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Development and evaluation of a food literacy questionnaire for schoolchildren in France

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ABSTRACT

Food literacy is gaining importance in nutrition education programs for children. To date, food literacy assessment tools have been developed in many countries, however, none exist in France. The objectives of this study were to develop a questionnaire and to evaluate its measurement properties among French schoolchildren aged 8–11 years. The questionnaire was developed in three phases: i) item selection (literature review and adaptation or creation of items) and content validity (submission to an expert panel), ii) questionnaire development including a pre-test in a small sample of children (n = 41) and item reduction and dimensionality based on the responses of children who completed the questionnaire in 31 schools between December 2022 and March 2023, and iii) questionnaire evaluation in terms of reliability, validity and acceptability. In total, 1187 responses were included in the analysis. The mean age of the children was 9.6 ± 0.7 years (girls: 51.2%, boys: 48.8%). The development process resulted in a 25-item questionnaire with good acceptability and satisfactory estimated reliability (McDonald omega coefficient = 0.73). Factor evaluation revealed a three-dimensional structure encompassing food and nutrition knowledge, participation in food preparation activities and food habits. To our knowledge, this study was the first to assess food literacy for schoolchildren in France. Our questionnaire can contribute to assess the factors that make food literacy vary, especially regarding socioeconomic variables to target priority populations for nutrition education actions and to describe changes in food literacy scores from a longitudinal perspective.

1. Introduction

Excess weight, obesity as well as unhealthy eating habits increase the risk of non-communicable diseases (Non communicable diseases). Childhood is a key period for preventing excess weight gain. Indeed, being overweight in childhood is a determining factor for being overweight at adolescence. In addition, this time provides a window of opportunity for learning healthy food habits for adulthood (De Peretti & Castetbon, 2004).

Numerous interventions targeting nutrition, physical activity or a combination of both, have been developed for children in elementary schools (Kelly & Nash, 2021). In 2019, a systematic review conducted by the Cochrane Public Health Group (Brown et al., 2019), covering 153 randomized controlled trials, showed that strategies to modify diet and physical activity levels were more likely to have an effect on Body Mass Index (BMI) in children under 12 years old than in adolescents. The elementary school is thus a privileged setting for the early prevention of overweight and obesity, in line with the *health promoting schools'* approach (Health promoting schools n), which aims to make schools a place to develop a culture of health in both children and staff.

Food literacy is part of health literacy (Sørensen et al., 2012). As defined by Cullen et al. (2015), the concept of food literacy is the ability

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to understand and develop a positive relationship with food and engage in complex food systems (Cullen et al., 2015). By improving people's knowledge of food and nutrition, developing their cooking skills and their search skills to find reliable information, nutrition education programs can help develop the motivation to eat healthily, while respecting the environment (Azevedo Perry et al., 2017). Long-term benefits on weight status are likely in view of the associations observed between food literacy and obesity in Korean adults (Yoo et al., 2023) or between health literacy and obesity in American adolescents (Chari et al., 2014).

Assessing food literacy can help identify priority areas for nutritional education and examine the effects of prevention programs. Several food literacy assessment questionnaires have been developed globally and are mostly culture-specific. A recent literature review by Carroll et al. (2022) identified twelve questionnaires that assess one or several components of food literacy in children and adolescents (Carroll et al., 2022). Among them, four provided a multidimensional measure in school-age children and were developed in the USA (Amin et al., 2019), Denmark (Stjernqvist et al., 2021), Iran (Doustmohammadian et al., 2017), and China (Liu et al., 2021). Park et al. (2020) also published findings of a questionnaire for Korean schoolchildren (Park et al., 2020). Food literacy assessment tools vary in their underlying frameworks. Some questionnaires refer to the Nutbeam et al. health literacy model (Nutbeam, 2021) which comprises of three levels: functional, interactive, and critical health literacy. Another is based on the Jette Benn model in 2014 (Stjernqvist et al., 2021) which distinguishes five food-related competencies: knowing, doing, sensing, caring and wanting. In 2017, Azevedo-Perry et al. proposed to group the different attributes of food literacy into five dimensions: food and nutrition knowledge, food skills, self-efficacy and confidence, food decisions and ecology (Azevedo Perry et al., 2017).

