive and skill domains

		Food and Nutrition Literacy				Food and Nutrition Literacy			
		Cognitive domain				Skill domain			
	Total	Low	Medium	high	P value*	low	Medium	high	P value*
	N (%)	N (%)	N (%)	N (%)		N (%)	N (%)	N (%)	
Overall	800	21(2.6)	229(28.6)	550(68.8)		200(25.0)	479(59.9)	121(15.1)	
Sex	800				0.05*				0.96
Female	381(47.6)	6(28.6)	100(43.7)	275(50.0)		94(47.0)	230(48.0)	57(47.1)	
Male	419(52.4)	15(71.4)	129(56.3)	275(50.0)		106(53.0)	249(52.0)	64(52.9)	
Grade	800				0.31				0.53
Fifth	413(51.6)	14(66.7)	121(52.8)	278(50.5)		99(49.5)	255(53.2)	59(48.8)	
Sixth	387(48.4)	7(33.3)	108(47.2)	272(49.5)		101(50.0)	224(46.8)	62(51.2)	

Table 1 (continued).

		Food and Nutrition Literacy				Food and Nutrition Literacy			
		Cognitive domain				Skill domain			
	Total	Low	Medium	high	P value*	low	Medium	high	P value*
	N (%)	N (%)	N (%)	N (%)		N (%)	N (%)	N (%)	
Birth order	798				0.47				0.21
1	437(54.8)	12(60.0)	118(51.5)	307(55.9)		107(54.0)	255(53.2)	75(62.0)	
>1	361(45.2)	8(40.0)	111(48.5)	242(44.1)		91(46.0)	224(46.8)	46(38.0)	
Father age tertile (year)	790				0.04*				0.63
30-40	300(38)	14(66.7)	90(40.2)	196(36.0)		75(38.5)	179(37.6)	46(38.7)	
41-45	265(33.5)	3(14.3)	68(30.4)	194(35.6)		63(32.3)	168(35.3)	34(28.6)	
≥ 46	225(28.5)	4(19.0)	66(29.5)	155(28.4)		57(29.2)	129(27.1)	39(32.8)	
Mother age tertile (year)	794				0.50				0.12
23-35	288(36.3)	10(47.6)	89(39.2)	189(34.6)		79(40.1)	158(33.2)	51(42.1)	
36-40	303(38.2)	8(38.1)	82(36.1)	213(39.0)		76(38.6)	190(39.9)	37(30.6)	
≥ 41	203(25.6)	3(14.3)	56(24.7)	144(26.4)		42(21.3)	128(26.9)	33(27.3)	
Ethnicity	797				0.49				0.95
Fars	441(55.3)	8(40.0)	128(55.9)	305(55.7)		108(54.3)	263(55.1)	70(57.9)	
Azeri	228(28.3)	9(45.0)	64(27.9)	155(28.3)		57(28.6)	141(29.6)	30(24.8)	
Fars-Azeri	56(7)	0(0)	18(7.9)	38(6.9)		14(7.0)	32(6.7)	10(8.3)	
Other	72(9)	3(15.0)	19(8.3)	50(9.1)		20(10.1)	41(8.6)	11(9.1)	
School status	800				0.48				0.41
