

ORIGINAL ARTICLE

Enhancing Nutrition-Related Literacy, Knowledge and Behavior among University Students: A Randomized Controlled Trial

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ABSTRACT

Background: Despite the key role of nutrition literacy and behavior in health, evidence suggests a low adherence to healthy nutritional behaviors. We sought to determine the influence of a group-based interactive training program on nutrition-related literacy, knowledge and behavior of students.

Methods: Two-hundred and three undergraduate students were enrolled by multi-stage cluster sampling and were randomly divided into two groups of intervention (n=106) and control (n=97). Four questionnaires measured the demographic variables, nutrition-related literacy, knowledge, and behavior. The educational intervention was performed as workshop using a new educational style.

Results: There was no significant difference between the two groups regarding demographic variables. After educational intervention, a significant increase was found in the mean scores of nutrition literacy from 22.20±3.85 to 31.95±2.19, nutrition knowledge from 54.23±1.80 to 77.06±7.20, and nutritional behavior from 52.32±16.54 to 67.52±19.69 (P<0.001), but no significant difference was observed in the control group. The correlation coefficients significantly increased (from 0.167 to 0.552).

Conclusion: Our educational pattern was effective in improving nutritional literacy, knowledge and behavior and is recommended for students in their curriculum.

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Introduction

Nutrition is recognized as a variable which controls related risk factors, health promotion and prevention of chronic diseases (1). Also, the spread

of the diet-related diseases indicates inadequacy of knowledge, motivation, or resources among the population. In many cases, this inadequacy may be rooted in poor health and nutrition literacy (2). In

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the health care domain, the consequences of low health literacy have been well documented for the US population and include poorer health/nutrition-related knowledge and practice (3, 4) developing ill-health conditions (5, 6), more hospitalizations (7, 8) and higher health care costs (9, 10).

Nutrition literacy is defined as a degree in which individuals have the ability to receive, process and understand basic nutritional information (11). Nutritional literacy is a key principle in promoting healthy eating habits as well as promoting general health (12). On the other hand, improved health/nutrition literacy is associated with better healthy behavior and well-being outcomes (13). Nutritional literacy can be a skill-based process that individuals can use to identify and transform nutrition messages into knowledge. In general, people who have sufficient nutrition knowledge, their food choices are healthier (14, 15).

However, most nutritionists do not evaluate their clients health literacy (16). Although health literacy plays an important role in decision-making including nutrition, the evidence shows the situations of this determinant in community are still far from ideal. According to the studies, about 36% of American adults (17) and 56.6% of Iranian adults from five provinces (18) had low health literacy. Although chronic diseases can start and develop slowly at young age, most youth often do not manifest disease symptoms (19, 20).

One of the main goals of the universities is the knowledge development of the community, thus, college students are an appropriate target group for nutritional education, because their lives are in transition and they can change positively (19, 20). Evidence suggests lack of studies about effective educational methods for promoting nutritional literacy and diet behavior (2, 21). Therefore, the aim of our study was to determine the influence of a group-based interactive training program on nutritional literacy, knowledge and behavior among Iranian students in Shiraz University of Medical Sciences, in Shiraz, southern Iran.

Materials and Methods

The present study was a randomized controlled trial interventional study. The research area was Shiraz University of Medical Sciences, one of the largest universities in Shiraz, southern Iran. In this study, the effect of independent variable (Nutrition Literacy Education Program) on dependent variables (nutrition-related literacy, knowledge, and behavior) has been investigated. Two-hundred and three undergraduate students (106 and 97 students in the intervention and comparison groups,

respectively), were enrolled through multistage random sampling method.

In order to make more harmony between the intervention and control groups, we randomly assigned one class from the two classes of the same discipline (heads or tails) to the intervention group and the other to the control group (Figure 1). Sample size was calculated using the following formula, with $\alpha=0.05$ and $\beta=0.80$, while d =The least discernable difference between the two groups=8. There were 86 students for each study group that increased to 100, considering 20% as possible drop out.

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 (\sigma_1^2 + \sigma_2^2)}{d}$$

$$\sigma_1 = \sigma_2 = \frac{\max - \min}{6} = \frac{140 - 28}{6} = 18.66$$

Inclusion criteria were active student in an undergraduate discipline and willingness to contribute in the study and sign the informed consent. Exclusion criteria were the unwillingness to continue to collaborate in the study, not attending education programs and absences in the pre-test, post-test, or both. Data collection tools includes (i) Demographic and Anthropometric Questionnaire, (ii) Nutrition Literacy Assessment Instrument (22) consisted of 34 questions including four sections of macronutrient (6 items), household food scales (6 items), nutrition labels (6 items) and food groups (16 items).

