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Validation of Nutrition Literacy Questionnaire for High School Students

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ABSTRACT

Background: Nutrition literacy is the individuals' motivation and ability to obtain, process, and understand nutrition information and the skills needed in order to make appropriate nutrition decisions. The present study was conducted to determine the validity and reliability of the Chongqing Middle School Nutrition Literacy Scale (CM-NLS). **Methods:** The CM-NLS questionnaire was translated into Farsi and then back-translated, and its face validity and quantitative and qualitative content validity were investigated in a descriptive-cross-sectional study. This review was conducted using the opinions of expert faculty members. Besides, the Persian version was tested in a sample of 400 students of the first grade of high school in Bandar Anzali city. For this purpose, two schools were randomly selected and sampled using census method. Cronbach's alpha test method was used to examine reliability, and confirmatory factor analysis was used to evaluate construct validity (RMSEA=0.062). **Results:** In checking face validity, changes were made in the questionnaire, and some items were removed in content validity evaluation by calculating content validity ratio (CVR) and content validity index (CVI). In reliability analysis, Cronbach's alpha coefficient was calculated as 0.74 for functional literacy, 0.82 for interactive literacy, and 0.84 for critical literacy. The results of confirmatory factor analysis showed a good fit to measure the construct validity. **Conclusions:** Based on the results obtained, the CM-NLS questionnaire with 33 items, is a valid and reliable tool and can be used to measure the nutrition literacy of high school students.

Introduction

Non-communicable diseases (such as cardiovascular diseases, diabetes, cancer, high blood pressure, obesity, etc.) are the leading death factors worldwide (Terzic and Waldman, 2011). According to the World Health Organization (WHO), 71% of all deaths in the world in 2021 were due to non-communicable diseases, and based on this report, 77% of all non-communicable deaths occur in low- and middle-income countries (World Health Organization,

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2021). Iran, as a middle-income country, accounted for 83.5% of all deaths and 78.1% of the total disease burden in 2019 which were caused by non-communicable diseases (Aminorroaya *et al.*, 2020, Global Health Data Exchange, 2019, Khosravi Shadmani *et al.*, 2019). Unhealthy diet, inactivity, and smoking are the main factors for development of 80% of non-communicable diseases (O'Grady and Capretta, 2009).

The increasing prevalence of these diseases imposes huge economic losses on countries (Esteghamati *et al.*, 2017). The role of nutrition as the main cause of these diseases has been well established (World Health Organization, 2015). Therefore, improper diet is one of the main concerns of the health sector in developed and developing countries (UNICEF, 2019). To this end, the unhealthy eating behavior of teenagers is especially worrying since most of them do not consume enough fruits and vegetables; instead, the consumption of high-fat, energy-rich, and nutrient-poor foods is high among them (Bauer *et al.*, 2009, Hamidian Shirazi *et al.*, 2022, Savige *et al.*, 2007). Among Iranian teenagers, high consumption of fast food and unhealthy snacks, not eating breakfast, and low consumption of fruits, vegetables, whole grains and dairy products have been commonly reported (Akbari and Azadbakht, 2014). Childhood and adolescence are periods when eating habits and behaviors are shaped in individuals (Li and Wang, 2008). Eating habits include a broad range of behaviors related to eating; findings indicate that eating skills and behaviors learned in adolescence persist in the subsequent stages of life and can hardly be changed (Morris, 2019, Vaitkeviciute *et al.*, 2015). On the other hand, adolescence is a complex and sensitive period, and the most important change in this period is puberty, and proper nutrition in this period of life can affect the quality and quantity of growth and maturity (Pirzadeh *et al.*, 2014, Rahmati-Najarkolaei *et al.*, 2015). Evidence demonstrates that nutrition literacy has a significant impact on healthy eating habits and behavior (Kalkan, 2019, Koca and Arkan, 2021, Lai *et al.*, 2021, Taleb and Itani, 2021) and is a key factor in choosing healthy food and following healthy eating patterns in adolescents (Appleton, 2010, Lino *et al.*, 1999, Zoellner *et al.*, 2011). Nutrition literacy is an individual's motivation and ability to obtain, process, and understand nutrition information and the skills needed in order to make appropriate nutrition decisions (Silk *et al.*, 2008, Zoellner *et al.*, 2009). Inspired by Nutbeam's health literacy theories, nutrition literacy is divided into functional, interactive, and critical levels. Functional nutrition literacy refers to the capacity to read and write to follow simple nutrition messages, for example, one is familiar with the concept of a balanced diet, food groups, and nutrition facts labels and uses them. Interactive nutrition literacy refers to the cognitive and interpersonal skills required for information interaction with professionals, i.e., one is able to exchange nutrition information in interaction with nutritionists, peers, and family. Critical nutrition literacy refers to the analysis of nutrition information in a critical way and efforts to solve nutrition problems (Nutbeam, 2008, Nutbeam and Kickbusch, 2000, Pettersen *et al.*, 2009).

