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Research Paper

Development of a Home Food Safety Questionnaire Based on the PRECEDE Model: Targeting Iranian Women

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ABSTRACT

Food safety is an essential public health issue for all countries. This study was the first attempt to design and develop a home food safety questionnaire (HFSQ), in the conceptual framework of the PRECEDE (predisposing, reinforcing, and enabling constructs in educational diagnosis and evaluation) model, and to assess its validity and reliability. The HFSQ was developed by reviewing electronic databases and 12 focus group discussions with 96 women volunteers. Ten panel members reviewed the questionnaire, and the content validity ratio and content validity index were computed. Twenty women completed the HFSQ, and face validity was assessed. Women who were responsible for food handling in their households ($n = 320$) were selected randomly from 10 health centers and completed the HFSQ based on the PRECEDE model. To examine the construct validity, a principal components factor analysis with varimax rotation was used. Internal consistency was determined with Cronbach's α. Reproducibility was checked by Kendall's τ after 4 weeks with 30 women. The developed HSFQ was considered acceptable with a content validity index of 0.88. Face validity revealed that 95% of the participants understood the questions and found them easy to answer, and 90% confirmed the appearance of the HFSQ and declared the layout acceptable. Principal component factor analysis revealed that the HFSQ could explain 33.7, 55.3, 34.8, and 60.0% of the total variance of the predisposing, reinforcing, practice, and enabling components, respectively. Cronbach's α was acceptable at 0.73. For Kendall's τ_c, $r = 0.89$, with a 95% confidence interval of 0.85 to 0.93. The HFSQ developed based on the PRECEDE model met the standards of acceptable reliability and validity, which can be generalized to a wider population. These results can provide information for the development of effective communication strategies to promote home food safety.

Key words: Focus group discussion; Home food safety questionnaire; Reliability; Validity

Food safety is an essential public health issue for all countries *(52)*. Millions of people worldwide suffer from foodborne diseases acquired through the consumption of contaminated foods *(51)*. Studies suggest that the home may be the main source of contamination in cases of foodborne diseases *(15, 42, 47)*. In one study, the majority of consumers responsible for food handling had inadequate knowledge about foodborne illnesses in the home *(30)*. Experts agree that the home is the primary location where foodborne outbreaks occur, but many consumers do not consider the home to be a risky place with regard to foodborne illness *(6)*. One of the major issues of home food safety in Iran is lack of knowledge regarding food handling, storage, and hygienic practices, which may lead to foodborne illnesses. Based on an unpublished report of the Ministry of Health and Medical Education in Iran *(33)*, 2,797 cases of foodborne diseases were reported throughout the country in 2014, and of these 63 cases resulted in death.

Assessment of contamination risk in the domestic kitchen should be based on data from well developed and validated instruments. If a questionnaire of unknown validity or reliability were used, it would be difficult to determine whether the results were accurate *(7, 31, 40, 41, 50)*.

To our knowledge, limited studies have been conducted regarding home food safety in Iran. Generally, the PRECEDE (predisposing, reinforcing, and enabling constructs in educational diagnosis and evaluation) model can be used to extract information for the development of effective communication strategies to promote home food safety. Our study was conducted to develop a home food safety questionnaire (HFSQ) targeting Iranian women based on the PRECEDE model.

MATERIALS AND METHODS

This study was approved by the Ethical Committee of National Nutrition and Food Technology Research Institute (Faculty of Nutrition Sciences and Food Technology, Shahid

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Beheshti University of Medical Sciences, Tehran, Iran; grant 450.17). The participants in each phase of study were selected independently, these volunteers did not participate in other parts of the study, and they were informed that their participation in the study was voluntary and that they could withdraw from the study at any time. Written informed consent was obtained from all participants *(11)*. They did not receive monetary compensation for their participation. After completing the HFSQ, home food safety consultation was provided for all participants based on incorrect answers. The PRECEDE model was used as the theoretical framework for development of the HFSQ for assessing the health needs of this community or population group. This model can be used to detect and classify factors associated with home food safety. The three constructs are predisposing factors (knowledge, attitudes, and social status of households), reinforcing factors (those factors that reward or reinforce the desired food safety practice), and enabling factors (economic factors) that facilitate motivation to change home food safety behavior *(10, 19, 29)*. Instrument development was conducted across three sequential phases.

Phase 1: exploratory. This phase included review of the literature and focus group discussions (FGDs). For review of the literature, electronic databases including PubMed, Scopus, and ISI Web of Science were searched using the key words validity, home food safety questionnaire, PRECEDE model, focus group discussion, and mixed method to identify home food safety concepts. Criteria for including published articles were having home food safety practices that could be adapted for use in Iran and availability of acceptable methods to assess such practices. Appropriate questionnaires and related studies were extracted, and items measuring the same food safety concept were grouped together in a scale. The initial instrument was formulated with 105 questions. It was then revised by 10 food safety experts to select the most salient questions and identify improvements needed.

