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A short food literacy questionnaire (SFLQ) for adults: Findings from a Swiss validation study

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ABSTRACT

The short food literacy questionnaire (SFLQ) was developed to measure a broad range of skills including functional, interactive, and critical elements of FL. This study evaluated SFLQ measurement properties. We used a workplace intervention trial to reduce salt intake in Switzerland to explore the underlying structure of the questionnaire with 350 respondents and identify the ideal number of SFLQ items to capture the different elements of FL. Exploratory factor analysis showed a unidimensional structure of the final 12-item questionnaire. A sum score based on all 12 items (Cronbach's $\alpha = 0.82$) showed expected positive associations with health literacy and knowledge of recommended salt intake. The findings indicate the SFLQ is a feasible and reliable tool to assess FL among adults that can be helpful in public health practices focusing on FL.

1. Introduction

Food literacy (FL) has gained increasing importance in food and nutrition research during the last 25 years. FL is regarded as a key factor in population health and a promising approach to address complex public health problems from obesity to environmental sustainability (Palumbo, 2016). A widely-cited definition describes FL as "a collection of inter-related knowledge, skills and behaviors required to plan, manage, select, prepare and eat foods to meet needs and determine food intake. FL is the scaffolding that empowers individuals, households, communities, and nations to protect diet quality through change, and support dietary resilience over time." (Vidgen & Gallegos, 2014). Other approaches go further to suggest understanding FL as a comprehensive concept including a variety of skills and abilities needed for a healthy relationship with food and to participate and engage for a sustainable food system (Azevedo Perry et al., 2017; Cullen, Hatch, Martin, Higgins, & Sheppard, 2015; Palumbo, 2016; Truman, Lane, & Elliott, 2017).

FL is closely linked to the concept of health literacy, which is understood as abilities or a set of skills needed for a healthy lifestyle (Kickbusch, Wait, & Maag, 2006; Nutbeam, 2008). Nutbeam's model, with its theorized constructs of functional, interactive, and critical health literacy, encompasses reading and understanding, exchanging, and critically analyzing and using health information to gain greater control over life events and situations. The model has often been used to conceptualize FL (Begley & Vidgen, 2016; Gillis, 2016; Nutbeam, 2000, 2008). A recent literature analysis showed that FL can be understood as a specific form of health literacy (Krause, Sommerhalder, Beer-Borst, & Abel, 2016b).

Several conceptual models suggest how improved FL might influence nutrition behavior and well-being (Colatruglio & Slater, 2016; Vidgen & Gallegos, 2014). However, empirical research on this topic is limited since comprehensive tools to measure FL are rare, and thus any relationship between food literacy and diet or other health outcomes still needs to be established. Most existing instruments focus on single abilities/skills such as the ability to read and understand nutrition information (nutrition literacy), nutrition knowledge, or cooking skills (Vaitkeviciute, Ball, & Harris, 2015). A recent instrument measures a wider range of food literacy skills, but the tool was designed for application among schoolchildren (Skeaff & O'Sullivan, 2015). To the best of our knowledge, no instrument currently available measures FL skills among adults and covers the range of skills and abilities described by the concept

Abbreviations: EFA, Exploratory Factor Analysis; FL, Food Literacy; SFLQ, Short Food Literacy Questionnaire.

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(Krause et al., 2016b).

Therefore, we developed a baseline questionnaire in the frame of an environmental and educational intervention trial in the workplace that was guided by the concept of FL (Krause, Sommerhalder, & Beer-Borst, 2016a). Subsequently applying an explanatory factor analysis (EFA), we aimed to provide a practical and short, but still comprehensive questionnaire, the SFLQ, that represents the key functional, interactive, and critical elements of FL in order to build a reliable FL score for application in public health practice settings.

The objective of the present study was to evaluate the measurement properties of the SFLQ, testing its short set of items for internal consistency and construct validity.

2. Methods

2.1. Data collection

From May 2015 through April 2016 we collected data from 15 to 65 year old employees of eight organizations located in the German-speaking part of Switzerland that were part of a cluster intervention trial to lower salt intake in the Swiss working population (Swiss National Science Foundation, 2016). A 64-item questionnaire in paper or electronic format was completed by 142 intervention study participants and 266 employees not participating in the trial. Among the 64 items, 15 questions were specific to self-rated FL.