Considering the importance of nutrition literacy in many countries of the world as an area of increasing research focus, only a limited number of tools are available to assess nutrition literacy of children and adolescents, and the existing nutrition literacy assessment tools are mainly focused on the assessment of adults (Doustmohammadian *et al.*, 2017, Gibbs *et al.*, 2016a, Gibbs *et al.*, 2018, Gibbs *et al.*, 2016b). In Iran, Doost Mohammadian *et al* developed and validated Food and nutrition literacy (FNL) tool to measure the nutrition literacy of children aged 10-12 (Doustmohammadian *et al.*, 2017). However, the level of knowledge and skills in the questionnaire is not sufficient to assess the nutrition literacy of adolescents. Ashouri *et al.* developed Food and nutrition literacy assessment tool (FNLAT) tool to assess the nutrition literacy of high school graduates and young people in Iran, which is for the age group of 17 to 18 (Ashoori *et al.*, 2020). Therefore, a tool suitable for assessing the nutrition literacy of adolescents

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aged 12 to 18 is not available in Iran. According to the importance of nutrition literacy and the need for appropriate tools to measure it regarding Iranian adolescent students, the present study was conducted to evaluate the nutritional literacy scale for middle school in Chongqing (CM-NLS) questionnaire in high school students.

Materials and Methods

Study design and participants

This descriptive-cross-sectional study was conducted in 2022. The research statistical population included 400 first grade high school students in Bandar Anzali city. Two schools were randomly selected among the public high schools of this city, which did not differ much in terms of cultural, economic, and social characteristics using census sampling method. The inclusion criteria included students' willingness to participate in the research, not having a special diet, and not suffering from chronic diseases, and the exclusion criteria were unwillingness to participate and complete the questionnaire by the students. After obtaining permission from the ethics committee of Iran University of Medical Sciences and making necessary arrangements with education organization of Bandar Anzali city and the principals and officials of the relevant schools and taking the informed consent of the students, the study officially began. The CM-NLS questionnaire (Zeng *et al.*, 2021) received from the author in English was translated using the approach of Jones *et al.* (Jones *et al.*, 2006), which is a combination of symmetrical and asymmetrical strategies (Mohammadi Zeidi *et al.*, 2012). The questionnaire was translated in several steps. First, translators who were fluent in the two languages and were familiar with the two cultures, translated the questionnaire, and then two translators were used to translate the English version into Farsi, as well as the Persian to English translation. The panel of experts then compared the existing versions in order to correct the clarity and semantic differences, and the semantic differences between the translation and the transliteration of the translation were resolved, and finally, the CM-NLS questionnaire was modified. The steps of validity and reliability were as follows.