To our knowledge, there is no validated questionnaire to assess food literacy in French schoolchildren, which is an obstacle to carrying out studies to identify weak domains, develop nutrition education programs and evaluate them in an evidence-based public health approach (Halley des Fontaines & Alla, 2007). It is therefore necessary to develop a tool for measuring food literacy in children, which would take into account the characteristics of the food environment in France. Indeed, the determinants of diet and dietary behaviours encompass a number of sociodemographic, socioeconomic and sociocultural factors, such as the share of income spend on food, food preferences, eating occasions or portion size, that may vary between countries (Marijn Stok et al., 2018). As a result, significant differences may be observed in dietary behaviours and obesity prevalence between countries. For example, Americans have been shown to consume fruits and vegetables less often than French people (Tamers et al., 2009), and the prevalence of obesity is twice as high as in France (Matta et al., 2018). Another key element to consider in the French context is the use of a 5-colour label on food packaging to inform consumers about the nutritional value of products, the "Nutri-score", which is also used in six European countries (Julia & Hercberg, 2017). In this context, the primary objectives of this study were to develop a food literacy questionnaire and to evaluate its measurement properties among French schoolchildren aged 8–11 years.

2. Methods

2.1. Study design

This study was conducted at the University of Versailles Saint-Quentin-en-Yvelines (UVSQ) in collaboration with the JDB Foundation for primary cancer prevention in the Essonne Department in the Île-de-France region of France, between 2022 and 2023. The food literacy questionnaire was developed in three phases (item development, questionnaire development and questionnaire evaluation) according to the guidelines for developing and validating scales for health, social, and behavioral research by Boateng et al. (2018) (Boateng et al., 2018). The steps in each phase are described in Table 1.

Table 1
Phases and steps in the development of the food literacy questionnaire in France.

Steps involved	Methodology description	Questionnaire
Phase 1: Item development		
Step 1: Item selection	- Literature review with definition of food literacy and existing tools for food literacy assessment. - Item production (adaptation or creation)	Version 1 with 34 items
Step 2: Content validity	- Review of items by an expert panel - Modifications (rewording, 1 deletion and 2 new items)	Version 2 with 35 items
Phase 2: Questionnaire development		
Step 3: Pre-test	- Questionnaire administered to 41 children in 2 classes - Feasibility, comprehension and difficulty - 5 items modified (1 deleted since it was too easy)	Version 3 with 34 items
Step 4: Questionnaire administration	- Questionnaire administered to 1205 children in 63 classes in 31 schools - 18 questionnaires excluded (15 with at least one page skipped, 3 because of help from an adult) - 1187 responses analyzed	
Step 5: Item reduction	- Test for floor and ceiling effects with thresholds set at <10 and >90% - No change to the questionnaire	
Step 6: Dimensional analysis	- Factor analysis after imputation of missing data - 3-dimensional questionnaire - 9 items deleted due to factor loadings<0.3	Version 4 with 25 items
Phase 3: Questionnaire evaluation		
Step 7: Reliability	- MacDonald Omega coefficient = 0.73	
Step 8: Validity	- Hypothesis testing based on information at individual/class/school level - Eight hypotheses verified on total score	
Step 9: Acceptability	- Analyses of the answers to the open question "How did you find this questionnaire?" - Word cloud based on 880 answers	

In the first phase, two steps were performed which involved item selection and content validity. In the second phase, the questionnaire was assessed in four steps (pre-test, administration, item reduction and dimensional analysis). In the third phase, the evaluation of the questionnaire was performed based on reliability, validity and acceptability. The COSMIN study design checklist was used in this study (Mokkink et al., 2010).

