Analysis of food literacy dimensions and indicators: A case study of rural households

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Food has always been the focus of much discussion due to its value and importance in human life. Policymakers use the idea of food literacy as a solution to population and environmental health and food security. Two objectives were considered in this research: investigating food literacy construct validity and reliability and also analyzing five dimension that reflect food literacy scale. The present research is a survey and the statistical population is rural households in Dashti County of Bushehr province. The number of statistical populations was determined by Cochran's formula 232 households. They were selected by stratified multi-stage random sampling method. Based on the results and fitness indicators, it was determined that the research factor analysis model based on the five dimensions of food literacy (social, economic, health, skills, environmental and welfare of farm animals) has suitable and acceptable measures (RMSEA = 0.065). Evidence from this study has shown that creating an effective link to promoting the indigenous and local foods and food production process is effective in promoting food diversity, food literacy and food security in rural communities. There is little research that considers food literacy indicators empirically, based on the proposed model, the selected constructs of the research had examined food literacy indices in rural communities. The results of cluster analysis showed that most studied groups classified in the average level in terms of food literacy and had the highest average in the social index of food literacy. The results of this study can help to perception and further professionalize and exploit opportunities to promote food literacy and provide guidance for planners and other stakeholders working in food security and sustainable development.

KEYWORDS

food literacy, indicators, rural households, CFA, food security

Introduction

Malnutrition is still one of the most important challenges in the world (Alam et al., 2021); so that one in three people directly suffer from under/overweight, lack of vitamins and minerals, obesity, and diet-related illnesses (IFPRI, 2017). In the present century, malnutrition has become a serious crisis in most societies, especially in third world countries. Currently, 842 million people suffer from food shortages worldwide and 96%

of them suffer from energy shortage and absolute poverty. Consequently, food security of individuals, households, communities and nations depend on the supply, access and consumption of sufficient quantities and appropriate quality food to maximize health (Vidgen and Gallegos, 2014).

One of the most critical factors in increasing the quantity and quality of food consumed among individuals and households, is their desirable level of food literacy. Food literacy enables individuals and households to retain the quality of their diet by changing foodstuffs. This can help to increase the flexibility of food items consumed over time. There are many definitions of 'Food literacy' depending on the point of view and interests (Table 1).

Food literacy includes the knowledge, skills and behaviors needed to plan, manage, select, prepare and eating food to meet the needs and determine consumption (Truman et al., 2017). It reflects the knowledge, skills and behaviors of individuals, and leads to a balance between the quantity and quality of diets (Vidgen and Gallegos, 2014).

In other words, food literacy is a set of skills and characteristics that help people to provide healthy, tasty and affordable food for themselves and their families. Food literacy makes people's eating behaviors flexible since it includes nutritional skills (techniques, knowledge and planning ability), trust in improvisation and problem solving, and the ability to access and share information. Strengthening food literacy is possible through external support and internal intention to access healthy food and living conditions, ample learning opportunities and positive socio-cultural environments (Desjardins, 2013).

Food literacy has two micro and macro aspects. Micro aspects include food safety, storage methods and food preparation skills. Macro aspects of food literacy include dimensions such as animal welfare and environmental sustainability. Changes due to lifestyle and household waste generation over time are some examples (Parfitt et al., 2010; Ronto et al., 2016). Policymakers use the idea of food literacy as a means for achieving to a healthy population and environment (Truman et al., 2017). Limited knowledge of food literacy and its dimensions such as culinary skills and production and processing methods can be a serious obstacle to a healthy diet (Lang and Caraher, 2001; Cullen et al., 2015). Numerous studies have revealed that a community with food literacy knowledge can help local food systems to be maintained. Since this type of community is more aware of the value of buying local foods, it generates more income for local farmers and markets. This, in turn, strengthens local food systems and increases consumer knowledge and stimulate the demand for local products (Topley, 2012).

The concept of food literacy has been repeatedly challenged and some researchers (Bellotti, 2010; Cleland, 2013) believe that the current models only take individual knowledge and skills into consideration when they are assessing factors

that determine dietary choices, nutritional behaviors and food preparation procedures. While interactive and analytical capabilities of food literacy, responsible food decisions, Equality and fair trade in the context of environmental sustainability and individual and social health are less considered (Kimura, 2011). Similar arguments (see Colatruglio and Slater, 2014; Vaitkeviciute et al., 2015; Ronto et al., 2016) express that despite comprehensive definitions about food literacy, no comprehensive studies have been conducted. In particular, few researches have been done on measuring and explaining food literacy measurement indicators (Parfitt et al., 2010; Ronto et al., 2016; Truman et al., 2017). So, the development of indicator-based tools for conducting the assessments has been almost neglected. There are many reasons for this lack of attention. The first reason is the inherent complexity of designing and validating these indicators. The process of developing and validating a food literacy scale is inherently complex. Therefore, many researchers try to measure food literacy by introducing general dimensions and some specific indicators (Valizadeh and Hayati, 2021).

The second reason stems from the traditional definition of food security, in which food security was defined more in terms of availability and accessibility (Korthals, 2011). Believing this point of view, kicks the attention to food literacy and the development of standard tools for measuring it out of priority. Because food literacy is a concept that relies more on food quality, while definitions that base on the availability and access focus on quantity and abundance of food. In this situation, the development of tools for measurement and evaluating food literacy is considered optional.