The FGDs were conducted to better understand the food safety knowledge and potential household food safety issues in Iran so that we could better ensure that the questionnaire properly addressed important home food safety issues in our community. Twelve FGDs were convened in 10 health centers from five districts (north, east, west, south and center) of Tehran. To obtain a variety of answers, districts were chosen based on the socioeconomic status of the residents. In Tehran, the districts were classified as high, moderate, and low socioeconomic status based on a report from the Ministry of Economic and Financial Affairs *(49)*. FGDs were held until the discussion reached saturation in each center (i.e., no new ideas or comments were being submitted) *(20)*. Using a continuous procedure, 103 women were contacted, and 96 of them agreed to cooperate; 7 were excluded because they were not available on the study date. The women were invited by the health center staffs; they were contacted by phone, informed about the purpose of the study, and invited to participate in the study based on their willingness to do so on a specific date.

Each FGD involved 7 to 10 participants and lasted for 60 min. After each FGD session, food safety and nutrition consultation was provided for all participants. The moderator's guide consisted of a series of open-ended questions to allow the respondents to explain their opinions and experiences, and it was designed based on the research objectives (Table 1). Each team consisted of one moderator, one observer, and two note takers. The notes were organized based on the focus group questions and probes. Participant voices were recorded, and expressions of emotion such as laughter and sighs were noted.

TABLE 1. *Focus group discussion moderator's guide*

What are the easiest and the most important ways to maintain personal hygiene?
What do you think of when you hear the words "food poisoning"? What are the symptoms?
Have you gotten sick from homemade foods in the last 6 months?
Do you consume canned foods? If yes, how?
Do you consume raw milk? If yes, how?
What are the most important factors in your view for selecting foods?
What is the appropriate temperature for a refrigerator?
How do you store raw and cooked foods in the refrigerator?
How do you store eggs, fresh fruits, and vegetables?
How do you disinfect fresh vegetables?
Do you use separate cutting boards for raw meat, chicken, and vegetables?
How do you defrost frozen raw meat?
How many hours do you leave the leftovers at room temperature?
How do you reheat the leftovers?

The record of each FGD was transcribed verbatim and compared with notes to fix potential discrepancies. Data analysis started with reading the final transcript repeatedly to achieve immersion and obtain a sense of the whole, as one would read a novel. Then, the data were read word by word by two investigators independently (who agreed on interpretations) to derive codes by highlighting the exact words from the text that appear to capture key thoughts or concepts. These words often came directly from the phrases that frequently appeared in the text and then became part of the initial coding scheme. The codes were then sorted into categories based on how different codes were related or linked. The categories that emerged were used to organize and group the codes into meaningful themes. These themes were later used to identify different constructs of the instrument and thus to verify it *(21, 23, 28, 36, 38)*. These data were read independently by two other investigators, who agreed on interpretations. Food safety and nutrition education was provided for participants after each session. The FGD results were then used to examine the content representativeness and relevance of each question on the 40-item questionnaire. Those questions that addressed duplicate content or were beyond the scope of our study were eliminated.

Phase 2: validity. Three types of validity were checked: content, face, and construct validity *(25)*. Content validity refers to how well items of the instrument represent the domain of the content to be measured *(50)*. A high score implies that the performance of this instrument is consistent with the understanding of food safety arisen from qualitative research *(12, 17)*. Content validity assessments involve comparing the content of each question and carefully considering question type and construction *(37)*. Therefore, according to the study goals, 10 panel members (from related organizations) who were experts in food safety reviewed the questionnaire. They were asked to rate the appropriateness of each question based on a 3-point Likert scale (1 = not necessary, 2 = helpful but not necessary, and 3 = necessary). The content validity ratio (CVR), which offers information about the item validity score, was calculated *(2)*. Using a Lawshe table of critical values for the CVR, the questions with a CVR higher than 0.62 were considered acceptable, and items with lower scores were considered unable to measure the desired concept or were judged to have little connection with the issue and thus were excluded *(2)*. Then the content validity index

TABLE 2. *Demographic characteristic of study participants*[a]

Variable	*n* (%)
Mother's age (yr)	
<35	280 (60)
35–45	126 (27.1)
>45	60 (12.9)
Mother's educational level	
Illiterate or primary school	167 (35.8)
Middle school to diploma	252 (54.1)
University	47 (10.1)
Mother's occupation	
Housewife	429 (92.0)
Employed	37 (8.0)

[a] $n = 466$ participants, including 96 in the FGDs, 320 for construct validity, 20 for face validity, and 30 for test-retest evaluation.

(CVI) was computed for the remaining questions to determine the total content appropriateness of the questionnaire. Content valid instruments tending to have a CVI of 0.99 or higher *(2, 3)*.