Face validity

In face validity, only the external aspect of the test is considered. Face validity refers to the extent to which test items are similar in appearance to the subject they were prepared to measure (Bazargan, 2002). Quantitative and qualitative methods were used to check face validity. In order to examine qualitative face validity, each of the items of the questionnaire were presented to 10 health education and health promotion experts and 5 nutritionists to find the level of difficulty, the degree of appropriateness, the ambiguity of the terms or the existence of insufficiency in word meanings, and their opinions were applied in the questionnaire in the form of minor changes. Quantitative face validity was obtained by calculating the items according to a five-point Likert scale, and the impact score equal to 1.5 or higher was acceptable (Hajizadeh and Asghari, 2011). In order to determine quantitative face validity, the impact score of each item was calculated. First, for each item of the tool, a five-point Likert scale was considered, including very important (5 points), important (4 points), moderately important (3 points), slightly important (2 points) and not at all important (1 point). Then, the questionnaire was given to 20 students. After completing the questionnaire by the target group, face validity was calculated using the impact method formula (Impact Score = Frequency (%) × Importance). After calculating the impact formula, all the items got an impact score above 1.5.

Content validity

Content validity is measured by a group of experts who comprehensively review the content of the proposed tool quantitatively and qualitatively (Seif, 2005). In the qualitative review of content validity, a panel of experts (10 health education and health promotion experts and 5 nutritionists) was asked to present their corrective views in writing after carefully examining the tool. It was also emphasized that in the qualitative evaluation of the content validity,

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they should take into account grammar, the use of appropriate wording, the importance of the items, the placement of the items in their proper place, and the completion time of the designed tool. In order to check the quantitative content validity and ensure that the items were designed correctly and in the best way, two quantitative methods, including the content validity ratio (CVR) and content validity index (CVI) were used. In order to determine CVR, the criterion of necessity was considered using experts' opinion regarding the items and all the items of each construct with the terms of "necessary", "useful but not necessary" and "not necessary" (Bennett *et al.*, 2006). In this study, according to the number of panel members (15 members) and by referring to Lawshe table (Lawshe, 1975), the minimum accepted score was 0.49. In order to check CVI, the opinions of experts regarding the items were evaluated based on the three criteria of simplicity and fluency, relevance or specificity, and clarity or transparency in a four-point Likert scale from 1 to 4, and the content validity index (CVI) was calculated. A CVI above 79% was considered appropriate (Peyman *et al.*, 2012).

Construct validity

First and second order confirmatory factor analysis was performed using LISREL software version 8.8 in order to examine the proposed factor structure, internal reliability of all sub-categories, and correlation between sub-categories. The subcategories included 35 functional nutrition literacy questions, 7 interactive nutrition literacy questions, and 10 critical nutrition literacy questions. 33 items entered the structural validity stage. Some of the fit indices used in confirmatory factor analysis in this research were comparative fit index (CFI), goodness of fit index (Chan *et al.*), root mean square error of approximation (RMSEA), Chi-square index and its corresponding degree of freedom, and the adjusted goodness-of-fit (Chan *et al.*, 2011, Tabachnick *et al.*, 2007) . CFI, GFI, and adjusted goodness of fit index (AGFI) were between 0 and 1, and the closer they were to 1, the more appropriate they were (Kline, 2011). The RMSEA index of less than or equal to 0.06 indicated a good fit, between 0.06 and less than and equal to 0.08 indicated an acceptable fit, between 0.08 and less than and equal to 1 showed a moderate fit, and greater than 1 suggested a poor fit (Byrne, 1998).

Reliability

The reliability of the research tool was the degree to which an assessment tool produced stable and consistent results in the same conditions (Fleiss, 2011). To calculate reliability, a sample size between 15 and 20 was suitable (Shahbeigi and Nezari, 2012.). A reliability coefficient of 0.7 or higher also showed an acceptable level of reliability (Naderimagham *et al.*, 2013). To measure the reliability of the structures, Cronbach's alpha test method was used with SPSS version 22 software. To this end, the questionnaire was given to 20 female students in the first grade of high school who were identified as demographically similar to the target population, and the students who were involved in reliability assessment were no longer considered as research samples. Cronbach's alpha coefficient can be observed in the findings section.

Ethical considerations

This article was a part of the study approved by Iran University of Medical Sciences with ethics code number: IR.IUMS.REC.1401.080.

Results

In this study, the mean age of the students was 14.9 ±12.6 years. Their mean height and weight were 159.7±10.7 cm and 54.7±1.4 kg, respectively. The household size was 4.1±0.8. The frequency of qualitative demographic variables studied is presented in **Table 1**.