The third reason of weak focus on indicator-based tools, especially in food literacy context, is that the development and utilizing these tools can upgrade the public awareness about food and this can make some changes in dietary choices and preferences. Hence the producers, policymakers and decisionmakers of food area might face strong criticism and demands.

None of the above mentioned, problems can vindicate not trying to develop indicator-based tools. This is especially important in underdeveloped and developing countries, where people are usually less food literate than developed countries for various reasons. Main risk factors of malnutrition in Iran have been mentioned as lack of access to health services, low education, poverty, food insecurity and lack of nutritional knowledge (Azizi-Soleiman et al., 2020).

Despite the fact that World Bank classified Iran as an upper-middle income country, malnutrition is still a problem in this country. In the UNICEF global nutrition report in 2016, Iran has been ranked 14th and 53rd regarding stunting and wasting among nearly 130 countries, respectively (Azizi-Soleiman et al., 2020). Iran is one of the developing countries in which very few studies have been conducted in the field of food literacy (Arvand et al., 2018). None of these researchers have developed

TABLE 1   Food literacy definitions.

| Authors/ year	Food literacy definitions
Truman et al. (2017)	Food literacy includes the knowledge, skills and behaviors needed to plan, manage, select, prepare and eat food to meet needs and determine consumption.
Parfitt et al. (2010), Ronto et al. (2016)	Food literacy has two aspects, micro and macro. Micro aspects include food safety, storage methods and food preparation skills. Major aspects of food literacy include dimensions such as animal welfare and environmental sustainability.
Cullen et al. (2015)	"Food literacy is the ability of an individual to understand food in a way that they develop a positive relationship with it, including food skills and practices across the lifespan in order to navigate, engage and participate within a complex food system. It's the ability to make decisions to support the achievement of personal health and a sustainable food system considering environmental, social, economic, cultural and political components." (p. 143)
Lang and Caraher (2001), Cullen et al. (2015)	Food literacy refers to culinary skills, production methods, food processing.
Vidgen and Gallegos (2014)	"Food literacy is the scaffolding that empowers individuals, house-holds, communities or nations to protect diet quality through change and strengthen dietary resilience over time. It is composed of a collection of inter-related knowledge, skills and behaviors required to plan, manage, select, prepare and eat food to meet needs and determine intake." (p. 54)
Desjardins (2013)	Food literacy is a set of skills and characteristics that help people to provide healthy, tasty and affordable food for themselves and their families on a daily basis.
Cleland (2013) Thomas and Irwin (2013)	"Food Literacy is a multi-faceted concept that comprises three integrated components: Food, nutrition and health; Agriculture, environment and ecology; Social development and equity (Bellotti, 2010, p. 23)" (p. 10). "Youth described 'food literacy' as an understanding and knowledge of food preparation, from start to finish. Their definition included food selection, purchase, preparation and preservation. Participants also indicated that food literacy expanded the ability to prepare food into an exploration of the agricultural origins of food." (p. 17)
Bellotti (2010), Cleland (2013)	Two dimensions of "health" and "nutritional needs" are important aspects of food security that should be considered in food literacy. Other dimensions of food literacy include biodiversity, environment, climate, equity and fair trade, skills, local and seasonal ecosystems, and cultural heritage.
Committee on World Food Security (2012)	Food literacy involves the process of preparing and eating food, which refers to having a good meal, enjoying eating, being aware of food safety principles and understanding the impact of food on health. Food literacy is closely related to the quality and quantity of food consumed.

and validated indicator-based tools. In this regard, designing and validating an indicator for measuring and evaluating food literacy was determined as the main goal of present study. The present study is quantitative applied research in which the cross-sectional survey method has been utilized.

Bushehr province is one of the provinces with a strategic location in the hot and dry climate of Iran and in the vicinity of the Persian Gulf and neighboring Arab countries. Dashti city is one of the agricultural poles of Bushehr province with three active parts with different mountain, plain and desert climates with climate changes that are happening now. Food security and strategies adopted for food supply and management in this region are important. Today, food security is one of the most important concerns of different societies. In this regard, we can refer to the research of Abdshahi et al. The results of the grouping of food security among rural households showed that more than 60% of rural households are in the food insecurity sector and economic, geographical and social factors have the greatest impact on food security (Abdeshahi et al., 2022). Concern about the food security of rural areas that produce their own food crops becomes more important. In this research, two important factors intertwined in the society and household

under the title of food security and dimensions of food literacy have been investigated in order to provide appropriate solutions for agricultural macro planning in areas with similar conditions.

The food literacy model presented in this research is derived from the components of food literacy models in which attention is paid to sustainable nutrition. Among the most important sources used are: Bellotti (2010), Bublitz et al. (2011), Topley (2012), Desjardins (2013), Slater (2013), Sumner (2013), Johnston et al. (2014), Vidgen and Gallegos (2014), Palumbo (2016), Ronto et al. (2016). Theoretical framework based on these studies has delivered in Figure 1. Based on the problem statements of this research two objectives were considered: (1) Investigating food literacy construct validity and reliability (2) Probing the dimension that reflect food literacy scale.

