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Reproducibility and validity of a food consumption questionnaire for schoolchildren

ABSTRACT

The aim of the study was to assess the reproducibility and validity of the previous day food questionnaire (PDFQ) for schoolchildren. The questionnaire is illustrated with 21 foods and was designed for use at group level. The participants were 131 schoolchildren aged eight to ten years who were studying full-time in a public school in a city of Southern Brazil, in 2005. Reproducibility was assessed by applying the questionnaire twice on the same day. Validity was assessed by comparing the food items selected on the questionnaire and direct observations from three school meals on the previous day. The questionnaire presented high sensitivity, ranging from 73.4% (beans) to 95.5% (rice), and high specificity, ranging from 87.3% (fruits) to 98.8% (beans). It was concluded that the questionnaire was capable of generating reproducible and valid data for assessing the food intake of schoolchildren on the previous day.

KEY WORDS: Food consumption. Questionnaires. Diet surveys. Students. Reproducibility of results. Validation studies.

INTRODUCTION

The construction of instruments for collecting dietary data for population studies on children of school age is a challenging task in which matters relating to cognitive abilities, investigator training and resource availability need to be taken into consideration.³ The 24-hour recall methods and food registers may provide valid measurements of foods and nutrients.^{3,5} However, younger children have difficulty in filling out these questionnaires and do not know the names of some foods and preparations.^{1,3} Food diaries completed with the help of parents may furnish imprecise information, since parents may not be present at the different times of their children's meals.³ Moreover, the quantity of time and resources required for data collection limits the usefulness of these instruments for large-scale assessments.³ Food frequency questionnaires that are used for evaluating diets in studies among adult populations seem to be inadequate for children who have not yet reached the stage of abstract reasoning (which is reached at around ten to eleven years of age).^{3,5}

Easily applied short illustrated questionnaires are useful for research on food consumption and assessment of the effectiveness of nutritional intervention programs.^{1,3} Besides, they are instruments appropriate for the stage of cognitive development of children aged seven to ten years.

The aim of the present study was to test the reproducibility and validity of an illustrated questionnaire for obtaining a report on 21 foods consumed on the previous day by schoolchildren.

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METHODS

This was a validation study with a convenience sample composed of all of the students in the third and fourth grades of elementary education at a public school in Balneário Camboriú, Southern Brazil, in 2005. This school was selected because it was the only one in the region with full-day attendance that provided three meals per day. All the 155 students in the third and fourth-grade levels were invited to take part in the study, and parental consent was given for 153 of them. In the analyses, the data relating to 22 students who did not do the reproducibility or validity tests were excluded. The final sample was thus composed of 131 students, of whom 73 were in their third grade (60.3% girls) and 58 in their fourth grade (62.1% girls). The participants' mean age was 9.4 years (standard deviation=0.4). The parameters used for calculating the sample size were an expected sensitivity of 75%, margin of error of 20% for the lower limit of this sensitivity and prevalence of 50%, thus obtaining a minimum sample size of 124 children.²

The instrument format and the application protocol were determined by nutritionists, educators and graphic artists, taking into consideration the cognitive abilities of the age group and the practicality of application. To include meals, foods or food groups, the dietary habits of this age group, the foods provided in school meals* and the Dietary Guide for the Population of Brazil** were taken into consideration. The first version of the instrument was tested in a pilot study on 69 children in the first to fourth grades of another public school, in Florianópolis (September 2002), to check the consistency of responses and the clarity of the questionnaire. Based on this test, a second version of the instrument was constructed. This was named the previous day food questionnaire (PDFQ). This illustrated instrument consisted of four sheets of A4 paper and was structured into five meals per day (breakfast, mid-morning snack, lunch, mid-afternoon snack and dinner) and present choices of 21 foods at each meal.***

The PDFQ relates to the foods consumed during a single day and furnishes a measurement of the actual intake that is appropriate for estimating the group mean. In this way, it enables identification of the proportions of the schoolchildren who consumed the 21 foods in the five meals of the previous day. The meals can be evaluated qualitatively, by means of the nutritional profile that is represented by the nutrient sources in the food groups.