2.2. Item selection

We outlined the conceptual framework of food literacy best adapted to our study population and adopted the Azevedo Perry et al. (2017) framework which distinguishes five dimensions: food and nutrition knowledge, food skills, self-efficacy and confidence, food decisions and ecology. We looked for questions related to each of the five dimensions of food literacy contained in five questionnaires from the literature review (Carroll et al., 2022).

Items were contextualized to better correspond with French culture and covered specific topics such as the origin of different foods, knowledge of the actors in the food chain, nutrients provided by different foods, and the use of Nutri-score to guide food choices. The aim of the first phase was to target at least five questions per dimension of food literacy, so as to have at least three items per dimension if some of them were to be removed in subsequent stages (MacCallum et al., 1999). The format of the questions was to include single choice, multiple choice, connect-the-dot items, rankings, and 4-to-5-point Likert scale. The use of color-printed images was encouraged to enhance

user-friendliness. Three investigators from the fields of public health and health promotion participated in this step and the first version of the questionnaire was created with 34 items.

2.3. Content validity

The first version of the questionnaire was submitted to an expert panel involving: i) a prevention and health promotion professional relating to children, ii) a nutritionist, iii) a pediatrician, iv) three representatives of the national education system including a nurse, v) a specialist of health studies in children and adolescents, and vi) two public health academics including an expert in psychometric properties of health questionnaires. The panel members were provided with an explanation of the questionnaire objectives and were invited to provide feedback on various aspects including the appropriateness of the wording used for children aged 8–11 years, level of difficulty, and the relevance to the five dimensions of food literacy.

The exchanges with the expert panel led to the clarification of the instructions and some rewording and simplification of food consumption frequency levels. An item deemed questionable was removed and two new items were added based on suggestions from the investigators. The first concerned the recognition of high fat and sugary foods, and the second related to the recognition of the Nutri-score among a panel of other food labels. An open-ended question was added at the end of the questionnaire to allow children to share their feedback on the questionnaire itself. These changes resulted in a second version with 35 items.

2.4. Pre-test

In September 2022, the revised questionnaire was given to 41 children in two 4th and 5th grade classes in an elementary school located in a priority education area in the Essonne Department. Among them, 18 were 4th graders and 23 5th graders, and 55% were girls. Children were asked to complete the questionnaire and circle the terms they did not understand. They were reassured that this was not a graded evaluation and that incorrect answers were as needed as the correct ones. The pretest enabled to assess the feasibility of the questionnaire in a real-life situation. The mean time for completion was 26 min and acceptability was considered good according to the children, teachers and investigators feedback. It also enabled us to modify items that posed comprehension problems as well as to delete a question (about the animal behind three different types of food) that consistently received a high number of correct answers (95%).

2.5. Questionnaire administration

Between December 2022 and March 2023, the 34-item questionnaire was distributed to children at 31 schools with the support of Essonne Education Department for school recruitment. Three schools were localized in *Cités Educatives* which are defined as areas where teachers, parents, public services, associations, among others, work together to consolidate the educational community around children. Eleven schools were situated in *Réseaux d'Education Prioritaire* which employ educational initiatives aimed at addressing socioeconomic and academic disparities in specific regions or schools, the involvement of additional resources and support, and employing tailored educational strategies to improve outcomes for students in underprivileged areas. An investigator visited each school to support the completion of the questionnaires. Teachers were asked not to help children with their answers.

2.6. Item reduction and dimensional analysis

In the item reduction step, we looked for floor and ceiling effects that were defined with thresholds set at $<10\%$ and $>90\%$. The dimensionality of the questionnaire was assessed using exploratory factor analysis (EFA) under the principal component factor method. Before applying EFA to our data, we first performed multiple imputations to fill in missing data in variables related to the food literacy assessment. We randomly selected one of five imputed datasets for the rest of the analysis. The number of factors was determined via a parallel analysis (Timmerman & Lorenzo-Seva, 2011), and we used an oblique promax rotation after EFA. The meaning of each factor was determined according to the items related to it, with factor loadings of at least 0.3 in analysis on imputed data and/or complete cases. Items that did not contribute to at least one dimension were deleted. We calculated the scores per dimension, with each item scoring 1 point as well as a total score based on the sum of the three scores per dimension.