This research, considering the conditions that food insecurity creates for the household, investigate the multidimensional factors related to food literacy, focusing on the household and the individual. It could empower the household and the community through increasing knowledge and skills. Food literacy can lead to the adoption and creation of strategies by the individual and finally the society, which

FIGURE 1
Theoretical framework of the study.
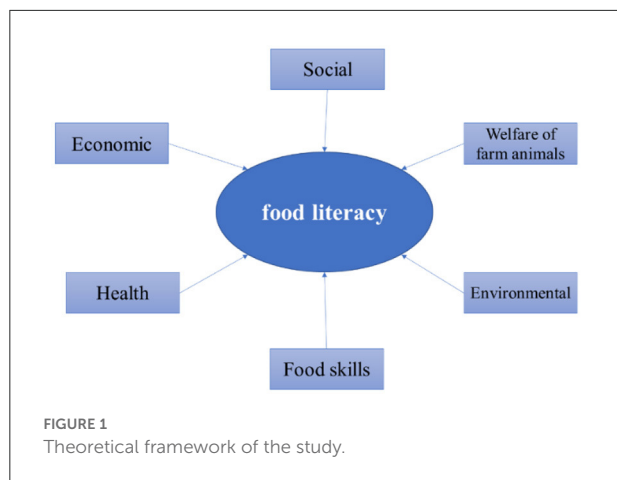
can deal with the conditions of food insecurity, in all around the world.

Materials and methods

The present study is a kind of quantitative applied research in which the cross-sectional survey method has been used. Two methods of library study and face-to-face interview with participants were used to collect information on the dimensions and indicators of food literacy. The structure of food literacy scale was confirmed and finally proved using second-order confirmatory factor analysis. SPSS22 software was used for principal component analysis and LISREL software was used for second-order factor analysis. Then, the process was followed by reliability tests, formal and content validity, discriminating power and confirmatory factor analysis. It should be noted that after confirming the structure of food literacy scale, rural households were classified using cluster analysis method.

Population and sampling

The statistical population of the study included rural households living in Dashti county of Bushehr province (24474). Cochran's formula was used to determine the sample size. Therefore, the sample size was estimated to be 232 people. Equation 1 shows the values of each of Cochran's formula parameters and the sample size determination process.

$$n = \frac{Nz^2pq}{Nd^2 + z^2pq}$$

$$n = \frac{(24474)(1/96)^2(0.5)(0.5)}{(24474)(0.06)^2 + (1.96)^2(0.5)(0.5)}$$

$$= \frac{23504.8296}{101.205904} = 232.24$$

Multi-stage stratified random sampling method was used to select the samples. For this purpose, first, based on the official divisions of the country, the study area was divided into two parts, including the central part and the Shonbeh and Tasuj sections. Therefore, the required sample size of each of these sections was estimated using the appropriate method. In the second stage, the number of villages and households within each of these sections was extracted from the data of the Statistics Center of Iran. In the third stage, according to the number of villages in each part of the study area, several villages were randomly selected. In the fourth stage, the calculated sample volume for each of the sections in the first stage was randomly distributed among the households of the selected villages. In the last step, rural households were randomly selected for the study.

Research tool

A close-ended questionnaire was used to collect research data. This questionnaire was prepared by studying previous food literacy and food safety questionnaires [a case for food literacy coordination, Food Literacy Questionnaire (UCCS, University of Colorado Springs)] and previous theoretical/research literature. This questionnaire consisted of two parts. The first part included the personal and demographic characteristics of the respondents. The second part included items of different dimensions of food literacy (social, economic, health, skills, environmental and welfare of farm animals). Five Likert levels (strongly disagree, to strongly agree) were used to assess items in different dimensions of food literacy.

Reliability and validity tests

The fit of a measurement model relates to a part of the overall model that includes a variable with its items. Two parts are used to fit the measurement models in the partial least squares method: index reliability and convergent validity. Index reliability by two Cronbach's alpha criteria and composite reliability and convergent validity by factor loading factors of items in first-order confirmatory factor analysis are measured.

In this study, in order to administrate the internal consistency, composite reliability and Cronbach's alpha were used. The face and content validity of this questionnaire was assessed using a panel of faculty members of Shiraz university and food safety experts. Some members of the panel of experts were researchers who conducted extensive research on food security, food science and food security development strategies in communities. By carefully reviewing the research background and records of these experts, the people whose work was most relevant to the subject of the present study were selected. These thematic experts were then selected as members of a panel to evaluate face and content validity based

TABLE 2 Cronbach's alpha and CR coefficients of the questionnaire variables.

Variable		Dimensions	Cronbach's alpha coefficients	CR
		Dimensions	Total	
Demographic			-	
Food literacy	Social	0.78	0.81	0.73
	Economical	0.81		0.72
	Health	0.70		0.77
	Skills	0.85		0.84
	Environmental	0.82		0.74
	Animal welfare	0.73		0.78

on the quantity and quality of their work in the field of food literacy. The initial version of the research tool was provided to them. Then, the research team held two meetings to reach a consensus on the opinions of food literacy experts. Finally, after modifying the questionnaire based on the opinions of experts, the questionnaire was ready for the pilot phase. The pilot study was conducted in the villages of Khivid Mubaraki and Bagh Shah. The villages of this area were located outside of the study area. The reason for choosing this area for the pilot was that the rural living conditions in this area were similar to the main survey conditions. In the pilot phase, 30 questionnaires were completed to carefully monitor the research process on a smaller scale.

The confirmatory construct validity test convergent validity composite reliability and Cronbach's alpha were utilized. Cronbach's alpha coefficients were used to measure the reliability of the questionnaire at this stage (Table 2). The calculation of these coefficients was also performed using SPSS software version 25. The results showed that Cronbach's alpha coefficients for different parts of this study are greater than the marginal value of 0.6 (are greater than the acceptable cut-off 0.6 (Mansouri Moayed and Yavari Gohar, 2017), which indicates an acceptable reliability. However, Moss et al. (2001) introduced 0.6 as the limit of Cronbach's alpha coefficient for variables with a small number of questions.