Each correct answer was scored 1 and the wrong response was scored zero. Totally, the scores of each person varied from 0 (minimum) to 34 (maximum). (iii) The Knowledge Questionnaire for Adults (23) consisted of 91 questions. Each correct answer was scored 1 and the wrong reply was scored zero. Totally, the scores of each person varied from 0 (minimum) to 91 (maximum). (iv) Healthy Eating Every Day Goals Assessment (24) consisted of 35 questions including six sections of fruits and vegetables (5 items), fats (8 items), dairy and its substitutes (4 items), whole grains (6 items), energy balance (6 items), and nutrition literacy (6 items).

For questions with 4 options, the first, second, third and fourth options were scored 0, 1, 3, and 5, respectively. For questions with 3 options, the first, second, and third choices were scored 0, 3, and 5, respectively. Totally, the scores of each person varied from 0 (minimum) to 175 (maximum). Translation of questionnaires were done according to the four ordinal stages of translation and back-translation as recommended by the World Health Organization (25).

In order to determine the validity of instruments, test-retest method was used with a two week

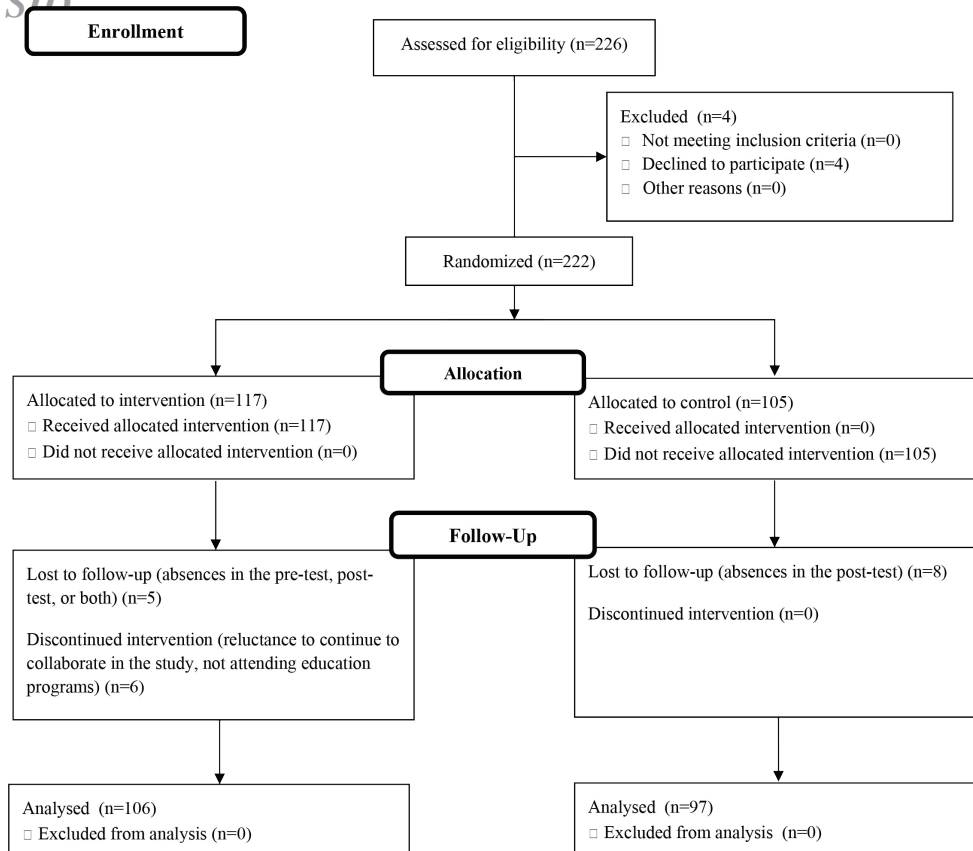


Figure 1. Flow diagram of the progress through the phases of the randomized trial.

interval. In this study, 30 undergraduate students of Shiraz University of Medical Sciences completed questionnaires by using simple sampling method and again after 2 weeks, the same questionnaires were given to the same individuals, and the Cronbach's alpha and Pearson correlation coefficients were calculated. The Cronbach's alpha coefficients of Nutrition Literacy Assessment Instrument, Nutrition Knowledge Questionnaire for Adults, and Healthy Eating Every Day Goals Assessment, were 0.70, 0.89, and 0.71, respectively.