The research team checked each intervention study participant's completed questionnaire for missing data and inconsistencies, and invited participants to correct their information. The survey was realized as an anonymous online survey for intervention nonparticipants. Of these, 21 questionnaires with more than 50% missing values were excluded.

From the remaining overall sample of 387 questionnaires, we excluded 37 that had one or more missing values among the questionnaire's FL items (missing FL item, 9.6%). This resulted in a final sample size of 350.

The multicentre intervention trial was approved by Swissethics (KEK BE 130/14, PB_2016_01156) and registered in the German Clinical Trials Register (DRKS00006790). All trial participants gave informed consent. Their privacy rights as well as those of trial nonparticipants (online survey) were observed. Study data were collected and managed using REDCap (Research Electronic Data Capture), a secure, web-based application designed to support data capture for research studies, hosted at the Clinical Trials Unit, University of Bern (Harris et al., 2009).

2.2. Measurement

The study questionnaire included questions on sociocultural characteristics, health status, nutrition knowledge, and a core set of questions on health literacy and FL.

Self-rated food literacy was assessed with 15 newly developed questions that, depending upon the question, respondents answered via four- or five-point Likert scales that offered the choices very bad to very good, disagree strongly to agree strongly, very difficult to very easy, very hard to very easy, or never to always. The questionnaire development followed a stepwise process. Due to the lack of conceptual clarity in the field (Krause et al., 2016b), we first explored existing definitions related to literacy in the field of nutrition and food research and performed a comprehensive literature search for existing instruments. In this early phase of our research, we referred to the term "nutrition specific health literacy" because researchers used either the term nutrition literacy or FL to describe literacy skills in the field of food and nutrition (Krause et al., 2016a). Once we gained more conceptual clarity, we used the term FL as it appears the more inclusive term and concept (Krause et al., 2016b). Our questionnaire items are directly related to Nutbeam's model of functional, interactive, and critical health literacy (Nutbeam, 2000, 2008). Because we could not find an established measurement instrument that would fit with our FL-assessment goals, we adapted items from different existing instruments on health and nutrition literacy and in addition, developed new items. Response categories for adapted questions were carried over unchanged (Krause et al., 2016a). All items underwent a face validity test, followed by a cognitive and a standard pretest. Of the 15 self-rated items, seven focused on functional skills such as understanding nutrition information and composing a balanced menu, three focused on interactive abilities such as exchanging nutrition information with family and peers, and another five asked about abilities such as critically judging nutrition information or evaluating the longer-term impact of dietary habits on health (critical FL). For a more detailed description of the development process of the questionnaire see (Krause et al., 2016a).

Health literacy was assessed using the German version of the validated multidimensional European Health Literacy Survey (HLS-EU) (Sorensen et al., 2015). We integrated only the 16 items of the health promotion domain into the study questionnaire because of the intervention study's focus on health promotion activities in the workplace. Answers were scored on a four-point Likert scale from very easy to very difficult. The HL score (0–50) and thresholds for levels of health literacy (inadequate, problematic, sufficient, excellent) were calculated according to the recommendations of the European Health Literacy Project. The index score was computed if at least 80% of the items were answered (HLS-EU Consortium, 2012).

For *nutrition knowledge*, we included two items in the overall questionnaire. One item focused on the composition of a so-called healthy plate and was developed for the specific study purpose. Participants were asked to select one of three images that depicted different proportions of vegetable, protein, and carbohydrate/starchy food on a plate. As was done for the self-rated FL-items, this knowledge question underwent a face validity, a cognitive and a standard pre-test. The second item asked for the recommended maximum amount of daily salt consumption and was taken from an existing questionnaire (Sadeghi & Beer-Borst, 2009). Participants had to choose the correct answer out of four options ranging from 5 to 15 g of salt per day.

We chose the following variables to characterize the sample: age, gender, household structure, education, employment (mostly manual or sedentary type of work), and self-rated health.

2.3. Analysis

We performed an exploratory factor analysis (EFA) in order to gain insights into a possible multivariate structure of the self-rated FL instrument. Due to ambiguity, we scored all answers not on an ordinal scale (e.g., "don't know", "I don't make use of this kind of information") at 0 points.