Face validity refers to how relevant the items appear to the respondents *(37)*. It is the easiest validation process to undertake; however, it is the weakest form of validity *(13)*. For further refinement, the revised questionnaire was assessed for language appropriateness, format, reasonableness, readability, consistency, attractiveness, and logical sequence of items using "yes" or "no" questions *(13, 24, 26)*. Twenty women who were responsible for food handling and were selected by convenience sampling completed the questionnaire through an interview with an experienced interviewer. Their comments and points of view regarding the questionnaire were recorded. Based on their comments and feedback from the panel of experts, minor editorial changes were made to increase the clarity of the questionnaire items *(8)*.

Construct validity mainly refers to the measurement of variables. The issue is that the items are chosen to build up a construct interaction in a manner that allows the researcher to capture the essence of the latent variable to be measured. Construct validity implies the use of more quantitatively oriented analysis *(4)*. In this part of the study, 350 women who were responsible for food handling in their households were recruited; 30 were eliminated because they did not agree to participate, leaving 320 women who were selected at randomly from the same health centers. Sample size was adequate for a factor analysis, which requires 5 to 10 samples for each question *(35)*. The HFSQ was completed in 20 min and was based on the PRECEDE model with 15, 11, 4, and 5 questions in the predisposing, practice, reinforcing, and enabling sections, respectively. An exploratory factor analysis was conducted for each section using principal components factor analysis (PCFA) with varimax rotation. An eigenvalue greater than 1 was considered to define the main components, and questions with a loading factor higher than 0.3 were entered into the final questionnaire *(35)*.

Phase 3: reliability. All items with a Cronbach's α of >0.7 were included in the instrument *(18)*. Test-retest reliability was also assessed to check the stability of the questionnaire. All women who were referred to the health center in a certain day, were informed about study goal and procedure, were responsible for food handling in their home, and agreed to participate in the study ($n = 30$) were recruited to complete the questionnaire at two times points 4 weeks apart with no intervening food safety education. Kendall's τ was used for nonparametric variables; its acceptable level can be any value between 0 and 1 *(1, 43)*.

Data analysis. Qualitative data from the literature review and FGD findings were analyzed using constant comparative methods in the qualitative research *(39)*. Quantitative data were analyzed with SPSS software version 21.0 (SPSS, IBM, Armonk, NY) and Stata version 11.1 (StataCorp, College Station, TX) using PCFA with varimax rotation, Cronbach's α, and Kendall's τ.

RESULTS

Demographic and socioeconomic characteristics of the women participating in different phases of the study ($n = 466$) revealed that the majority of them (60%) were younger than 35 years old, most (54%) had an educational level of middle school to diploma, and 92% were housewives (Table 2).

Phase 1: exploratory. Appropriate questionnaires and related studies were obtained through the literature research, items measuring the same food safety concept were grouped in a scale, and the initial instrument with 105 questions was formulated. It was then revised by food safety experts to select the most salient questions and identify improvements needed. Sixty-five questions were eliminated because they were duplicated in content, they were outside the scope of the study, or they were not related to Iranian foods (e.g., sushi, oysters, and pork); this process shortened the instrument, and similar categories were merged. FGDs were undertaken to evaluate the content appropriateness and to improve the refined draft of the questionnaire.

According to the FGD results, three categories and nine themes were explored based on the perspectives of the participants who were responsible for food handling in their households. The first category was personal hygiene and poisoning: washing hands as priority in personal hygiene. The second category was food safety, preparation: and storage, covering (i) inadequate knowledge about proper time for boiling raw milk, (ii) lack of awareness about temperature, (iii) incorrect storage of food in the refrigerator, (iv) storage of unwashed and unpacked eggs, fresh fruits, and vegetables in the refrigerator, (v) thawing frozen raw meat (including chicken) at room temperature, (vi) incorrect separation and sanitization of cutting boards for fresh vegetables and raw meat (including chicken), and (vii) inappropriate washing of fresh leafy vegetables. The third category was safety of cooked foods, which included improper reheating of leftover foods.

The last draft of the 40-item questionnaire was developed from the literature review (refined draft) and the FGD results to examine content representativeness and relevance.

Phase 2: validity. Of the 40 questions, 30 questions with CVR scores greater than 0.62 remained (10 removed items did not meet the cutoff values) (Table 3). The CVI was calculated as 0.88 for the 30 remaining items.