In the review of qualitative face validity, the corrective comments of students were applied, and regarding quantitative face validity, since the impact of all the items was higher than 1.5, the items were kept. In order to determine qualitative content validity and give more explanations to the respondents, changes were made in some items. Quantitative content validity was obtained by determining CVR and

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CVI. In the analysis of the CVR, according to the number of panel members in this study (15 members) and referring to Lawshe table (Lawshe, 1975), the minimum acceptable score was regarded as 0.49. The items with a CVR of higher than this value were kept in the questionnaire (the average CVR of the items was 0.74), and 8 items related to functional nutrition literacy and 3 items related to critical nutrition literacy were omitted due to the CVR of lower than the acceptable value. Moreover, in the analysis of content validity index in this study, 7 items related to functional nutrition literacy and 1 item related to interactive nutrition literacy were omitted due to CVI of lower than 0.79. Finally, due to the fact that the professors found the questionnaire suitable and usable, construct validity was investigated using confirmatory factor analysis. In order to check reliability, Cronbach's alpha test method was used. Cronbach's alpha coefficient was calculated for functional nutrition literacy as 0.74, interactive nutrition literacy as 0.82, and critical nutrition literacy as 0.84.

In order to examine the proposed factor structure and the internal reliability of all sub-categories and their correlation, first and second order confirmatory factor analysis was used. The results of the confirmatory factor analysis based on the measurement model can be observed in **Table 2**, where all indexes indicated a good fit. **Figures 1** and **2** show the results of the first and second order factor analysis based on standard coefficients, respectively, and present a significant correlation between items and factors in both orders of confirmatory factor analysis (P<0.001).

Table 3 shows the measurement items of each variable of the nutritional literacy questionnaire.

Table 1. Demographic characteristics of the studied samples.

Variable	N	%
Gender		
Female	212	53.0
Male	188	47’0
Father's job		
Unemployed	12	3.0
Employee	75	18.6
Worker	70	17.5
Free	197	49.2
Other	46	11.5
Mother's job		
Housewife	292	73.0
Employee	108	27.0
Father's education		
Elementary education	74	18.6
Middle school education	133	33.2
High school diploma	153	38.2
University degree	40	10.0
Mother's education		
Elementary education	70	17.5
Middle school education	142	35.5
High school diploma	158	39.5
University degree	30	7.5

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Table 2. The results of confirmatory factor analysis based on the measurement mode.

Indicators	GFI	CFI	RMSEA	AGFI
First-order confirmatory factor analysis	0.91	0.92	0.062	0.91
Second-order confirmatory factor analysis	0.91	0.91	0.062	0.91

GFI: Goodness of fit index; **CFI**: Comparative fit index; **RMSEA**: Root mean square error of approximation; **AGFI**: Adjusted goodness of fit index