To explore the number of factors that meaningfully group the items, the analysis was carried out several times using a different number of factors. To determine the number of potential underlying factors, we applied the following criteria: eigenvalues >1, scree plot, factor loadings >0.40 (Stevens, 1992), and plausibility of the factors in terms of their substantive meaning. To assess whether data were suitable for EFA, Bartlett's test of sphericity (significance level 0.05) and Kaiser-Meyer-Olkin (KMO, cut-off for adequacy set at >0.6) were used.

To assess construct validity, we built a FL sum score and examined a priori anticipated associations between the sum score

and the following characteristics: health literacy, gender, education, and nutrition knowledge.

To choose the appropriate statistical analysis to assess construct validity, we first checked for normality of the FL score using a quantile-quantile plot and a Shapiro-Wilk test. As significant deviation from normality was found, we used either Spearman's rank correlation for continuous variables, Wilcoxon rank-sum test for categorical variables with two groups, and Jonckheere Terpstra test for categorical variables with more than two ordered groups.

Based on the conceptual considerations presented in the introduction, we expected FL to be positively associated with the overarching concept of health literacy (Menghini, Pfoestl, Marinelli, & Palumbo, 2016). Furthermore, based on previous studies on health literacy and nutritional knowledge we expected FL to be higher among women, and to be associated with higher levels of education (Clouston, Manganello, & Richards, 2016; Groth, Fagt, & Brondsted, 2001; Grunert et al., 2012; HLS-EU Consortium, 2012; von Wagner, Knight, Steptoe, & Wardle, 2007; Wardle, Parmenter, & Waller, 2000).

Because nutrition knowledge may be considered as part of FL (Krause et al., 2016b), we also expected a positive association between the FL score and the nutrition knowledge questions. We further checked how the indication of the recommended salt intake in g/day and the self-rated knowledge of the official Swiss recommendations on salt intake (four-point Likert) were associated (see Table 2, item 6) by using Spearman rank correlation.

Cronbach's Alpha was used to assess internal consistency of the FL scale. The significance level was set at 0.05. As no correction for multiple testing was applied, all analyses are considered explorative. All analyses were performed using STATA 14.0 (StataCorp, 2015).

Table 1
Participant demographic information.

	n	(%)
Gender (N = 347)		
Female	215	(62.0)
Male	132	(38.0)
Age (N = 350)		
15–34 years	112	(32.0)
35–54 years	186	(53.1)
55–65 years	52	(14.9)
Education (N = 349)		
Primary or Secondary	80	(22.9)
Tertiary	269	(77.1)
Household structure (N = 350)		
Single-person household	68	(19.4)
Couple without children	110	(31.4)
Couple with children	127	(36.3)
One-parent household	20	(5.7)
Adult who lives with parent/s	7	(2.0)
Other kind of household	18	(5.1)
Employment (N = 349)		
Mostly manual work	21	(6.0)
Mostly sedentary work	328	(94.0)
Self-rated health (N = 350)		
Very bad	0	(0.0)
Bad	0	(0.0)
Intermediate	24	(6.9)
Good	206	(58.9)
Very good	120	(34.3)
Nutrition knowledge (N = 349/350)		
Correct answer healthy plate	185	(53.0)
Correct answer salt recommendation	185	(52.9)
Health literacy (N = 348)		
Inadequate	40	(11.5)
Problematic	125	(35.9)
Sufficient	143	(41.1)
Excellent	40	(11.5)

3. Results

3.1. Sample characteristics

Women comprised 62% of the respondents. Median age of all respondents was 43 years (range 16–65), and 77% had finished tertiary education. About half of the sample correctly identified the healthy plate and the correct salt intake recommendation (nutrition knowledge) and was rated as sufficiently health literate. Further details are given in Table 1.

3.2. Factor structure

After confirming the adequacy of the sampling based on the KMO and Bartlett's test of sphericity (KMO = 0.83 and X2 = 1429.87, p= <0.0001), one factor emerged with an eigenvalue >1 (eigenvalue 3.96), which accounted for 76.4% of the variance observed.