One of the most important results of the pilot test was to acquaint the researchers with some of the shortcomings of the research tool and the concepts used in it. As a result, at this stage, corrections were made in the text and the number of items needed to measure different food dimensions. After these modifications, a large-scale cross-sectional survey was conducted in Bushehr province. Credits were acceptable for all questions. Further details on the dimensions and number of items and questions related to each variable. The results of reliability of the dimensions of the various variables in the questionnaire are presented in Table 2.

Composite reliability to measure internal consistency in scale items was used (Brunner and Süß, 2005). Then, an attempt was made to evaluate the validity of the main survey questionnaire. For this purpose, composite reliability index was used. Convergent validity, is a subtype of construct validity. Based on the calculation, as can be seen, the reliability value of both variables is at the desired level and above 0.7.

Confirmatory Factor Analysis (CFA) is used to test the construct validity and reliability of the indicators (items) that form a latent construct (Wahab et al., 2020). CFA should be administered to obtain construct validity based on Joreskog (1969). Based on some studies CFA allows the researchers to identify fitting of the factor structure of a model and also gives some indexes to define factor structure of a scale such as Chi-Square Goodness, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residuals (RMR), Standardized Root Mean Square Residuals (SRMR), Normed and Non-Normed Fit Index (NFI and NNFI) (Dilekli and Tezci, 2019). The first level of analysis is done from the aspects' latent construct to the indicators' latent construct (Wahab et al., 2020). The CFA used in this research is the second order confirmatory factor analysis. It is a two-level measuring model. The first level of analysis is done from the aspects' latent construct to the indicators' latent construct.

Study area

Bushehr province is located in the south of Iran on the Persian Gulf. The province has a hot and dry climate, but the coastal areas have a hot and humid climate. Also, this province is one of the suppliers of agricultural products for the Persian Gulf countries due to its strong capacities for export (Encyclopedia of Islamic World, 2022). This province is one of the important and strategic provinces in the production of various agricultural products in Iran (Roshan bakhsh, 2021).

Dashti county is one of the agricultural hubs of Bushehr province. It has a high diversity in terms of agricultural products. This county has several fertile plains and is one of the largest out-of-season tomato producers in the country. Dashti county has three distinct: central parts, Kaki and, Shonbeh and Tasuj. According to the last statistical census of 2016, this county has a population of 86,319 people and the number of households is 24,474.

Results

The results of descriptive statistics related to food literacy status of the respondents showed that in terms of gender, 102 (44%) were female and 130 (56%) were male. In terms of housing ownership status, 193 people (83.2%) had

private housing and 33 people (14.2%) had rented housing. The mean age of the respondents was 40 years and in terms of average education, it was 10 years (in the range of zero to 19 years). The average number of household members was 4 and the average number of employed people in the household varied 1–2 people. The average monthly income of the studied households was 2 million Tomans. In terms of the main job of the head of the household, 97 person (41.8%) reported their occupation as agriculture, 49 person (21.1%) as self-employed and 44 person (19.0%) were retired.

According to the results of the statistical test comparing the mean (*t*-test) between food literacy and gender, a significant difference was observed at the level of 5% between the two groups of men and women (Table 3). Thus, women with an average of 91.62 had a higher level of literacy than men, this may be due to the status, social role and duties of rural women in the studied households. Accordingly, women in rural areas are more familiar with food information and have higher food literacy in this regard in terms of family duties and roles, which are mainly cooking and food preparation.

According to the results of ANOVA, the average food literacy among rural households in five educational groups, including illiterate, elementary, middle school, high school and diploma and above, is a significant difference of 5%. This test showed that people with secondary education had the highest level of food literacy. Based on this, it can be concluded that different study groups in the sample have differences in food literacy.

Also, the mean square food literacy among rural households with four income groups was significantly different at the level of 0.001. The highest level of food literacy has been seen in the income group below one million tomans. According to this finding, the people with the lowest income had the highest level of food literacy. LSD *post-hoc* test was used to determine the differences between the groups in both tests. The results of these tests has showed in Table 4.

Results of structural equation analysis

Structural equation modeling and application of LISREL 8.8 software were used to more accurately study food literacy index and confirm the structure of the index. In the structural equation model, the characteristics are estimated by minimizing the difference between the observed covariances and the model covariances. The collected data on food literacy variable were analyzed using confirmatory factor analysis technique. Confirmatory factor analysis (CFA) also calculates the fit of the model with the data (Kareshki, 2019).

CFA is used to test the construct validity and reliability of the indicators (items) that form a latent construct and also it gives some indexes to define factor structure of a scale (Hu and Bentler, 1999; Brown, 2006; Dilekli and Tezci, 2019; Wahab et al., 2020). CFA should be administrated to obtain construct validity based on Joreskog (1969). Based on some studies (Brown, 2006), CFA allows the researchers to identify fitting of the factor structure of a model and also gives some indexes to define factor

TABLE 3 Mean comparison test of food literacy in terms of gender.

Comparable variable	Gender	Mean	Standard deviation	T	Significance level (sig)
Food literacy	Female	91.62	9.47	2.32	0.021
	Male	88.64	9.57		

TABLE 4 Mean comparison tests of food literacy between the five educational groups and monthly income.