The reproducibility was evaluated by means of applying the questionnaire twice, at the start of the

morning (test) and the end of the afternoon of the same day (retest), to the same group of students. The application was conducted by one of the female teachers at that school, in a classroom. She had received previous training for this and followed a standardized protocol with a duration of around 40 minutes. With the aid of a questionnaire of poster size (85 x 125 cm) that she presented to the students, she asked: "What day of the week was it, yesterday?", "Did you come to school yesterday?" "Which of the foods shown in the pictures of this meal did you eat yesterday?". The students were asked to circle the drawings relating to the foods consumed on the previous day, in each meal represented in the questionnaire.

To externally validate the instrument, the reference method for comparison with the questionnaire was direct observation of the foods consumed during three school meals (mid-morning snack, lunch and mid-afternoon snack), on the day prior to applying the questionnaire. These observations were made by five nutrition students who had received previous training for this, by using a standardized protocol in a pilot study. This pilot was conducted among 30 second-grade children, in order to measure the consistency level of the responses between the observers. Six calibration tests were carried out on different occasions, each with five different children who were observed by the same investigators. The tests were performed while the children were having their school lunch, and the observers noted down all the items consumed, exchanged and spilled. At the end of the six tests, general concordance of 95% was obtained among the observers. During the data collection, the team members constantly held meetings to review and discuss the observation procedures.

For the analyses, the 21 foods or food groups were grouped into 16 categories according to their nutritional profile: rice; beef and chicken; fruit; sweets; bread and pasta; greens and other vegetables; chocolate drinks; dairy products (milk, cheese and yoghurt); beans; soft drinks; fruit juices; chips (French fries); eggs; pizza; hamburgers; fish and seafood. The analyses were performed item by item, grouping the data for the meals and school years for the two sexes. To check the reproducibility, the McNemar test was used. To determine the external validity, the following were calculated: sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), using the observations as the gold standard.⁴ The kappa coefficient (k) was also calculated. The significance level adopted was 0.05. The analyses were carried out using the SPSS 10.0 software.

* Weis B, Chaim NA, Belik W. Manual de gestão eficiente da merenda escolar. 2 ed. São Paulo: Apoio fome zero associação de apoio à políticas de segurança alimentar; 2005. [acesso em 10/9/2006]. Disponível em: <http://www.acaofozero.org.br/arquivos/ManualdeGestaoEficientedaMerendaEscolar2005.pdf>

** Ministério da Saúde. Guia alimentar para a população brasileira: promovendo a alimentação saudável. Brasília; 2006 [acesso em 10/3/2006] (Série A: Normas e manuais e técnicos). Disponível em: http://dtr2004.saude.gov.br/nutricao/documentos/guia_alimentar_contenido.pdf

*** Laboratório do Comportamento Alimentar. Universidade Federal de Santa Catarina. Questionário alimentar do dia anterior – Quada. [acesso em 11/10/2007] Disponível em: <http://www.comportamentoalimentar.ccs.ufsc.br/?page=questionario>

The study was approved by the Ethics Committee for Research on Human Beings of the Universidade Federal de Santa Catarina.

RESULTS

The Table presents the reproducibility and validity results. Out of the 16 food items represented in the questionnaire, seven were not observed or reported in the school meals of the previous day, namely pizza, hamburgers, soft drinks, chips (French fries), fruit juices, fish and eggs. In the reproducibility evaluation, the McNemar test indicated non-significant values for the nine foods reported in the PDFQ, meaning that the consumption data were similar in the test and retest. In the validity evaluation, among the nine foods, rice presented the greatest sensitivity (95.5%), high specificity (98.6%) and the highest PPV (96.3%) and NPV (98.3%). This indicates that the chance of correctly estimating the proportions of the children who really did or did not consume rice were 96.3% and 98.3%, respectively, through using the PDFQ. Beans presented the lowest sensitivity (73.4%), the highest specificity (98.8%) and high PPV (92.2%) and NPV (95.1%).