TABLE 3. *CVR scores of home food safety questionnaire*

Question	CVR
1. Sponge and wiping cloth can spread microorganisms (true, false, don't know)	0.8
2. The same cutting board can be used for both raw and cooked foods provided it looks clean (true, false, don't know)	0.8
3. Cooked foods should be thoroughly reheated (true, false, don't know)	0.8
4. Safe water can be identified by the way it looks (true, false, don't know)	0.8
5. Leftover foods can be kept at room temperature (true, false, don't know)	0.8
6. Pasteurized milk is safer than bulk milk (true, false, don't know)	0.8
7. Consuming foods from swollen cans may cause death (true, false, don't know)	0.8
8. Keeping kitchen surfaces clean reduces the risk of illness (agree, not sure, don't agree)	1
9. Keeping raw and cooked food separately helps to prevent illness (agree, not sure, don't agree)	0.8
10. Using different knives and cutting boards for raw and cooked foods is worth the extra effort (agree, not sure, don't agree)	0.8
11. Meat or chicken that is not cooked thoroughly can cause disease (agree, not sure, don't agree)	0.8
12. Thawing meat in a cool place is safer (agree, not sure, don't agree)	0.8
13. I think it is unsafe to leave cooked foods out of the refrigerator for more than 2 h (agree, not sure, don't agree)	0.8
14. I think it is important to throw away foods that have reached their expiry date (agree, not sure, don't agree)	1
15. I wash my hands thoroughly with soap or liquid soap after using the toilet (5-point scale)[a]	0.8
16. I wash my hands before and during food preparation (5-point scale)	1
17. I clean surfaces and equipment or utensils used for food preparation before reusing them for other foods (5-point scale)	1
18. I use separate knives and cutting boards when preparing raw and cooked foods (5-point scale)	0.8
19. I reheat cooked food until it is piping hot throughout (5-point scale)	0.8
20. I thaw meat in a cool place or refrigerator (5-point scale)	1
21. I store cooked foods in a cool place within 2 h after cooking (5-point scale)	1
22. I store raw and cooked foods in the refrigerator separately in covered dishes (5-point scale)	1
23. I consume only pasteurized milk and dairy products (5-point scale)	1
24. I wash fruits and vegetables with safe water, dishwashing liquid, and disinfectant (5-point scale)	1
25. I store unwashed eggs in the refrigerator (5-point scale)	1
26. It is better to consume pasteurized milk and dairy products (agree, not sure, don't agree)	1
27. What are the most important sources for getting food safety related information? (multiple choice)	1
28. Is your family satisfied with the hygienic condition of your foods and kitchen? (multiple choice)	1
29. Have you attended classes about home food safety? If yes, how many sessions? (multiple choice)	0.8
30. How many years of experience do you have in food preparation? (multiple choice)	0.8

[a] 5-point scale: never, rarely, some of the time, most of the time, always.

For face validity, 95% ($n = 19$) of the women understood the questions and found them easy to answer, and 90% ($n = 18$) declared that the appearance and the layout of the questionnaire were acceptable.

Construct validity was divided into four parts: predisposing, practice, reinforcing, and enabling. Three main constructs (factors) emerged from the rotated PCFA of the 15 predisposing items. All the items had factor loadings in acceptable ranges. The first factor was "safety of preparation and processing of cooked foods," and items 1 through 9 were loaded onto this factor, which explained 14.4% of the variance (Table 4). Two main factors emerged from the rotated PCFA of the 11 practice items. Item 11 was not loaded in any of the factors, had low value, and needed corrections. The first factor was "personal hygiene, kitchen surface, and equipment," and items 1 through 6 were loaded onto this factor, which explained 19.80% of the variance (Table 5). Two main factors emerged from the PCFA of the four reinforcing items. The first factor was "information source," which explained 28.58% of the variance (Table 6). One main factor emerged from the PCFA of the five enabling items. Items 1 through 5 were loaded onto this factor, which explained 59.98% of the variance (Table 7).

Phase 3: reliability. Internal consistency, as measured with Cronbach's α, was acceptable for all the predisposing, practice, reinforcing, and enabling factors (0.72, 0.75, 0.70, and 0.77, respectively), and the total α was 0.73.

Reproducibility, as measured with Kendall's τ_c calculation, gave acceptable test-retest reliability for the HFSQ, with $r = 0.89$ and a 95% confidence interval of 0.85 to 0.93.

DISCUSSION

This is the first study to develop a valid and reliable HFSQ with a diverse and wide range of questions to assess the levels of home food safety and its determinants among Iranian women. The first phase (exploratory) included the literature review and use of FGDs to avoid further problems regarding the validity scale *(3)*. Qualitative research covers a wide variety of conceptual principles and methodologies, which allows for tailoring the study design to a specific research purpose *(5)*. The HFSQ with 30 items was

TABLE 4. *Factor loadings for rotated component matrix for responses of 320 women to 15 predisposing questions*[a]