Comparable variable	Groups	Mean square*	Standard deviation	F	Sig
Educational degree	Illiterate	93.45[b]	8.46	2.74	0.029
	Elementary school	90.81[abc]	10.07		
	Tips	95.16[bc]	8.28		
	Secondary	88.80[a]	9.28		
	High school	88.33[a]	9.92		
Monthly income (Tooman)	<1 million	93.96[b]	9.66	4.96	0.002
	1–3 million	89.06[a]	9.12		
	4–6 million	85.58[a]	9.50		
	>7 million	90.75[ab]	11.79		

*Different Latin letters in each column indicates significant difference.

structure of a scale. The CFA used in this research is the second order confirmatory factor analysis. It is a two-level measuring model. The first level of analysis is done from the aspects' latent construct to the indicators' latent construct.

The latent variables were entered into confirmatory factor analysis and the standardized factor load of the indicators in factor analysis, t-factor and their significance level are given in Table 5. calculating the loading factors for the items using estimating measurement models of the variables showed that all the items constituting food literacy dimensions were approved and remained in the model except the two items "education of children" and "cooking simple and fast food," which were removed from the model due to a factor load lower than 0.3. Therefore, all loading factors were greater than the acceptable cut-off (0.4) and the value of t was greater than 1.96 and all coefficients were significant ($p < 0.03$), which indicates the reliability of food literacy tool.

For Chi-square food literacy confirmation factor model (X2), degree of freedom (df), adaptive fitness index (CFI), softened fitness index (NFI), non-softened fitness index (NNFI), fitness index (GFI), fitness fit index (AGFI), incremental fit index (IFI), root mean square estimation index (RMSEA) and mean squared residual index (RMR) were also calculated, which according to the results presented in Table 6 and Figure 3 can be He said that the data are in line with the standards of structural equations of research and the indicators presented show that in general the proposed factor analysis model has a good fit.

According to the Table 6, it can be found out from general indicators of goodness of fit that the overall fit of the proposed model with the data and the selected constructs of the research have their effect on measuring food literacy in a meaningful way. Therefore, based on the fitted model of the research, it can be said that the structure used to examine the dimensions of food literacy shows acceptable compatibility.

Based on the results presented in Table 7 and Figure 2, the square values of multiple correlations of the observed variables (SMC) are observed in the output. The highest rate of coefficient of reliability in the dimension of social is observed in the item of indigenous knowledge of food literacy (0.23), in the dimension of economic: the item of shopping from traditional neighborhoods (0.57) in the dimension of health: Use local food (0.24), in the dimension of Food skills: Having sufficient food preparation skills (0.76), in the dimension of Environmental: Use of organic plants (0.46) and in the dimension of Welfare of farm animals: Food consumption and animal life (0.42).

Results of cluster analysis

To analyze the differences between the respondents in terms of food literacy, they were divided into three categories according to the dimensions of food literacy including social, economic, health, skill, environmental and welfare of farm

animals using cluster analysis test. According to the results of Table 5, these three groups were: the group with low food literacy, the group with moderate food literacy and finally the group with the desired (high) level of food literacy. The group with high food literacy included 68 people and the averages of this group were lower in environmental (17.27) and farm animal welfare (13.54). According to Figure 3, in general, the average food literacy rate for a group with high food literacy is higher than the overall average.

According to the results presented in of the comparison test, there is a significant difference between the mean score of food literacy at the level of 0.0001 among the people of the three considered clusters. The average level of food literacy for the group with low level of food literacy is lower than the general average for all dimensions of food literacy except the social dimension. The group with moderate food literacy, with the largest number, included 102 people and the average of this group in the field of social (15.80), economic (15.49), health (16.31), skill (15.24), environmental (16.16) and farm animal welfare (12.29). Also, according to Figure 3, in general, the average food literacy rate for the group that was average for all dimensions except the health dimension is slightly lower than the overall average. According to the results, most people are in the cluster with moderate food literacy and also the percentage of people with high food literacy was somewhat higher than the number of people with low food literacy in the study group.

Discussion

Food literacy empowers individuals, households, communities and countries to maintain the quality of nutrition through change and enhance resilience over the time. This set includes the knowledge, skills, and behaviors needed to plan, manage, select, prepare and eat food to meet needs and determine consumption (Truman et al., 2017).

The findings of the present study showed that there is a significant difference between men and women in terms of food literacy so that women had a higher average food literacy than men. This can be influenced by the rural social structure in Iran and the way of division of duties between men and women and the way the position and social responsibilities of men and women are divided. In addition to housework and food production and cooking management, women also engage in marginal agricultural food production activities on farms. This result is consistent with a study by Ronto et al. (2016) measuring food literacy. Riyahi (2003) in line with this finding, showed that in general, girls have more healthy and beneficial eating habits than boys. In order to improve men's food literacy, it is suggested to hold workshops to improve food skills.