Public	725(90.6)	19(90.5)	212(92.6)	494(89.8)		184(92.0)	435(90.8)	106(87.6)	
Private	75(9.4)	2(9.5)	17(7.4)	56(10.2)		16(8.0)	44(9.2)	15(12.4)	
Family size	797				0.02*				0.28
<4	160(20.1)	2(10.0)	44(19.2)	114(20.8)		42(21.3)	90(18.8)	28(23.1)	
4	465(58.3)	10(50.0)	123(53.7)	332(60.6)		106(53.8)	285(59.5)	74(61.2)	
>4	172(21.6)	8(40.0)	62(27.1)	102(18.6)		49(24.9)	104(21.7)	19(15.7)	
Father education	789				0.28				0.63
illiterate or ≤5years	85(10.8)	3(14.3)	26(11.6)	56(10.3)		23(11.8)	54(11.4)	8(6.7)	
6-9 years or diploma	395(50.1)	11(52.4)	123(54.9)	261(48.0)		98(50.3)	236(49.7)	61(51.3)	
associate's degree or higher	309(39.2)	7(33.3)	75(33.5)	227(41.7)		74(37.9)	185(38.9)	50(42.0)	
Mother education	794				0.004*				0.07
illiterate or ≤5years	86(10.8)	1(4.8)	21(9.3)	64(11.7)		21(10.7)	52(10.9)	13(10.7)	
6-9 years or diploma	461(58.1)	15(71.4)	154(67.8)	292(53.5)		129(65.5)	270(56.7)	62(51.2)	
associate's degree or higher	247(31.1)	5(23.8)	52(22.9)	190(34.8)		47(23.9)	154(32.4)	46(38.0)	
Father job position	778				0.48				0.67
Worker	106(13.6)	2(9.5)	35(16.1)	69(12.8)		29(15.3)	64(13.6)	13(11.0)	
employee	327(42)	13(61.9)	84(38.5)	230(42.7)		82(43.2)	191(40.6)	54(45.8)	
high rank employee	139(17.9)	1(4.8)	37(17.0)	101(18.7)		28(14.7)	93(19.8)	18(15.3)	
Retired	20(2.6)	1(4.8)	6(2.8)	13(2.4)		5(2.6)	10(2.1)	5(4.2)	
self-manager	186(23.9)	4(19.0)	56(25.7)	126(23.4)		46(24.2)	112(23.8)	28(23.7)	
Mother employment	794				0.27				0.88
Working	630(79.3)	18(85.7)	187(82.4)	425(77.8)		154(78.2)	379(79.6)	97(80.2)	
housewife	164(20.7)	3(14.3)	40(17.6)	121(22.2)		43(21.8)	97(20.4)	24(19.8)	
House ownership status	799				0.22				0.44
Owner	427(53.4)	10(47.6)	127(55.5)	290(53.4)		101(50.5)	256(53.6)	70(57.9)	
Tenant	262(32.8)	8(38.1)	80(34.9)	174(31.7)		77(38.5)	152(31.8)	33(27.3)	
mortgage	35(4.4)	0(0)	10(4.4)	25(4.6)		8(4.0)	21(4.4)	6(5.0)	
Other	75(9.4)	3(14.3)	12(5.2)	60(10.9)		14(7.0)	49(10.3)	12(9.9)	