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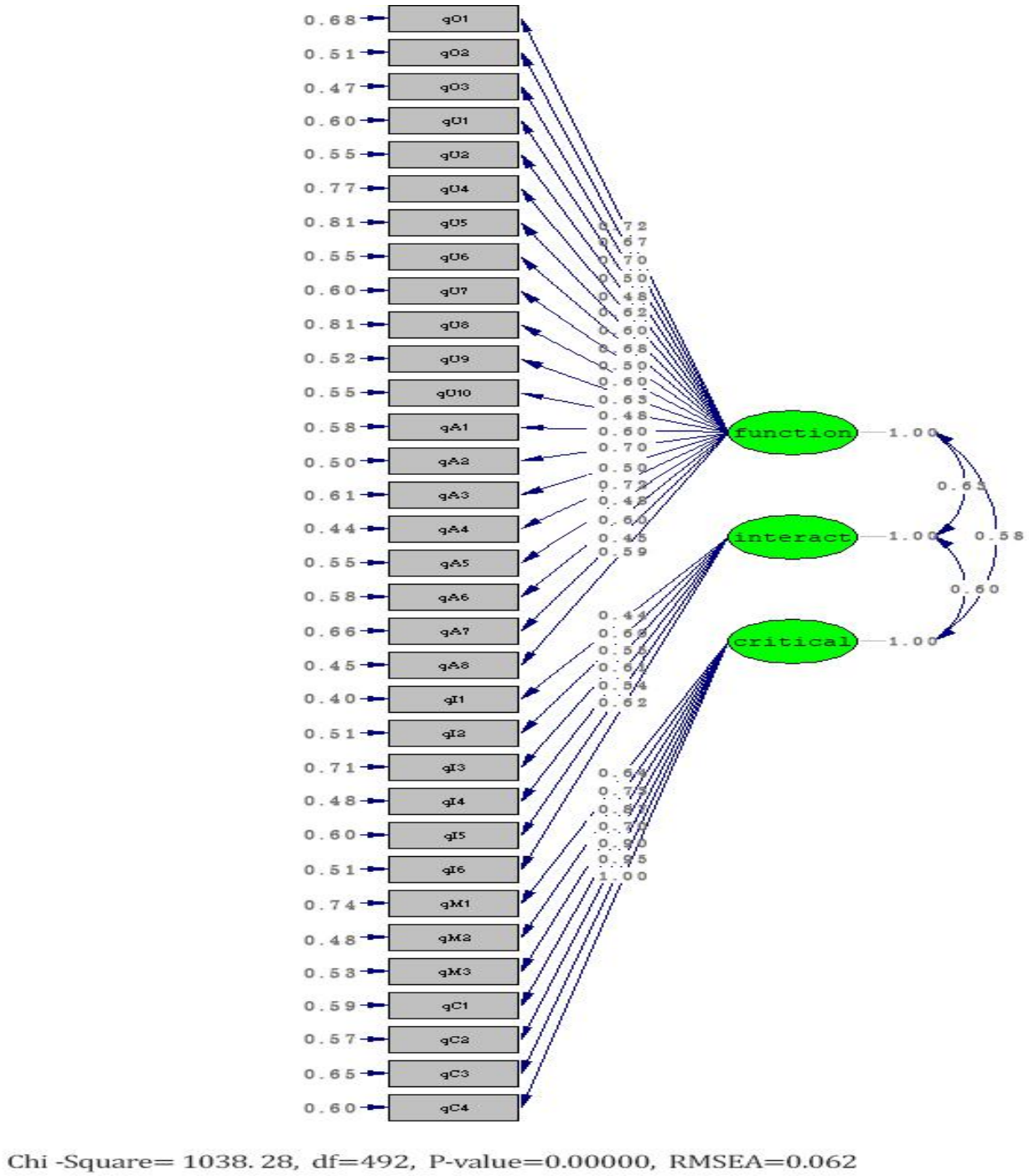

Figure 1. First-order confirmatory factor analysis based on standard coefficients.