Mean comparison test between different educational groups showed that people with different levels of education had

FIGURE 2
Estimate model.
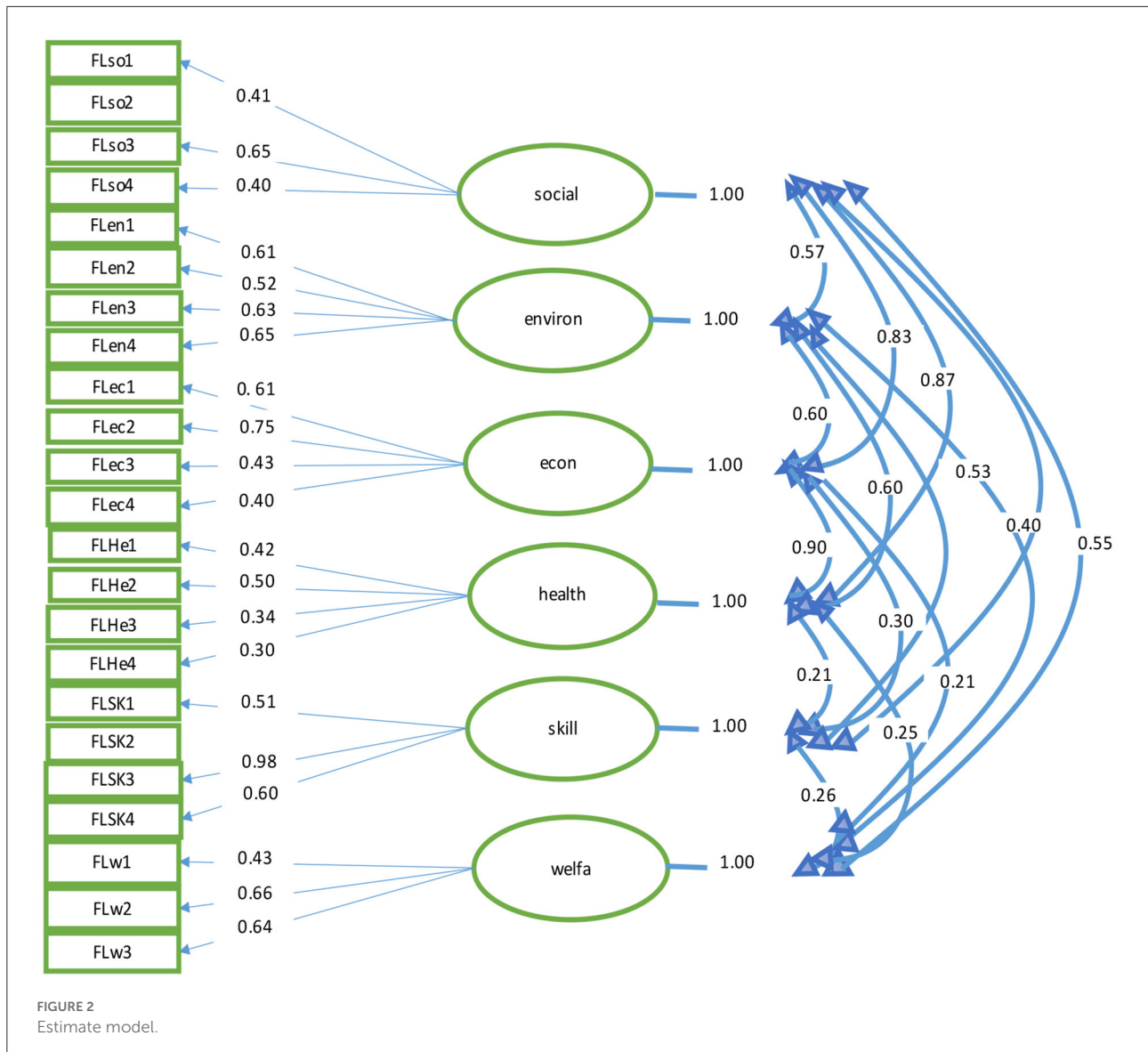
different food literacy. The results of Ronto et al. (2016) in line with this finding indicate a significant difference in food literacy among people with different levels of education. According to the results, people with secondary education had the highest level of food literacy and people with diploma and higher education had lower levels of food literacy. In general, an inverse relationship has been observed between the level of education and food literacy of individuals. This can indicate that non-scholastic and grounded experiments have played a more effective role than formal education in promoting food literacy. On the other hand, the formal education provided in schools and universities has not been effective on the factors that enhance food literacy-related skills. In general, it seems that despite the importance of food literacy and nutrition in educational programs and textbooks from both theoretical and practical

dimension, in school education programs, little attention has been paid to these issues (Strohl, 2015).

The content of textbooks, should be practical, also be engaging and enjoyable so that the concepts taught can change students' attitudes and be used in their daily lives (Li and Wang, 2008). The experience of some countries, such as the United States, France and Argentina, in teaching food-related skills through the establishment of "Culinary schools" and the "My Garden" project in schools is noteworthy (Strohl, 2015). Portugal and Australia are also examples that have used these methods to institutionalize principles and skills related to food and nutrition and to improve students' academic performance (García-Feijoo et al., 2020). The results of content analysis by Turk et al. (2016) showed that food and nutrition in the content of elementary school

TABLE 5 Standard values and fit indicators of social impact assessment model.

	Initial model	Fitted model
Chi Square / degree of Freedom (X^2/df)	3≥	0.51
Normed Fit Index (NFI)	90≤	0.84
Non-Normed Fit Index (NNFI)	90≤	0.83
Comparative Fit Index (CFI)	90≤	0.84
Goodness of Fit Index (GFI)	90≤	0.86
Adjusted Goodness of Fit Index (AGFI)	≤90	0.83
Increasing fitness index (IFI)	90≤	0.85
Root mean square residual (RMR)	0.05≥	0.062
Root mean square error of approximation (RMSEA)	0.08≥	0.065

textbooks in Iran has often been used as a tool and skill and value-attitude categories of food literacy and nutrition in textbooks. The elementary has not been dealt with effectively and practically. Findings of Omidvar et al. (2010), Rafieian (2014), Kian (2016), and Arvand et al. (2018) also confirm this finding.