Question	Factor loadings		
	Safe food storage	Milk safety	Safety of preparation and processing cooked food
1. Consuming grilled meat and chicken that is not cooked thoroughly	0.607	−0.029	0.130
2. Consuming canned foods	0.585	−0.024	0.033
3. Sponge and wiping cloth can spread microorganisms	0.572	−0.139	0.144
4. Using different or separate knives and cutting boards for raw and cooked foods	0.432	0.038	0.170
5. Using the same cutting board for raw and cooked foods	0.431	0.187	−0.017
6. Leaving cooked food out of the refrigerator	0.396	0.201	−0.098
7. Keeping leftover foods at room temperature	0.391	0.333	−0.190
8. Safe water can be identified by the way it looks	0.367	0.178	0.159
9. Thawing meat	0.353	0.032	0.288
10. Use pasteurized dairy	0.027	0.778	0.280
11. Pasteurized milk is safer than bulk milk	0.246	0.759	0.042
12. Keeping kitchen surfaces clean	0.061	−0.066	0.689
13. Production expiry date	−0.035	0.170	0.567
14. Keeping raw and cooked foods in the refrigerator	0.160	0.105	0.532
15. Consuming leftover foods	0.054	−0.302	0.303
Variance	14.42	9.69	9.62

[a] Extraction methods: principal components analysis with varimax rotation and Kaiser normalization. Kaiser-Meyer-Olkin measure of sampling adequacy = 0.7. Bartlett's test of sphericity = 762.41, approximate $P < 0.0001$.

developed by modifying a pool of 105 questions from the literature review and FGD results. A strength of this study was the use of FGDs, which provided of a wide variety of data and allowed precise articulation of home food safety issues that were used to develop this HFSQ. The FGD method also has been used by other researchers for development, evaluation, and improvement of a questionnaire *(24, 31)*. The exploratory phase also included review of the majority of the global literature to assess the status and importance of home food safety and FGD findings, which led to development of the primary draft of the HFSQ.

The main purpose of the second phase (validity) was to draw attention to alternative methods for scale validation. The CVR and construct validity were applied in the process of developing a scale for perceived risk *(3)*. The content validity analysis served as a useful tool to assess the relevance and comprehensiveness of the study purpose, to minimize error variance associated with the HFSQ, and to ensure that inferences could be made from the data obtained with the HFSQ *(9, 48)*. Therefore, establishing content validity is the first appropriate step to ensure that a questionnaire will collect data on food safety as intended.

TABLE 5. *Factor loadings for rotated component matrix for responses of 320 women to 11 food safety practice questions*[a]

Question	Factor loadings	
	Personal hygiene, kitchen surface, equipment	Safety of food processing and storage
1. I use separate utensils and cutting boards when preparing raw and cooked foods.	0.690	0.043
2. I wash my hands thoroughly with soap or liquid soap after using toilet.	0.622	−0.053
3. I clean kitchen surfaces and equipment used for food preparation before reusing them with other foods.	0.600	0.037
4. I wash my hands before and during food preparation.	0.593	0.093
5. I store raw and cooked foods in the refrigerator separately in covered dishes.	0.567	0.253
6. I store cooked foods in a cool place within 2 h of cooking.	0.397	0.140
7. I thaw meat in a cool place.	0.115	0.729
8. I wash fruits and vegetables with safe water, dishwashing liquid, and disinfectants	0.125	0.636
9. I reheat cooked food until it is piping hot throughout.	−0.049	0.626
10. I consume only pasteurized milk and dairy products.	0.305	0.457
11. I store unwashed eggs in the refrigerator.[b]	0.010	0.120
Variance	19.80	14.99

[a] Extraction methods: principal components analysis with varimax rotation and Kaiser normalization. Kaiser-Meyer-Olkin measure of sampling adequacy = 0.753. Bartlett's test of sphericity = 636.88, approximate $P < 0.0001$.

[b] Item 11 was not loaded in any of the factors.

TABLE 6. *Factor loadings for rotated component matrix for the responses of 320 women to four food safety reinforcing questions*[a]

Question	Factor loadings	
	Information source	Food preparation experience
1. What are the most important sources for getting food safety related information?	0.756	0.087
2. Have you attended classes about home food safety?	0.744	−0.131
3. Is your family satisfied with the hygienic condition of your foods and kitchen?	0.74	0.725
4. How many years of experience do you have in food preparation?	−0.116	0.721
Variance	28.58	26.78

[a] Extraction methods: principal components analysis with varimax rotation and Kaiser normalization. Kaiser-Meyer-Olkin measure of sampling adequacy = 0.502. Bartlett's test of sphericity = 19.642, approximate $P < 0.0001$.

In 2012, Kelishadi et al. *(24)* designed a questionnaire and tested its validity and reliability for screening weight disorders among children and adolescents in Iran. As in our study, the content validity of the questionnaire was verified by a panel of experts, and the reliability of the dimensions (CVI) was calculated as >0.75, with $\alpha = 0.97$. In three other studies *(22, 32, 46),* questionnaires were developed and evaluated based on content validity. The questionnaire items were convergent and were judged to have content validity. Overall, the high CVI for both representativeness and clarity provided evidence that the questionnaires had a high degree of content validity.