The eigenvalue of a second emerging factor was just below 1 (0.99). Therefore, we also tested a two-factor solution. The loadings on the second factor were generally low and only one item loaded on this factor. We concluded that the two-factor solution had a poor scale balance and lacked interpretational plausibility, and we retained the one-factor solution.

Three items had very low loadings on the factor and high uniqueness (>0.79). We therefore limited the number of items to 12 with a minimum factor loading of 0.40. The final 12 items (mean, standard deviation (SD) and factor loadings) are shown in Table 2.

4. Internal consistency

The Cronbach's alpha coefficient for the entire scale with 12 items was 0.82. Because none of the single-item values was greater than the Cronbach's alpha of the whole scale, we did not delete any item.

4.1. Sum score (12 items)

The EFA indicated that 12 of the initial 15 items were useful to build a FL scale. Spearman's rank correlation coefficients showed that the 12 items were consistently and positively associated with each other (rs ranged from 0.18 to 0.55). We created a sum score of the 12 items (maximum score 52) to provide a simple survey measure. The mean was 37.2 (SD 6.3), ranging from 11.4 to 51.

4.2. Construct validity

We investigated the construct validity of our 12-item FL scale by examining its association with gender, health literacy, education, and nutrition knowledge (see Fig. 1).

We observed the anticipated, a priori positive associations between gender (females had a significantly higher FL score) and general health literacy (see Fig. 1). Spearman's rank correlation coefficient for FL score and health literacy score was rs = 0.46.

A Jonckheere-Terpstra test showed that the FL score was associated with ascending ordered alternatives of the health literacy score (inadequate, problematic, sufficient, and excellent; $J^* = 8.31$ [corrected for ties], $p < 0.001$).

A Wilcoxon rank sum test showed no significant difference in FL scores between educational levels. Applying the same test to nutrition knowledge questions, we could not find a significant difference in FL scores between respondents who correctly answered the question on the composition of a healthy plate and those who did not ($Z = -1.68$, $p = 0.09$). However, the FL score was higher among respondents who knew the recommended amount

Table 2
Retained items, descriptive results and results from EFA (n = 350).

	Item	Min-Max	Mean	(SD)	Factor Loading
1	When I have questions on healthy nutrition, I know where I can find information on this issue.	Disagree strongly = 1 to Agree strongly = 4; I do not have experience with these issues = 0	3.71	(1.07)	0.60
2	In general, how well do you understand the following types of nutritional information? (A) Nutrition information leaflets (B) Food label information (C) TV or radio program on nutrition (D) Oral recommendations regarding nutrition from professionals. (E) Nutrition advice from family members or friends	Very bad = 1 to Very good = 5; I do not make use of this kind of information = 0	3.31[a]	(0.81)	0.49
3	How familiar are you with the Swiss Food Pyramid?	Very bad = 1 to Very good = 5	2.89	(0.82)	0.58
4	I know the official Swiss recommendations about fruit and vegetable consumption.	Disagree strongly = 1 to Agree strongly = 4	2.35	(0.97)	0.57
5	I know the official Swiss recommendations about salt intake.	Disagree strongly = 1 to Agree strongly = 4	3.67	(1.05)	0.44
6	Think about a usual day: how easy or difficult is it for you to compose a balanced meal at home?	Very hard = 1 to very easy = 4; not applicable = 0	2.68	(0.80)	0.49
7	In the past, how often were you able to help your family members or a friend if they had questions concerning nutritional issues?	1 = Never to always = 5; there have never been any questions = 0	2.71	(1.17)	0.45
8	There is a lot of information available on healthy nutrition today. How well do you manage to choose the information relevant to you?	Very bad = 1 to Very good = 5; I have not been interested in these issues = 0	2.71	(0.74)	0.56
9	How easy is it for you to judge if media information on nutritional issues can be trusted?	very difficult = 1 to very easy = 4	2.99	(0.98)	0.55
10	Commercials often relate foods with health. How easy is it for you to judge if the presented associations are appropriate or not?	Very hard = 1 to very easy = 4	2.98	(0.59)	0.67
11	How easy is it for you to evaluate if a specific food is relevant for a healthy diet?	Very hard = 1 to very easy = 4	3.01	(0.67)	0.64
12	How easy is it for you to evaluate the longer-term impact of your dietary habits on your health?	Very hard = 1 to very easy = 4	3.78	(1.01)	0.60

[a] This mean averages the scores of answers to A-E; SD = standard deviation.

of daily salt consumption than those who did not (Z = 3.93, p < 0.001; see Fig. 1). Moreover, spearman rank correlation (rs = 0.37) showed a medium correlation between the FL question on about knowing the official recommendation for maximum amount of salt intake and the knowledge questions on the recommended salt consumption in grams per day.