In order to improve food literacy of the community, it is possible to identify and collect useful experiences that can be presented in schools by using scientific methods and to make it a part of the curriculums. On the other hand, the use of experimental knowledge of villagers in relation to food skills as well as proper management, training in relation to food literacy is recommended.

The study of food literacy of households with different incomes showed that the monthly income level affects food literacy of individuals and households with the lowest monthly income had the highest food literacy level. Given the relevant items, this could indicate a greater effort by people in lower-income families to provide food and better budget management to meet the basic needs of themselves and their families, which improve food literacy. This finding is consistent with the conclusion that low-income households consume more home-cooked foods and have higher food literacy (McLachlan et al., 2013; Smith et al., 2014).

Evidence shows that lower-income households generally have high food literacy skills to provide food in food basket and use strategies that include inexpensive cooking utensils as well as inexpensive food. According to Coveney (2005), lower-income families understand the nutritional value of food and are aware of its nutritional value. This result differs from the results of Cluss et al. (2013) have shown that nutritional knowledge is low among low-income families. According to sources, use frozen foods, store and use leftovers, distribute food to large numbers of people, remove spoiled or damaged parts of food and use it, prolong food storage All of these strategies in the direction of high food literacy (Crotty et al., 1992; Kempson

et al., 2003; Nielsen et al., 2015; Warin et al., 2015) should be given more attention.

Conclusion

According to the findings, food literacy of the villagers in the dimension of social skills has a favorable situation and also the item "customs" in this dimension has particular importance. Sociologists believe that customs and culture have always been intertwined with human life. According to studies, the totality of social and cultural issues of nutrition and eating habits cannot be ignored in the production and supply of products. To address the problem of food insecurity, environmental, social and cultural conditions must be considered (Roder, 2008). Unfortunately, solutions often focus on technological innovations and do not necessarily take the social differences into account (Beuchelt and Badstue, 2013).

The potential positive or negative effects of advanced agricultural technologies may be very specific depending on cultural and social conditions (Paris and Pingali, 1996). For example, empowerment, interaction, culture, food security and entertainment are important components of food literacy (Mclaughlin et al., 2003; Anderson, 2007). Therefore, the cultural context and social customs of any society are the key to initiating measures to promote food literacy. In fact, effective management requires more attention to indirect effects such as demographic, economic, social, political and cultural factors on food issues (Carpenter et al., 2006; Hou et al., 2014).

Therefore, based on the results, as a solution to strengthen people's food literacy, different dimensions of social and cultural skills related to food can be considered and exploited. Customs are a key factor for recognizing knowledge and attitude as well as the ability of communities, especially in rural communities and therefore have a positive and significant impact on food literacy of villagers and show the greatest impact on the social sector of food literacy. Therefore, in order to improve food security of rural communities, identify and introduce positive food customs of rural communities and strengthen it, as well as identify dimensions that enhance indigenous knowledge related to food literacy and use it in formal and informal education related to nutrition is recommended.

Also, based on the analysis of the results, the lack of formal education for children in school is known as a weak factor. It is recommended to provide nutrition education to formal education curricula and to implement proper educational management for children in order to promote food literacy and food security.

Regarding the food literacy economic index, the subjects had a favorable situation and considered the management of household food budget. However, despite the expectations, in the rural communities, the purchase from food farms has the lowest average, which indicates the lack of necessary conditions

TABLE 6   Results of the Cluster analysis of respondents based on food literacy.

Dimensions of food literacy	Food literacy rate			F	Sig
	High	Moderate	Low		
Social	17.55	15.80	14.59	43.20	0.0001
Economical	17.51	15.49	12.08	102.05	0.0001
The health	18.00	16.31	14.53	51.84	0.0001
Skills	17.63	15.24	12.47	89.85	0.0001
Environmental	17.27	14.16	12.30	99.8	0.0001
Welfare of farm animals	13.54	12.29	11.41	25.37	0.0001
Number of people in each group	68	102	62		

TABLE 7   Summary of results of food literacy measurement model (Second-order confirmatory factor analysis).

Dimension	Indicators	Average	Markers in the model	Standard coefficient	standard error	T Value	SMC
Social	Customs	15.99	FLso1	0.41	0.31	4.83	0.16
	Children's education		FLso2	0.16	0.24	0.55	-
	Indigenous knowledge of food literacy		FLso	0.65	0.37	3.96	30.23
	Notification of food losses		FLso4	0.40	0.29	4.77	0.15
Economic	Purchase from farms	15.17	FLec1	0.61	0.76	8.84	0.37
	Shopping from traditional neighborhoods		FLec2	0.75	0.81	10.97	0.57
	Pay attention to the distance traveled by food consumed (transportation)		FLec3	0.43	0.40	5.88	0.18
	Managing household food budget		FLec4	0.40	0.38	4.10	0.15
Health	Use processed foods	16.33	FLHe1	0.09	0.42	0.32	3.88
	Use local food		FLHe2	0.50	0.45	5.86	0.24
	Pay attention to the health of car plants and wild animals		FLHe3	0.34	0.35	4.32	0.12
	Pay attention to the health of crops		FLHe4	0.30	0.32	3.24	0.17
Food skills	Teaching food skills in the family	15.27	FLSk1	0.51	0.41	5.19	0.25
	Cook simple and fast food		FLSk2	0.60	0.60	1.54	-
	Having sufficient food preparation skills		FLSk3	0.98	1.04	10.05	0.76
	Having sufficient skills		FLSk4	0.43	0.38	3.88	0.18
Environmental	Drinking water health	14.58	FLen1	0.61	0.61	5.49	0.43
	Recycling of food waste		FLen2	0.52	0.52	5.82	0.21
	Use of organic plants		FLen3	0.63	0.63	8.49	0.46
	Cultivation of consumer plants		FLec4	0.65	0.63	6.98	0.30
Welfare of farm animals	More production and animal health	12.42	FLw1	0.43	0.36	3.95	0.11
	Food consumption and animal life		FLw2	0.66	0.44	7.11	0.42
	Hormonal nutrition of domestic animals		FLw3	0.64	0.46	7.01	0.40