All the items other than those formatted in Likert scales, scored 1 point if the answer was true or 0 if false. For Likert scales, we excluded the use of binary responses in order to make the items more sensitive to change in the event that they would subsequently be used as a tool for evaluating interventions in schools. We considered scores of 0/0.33/0.66/1 and 0/0.25/0.5/0.75/1 for the 4-point and 5-point items respectively.

2.7. Reliability, hypothis testing and acceptability

The McDonald omega coefficient was determined for the entire questionnaire since it was considered a more sensitive indicator of the internal consistency of a psychometric scale than Cronbach alpha (Dunn et al., 2014), and was compared to the 0.7 reliability threshold (Béland et al., 2018).

Hypothesis testing is about whether the observed differences between categories are similar to those expected based on the construct being measured. Thus, we specified and tested on expected variations of food literacy scores according to contextual variables. We hypothesized that the scores were higher: i) among fifth grade children than fourth graders, ii) among girls, iii) among the physically active, and iv) based on whether or not nutrition was previously addressed in the classroom. Conversely, the scores were expected to be lower in: i) more sedentary children (based on daily screen-time), ii) in larger families (>3 children), and iii) in priority education areas. We also hypothesized that the scores were not expected to vary in classes where the teachers read the questionnaire along with the students. Student characteristics were collected at the end of the questionnaire and class- or school-level variables were collected by the investigator. As an additional step in the validation phase, we asked children for their opinion about the questionnaire via an open-ended question: "How did you find this questionnaire?". Answers were visually analyzed using a word cloud designed with R V4.3.0 software.

2.8. Statistical analysis

The characteristics of the study sample and answers to the different items of the questionnaire were described in numbers and percentages (%). Age and food literacy scores were described by mean ±Standard Deviation (SD). The different hypotheses were tested using the Student t-test for binary variables and analysis of variance (ANOVA) for categorical variables with more than two categories. The significance level was set at 5%. Statistics were performed with Stata® V17 software (StataCorpLLC, College Station, Texas, USA).

2.9. Ethical considerations

This study was approved by the Ethics Committee of INSERM as part of the evaluation of the Croq'Santé program (Reference 22–951). Informed parental consent was obtained prior to the visit for the administration of the questionnaire.

3. Results

In total, 1205 children in 63 fourth and fifth grade classes in 31 schools in the Essonne Department of France participated in the food literacy questionnaire. Eighteen responses were excluded because 15 had at least one entire page skipped and three were provided with the help from an adult. Therefore, 1187 responses were included in this study. The mean age of the children was 9.6 ± 0.7 years, with 51.2% being girls and 48.8% boys.

The mean time to complete the questionnaire was 24.2 ± 9 min and the proportion of missing data varied from 0.3% to 14.2% depending on the item. The question receiving the highest rate of correct answers concerned the children's knowledge of cooking utensils (86.7%). The question with the lowest rate of correct responses concerned the nutrients provided by meat/eggs/fish, carbohydrates and fats (25.0%). There was no removal of items due to the floor or ceiling effect. However, the number of items was reduced at the factor analysis stage.

The parallel analysis indicated three main factors (Fig. 1). Fourteen questionnaire items had factor loadings of at least 0.3 for the first dimension (Factor 1). Items were mostly about food and nutrition knowledge, however, also included two items about nutrition literacy (those involving the Nutri-score) and two items about frequency of eating fruits and vegetables. The second dimension (Factor 2) counted seven items that concentrated on participation in cooking activities as well as interest in food and cooking. The third dimension (Factor 3) was composed of four questions regarding food habits. Questions not associated with at least one dimension at the 0.3 threshold analysis on imputed data or complete cases were deleted. The EFA factor loadings on the 25 questionnaire items, with factor loadings for both imputed dataset (n = 1187) and complete cases (n = 693), are presented in Table 2.