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Table 2. Food security, physical activity, weight status and energy intake characteristics of the participants based on the food and nutrition literacy scores in congnitive and skill domains

		Food and Nutrition Literacy				Food and Nutrition Literacy			
		Cognitive domain				Skill domain			
	Total	Low	Medium	high	P value*	low	Medium	high	P value*
	N (%)	N (%)	N (%)	N (%)		N (%)	N (%)	N (%)	
Overall	800	21(2.6)	229(28.6)	550(68.8)		200(25.0)	479(59.9)	121(15.1)	
HH[1] food security status	639				0.52				0.05
FS[2]	481(75.3)	10(66.7)	136(73.9)	335(76.1)		117(72.7)	285(73.8)	79(85.9)	
FI[3] without hunger	111(17.4)	4(26.7)	30(16.3)	77(17.5)		32(19.9)	67(17.4)	12(13.0)	
FI with hunger	47(7.4)	1(6.7)	18(9.8)	28(6.4)		12(7.5)	34(8.8)	1(1.1)	
Physical activity tertile MET.h/day)	787				0.47				0.28
Mean *T1*: 33	260(33.0)	6(28.6)	75(33.5)	179(33.0)		74(37.4)	155(32.9)	31(26.3)	
Mean *T2*: 38.37	262(33.3)	6(28.6)	66(29.5)	190(35.1)		57(28.8)	160(34.0)	45(38.1)	
Mean *T3*: 47.71	265(33.7)	9(42.9)	83(37.1)	173(31.9)		67(33.8)	156(33.1)	42(35.6)	
Weight statue (BMI Z scores)	800				0.02*				0.85
Thin	15(1.9)	2(9.5)	6(2.6)	7(1.3)		5(2.5)	9(1.9)	1(0.8)	
Normal	381(47.6)	12(57.1)	118(51.5)	251(45.6)		100(50.0)	222(46.3)	599(48.8)	
Overweight	213(26.6)	2(9.5)	58(25.3)	153(27.8)		47(23.5)	133(27.8)	33(27.3)	
Obese	191(23.9)	5(23.8)	47(20.5)	139(25.3)		489(24.0)	115(24.0)	28(23.1)	
Energy intake tertile (kcal/day)	493				0.78				0.36
Mean T1:1553.0	93(18.9)	2(16.7)	24(15.9)	67(20.3)		22(16.5)	56(19.4)	15(20.8)	
Mean T2:1905.5	196(39.8)	4(33.3)	63(41.7)	129(39.1)		49(36.8)	113(39.2)	34(47.2)	
Mean T3: 2470.4	204(41.4)	6(50.0)	64(42.4)	134(40.6)		62(46.6)	119(41.3)	23(31.9)	

*Significant at $p < 0.05$ for x^2 tests.
[1]HH: household, FS: food secure, FI: food insecure

Table 3. Eating behaviors based on the food and nutrition literacy scores in congnitive and skill domains

		Food and nutrition literacy score							
		Cognitive domain				Skill domain			
	Total	low	moderate	high	P value*	low	moderate	high	P value*
	N (%)	N (%)	N (%)	N (%)		N (%)	N (%)	N (%)	
Breakfast	797				0.009*****				<0.001*****
every day	475(59.6)	13(61.9)	115(50.2)	347(63.4)		95(47.5)	291(61.0)	89(74.2)	
3-6 times a week	188(23.5)	4(19.0)	66(28.8)	118(21.6)		52(26.0)	118(24.7)	18(15.0)	
1-2 times a week	95(11.9)	2(9.5)	39(17.0)	54(9.9)		37(18.5)	47(9.9)	11(9.2)	
never	39(4.9)	2(9.5)	9(3.9)	28(5.1)		16(8.0)	21(4.4)	2(1.7)	
Lunch	796				<0.001*****				0.02*****
every day	635(79.8)	17(81.0)	158(69.0)	460(84.2)		143(71.9)	390(81.8)	102(85.0)	
3-6 times a week	110(13.8)	2(9.5)	53(23.1)	55(10.1)		35(17.6)	64(13.4)	11(9.2)	
1-2 times a week	47(5.9)	2(9.5)	16(7.0)	29(5.3)		20(10.1)	21(4.4)	6(5.0)	
never	4(0.5)	0(0)	2(0.9)	2(0.4)		1(0.5)	2(0.4)	1(0.8)	
Dinner	797				0.04*****				0.002*****
every day	568(71.3)	17(81.0)	146(63.8)	405(74.0)		127(63.5)	351(73.6)	90(75.0)	
3-6 times a week	152(19)	1(4.8)	53(23.1)	98(17.9)		38(19.0)	94(19.7)	20(16.7)	
1-2 times a week	65(8.2)	3(14.3)	25(10.9)	37(6.8)		29(14.5)	28(5.9)	8(6.7)	
never	12(1.5)	0(0)	5(2.2)	7(1.3)		6(3.0)	4(0.8)	2(1.7)	
Snack	797				0.83				0.11
≥3 times a day	273(34.3)	8(38.1)	76(33.2)	189(34.6)		66(22.0)	153(32.1)	54(45.0)	
2 times a day	225(28.2)	6(28.6)	62(27.1)	157(28.7)		48(24.0)	149(31.2)	28(23.3)	
1 times a day	202(25.3)	4(19.0)	66(28.8)	132(24.1)		55(27.5)	119(24.9)	28(23.3)	
never	97(12.2)	3(14.3)	25(10.9)	69(12.6)		31(15.5)	56(11.7)	10(8.3)	
Water					0.06				0.01*****

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[DOR: 20.1001.1.23830441.2021.8.3.6.8]
[DOI: 10.52547/nfsr.8.3.37]

Table 3 (continued).