The correlation coefficients of Nutrition Literacy Assessment Instrument, Nutrition Knowledge Questionnaire for Adults, and Healthy Eating Every Day Goals Assessment, were 0.78, 0.82, and 0.71, respectively. The intervention group completed the questionnaires in three stages of pre-test, first post-test (one week after intervention) and second post-test (2 months after intervention), except for the nutritional behavior questionnaire, which was completed in two stages of pre-test and post-test (2 months after the intervention). The control group completed the questionnaires in 2 stages of pre-test and post-test (2 months after the pre-test).

The protocol of intervention method was defined as educational intervention to be performed separately for each courses of interventional group in a 4-hour workshop and a 1-hour problem solving

session by using a new type of educational plan. Educational programs based on nutrition literacy with specific purposes, valid scientific content and appropriate teaching materials, included direct and indirect training sessions. Direct teaching method in the training sessions was performed with the general purpose of "Promoting Nutrition Literacy in Students" by using interactive approaches and strategies of short interactive lecture, small group discussion technique with questions and answers, individual learning assignments with a directed exploration approach, brain storming, games, racing, and the use of food samples.

The lecture method was used to save time, resources and facilities to provide a lot of theoretical content in one session, as well as creating a sense of safety and usefulness in the participants. The remaining methods were used to contribute participants in learning and discussion process. Educational media such as power point, video projector, video clips and internet were used to educate. Indirect training was done using booklets, pamphlets, targeted gifts and CD workshops.

All the participants received verbal explanation about the study objectives and procedures and then signed written informed consents for taking part in the study. The participants were also reassured about the anonymity and confidentiality of their

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information. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments including informed consent and confidentiality of all personal information.

The data was analyzed with SPSS software (–version 22, IBM Corp, Armonk, NY, USA) and descriptive statistics consisted of number, percentage, mean, and standard deviation, and inferential statistics involved independent t-test, Chi-square test, paired t-test, repeated measures analysis of variance (ANOVA), Pearson's correlation coefficient and linear regression. The significance level of tests was considered $p < 0.05$. Test Effect (26) was one of the factors that may harm internal validity. Due to this concern, the questionnaires in the control group were collected only in two stages; the first stage was at the beginning of the study and the other one was two months later. Then, the mean of these two steps for implementing Repeated Measure Test was considered equal to the first post-test in the intervention group.

Results

At runtime, 121 and 105 students participated in the intervention and control groups, respectively. During the study, 15 and 8 students dropped out of the intervention and control groups, respectively. Finally, 203 students (106 students in intervention group and 97 students in control group) with a

mean age of 21.31 ± 2.40 years and the mean body mass index (BMI) of 22.50 ± 3.84 completed the study. The demographic characteristics were shown in Table 1. Results of the demographic data of the participants showed that there was no significant difference between the intervention and control groups at the beginning of the study (Table 1).

Results of repeated measures (ANOVA) showed significant difference after the intervention in the mean of nutritional literacy and knowledge scores between the two intervention and control groups. Post-Hoc LSD test indicated that the mean of nutritional literacy and knowledge scores significantly increased in both first and second post-tests ($P < 0.001$). However, the mean of nutrition literacy ($P = 0.80$) and knowledge ($P = 0.59$) scores did not change significantly in the control group (Table 2).

Paired t-test showed that the mean of nutritional behavior score in the intervention group significantly increased from 52.32 ± 16.54 to 67.52 ± 19.69 ($P < 0.001$). But, the average score of nutritional behavior in the control group did not change significantly from 54.57 ± 18.97 to 53.13 ± 17.51 ($P = 0.21$). In this study, the greatest inter-correlation was observed between nutritional literacy and knowledge (0.522, $P < 0.01$) and the least inter-correlation was between nutritional literacy and behavior (0.167, $P < 0.05$). The inter-correlation between nutritional knowledge and behavior was 0.205 ($P < 0.01$).