5. Summary and discussion

The short food literacy questionnaire, the SFLQ, assesses FL in food and nutrition intervention studies to capture a range of aspects of functional, interactive, and critical FL skills (Krause et al., 2016a,b). This study identified a small number of items sufficient to represent the key elements of FL in one short, reasonably practical questionnaire that would yield a reliable FL score.

The EFA identified a unidimensional structure and showed that the SFLQ captures the concept of FL. The EFA also showed that the original 15 self-rated items could be shortened by three items without substantially reducing its reliability. The 12 items remaining in the final SFLQ cover aspects of functional, interactive, and critical literacy and showed good internal consistency, which allowed us to build an overall FL sum score and test construct validity of the new instrument.

The overall construct validity was adequate because the associations between FL scores and health literacy, knowledge on salt, and gender were in the expected directions. However, we did not see the expected difference in FL scores by educational level. This might be explained by the skewed distribution of educational level in our sample (Table 1), which had a high proportion, 77%, of participants with tertiary education. We also expected a stronger association between the FL score and the knowledge scores on the healthy plate model because nutrition knowledge is considered an important part of FL (Krause et al., 2016b). We used the healthy plate model in the intervention study as the more practice-oriented educational tool for daily food intake compared to the food pyramid, which might be better known from public campaigns. This may partly explain the lower than expected association.

These results must be interpreted in light of several limitations. Though our study sample was drawn from eight organizations of different sizes and fields (social services, production & service, university/research, administration, public service) in the German-speaking part of Switzerland, our results may not be generalizable to other settings or national contexts. Our respondents were fairly homogenous in both age (most were between 35 and 54 years old) and terminal educational level (most had tertiary education). Moreover, we may assume that many were interested in food and nutrition topics. For broader population studies, we thus consider it important to examine validity in a more varied adult population that also includes those over 65 years.

Finally, self-rating of FL may to a certain extent risk assessing nutritional behavior related traits (Ishikawa & Yano, 2008). When answering questions that require self-rating of abilities or skills, respondents will consider individual attributes that occur in different situations and contexts (Braun, Woodley, Richardson, & Leidner, 2012). Respondents may thus have over- or underestimated their FL, which may affect the instrument validity (Braun et al., 2012). We recommend complementing the respondents' self-rating of FL with true/false nutrition knowledge questions, as we did, and combining the FL questionnaire with a measure of food choice or nutrition behavior (Krause et al., 2016b).

The SFLQ focuses on individual skills and abilities needed for healthy food choices. The instrument thus does not capture all aspects potentially relevant for the complex concept of FL. As Vidgen and Gallegos point out, the measurement of FL is a challenging task because FL is never independent of the societal or environmental context in which these skills will be applied (Vidgen & Gallegos, 2014). This might be particularly true for measuring elements of FL that demand complex skills such as understanding and advocating health promoting conditions of food production or consumption, and understanding the consequences of personal food choices on the environment and society. Such critical food literacy skills are particularly difficult to measure (Frisch, Camerini, Diviani, & Schulz, 2012) and we believe that further efforts are needed to assess cultural, political, and societal aspects of FL in a meaningful way. The SFQL is a short, practical tool that yields an overall FL score. Studies interested in different aspects of FL may