	Food and nutrition literacy score								
		Cognitive domain				Skill domain			
	Total	low	moderate	high	P value*	low	moderate	high	P value*
	N (%)	N (%)	N (%)	N (%)		N (%)	N (%)	N (%)	
≥5 cups a day	581(72.9)	17(81.0)	157(68.9)	407(74.3)		132(66.0)	361(75.7)	88(73.3)	
3- 4 cups a day	149(18.7)	3(14.3)	47(20.6)	99(18.1)		44(22.0)	80(16.8)	25(20.8)	
1- 2 cups a day	59(7.4)	0(0)	19(8.3)	40(7.3)		18(9.0)	34(7.1)	7(5.8)	
0 cup a day	8(1)	1(4.8)	5(2.2)	2(0.4)		6(3.0)	2(0.4)	0(0)	
Tea/Coffee/Hot cacao	798				0.59				0.52
≥ 5 times a week	184(23)	3(14.3)	59(25.8)	122(22.3)		43(21.5)	119(24.9)	22(18.3)	
3-4 times a week	175(21.9)	3(14.3)	54(23.6)	118(21.5)		44(22.0)	105(22.0)	26(21.7)	
1-2 times a week	306(38.3)	11(52.4)	82(35.8)	213(38.9)		73(36.5)	180(37.7)	53(44.2)	
never	133(16.7)	4(19.0)	34(14.8)	95(17.3)		40(20.0)	74(15.5)	19(15.8)	
Soft drinks/Industrial fruit juices	798				0.46				0.06
≥ 5 times a week	61(7.6)	3(14.3)	20(8.7)	38(6.9)		26(13.0)	32(6.7)	3(2.5)	
3-4 times a week	122(15.3)	2(9.5)	37(16.2)	83(15.1)		35(17.5)	72(15.1)	15(12.5)	
1-2 times a week	329(41.2)	11(52.4)	98(42.8)	220(40.1)		77(38.5)	204(42.7)	48(40.0)	
never	286(35.8)	5(23.8)	74(32.3)	207(37.8)		62(31.0)	170(35.6)	54(45.0)	
Sausage/Hamburger	798				<0.001*				0.01*
≥ 5 times a week	15(1.9)	2(9.5)	7(3.1)	6(1.1)		7(3.5)	8(1.7)	0(0)	
3-4 times a week	40(5)	2(9.5)	15(6.6)	23(4.2)		11(5.5)	27(5.6)	2(1.7)	
1-2 times a week	222(27.8)	7(33.3)	80(34.9)	135(24.6)		68(34.0)	120(25.1)	34(28.3)	
never	522(65.3)	10(47.6)	127(55.5)	384(70.1)		114(57.0)	323(67.6)	84(70.0)	
Pizza	798				0.24				0.14
≥ 5 times a week	14(1.8)	1(4.8)	5(2.2)	8(1.5)		6(3.0)	8(1.7)	0(0)	
3-4 times a week	13(1.6)	1(4.8)	6(2.6)	6(1.1)		6(3.0)	6(1.3)	1(0.8)	
1-2 times a week	175(21.9)	7(33.3)	52(22.7)	116(21.2)		50(25.0)	98(20.5)	27(22.5)	
never	596(74.7)	12(57.1)	166(72.5)	418(76.3)		138(69.0)	366(76.6)	92(76.7)	
French fries	798				<0.001*				<0.001*
≥ 5 times a week	49(6.1)	6(28.6)	23(10.0)	20(3.6)		21(10.5)	25(5.2)	3(2.5)	