To measure a latent variable, it is important to introduce the construct validity, which can capture the essence of the variable *(3)*. In 2014, Fooladi Moghaddam et al. *(16)* developed a promising tool to measure food safety attitudes and practices in Tehran. A PCFA with a varimax rotation method was used to explore construct validity *(35)*. The PCFA revealed that three and four main components existed in the attitude and practice questionnaires, respectively. In our study, the PCFA revealed three, two, two, and one main component in the predisposing, practice, reinforcing, and enabling factors, respectively, in the conceptual framework of the PRECEDE model. In three other studies *(27, 34, 44)* regarding the household food insecurity access scale questionnaire, validation by PCFA method with two main components was achieved. Therefore, our results were in line with those of these studies. Using this method, investigators can be sure that the questions are related to the construct validity. Construct validity concerns the degree to which the survey respondent possesses some trait or quality presumed to be reflected by the measure *(14)*.

In the third phase (reliability), Cronbach's α was used to measure a certain type of reliability, which offers information on how items that form a scale are correlated with each other. In the present study, home food safety scales generated acceptable Cronbach's α values for internal consistency in predisposing, practice, reinforcing, and enabling factors. In a previous study about food safety, knowledge, and attitude *(31),* internal reliability was >0.75, which was in agreement with our results. According to the results of a study on the development and implementation of a food safety questionnaire for young adults *(7),* the questionnaire met the generally recognized standards of reliability and validity. In validating the questionnaire to measure adolescent food safety, the results indicated that the instrument accurately measured and captured adolescent food safety, and its self-efficacy was achieved by using proven valid and reliable methods *(4)*. Byrd-Bredbenner et al. *(8)* used Cronbach's α for to evaluate the internal consistency of a food safety questionnaire for young adults. In the present study, Kendall's τ was used as a measure of test-retest reliability of the HFSQ and indicated an acceptable level of reproducibility. Salarkia et al. *(45)* found a close correlation, as indicated by Kendall's τ, between the food security groups of households in the two stages. In validity and reliability phases, the home food safety instrument was considered acceptable and was confirmed by food safety experts for assessing food security in households.

Overall, the present study revealed that the newly developed HFSQ can detect critical points for promoting home food safety among Iranian households. Future research should be conducted to evaluate home food safety using this instrument in a larger sample of the population. However, certain limitations of the study must be addressed. The participants were recruited from health centers, and most participants were housewives; therefore, the sample was not representative of Tehran Province. The HFSQ was assessed through self-reporting, which may overestimate actual practices. A strength of this study was the novel approach to design and development of the HFSQ based on the PRECEDE model, which can be useful in education intervention for future research and has the advantages of being simple and quick to administer.

In general, the HFSQ developed based on the PRECEDE model in the present study met the standards, and statistical measures indicated strong validity and

TABLE 7. *Factor loadings for rotated component matrix for the responses of 320 women to five food safety enabling questions*[a]

Question	Factor loading for economic status
Family's income	0.872
Total expenses	0.863
Residential infrastructure (m^2)	0.548
Home appliance number	0.714
Food expenses	0.827
Variance	59.98

[a] Extraction methods: principal component analysis with varimax rotation and Kaiser normalization. Kaiser-Meyer-Olkin measure of sampling adequacy = 0.805. Bartlett's test of sphericity = 1,315.311, approximate $P < 0.0001$.

reliability. This HFSQ could be generalized to a wider population and different geographic regions and could provide information for the development of effective communication strategies to promote home food safety. This new instrument also could be used in surveillance systems to formulate essential messages for educational intervention programs that may be useful for implementing prevention programs and policy decisions to reduce foodborne diseases.