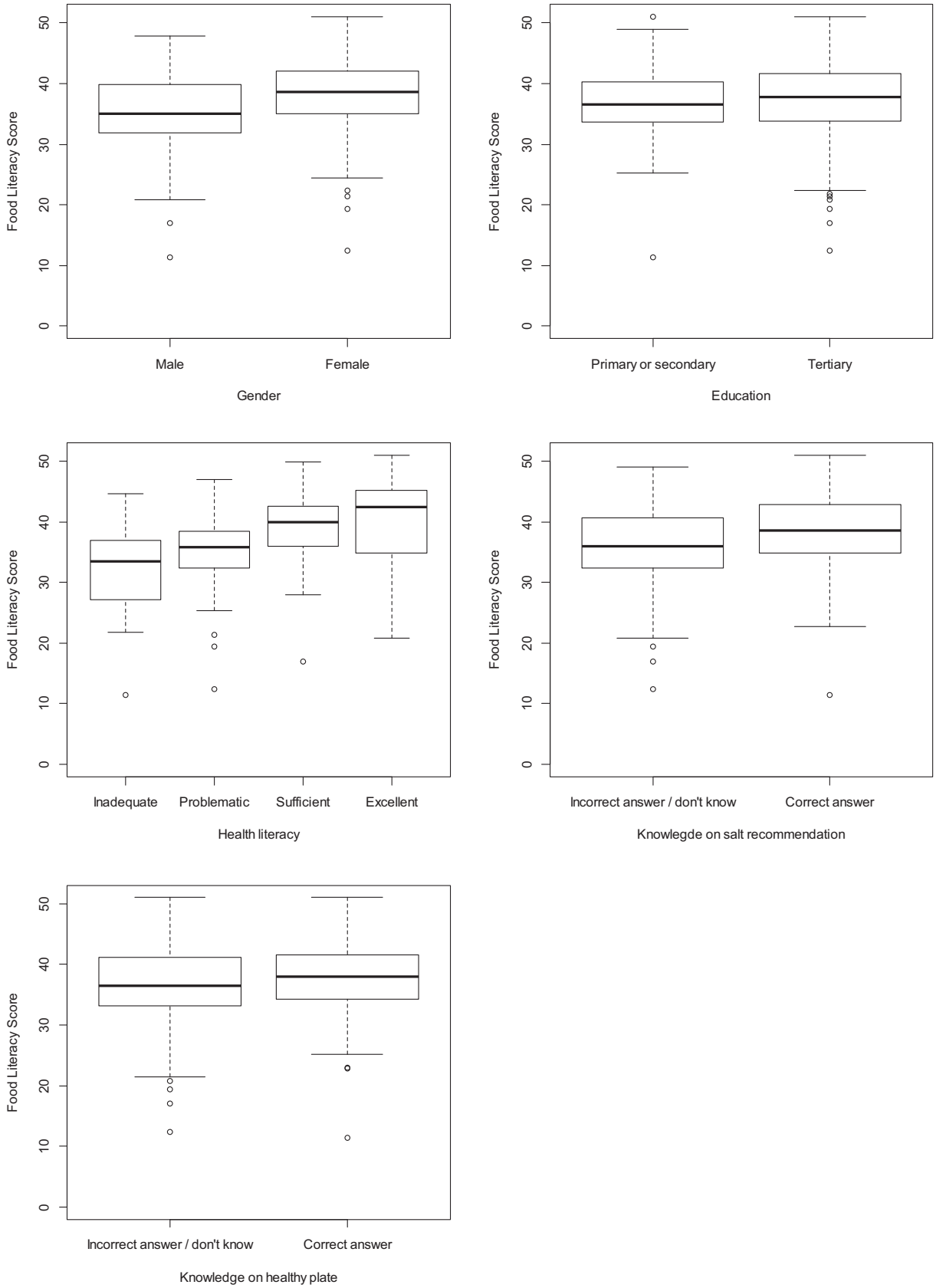

Fig. 1. Associations of the food literacy score with gender, education, health literacy, and nutrition knowledge.
Anticipated associations between food literacy and gender, health literacy, and knowledge of salt recommendation were significant at significance level 0.05. P-values were calculated using the Wilcoxon-rank test for gender, education, and nutrition knowledge, and Jonckheere-Terpstra test for health literacy.

need to develop tools that better distinguish and measure functional, interactive, and critical FL.

6. Conclusion

To the best of our knowledge, the SFLQ is the first validated questionnaire that empirically assesses FL among an adult population. The instrument may be used for planning and evaluation of public health interventions focusing on FL in organizational settings, and it may help improve our understanding of the distribution of FL skills.

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