3-4 times a week	101(12.7)	2(9.5)	33(14.4)	66(12.0)		30(15.0)	64(13.4)	7(5.8)	
1-2 times a week	389(48.7)	6(28.6)	109(47.6)	274(50.0)		97(48.5)	241(50.4)	51(42.5)	
never	259(32.5)	7(33.3)	64(27.9)	188(34.3)		52(26.0)	148(31.0)	59(49.2)	
Restaurant foods/ Fast foods	797				0.12				0.12
≥ 5 times a week	13(1.6)	0(0)	9(4.0)	4(0.8)		4(2.0)	9(1.9)	0(0)	
3-4 times a week	37(4.6)	1(4.8)	10(4.4)	26(4.8)		11(5.5)	24(5.0)	2(1.7)	
1-2 times a week	236(29.2)	8(38.1)	69(30.1)	159(29.1)		71(35.5)	131(27.5)	34(28.3)	
never	511 (64.1)	12(57.1)	141(61.6)	358(65.4)		114(57.0)	313(65.6)	84(70.0)	
Sweet snacks	798				0.01*				0.02*
≥ 5 times a week	120(15)	3(14.3)	35(15.3)	82(15.0)		31(1.5)	76(15.9)	13(10.8)	
3-4 times a week	236(29.6)	4(19.0)	85(37.1)	147(26.8)		67(33.5)	142(29.7)	27(22.5)	
1-2 times a week	333(41.7)	14(66.7)	81(35.4)	238(43.4)		74(37.0)	206(43.1)	53(44.2)	
never	109(13.7)	0(0)	28(12.2)	81(14.8)		28(14.0)	54(11.3)	27(22.5)	
Sugar	798				0.37				0.03*
≥ 5 times a week	193(24.2)	6(28.6)	68(29.7)	119(21.7)		55(27.5)	120(25.1)	18(15.0)	
3-4 times a week	191(23.9)	5(23.8)	52(22.7)	134(24.5)		50(25.0)	118(24.7)	23(19.2)	
1-2 times a week	284(35.6)	6(28.6)	77(33.6)	201(36.7)		64(32.0)	162(33.9)	58(48.3)	
never	130(16.3)	4(19.0))	32(14.0)	94(17.2)		31(15.5)	78(16.3)	21(17.5)	
Honey/Jam	798				<0.001*				<0.001*
≥ 5 times a week	148(18.5)	3(14.3)	41(17.9)	104(19.0)		27(13.5)	88(118.4)	33(27.5)	
3-4 times a week	134(16.8)	7(33.3)	30(13.1)	97(17.7)		29(14.5)	74(15.5)	31(25.8)	
1-2 times a week	221(27.7)	8(38.1)	62(27.1)	151(27.6)		49(24.5)	145(30.3)	27(22.5)	
never	295(37)	3(14.3)	96(41.9)	196(35.8)		95(47.5)	171(35.8)	29(24.2)	
Salty snacks	798				0.10				<0.001*
≥ 5 times a week	65(8.1)	4(19.0)	24(10.5)	47(6.8)		26(13.0)	33(6.9)	6(5.0)	
3-4 times a week	155(19.4)	5(23.8)	43(18.8)	107(19.5)		39(19.5)	98(20.5)	18(15.0)	
1-2 times a week	345(43.2)	10(47.6)	102(44.5)	233(42.5)		96(48.0)	210(43.9)	18(15.0)	
never	233(29.2)	2(9.5)	60(26.2)	171(31.2)		39(19.5)	137(28.7)	57(47.5)	