The correlation between the first and second dimension was 0.36. The third dimension correlated poorly with the first two dimensions (0.18 and 0.14, respectively). The maximum possible score being 14, 7 and 4 for the three dimensions respectively, the mean scores per dimension were 9.5 ± 2.4, 4.9 ± 1.1, and 2.7 ± 0.9 respectively, and the total score was 17.3 ± 3.3.

The McDonald Omega coefficient for the entire questionnaire was estimated at 0.73, which was satisfactory in regard to the reliability threshold commonly set at 0.7. The McDonald Omega coefficient was 0.65 for dimension 1, 0.60 for dimension 2 and 0.64 for dimension 3.

As hypothesized, we observed a higher score of food literacy in children in the fifth grade, mostly due to a higher level of food and nutrition knowledge compared to the fourth graders (Table 3). The total food literacy score was also higher in girls compared to boys, mostly due to a higher participation of girls in cooking activities. Children who spent more time on physical activities and less on screens had higher levels of food literacy. We also found that children in larger families and those schooled in priority education areas had lower levels of food literacy. Few children had already learned about nutrition in class at the time of the survey, but those who did had higher levels of food and nutrition knowledge and better food habits. Finally, collective reading of the questionnaire did not influence food literacy scores, except for a

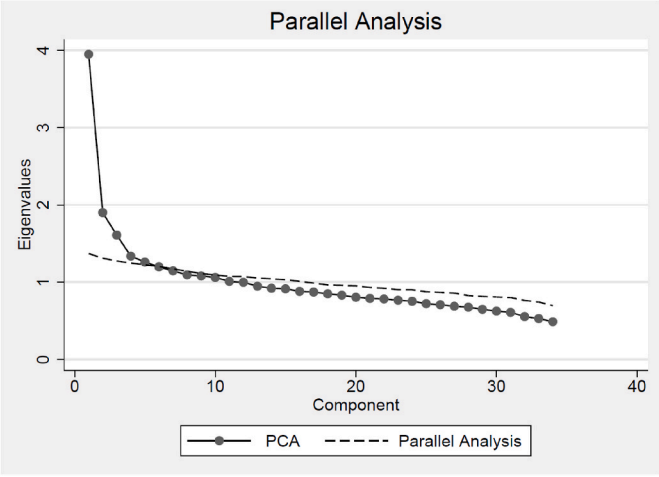

Fig. 1. Parallel analysis.

Table 2
Exploratory factor analysis (EFA) for imputed dataset and complete cases.

Questionnaire items	Factor loadings					
	Imputed dataset, n = 1187			Complete cases, n = 693		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Function of four different utensils	0.5350			0.4554		
Using a knife to cut food into small pieces		0.4214			0.4944	
Using a measuring cup		0.4157			0.4710	
Knowing which food needs to be cooked	0.3620			0.3428		
Replacing an ingredient in a recipe		0.7598			0.7302	
Describing a food's smell, taste or consistence		0.5102			0.5344	
Participation to meal preparation		0.6821			0.6351	
Best season for eating tomatoes	0.2346			0.2998		
Knowing which part of the plant a potato is	0.4298			0.4317		
Linking the food with the ingredient it comes from	0.4742			0.4908		
Food chain actors	0.5226			0.4343		
Foods that are too fat, salty or sweet	0.4095			0.3293		
Choosing the best-balanced snack	0.3773			0.3269		
Healthiest drink	0.2943			0.3387		
Food groups	0.5697			0.5457		
Nutri-score	0.3765			0.3848		
Choosing the healthiest pack of cereal	0.5021			0.5221		
Enjoying cooking		0.4947			0.4948	
Enjoying tasting new food		0.3251			0.3999	
Trying to eat healthy			0.4324			0.4428
Frequency of eating/ drinking						
Fruits	0.3546					0.2499
Vegetables	0.4234			0.4296		
Sugary food			0.6976			0.6949
Soda			0.7708			0.7570
Chips			0.7175			0.6769

Table 3
Baseline characteristics and food literacy scores based on imputed dataset, n = 1187.