Comparison of the mean changes in nutritional literacy and knowledge had significant difference

Table 1. Demographic characteristics data^a for students enrolled in the study and total scores of questionnaires (n=203, $P \leq 0.05$)

Categories	Subcategories	Intervention group	Control group	P value
		N (%)	N (%)	
Discipline of study	Public health	22 (20.8%)	26 (26.8%)	0.066
	Occupational health	31 (29.2%)	20 (20.6%)	
	Environmental health	34 (32.1%)	21 (21.6%)	
	Health information Technology management	11 (10.4%)	13 (13.4%)	
		8 (7.5%)	17 (17.5%)	
Passed the nutrition course unit ^b	Yes	53 (50%)	46 (47.4%)	0.714
	No	53 (50%)	51 (52.6%)	
Marital status	Single	83 (78.3%)	67 (69.1%)	0.135
	Married	23 (21.7%)	30 (30.9%)	
Gender	Female	105 (99.1%)	91 (93.8%)	0.056
	Male	1 (.9%)	6 (6.2%)	
Quantitative variables		Mean±SD	Mean±SD	P value
Age		21.35±1.63	21.27±2.40	0.781
Body mass index		22.43±4.23	22.58±3.38	0.781
Nutrition literacy		22.20±3.85	21.69±3.45	0.317
Nutrition knowledge		54.23±11.80	55.34±11.81	0.507
Nutritional behavior		52.32±16.54	54.57±18.97	0.370

a. Independent t-test. χ^2 test. b. nutrition information collected from passing of “introduction to nutritional sciences in past semesters”.

Table 2: Comparison of mean changes^a in nutritional literacy and knowledge in two intervention (n=106) and control (n=97) groups at the beginning of intervention, one week after intervention and two months after intervention

Variables	Groups	Before intervention		First post-test		Second post-test		P value		
		M	SD	M	SD	M	SD	Time	Group	Time-Group
		Nutritional literacy	Intervention	22.20	3.85	31.95	2.19	29.58	1.91	<0.001
	Control	21.69	3.45	21.72	3.11	21.75	3.23			
Nutritional knowledge	Intervention	54.23	11.80	77.06	7.20	77.73	3.61	<0.001	<0.001	<0.001
	control	55.34	11.81	55.54	10.88	55.74	11.15			

a. Repeated measures analysis of variance

after intervention based on the discipline of the study, passing the nutritional course unit (nutritional information collected from passing of “introduction to nutritional sciences in past semesters”), age and BMI of the students in the intervention group. The results indicated that the highest changes in nutritional literacy and knowledge were found among students who were studying in the disciplines of management, health information technology, environmental health, occupational health and public health, respectively. They did not pass the nutritional course unit, and had a lower BMI and age (Tables 3 and 4). However, there was no significant difference in the mean changes in nutritional behavior after intervention based on the demographic variables.

Discussion

According to what has expected from people to have greater responsibility for their self-care health and making informed decisions for their own health (27). Therefore, the present study was conducted to determine the effect of nutritional literacy on nutritional knowledge and behavior. Comparing the mean changes in nutrition literacy score in both

intervention and control groups indicated that the nutritional literacy score in the intervention group was significantly higher than the control group.

Jay et al. (28) reported an increase in the perception of food labels as a nutritional factor, after multimedia intervention such as video and print in their study. The results of a study (29) showed that nutritional literacy of mothers increased after the educational intervention through three methods of website, play and print, which the highest increase was in the method of the website. These results indicated that the nutrition knowledge score in the intervention group increased after education.

A study showed that nutrition knowledge increased significantly after 6 weeks of intervention (30). Also, another one revealed that nutritional literacy intervention by the website method had more impact on nutrition knowledge than the other methods (29). The food behavior score in the intervention group was significantly higher than the control group. The results of the other studies were parallel with our study (30, 31). Dietary pattern scales and dietary choices improved after nutrition-related health literacy interventions (31).

Table 3. The effect of demographic variables on nutrition literacy means changes in the intervention group^a (n=106)

	Unstandardized coefficients		Standardized coefficient	T	P value
	B	Std. Error	Beta		
Discipline of study	1.28	0.32	0.36	4.00	<0.001
Passed the nutritional course unit	-3.41	0.72	-0.42	-4.73	< 0.001
Marital status	-0.008	0.96	-0.001	-0.008	0.994
Age	-0.53	0.23	-0.21	-2.23	0.028
BMI	-0.19	0.09	-0.20	-2.09	0.038

a. Linear regression

Table 4. The effect of demographic variables on nutritional knowledge means changes in the intervention group^a (n=106)