Notes: *Significant at $p < 0.05$ for x^2 tests.

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Table 4. The adjusted[‡] odds ratios (95% CI) of healthy eating behaviors[†] for FNLIT domains

Main meals	Breakfast			Lunch		Dinner	
	never	1-2 times a week	3-6 times a week	never /1-2 times a week	3-6 times a week	never /1-2 times a week	3-6 times a week
High FNLIT in cognitive domain[§]	1.08 (0.33-3.51)	0.34 (0.18-0.65)*	0.68 (0.41-1.13)	0.40 (0.17-0.93)*	0.45 (0.25-0.80)*	0.32 (0.14-0.68)*	0.76 (0.44-1.32)
Low & Medium FNLIT in cognitive domain	reference			reference		reference	
High FNLIT in skill domain[§]	0.27 (0.31-2.40)	1.16 (0.48-2.81)	0.33 (0.13-0.78)*	1.04 (0.27-4.00)	1.21 (0.51-2.88)	0.11 (0.33-3.67)	0.65 (0.28-1.52)
Low & Medium FNLIT in skill domain	reference			reference		reference	

Snack and water	Snack(s)			Water	
	never	1 times a day	2 times a day	Never/1-2 cups a day	3-4 cups a day
High FNLIT in cognitive domain[§]	0.83 (0.42-1.67)	01.05 (0.61-1.81)	1.08 (0.63-1.84)	0.98 (0.46-2.11)	0.77 (0.46-1.30)
Low & Medium FNLIT in cognitive domain	reference			Reference	
High FNLIT in skill domain[§]	0.44 (0.15-1.29)	0.76 (0.38-1.53)	0.51 (0.24-1.05)	1.12 (0.38-3.25)	1.04 (0.50-2.16)
Low & Medium FNLIT in skill domain	reference			Reference	

Notes: [†]Multinomial logistic model **comparing eating behaviors category to ≥ 5 cups group in water, to every day group in Breakfast, Lunch, dinner and ≥3 times a day group in snack categories.** FNLIT references category is moderate and low. [‡]Adjusted for sex, school status (governmental and nongovernmental), grade, birth rank, family size, ethnicity, parents age, parents' education, father job position, mother employment, Other income source of family members, weight status and calorie intake. *Significant at $p < 0.05$.

Discussion

Findings showed that high FNLIT scores in the cognitive and skill domains were associated to healthy eating behaviors. The findings were similar to those in previous studies, which showed that high food literacy/nutrition literacy was associated to frequencies of main meal consumption (30), preferences for healthy foods, decreased fast-food portion sizes and decreased consumption frequencies of packaged or processed snacks in school-age children and adolescents in developed and developing countries (31, 32). Children food preferences are established at younger ages and evolve around family cultural preferences, beliefs and attitudes (33) as well as their food environments and peer behaviors in schools (34). The FNLIT includes key roles in forming children preferences (35). Evidence have shown that involving children in healthy food preparation and improving their nutrition skills can lead to subsequent preferences for intake of healthy foods (36–38). Findings by Larson et al. revealed that higher levels of food and nutrition skills were associated to increased fruit and vegetable consumption and inversely linked to unhealthy food choices, including consumption of soft drinks and fried foods, in children and adolescents (39). Lack of food skills and confidence, specifically in cooking and food preparation (as FNLIT skill), seems as barriers to healthy eating behaviors (40, 41).

In the current study, unhealthy eating behaviors such as consumption sweet snacks and processed meats were quite prevalent between the children, similar to those of previous reports from Iran (42, 43) and other countries (25, 44). However, these were significantly lower in children with higher FNLIT scores. Despite the current government regulations, Iranian children are exposed to considerable numbers of food advertisements (45). Food producers highly affect most advertised foods and information they provide may not necessarily be interested by the publicity (46). In contrast, the easy access to junk foods in schools (43, 47, 48) affects taste preferences of the children (49). Improving food and nutrition skills such as food advertising literacy, food purchasing behaviors and food label literacy can help children respond critically to such food media and make better food choices (50).