Characteristics	n (%)	Total food literacy score[a] Mean ± SD	Dimension 1 score[b] "Food and nutrition knowledge" Mean ± SD	Dimension 2 score[c] "Participation in cooking activities" Mean ± SD	Dimension 3 score[d] "Food habits" Mean ± SD
Mean age±SD (years), n = 1160	9.6 ± 0.7	–	–	–	–
School grade, n = 1175					
fourth grade (CM1)	591 (50.3)	16.9 ± 3.4[g]	9.3 ± 2.4[g]	4.9 ± 1.2[e]	2.7 ± 0.9
fifth grade (CM2)	584 (49.7)	17.6 ± 3.2[g]	10.0 ± 2.3[g]	5.0 ± 1.1[e]	2.6 ± 0.9
Sex, n = 1175					
Boy	568 (48.3)	16.9 ± 3.5[g]	9.5 ± 2.5[e]	4.8 ± 1.2[g]	2.6 ± 0.9
Girl	607 (51.7)	17.6 ± 3.1[g]	9.8 ± 2.3[e]	5.1 ± 1.1[g]	2.7 ± 0.9
Family size, n = 1177					
1 child	88 (7.5)	17.6 ± 3.2[g]	9.8 ± 2.6[g]	5.1 ± 1.0	2.7 ± 0.9[g]
2 or 3 children	665 (56.5)	17.6 ± 3.2[g]	10.0 ± 2.4[g]	4.9 ± 1.1	2.7 ± 0.8[g]
>3 children	424 (36.0)	16.6 ± 3.4[g]	9.1 ± 2.5[g]	4.9 ± 1.2	2.5 ± 0.9[g]
Physical activity in a club, n = 1160					
Less than once a week	251 (21.6)	15.9 ± 3.3[g]	8.9 ± 2.4[g]	4.5 ± 1.3[g]	2.5 ± 0.8[g]
1-2 times a week	450 (38.8)	17.8 ± 2.9[g]	10.1 ± 2.3[g]	5.0 ± 1.0[g]	2.7 ± 0.8[g]
3 times a week or more	459 (39.6)	17.5 ± 3.3[g]	9.7 ± 2.4[g]	5.1 ± 1.1[g]	2.7 ± 0.9[g]
Physical activity outside of a club, n = 1176					
Less than once a week	237 (20.2)	16.1 ± 3.4[g]	9.1 ± 2.5[g]	4.4 ± 1.2[g]	2.6 ± 0.9
1-2 times a week	343 (29.2)	17.2 ± 3.0[g]	9.7 ± 2.3[g]	4.9 ± 1.1[g]	2.7 ± 0.8
3 times a week or more	596 (50.7)	17.7 ± 3.0[g]	9.9 ± 2.4[g]	5.2 ± 1.1[g]	2.7 ± 0.9
Daily screen time during school days, n = 1081					
Less than 2 h	743 (68.7)	17.7 ± 3.2[g]	9.9 ± 2.3[g]	5.0 ± 1.1[e]	2.8 ± 0.8[g]
Between 2 and 4 h	228 (21.1)	16.7 ± 3.2[g]	9.5 ± 2.4[g]	4.8 ± 1.2[e]	2.3 ± 0.8[g]
More than 4 h	110 (10.2)	15.4 ± 3.4[g]	8.4 ± 2.5[g]	4.9 ± 1.3[e]	2.1 ± 1.0[g]
Daily screen time on school-free days, n = 1092					
Less than 2 h	349 (32.0)	17.9 ± 3.4[g]	9.9 ± 2.5[g]	5.0 ± 1.2	3.0 ± 0.8[g]
Between 2 and 4 h	408 (37.4)	17.6 ± 3.2[g]	10.0 ± 2.4[g]	5.0 ± 1.1	2.7 ± 0.8[g]
More than 4 h	335 (30.7)	16.3 ± 3.0[g]	9.2 ± 2.2[g]	4.8 ± 1.2	2.2 ± 0.9[g]
Priority education area, n = 1187					
No	533 (44.9)	18.4 ± 3.0[g]	10.5 ± 2.2[g]	5.0 ± 1.1[e]	2.9 ± 0.8[g]
Yes	654 (55.1)	16.3 ± 3.2[g]	8.9 ± 2.4[g]	4.9 ± 1.2[e]	2.5 ± 0.9[g]
Nutrition already addressed in the classroom, n = 1160					
No	1100 (94.8)	17.2 ± 3.3[f]	9.6 ± 2.4[f]	4.9 ± 1.1	2.6 ± 0.9[f]
Yes	60 (5.2)	18.5 ± 3.3[f]	10.5 ± 2.2[f]	5.1 ± 1.1	3.0 ± 0.8[f]
Collective reading of the questionnaire, n = 1160					
No	985 (84.9)	17.3 ± 3.3	9.7 ± 2.4	5.0 ± 1.1	2.7 ± 0.9[e]
Yes	175 (15.1)	17.0 ± 3.4	9.5 ± 2.5	5.0 ± 1.2	2.5 ± 0.9[e]