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REFERENCES

1. Arndt, S., C. Turvey, and N. C. Andreasen. 1999. Correlating and predicting psychiatric symptom ratings: Spearman's *r* versus Kendall's tau correlation. *J. Psychiatr. Res.* 33:97–104.
2. Ayre, C., and A. J. Scally. 2014. Critical values for Lawshe's content validity ratio revisiting the original methods of calculation. *Meas. Eval. Couns. Dev.* 47:79–86.
3. Bertea, E., and P. A. Zaiţ. 2013. Scale validity in exploratory stages of research. *Manag. Market. J.* 11:38–46.
4. Brandon, M. K. 2010. Developing, refining, and validating a survey to measure adolescent food safety self-efficacy. M.S. thesis. University of Tennessee, Knoxville.
5. Brod, M., L. E. Tesler, and T. L. Christensen. 2009. Qualitative research and content validity: developing best practices based on science and experience. *Qual. Life Res.* 18:1263–1278.
6. Byrd-Bredbenner, C., J. Berning, J. Martin-Biggers, and V. Quick. 2013. Food safety in home kitchens: a synthesis of the literature. *Int. J. Environ. Res. Public Health* 10:4060–4085.
7. Byrd-Bredbenner, C., V. Wheatley, D. Schaffner, C. Bruhn, L. Blalock, and J. Maurer. 2007. Development and implementation of a food safety knowledge instrument. *J. Food Sci. Educ.* 6:46–55.
8. Byrd-Bredbenner, C., V. Wheatley, D. Schaffner, C. Bruhn, L. Blalock, and J. Maurer. 2007. Development of food safety psychosocial questionnaires for young adults. *J. Food Sci. Educ.* 6:30–37.
9. Campbell, J. P., E. E. Ghiselli, and S. Zedeck. 1981. Measurement theory for the behavioral sciences. W. H. Freeman, San Francisco.
10. Castellanos, D. C., L. Downey, S. Graham-Kresge, K. Yadrick, J. Zoellner, and C. L. Connell. 2013. Examining the diet of post-migrant Hispanic males using the PRECEDE-PROCEED model: predisposing, reinforcing, and enabling dietary factors. *J. Nutr. Educ. Behav.* 45:109–118.
11. Council for International Organizations of Medical Sciences. 2002. International ethical guidelines for biomedical research involving human subjects. World Health Organization, Geneva.
12. Derrickson, J. P., A. G. Fisher, and J. E. Anderson. 2000. The core food security module scale measure is valid and reliable when used with Asians and Pacific Islanders. *J. Nutr.* 130:2666–2674.
13. DeVon, H. A., M. E. Block, P. Moyle-Wright, D. M. Ernst, S. J. Hayden, D. J. Lazzara, S. M. Savoy, and E. Kostas-Polston. 2007. A psychometric toolbox for testing validity and reliability. *J. Nurs. Scholarsh.* 39:155–164.
14. Dharod, J. M., S. Paciello, A. Bermúdez-Millán, K. Venkitanarayanan, G. Damio, and R. Pérez-Escamilla. 2009. Bacterial contamination of hands increases risk of cross-contamination among low-income Puerto Rican meal preparers. *J. Nutr. Educ. Behav.* 41:389–397.
15. Farahat, M. F., M. M. El-Shafie, and M. I. Waly. 2015. Food safety knowledge and practices among Saudi women. *Food Control* 47:427–435.
16. Fooladi Moghaddam, A., F. Khoshnevisan, D. Bondarianzadeh, M. Mohammadi, and H. Bakhshandeh Abkenar. 2014. Development of a food safety attitude and practice questionnaire for Iranian consumers. *Int. J. Consum. Stud.* 38:367–373.
17. Frongillo, E. A. 1999. Validation of measures of food insecurity and hunger. *J. Nutr.* 129:506S–509S.
18. Gliem, J. A., and R. R. Gliem. 2003. Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Presented at the Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education, Columbus, OH, 8 to 10 October 2003.
19. Green, L. W., and M. W. Kreuter. 1991. Health promotion planning: an educational and environmental approach, 2nd ed. Mayfield, Mountain View, CA.
20. Guest, G., A. Bunce, and L. Johnson. 2006. How many interviews are enough? An experiment with data saturation and variability. *Field Methods* 18:59–82.
21. Harris, J. E., P. M. Gleason, P. M. Sheean, C. Boushey, J. A. Beto, and B. Bruemmer. 2009. An introduction to qualitative research for food and nutrition professionals. *J. Am. Diet. Assoc.* 109:80–90.
22. Heidarnia, M.-A., S. Riazi-Isfahani, A. Abadi, and M. Mohseni. 2014. Cross cultural adaptation and assessing validity and reliability of SERVQUAL questionnaire in hospital service quality. *Res. Med.* 38:98–105. (In Persian.)
23. Hsieh, H.-F., and S. E. Shannon. 2005. Three approaches to qualitative content analysis. *Qual. Health Res.* 15:1277–1288.
24. Kelishadi, R., R. Majdzadeh, M.-E. Motlagh, R. Heshmat, T. Aminaee, G. Ardalan, A. Esmaillzadeh, L. Azadbakht, P. Poursafa, and M. Movahedian. 2012. Development and evaluation of a questionnaire for assessment of determinants of weight disorders among children and adolescents: the Caspian-IV study. *Int. J. Prev. Med.* 3:699–705.
25. Kendall, A., C. M. Olson, and E. A. Frongillo, Jr. 1995. Validation of the Radimer/Cornell measures of hunger and food insecurity. *J. Nutr.* 125:2793.
26. Kendall, P. A., A. Elsbernd, K. Sinclair, M. Schroeder, G. Chen, V. Bergmann, V. N. Hillers, and L. C. Medeiros. 2004. Observation versus self-report: validation of a consumer food behavior questionnaire. *J. Food Prot.* 67:2578–2586.
27. Knueppel, D., M. Demment, and L. Kaiser. 2010. Validation of the household food insecurity access scale in rural Tanzania. *Public Health Nutr.* 13:360–367.
28. Krueger, R. A. 2009. Focus groups: a practical guide for applied research. Sage, London.
29. Li, Y., J. Cao, H. Lin, D. Li, Y. Wang, and J. He. 2009. Community health needs assessment with PRECEDE-PROCEED model: a mixed methods study. *BMC Health Serv. Res.* 9:181.
30. Medeiros, L. C., V. N. Hillers, G. Chen, V. Bergmann, P. Kendall, and M. Schroeder. 2004. Design and development of food safety knowledge and attitude scales for consumer food safety education. *J. Am. Diet. Assoc.* 104:1671–1677.
31. Medeiros, L. C., P. Kendall, V. Hillers, G. Chen, and S. DiMascola. 2001. Identification and classification of consumer food-handling behaviors for food safety education. *J. Am. Diet. Assoc.* 101:1326–1339.
32. Miarrostami, M., and B. Kheiry. 2014. Impact of product packaging and family communication patterns on children and parents buying behavior (children and parents who go shopping in entertainment and shopping centers). *J. Market. Manag.* 9:19–48. (In Persian.)
33. Ministry of Health and Medical Education. 2015. Center of Foodborne Illness, Communicable Disease Management. Ministry of Health and Medical Education, Iran. Available at: www.behdasht.gov.ir. Accessed August 2016.
34. Mohammadi, F., N. Omidvar, A. Houshiar-Rad, M.-R. Khoshfetrat, M. Abdollahi, and Y. Mehrabi. 2011. Validity of an adapted household food insecurity access scale in urban households in Iran. *Public Health Nutr.* 15:149.