	Unstandardized coefficient		Standardized coefficient	T	P value
	B	Std. error	Beta		
Discipline of study	4.46	0.91	0.43	4.87	<0.001
Passed the nutritional course unit	-13.50	1.92	-0.56	-7.03	<0.001
Marital status	-0.33	2.83	-0.01	-0.12	0.905
Age	-1.51	0.70	-0.20	-2.15	0.033
BMI	-0.56	0.27	-0.20	-2.08	0.039

a. Linear regression

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In another study, total fat and saturated fats significantly decreased after 6 weeks of nutritional literacy interventions (30). The results of these studies also indicated improvements in nutritional behavior after intervention. There was a strong linear correlation between the nutritional literacy and knowledge ($r=0.552$, $P=0.01$). However, there was a weak and direct linear correlation between nutrition literacy and nutritional behavior ($r=0.167$, $P=0.05$). This means that the higher the level of nutritional literacy, the more likely they are to have a higher nutritional knowledge and more likely to adopt a healthier diet.

A systematic review showed that none of the studies assessed all aspects of nutritional literacy (32). The author revealed that from 13 studies, 8 of them had positive relationship, 3 of them had complicated relationship and 2 of them had no relationship between food literacy and dietary intake in adolescent. Cha et al. (33) in their study showed that the use of food labels in groups with low health literacy was significantly lower than those with high health literacy.

However, there was no significant difference between the medium and high health literacy group. In addition, the systematic review that was carried out in 2017 showed that empirical relationships between health literacy and the use of food labels are contradictory, and the empirical relationships between health literacy, literacy, the ability to calculate, understand, and use food labels are not well studied. As a result, they needed more attention for related issues with their measurement (34).

There is a weak and direct linear correlation between nutritional knowledge and behavior ($r=0.20$, $p=0.01$). According to the results of a systematic review conducted in 2014, most studies (63.6% of society, 71.4% of athletes) showed a significant positive nor poor relationship between higher nutritional knowledge and a healthier nutritional behaviors (35). Students who have higher scores of nutritional literacy and knowledge in disciplines such as public health and occupational health have passed nutritional course unit, confirm the role of nutrition course unit or, in other words, nutritional information.

Also, higher nutritional knowledge scores in students with a higher BMI may be due to the fact that they are looking for nutritional information more than those without a high BMI. As a result, this can cause higher score of nutritional knowledge among them. The high scores of nutritional knowledge in dietitian students in comparison with computer students support the role of discipline and passing the nutritional course unit (23). Also, in the study

of Ramezankhani et al. (36), the higher health literacy scores of medical students in comparison to non-medical students indicates the importance and impact of health-related information on health literacy ($P<0.001$).

Aihara et al. (15) found that people with higher nutrition information or health related occupations have adequate nutrition literacy. Also, overweight men have a higher nutritional literacy scores than men with a normal weight. According to Zoellner et al. (11), educational level affects nutrition literacy, but BMI does not affect nutrition literacy. Howard-Pitney et al. (30) considered BMI as one of the factors influencing nutritional knowledge. However, D'Amato-Kubiet (37) revealed conflicting results that the BMI did not affect nutrition knowledge and nutrition literacy.

In recent years, the number of male students in different disciplines of medical sciences has decreased significantly in Iran. In addition, 8 of the 15 students who left our study were male. Therefore, it was impossible to compare the results based on gender. As the strengths of the study, it can refer to the novelty of the study among Iranian student society and other Persian-speaking countries, and high response rate (90%). Also, the educational approaches and strategies used the oral and written feedback of the students in the intervention group were indicative of the positive and usefulness of the provided learning experiences.

The findings of this study could help to design educational intervention design and validate other studies. However, having self-administered and rely on individual self-report data may have led to some degree of bias in the results. It can be said that the level of education, proper collaboration, and explanations of the researcher minimized the amount of bias.

Conclusion

The educational program significantly increased the mean scores of nutrition-related knowledge, literacy and behavior in the intervention group students. The findings of this study showed the effectiveness of this type of educational program in order to integrate nutritional literacy education in the curriculum of various academic disciplines. In addition, they can be used in planning and evaluating nutritional health promotion interventions and health policies for young people and students at different levels such as universities, schools, media, etc. Therefore, it is recommended that more studies to be conducted in other demographic groups such as non-academic medical students, different languages and cultures, etc.

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Conflict of Interest

None declared.

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