[a] Total score based on 25 points.
[b] Score for dimension 1 based on 14 points.
[c] Score for dimension 2 is on seven points.
[d] Score for dimension 3 based on four points.
[e] $p<0.05$.
[f] $p<0.01$.
[g] $p<0.001$.

minor difference in self-reported food habits.

Regarding the acceptability of the questionnaire, the 880 answers to the open-ended question "How did you find this questionnaire?" indicated that most children enjoyed completing the form. The words "well", "very well", "liked", "funny" or "interesting" appeared in large and colored characters in the word cloud (Supplementary Figure 1). Regarding the difficulty of the questionnaire, the word "easy" was highlighted in the word cloud whereas the words "difficult" or "complicated" were in small size.

The English version of the 25-item food literacy questionnaire is presented in Supplementary Table 1. The original questionnaire in French can be available upon request. The number of correct answers as well as the scoring rules are presented in Supplementary Table 2.

4. Discussion

In 2020, the prevalence of overweight adults in France was 47.3%, and obesity 17% (Fontbonne et al., 2023). The prevalence of French children and adolescents with overweight or obesity in 2015 was estimated at 17% and 4%, respectively (Verdot et al., 2017). A national nutrition and health plan named *Programme National Nutrition et Santé 2019–2023* was initiated to reduce the prevalence of overweight children and adolescents by 20% (Ministère de la Santé et de la Prevention, 2019). In this context, we aimed to develop a questionnaire to assess the level of food literacy among French schoolchildren based on existing literature and the help of a multidisciplinary panel of experts. We formed a questionnaire that underwent a series of development and validation stages including factor analyses. Our final questionnaire included 25 items, had a 3-dimensional structure (food and nutrition knowledge, participation in cooking activities, and food habits) and was perceived as well accepted by the children. This tool may help identify food literacy domains that need to be developed to improve overall food literacy and, in turn, contribute to the prevention of overweight and obesity over the life course. It may also be used as an evaluation tool to measure the impact of nutrition education programs, such as school gardens or cooking classes (Kelly & Nash, 2021; Vaughan et al., 2024).

To our knowledge, this study was the first to assess food literacy for children aged 8–11 years old in France. Food literacy can be a determinative factor in developing healthy food habits, especially in a context of complex food environments and of continuous exposure to food

advertising (Carroll et al., 2022). According to the International Agency for Research on Cancer (IARC), early development of food literacy can contribute to the prevention of excess weight and obesity in adolescence as well as long-term health issues such as cancer (International Agency for Research on Cancer, 2018). Moreover, food literacy in children not only enhances their understanding of healthy eating but also promotes a sense of empowerment in which food literate children can more likely influence healthier habits within their families and communities, ultimately contributing to improved overall health and well-being.