In the present study, some eating behaviors were linked to the cognitive or skill domain and some to both domains. Literacy is the concept beyond the pure knowledge that emphasizes functional aspects rather than knowledge (9). Nutrition knowledge may play fundamental but small roles in adopting healthy eating behaviors, while food skills are essential to translate knowledge into practice. Food and nutrition skills can be development if children include prior food and nutrition knowledges (51). However, development of skills typically provides knowledge as practicing them lead to acquisition of knowledge (51, 52).

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Table 5. The adjusted‡ odds ratios (95% CI) of unhealthy eating behaviors† for FNLIT domains

Sugary drinks	Tea/Coffee/Hot cacao			Soft drinks/ Industrial fruit juices			Sausage/Hamburger	
	never	1-2 times a week	3-4 times a week	never	1-2 times a week	3-4 times a week	never	1-2 times a week
High FNLIT in cognitive domain§	1.30 (0.65-2.60)	0.91 (0.53-1.57)	0.76 (0.42-1.40)	0.95 (0.38-2.34)	0.93 (0.38-2.24)	0.98 (0.37-2.58)	2.16 (0.96-4.83)	1.08 (0.47-2.52)
Low & Medium FNLIT in cognitive domain		reference			reference			reference
High FNLIT in skill domain§	0.78 (0.27-2.23)	1.70 (0.81-3.57)	1.34 (0.57-3.15)	7.57 (0.90-63.03)	4.50 (0.54-37.31)	5.16 (0.58-45.45)	1.80 (0.38-8.50)	2.62 (0.53-12.81)
Low & Medium FNLIT in skill domain		reference			reference			reference

Fast foods	Pizza		French fries			Restaurant foods/ Fast foods	
	Never	1-2 times a week	never	1-2 times a week	3-4 times a week	never	1-2 times a week
High FNLIT in cognitive domain§	0.55 (0.15-2.02)	0.42 (0.11-1.63)	2.27 (0.92-5.62)	1.89 (0.80-4.46)	2.19 (0.82-5.83)	1.60 (0.66-3.86)	1.22 (0.49-3.01)
Low & Medium FNLIT in cognitive domain		reference		reference			reference
High FNLIT in skill domain§	2.42 (0.25-22.77)	2.28 (0.23-23.06)	6.54 (0.75-57.19	5.32 (0.62-45.38)	1.38 (0.12-15.68)	6.07 (0.72-51.439)	3.71 (0.42-32.68)
Low & Medium FNLIT in skill domain		reference		reference			reference

Sweet & Salty snacks	Sweet snacks			Sugar			Honey/ Jam			Salty snacks		
	never	1-2 times a week	3-4 times a week	never	1-2 times a week	3-4 times a week	never	1-2 times a week	3-4 times a week	never	1-2 times a week	3-4 times a week
High FNLIT in cognitive domain§	1.15 (0.49-2.69)	1.28 (0.68-2.38)	0.64 (0.34-1.22)	1.10 (0.56-2.16)	1.28 (0.75-2.20)	1.41 (0.78-2.51)	0.70 (0.37-1.32)	0.59 (0.31-1.15)	1.06 0.50-2.26)	2.16 (0.95-4.94)	1.83 (0.85-3.93)	2.58 (1.09-6.13)*
Low & Medium FNLIT in cognitive domain		reference			reference			reference			reference	
High FNLIT in skill domain§	4.19 (1.39-12.62)*	1.69 (0.63-4.55)	1.51 (0.53-4.32)	1.70 0.63-4.52)	2.25 (1.02-4.96)	1.02 (0.41-2.55)	0.46 (0.20-1.01)	0.43 (0.18-1.03)	1.14 (0.51-2.59)	4.27 (0.89-20.30)	1.64 (0.34-7.86)	2.35 (0.46-11.94)
Low & Medium FNLIT in skill domain		reference			reference			reference			reference	

Notes: †Multinomial logistic model **comparing eating behaviors category to ≥5 times group** in Tea/Coffee/Hot cacao, Soft drinks/ Industrial fruit juices, French fries, Sweet snacks, Sugar, Honey/ Jam, Salty snacks categories, to ≥ 3 times group in Sausage/Hamburger, Pizza and Restaurant foods/ Fast foods. FNLIT references category is moderate and low. ‡Adjusted for sex, school status (governmental and nongovernmental), grade, birth rank, family size, ethnicity, parents age, parents' education, father job position, mother employment, Other income source of family members, weight status and calorie intake. *Significant at $p < 0.05$.