35. Munro, B. H. 2005. Statistical methods for health care research. Lippincott Williams & Wilkins, Philadelphia.
36. Neuman, W. L. 2005. Social research methods: quantitative and qualitative approaches, 6th ed. Allyn and Bacon, Boston.
37. Parmenter, K., and J. Wardle. 2000. Evaluation and design of nutrition knowledge measures. *J. Nutr. Educ.* 32:269–277.
38. Parra, P. A., H. Kim, M. A. Shapiro, R. B. Gravani, and S. D. Bradley. 2014. Home food safety knowledge, risk perception, and practices among Mexican-Americans. *Food Control* 37:115–125.
39. Pope, C., S. Ziebland, and N. Mays. 2000. Analysing qualitative data. *Br. Med. J.* 320:114–116.
40. Redmond, E. C., and C. J. Griffith. 2003. A comparison and evaluation of research methods used in consumer food safety studies. *Int. J. Consum. Stud.* 27:17–33.
41. Redmond, E. C., and C. J. Griffith. 2003. Consumer food handling in the home: a review of food safety studies. *J. Food Prot.* 66:130–161.
42. Redmond, E. C., and C. J. Griffith. 2009. The importance of hygiene in the domestic kitchen: implications for preparation and storage of food and infant formula. *Perspect. Public Health* 129:69–76.
43. Rose, J. S., A. Vaewsorn, F. Rosselli-Navarra, G. T. Wilson, and R. S. Weissman. 2013. Test-retest reliability of the eating disorder examination–questionnaire (EDE-Q) in a college sample. *J. Eat. Disord.* 1:42.
44. Salarkia, N., M. Abdollahi, M. Amini, and M. Eslami Amirabadi. 2011. Validation and use of the HFIAS questionnaire for measuring household food insecurity in Varamin—2009. *Iran. J. Endocrinol. Metab.* 13:374–383.
45. Salarkia, N., M. Abdollahi, M. Amini, and T. R. Neyestani. 2014. An adapted household food insecurity access scale is a valid tool as a proxy measure of food access for use in urban Iran. *Food Secur.* 6:275–282.
46. Schutz, A. L., M. A. Counte, and S. Meurer. 2007. Development of a patient safety culture measurement tool for ambulatory health care settings: analysis of content validity. *Health Care Manag. Sci.* 10:139–149.
47. Scott, E. 2003. Food safety and foodborne disease in 21st century homes. *Can. J. Infect. Dis.* 14:277–280.
48. Streiner, D. L., G. R. Norman, and J. Cairney. 2014. Health measurement scales: a practical guide to their development and use. Oxford University Press, New York.
49. Tajali-Pour, M. R., and M. Alikhani. 2012. Economic perspective of Tehran Province. Ministry of Economic and Financial Affairs, Tehran. (In Persian.)
50. Windsor, R. A., T. Baranowski, N. Clark, and G. Cutter. 1994. Evaluation of health promotion, health education, and disease prevention programs. Mayfield, Mountain View, CA.
51. World Health Organization. 2000. Food safety. Resolution of the Executive Board of the WHO. EB105.R16. World Health Organization, Geneva.
52. World Health Organization. 2015. Five keys to safer food. Available at: http://www.who.int/foodsafety/consumer/5keys/en/index.html. Accessed 18 August 2015.