Several questionnaires were developed to assess food literacy among schoolchildren. However, since eating habits vary between countries, it may not be relevant to adapt assessment questionnaires from one country to another. Our approach consisted of developing a new questionnaire by building upon existing, validated questionnaires from other countries, while including original questions to assess specific skills in French schoolchildren. Our questionnaire was inspired by the US TFLAC (Amin et al., 2019) and the Danish FLQ-sc (Stjernqvist et al., 2021), and to a lesser extent by the Iranian FNLIT (Doustmohammadian et al., 2017), the Chinese FNLQ-SC (Liu et al., 2021) and the Korean food literacy questionnaire (Park et al., 2020).

From a health promotion perspective, we intended to develop a positive approach to food and nutrition while avoiding questions about the risks of an unbalanced diet. We built on the concepts of self-efficacy and confidence which encompass the ability to find accurate nutritional information, to succeed in nutrition-related tasks and to evaluate attitudes towards food. From a psychometric perspective, our questionnaire demonstrated a 3-dimensional structure consistent with Azevedo Perry et al. (2017) (Azevedo Perry et al., 2017).

Although the aspect of ecology was not directly addressed, the questionnaire still included two questions that could be related to ecology, namely the seasons for eating tomatoes and the actors involved in the food chain. The phase of hypothesis testing confirmed that the food literacy score reacted as expected and that the way our questionnaire was administered (in a classroom setting) did not significantly influence the results.

Strengths of this work include the sample size. According to Rouquette and Falissard, 500 observations are sufficient to reveal the 3-dimensional structure of a 35-item database (Rouquette & Falissard, 2011). It also provides a reliable estimation of internal consistency; although we have calculated the McDonald omega coefficient, the parallel can be drawn with the Cronbach alpha coefficient, for which a sample of 1000 observations enables a half-amplitude of the IC95% of less than 0.03 (Rouquette & Falissard, 2011). In addition, our study sample was socially diverse, with half of the children schooled in priority education areas. The supervision of the questionnaire administration by a study investigator also ensured that the questionnaire was administered individually, without the help of other children or the teacher. Lastly, we followed the COSMIN checklist (Mokkink et al., 2010).

However, our study has limitations. Regarding the methodology, we did not formalize a Delphi panel method for the item selection, we were unable to assess the test-retest reliability of the questionnaire and the sensitivity to change could not be assessed. Regarding the results, the McDonald Omega coefficient for the entire questionnaire is satisfactory but the three McDonald Omega coefficients per dimension are below the threshold. The consequence may be a lack of reliability in the measurement of each dimension. However, the fact that the overall questionnaire has a satisfactory Omega coefficient allows a correct reliability for the measure of food literacy as a whole. As any psychometric scale an external validation on other samples of the population should be performed in order to confirm its structure.

5. Conclusion

Our questionnaire demonstrated acceptable psychometric properties and can be used to assess food literacy in three different dimensions (food and nutrition knowledge, participation in cooking activities, and food habits) with quantitative scores that can be compiled in a score out of 25. Future studies are needed to assess the factors that make food literacy vary, especially regarding socioeconomic variables, in order to target priority populations for nutrition education actions and also to describe changes in food literacy scores from a longitudinal perspective.

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Ethical statement

This study was approved by the Ethics Committee of INSERM as part of the evaluation of the Croq'Santé program (Reference 22–951). Informed parental consent was obtained prior to the visit for the administration of the questionnaire.

CRediT authorship contribution statement

Titiane Dallant: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Amandine Bozonnet:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Elisabeth Delarocque-Astagneau:** Writing – review & editing, Methodology, Investigation. **Sylvain Gautier:** Writing – review & editing, Methodology, Investigation. **Ali Koné:** Writing – review & editing, Resources, Investigation. **Vincent Grasteau:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Alexandra Rouquette:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization. **Marie Herr:** Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2024.107420.

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