for purchase from farms and orchards and the supply of food products to farms does not take place in the same place of production. This is due to the fact that in the study areas, more of a crop is grown for larger markets and less attention is paid to the

needs of local markets. The importance of economic issues in the field of food literacy also in the studies of Carpenter et al. (2006) and Hou et al. (2014) have been approved. Ruel and Alderman also consider one of the main ways that agriculture can be

FIGURE 3
Grouping of respondents according to food literacy, the result of the final clustering.

affected by nutrition is the income from the sale of produced products (Ruel and Alderman, 2013). In this regard, creating local markets for the supply of products. Production in different areas, training in multi-crop farming practices and increasing the possibility of selling products on the farm are recommended.

Food literacy skills of the villagers were moderate and according to the participants in the study, most people were able to prepare their own food. But a lower mean than other items was observed in the field of preparing food at the desired speed. Most experts in this field, define food literacy in terms of functional abilities and nutritional skills (Association of Local Public Health Agencies, 2009; Desjardins, 2013; Sadegholvad et al., 2014; Ashoori, 2018). In this regard, it is suggested that the skills and abilities of individuals in informal training related to food literacy skills, including encouragement to prepare a variety of foods through the processing of raw agricultural products to be used.

In the environmental dimension, the subjects had a middle and lower position than other dimensions and areas of food literacy, which indicates the weakness of the local community in environmental issues. In this regard, promoting new methods of using food waste, promoting and teaching the cultivation of crops without fertilizers and toxins for household consumption and promoting and educating and other environmentally friendly methods for household consumption are suggested.

The literacy of the respondents after the welfare of farm animals had an inappropriate level, which is due to the low awareness of people about the welfare of the animals raised. In this regard, teaching appropriate methods of feeding and raising livestock and poultry and the use of educational media such

as posters, etc. are recommended to create a positive attitude regarding the basic breeding and their health and life.

In the structural equation modeling section, it showed that the research factor analysis model has suitable and acceptable fit and the overall structure of the research is approved. Therefore, based on the fitted model of the research, it can be argued that the components used in the research can estimate food literacy and therefore the structures used to measure food literacy have an acceptable validity and can be used and developed in future research of food literacy. In the social dimension, customs had the highest reliability, since customs have shown the greatest reliability in the social dimension. Studies by Teng and Chih (2022) and Stjernqvist et al. (2022) had presented finings similar to this research about importance of food and social skils. It is suggested to identify food-related customs in each place and use the most appropriate and enforceable ones in educational environments, including holding local food education festivals. Evidence has shown that creating an effective link between nutrition and food production process is effective in creating food security, food diversity and promoting the consumption of indigenous and local foods (Reinbott et al., 2016).

The results of cluster analysis showed that most studied groups classified in the average level in terms of food literacy and had the highest average in the social index of food literacy. Examination of the evidences showed that most people in the rural community achieve a moderate level of food literacy, because of the interaction with agriculture. For this reason, most of the subjects studied are classified in this cluster. Also, most people have good information and skills related to social issues related to food. The results indicate that individuals had a good level of social skills in food literacy but were weak in

food health skills and its diagnosis and production, so programs should be used in rural communities to disseminate and expand this. The use of various educational and promotional media such as brochures and educational classes is recommended to promote skills related to the health dimension of food literacy in rural communities.

There were some limitations in this study like other similar quantitative. It is recommended that other researchers base the same study on a larger sample size to end up with more accurate results. Also, the design of the current research was cross-sectional and the data were gathered at one specific point in time only. No pre- and post-event testing was used, and nor were longitudinal processes evaluated.

In Total, to face the challenges of food sustainability, in all around the world, food literacy is considered a necessity, it could promote individuals, households, communities and countries strength. Evidence has shown that the components used in the research can estimate food literacy and therefore the structures used to measure food literacy can be used and developed in future research of food literacy. Based on the findings and discussion, in order to improve food literacy of the community, investigating five dimension that reflect food literacy scale including social, economic, health, skills, environmental and welfare of farm animals in different communities is recommended. These set includes the knowledge, competencies and behaviors needed to enhance resilience over the time. Comparison test between different educational groups showed that people with different levels of education had different food literacy. It should be emphasized to identify and collect effective and appropriate educational experiences to empower each community in food literacy.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

BZ: conceptualization, data curation, formal analysis, investigation, methodology, validation, visualization, writing—original draft, and writing—review and editing. RN: conceptualization, data curation, formal analysis, funding acquisition, investigation, software, methodology, project administration, resources, supervision, validation, writing—original draft, and writing—review and editing. Both authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer NV declared a shared affiliation with the authors to the handling editor at the time of review.

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