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[DOI: 10.52547/nfsr.8.3.37]

Links between the nutrition knowledge, skill and critical decision-making (which is conceptualized as food literacy) help children control their eating behaviors (9). In the current study, a considerable proportion of the students included low FNLIT scores in the skill domain, compared to the cognitive domain. This reveals that despite importance of the cognitive domain of FNLIT, effective strategies for the improvement of dietary skills are absent. This may be attributed to the fact that training in schools is based on the factual information and theoretical concepts. Content analysis of the Iranian primary school textbooks has shown that nutritional contents of the school textbooks are majorly theoretical rather than practical (53). These contents have led to students with high food and nutrition knowledges but with major gaps in performances and skills, resulting in unhealthy eating behaviors (54).

Based on the current evidence, individuals with higher self-efficacies are more likely to achieve desirable outcomes despite existed barriers (55). Building self-efficacy and sharing nutrition information with others through discussions and group activities in schools may be the most common strategies to improve children skills for better food choices (56). To improve student food skills, changing food ideas may best support children in making healthier food choices. Evidence show that school food atmosphere is a critical element in forming student dietary intakes and food choices (57). To the best of the authors' knowledge, no studies are available to investigate associations between FNLIT and eating behaviors of school-age children. Therefore, the current study includes significant values due to its novel findings and contents of numerous covariates to analyze FNLIT of eating behaviors. This obviously enables researchers to minimize the confounding effects of other factors. However, this study included limitations. The current study could not identify causal relationships such as possible reverse causalities due to its cross-sectional design. As the present study included frequencies of food intakes, quantities of the consumed foods could not be estimated. Future studies should include longitudinal approaches to investigate potentially causal contributions of FNLIT to children dietary intakes in large sample sizes. In contrast, statistically significant associations between dietary attributes and FNLIT were small in this study. Future studies in various social and cultural settings are necessary to investigate such associations.

Conclusion

The current study has added knowledge to the field by providing a common language for FNLIT. The present results are general reminders to schools of various learning needs of children. Furthermore, study highlights the necessity of continuous improvements in health education curriculum of schools in Iran, particularly in practical and skill-based lessons. Further studies with long-term follow-up plans are needed to better understand associations between FNLIT and eating behaviors.

Ethics approval and consent to participate

The study was approved by the National Nutrition and Food Technology Research Institute (NNFTRI) Ethics Committee (approval code: IR.SBMU.nnftri.Rec.1394.20). Written informed consents were signed by the students and their parents before the commencement of the survey.

Authors' contributions

AD was responsible for analyzing and interpreting data and drafting and editing the manuscript NO, NKM, HE-Z carried out the study design and analysis. AD, ZA, SE, collected data. AD, NO, NKM, MA1, MA2 and HE-Z participated in conceiving and designing the study, revising the manuscript and collecting data. All authors read and approved the final manuscript.

Acknowledgement

The authors express their appreciation to Shahid Beheshti University of Medical Sciences, National Nutrition and Food Technology Research Institute (NNFTRI), for funding the study. All coordinators and students participated in this study are appreciated.

Financial disclosure

The authors declared no financial interest.

Funding/Support

This work was supported by Shahid Beheshti University of Medical Sciences, National Nutrition and Food Technology Research Institute (NNFTRI) (grant no. 1394.20/16-10-2015).

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[DOR: 20.1001.1.23830441.2021.8.3.6.8]

[DOI: 10.52547/nfsr.8.3.37]