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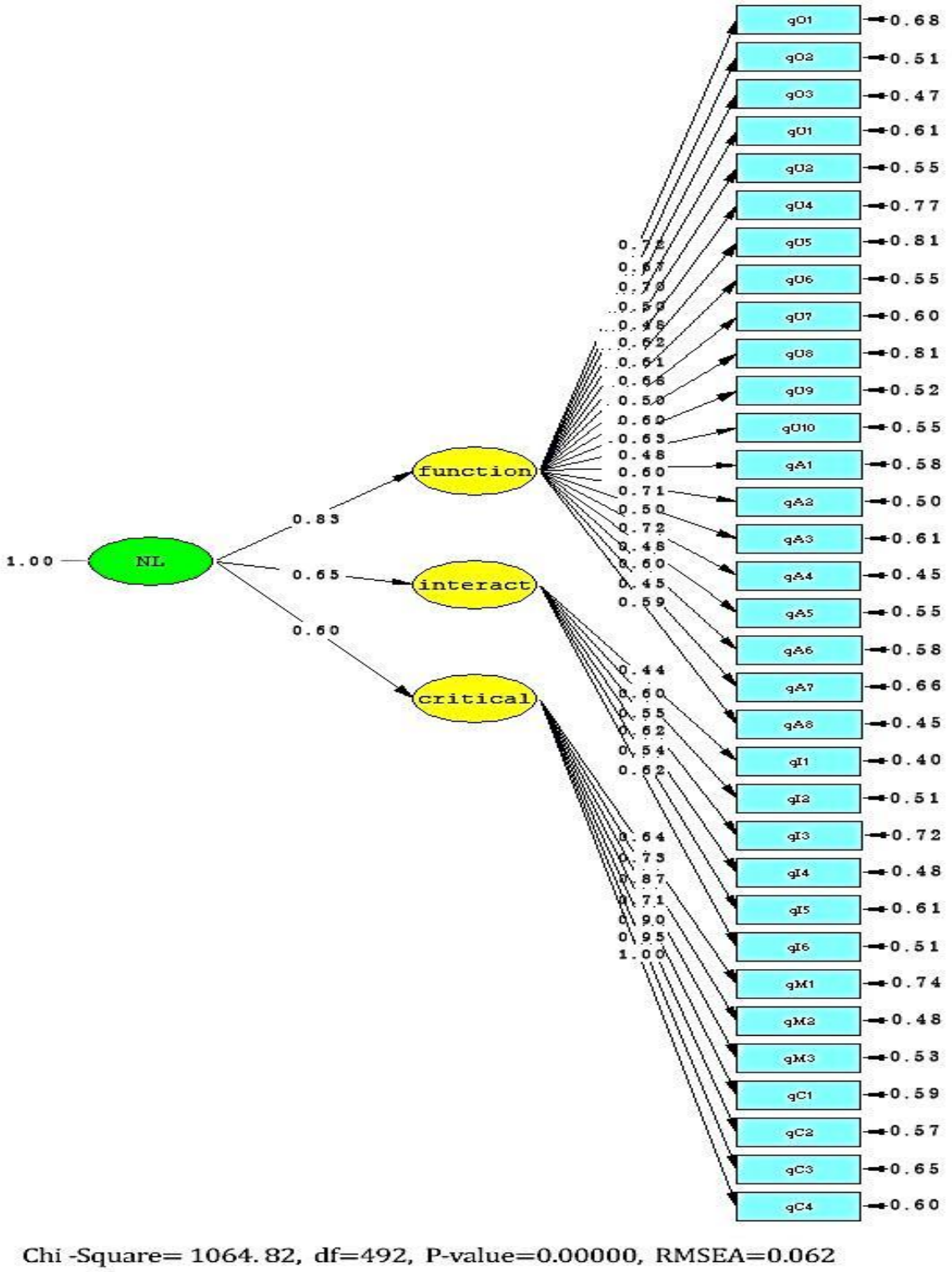

Figure 2. Second-order confirmatory factor analysis based on standard coefficients.

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Table 3. Measurement items of nutrition literacy questionnaire variables.

Question	Variables	Factor load
I will seek answers when I don't know anything about nutrition.	Functional literacy	0.72
When I have a nutrition-related problem or want to learn healthy eating habits, I know where to find accurate information.		0.67
It is not difficult for me to find the needed nutritional information from a large number of information sources.		0.70
Whole grains (millet, corn, etc.) are more nutritious than refined grains (rice, flour, etc.).		0.50
Smoking and salting foods can increase the risk of cancer.		0.48
Being overweight or underweight increases the risk of disease.		0.62
When eating meat, try to eat lean meat.		0.60
Good dietary habits can prevent chronic diseases such as hypertension and diabetes.		0.68
You can reduce your exercise if you eat less.		0.50
Drink water in small quantities more than once.(6-8 glasses a day)		0.60
It is easy to understand the nutritional information (such as energy, protein, sugar, etc.) on food packaging.		0.65
Health and nutrition advice is easy for high school students to understand.		0.48
It is easy to understand nutrition information you read in a brochure, book, or on the Internet.		0.60
Don't substitute fruits or vegetables.		0.70
Do not use canned fruit, preserved fruit, and other processed fruit products instead of fresh fruit.		0.50
Keep raw and cooked food separately.		0.72
Eat breakfast every day.		0.48
Cut down on Western fast food.		0.60
Cut down on fat, smoke, and spicy foods.		0.45
Do not patronize food and drink stalls such as roadside stands.		0.59
Be willing to communicate to learn about nutrition and health.	Interactive literacy	0.44
Be willing to receive nutrition education.		0.63
Be willing to change poor eating habits using the nutritional knowledge learned.		0.55
Be willing to convince others to change their bad eating habits.		0.61
Take the initiative to disseminate nutrition knowledge to others.		0.54
Talk about nutrition with others (e.g. friends, family, etc.).		0.62
Pay attention to nutritional information in the media.	Critical literacy	0.64
Judge the accuracy and scientific nature of nutrition information in the media.		0.75
Nutrition information in the media has a lot of influence on you.		0.87
It is easy to tell if nutritional information is scientific or not.		0.70
It is easy to distinguish between healthy and less healthy foods.		0.90
Assessing the impact of eating habits on health is easy.		0.96
When it comes to healthy eating recommendations, you can judge what meets your health needs.		1.00

Discussion

Despite the importance of nutrition literacy in adolescent students, only a limited number of tools are available to assess the nutrition literacy of children and adolescents, and the existing nutrition literacy assessment tools are mainly focused on the assessment of adults. In Iran, there is no tool to assess the nutrition literacy of adolescents aged 12 to 18 (high school students). The CM-NLS questionnaire was developed in China as a tool that evaluates the nutrition literacy level of this age group. This questionnaire

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included 3 main items (functional, interactive, and critical nutrition literacy) and 6 sub-items (acquiring, understanding, application, interaction, media literacy, and critical skills). Functional nutrition literacy measures the ability to access, understand, and use nutrition information. Interactive nutrition literacy measures the ability to take action to obtain and exchange nutrition information through interaction and participation, and critical nutrition literacy refers to the ability to critically evaluate nutrition information and recommendations from different sources with the proper perspective. Therefore, the present study investigated the psychometric properties of the CM-NLS questionnaire in high school students, which was the first attempt to localize this tool and was different from the original version in terms of the number of items. By conducting quantitative and qualitative face validity and content validity, 15 items from the functional nutrition literacy, 1 from interactive nutrition literacy, and 3 from critical nutrition literacy were removed. The optimal values of goodness of fit indices in confirmatory factor analysis indicated the construct validity of the questionnaire. Since the reliability of the instrument leads to an increase in the power of the study to determine the significant differences and relationships that actually exist in the study (Naderimagham *et al.*, 2013), Cronbach's alpha coefficient was used to estimate the internal consistency of the whole and different areas of the tool. The internal consistency of the tool confirmed the reliability of the questionnaire, which was consistent with the study by Zeng *et al*. (Zeng *et al.*, 2021).

Reforming and improving the nutritional status of students as teenagers who entered the maturity period requires effective design and interventions, which is not possible without knowing the level of their nutrition literacy. This study can be the first step in conducting national studies to measure and improve the nutrition literacy level of Iranian adolescent students.

The limitation of this study was the smallness of geographical area and the size of the sample, which is recommended to be carried out in next studies in wider geographical areas with larger sample size.

Conclusion

By analyzing the data of the present study, face validity, content validity, construct validity, and reliability of the nutrition literacy measurement tool in high school students with 33 items were confirmed which can be used as a valid and reliable tool to measure the level of nutrition literacy in teenage students. According to the obtained results, this questionnaire can be used as a valid and reliable tool to measure the level of nutritional literacy of teenage students. It is suggested that, in future studies, researchers should add items to the mentioned tool according to demographic and cultural characteristics and with the support of reliable scientific sources.

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Authors' Contributions

Ashrafi E. and Nouri M were involved in data collection and writing the first draft. Mansourian M and Ebadi Fard Azar F contributed to data collection and interpretation and statistical analysis; Mansourian M, Ebadi Fard Azar F and Osmani F contributed to the research concept, supervised the work and revised the manuscript. All authors read and approved the final manuscript.

Conflict of interest

All the authors declared no conflict of interest.

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