The mean concordance indicated by the kappa coefficient was 0.85, with a range from 0.71 (greens and other vegetables) and 0.76 (fruits) to 0.94 (rice) (data not presented in the Table).

DISCUSSION

The results indicated that the PDFQ presents good reproducibility and external validity, with high sensitivity and specificity values for all the foods consumed. No food consumption questionnaires validated for Brazilian children aged eight to ten years were found in the literature. This study used direct observation as the reference standard, which is considered to be a more objective and precise measurement method than are food recall and register methods, since it does not depend on memory for self-reporting the consumption.^{1,3} The use of a convenience sample and observation of the meals in the school to validate the instrument limit the ability to generalize the results to different contexts of children's lives.

The PDFQ presented its best PPV for the foods that were clearly defined and illustrated separately (rice, chocolate drinks, milk products and beans), in comparison with the food groups that included several foods (fruits and sweets) and those that might form part of mixed preparations (greens and other vegetables). Thus, precise illustration of the foods that are to be assessed seems to influence instrument validation.³

Table. Reproducibility and validity of the Previous Day Food Questionnaire (PDFQ), Balneário Camboriú, Southern Brazil, 2005.

Food item in PDFQ	Consumption* (%)				Reproducibility		Validity							
	Obs	Test	Retest	p	McNemar	Sensitivity		Specificity		PPV		NPV		
						%	95% CI	%	95% CI	%	95% CI	%	95% CI	
Rice	27.0	27.2	26.2	0.2	1.5	0.2	95.5	89.2;98.3	98.6	96.3;99.6	96.3	90.3;98.8	98.3	95.8;99.4
Beef and chicken	44.3	41.2	38.4	0.07	3.2	0.07	94.5	89.6;97.3	91.1	86.5;94.3	88.1	82.2;92.3	96.0	92.3;98.0
Fruit	38.4	31.8	29.5	0.2	1.6	0.2	92.8	86.4;96.4	87.3	82.7;90.9	76.8	69.1;83.1	96.4	93.0;98.2
Sweets	26.0	25.2	26.5	0.4	0.6	0.4	88.0	79.6;93.4	95.0	91.7;97.1	85.4	76.8;91.4	96.0	92.9;97.8
Bread and pasta	28.8	29.3	31.6	0.1	2.6	0.1	87.3	79.6;92.5	95.8	92.5;97.7	89.6	82.1;94.3	94.8	91.3;96.9
Greens and other vegetables	14.8	11.2	9.7	0.3	1.1	0.3	87.0	73.0;94.6	94.4	91.3;96.4	66.7	53.2;78.0	98.2	96.0;99.3
Chocolate drinks	24.4	28.5	30.0	0.2	1.4	0.2	81.6	73.0;88.0	98.3	95.7;99.4	94.9	87.9;98.1	93.1	89.4;95.6
Milk products	24.2	28.5	30.0	0.2	1.6	0.2	80.7	72.0;87.3	98.3	95.7;99.4	94.8	87.8;98.1	92.8	89.1;95.3
Beans	12.5	15.5	16.3	0.6	0.4	0.6	73.4	60.7;83.3	98.8	96.8;99.6	92.2	80.3;97.5	95.1	92.2;97.1

* Percentage of the schoolchildren who were observed consuming these foods (Obs) and percentages of the schoolchildren who reported that they had consumed them in the test and retest; PDFQ: previous day food questionnaire; PPV: positive predictive value; NPV: negative predictive value

Comparisons between the results from different validation studies is limited by the differences in study design, instruments, types of foods analyzed, reference standards and time periods and statistical tests used in the data analysis. No validation studies on food consumption questionnaires for schoolchildren of this age group that included analysis of sensitivity, specificity and positive predictive value were found in the literature. It has been recommended that these parameters should be analyzed.⁴ By way of comparison, the kappa coefficient values obtained for fruit (0.76) and greens (0.71) in the present study were higher than those reported in a validation study on a questionnaire for English children aged seven to nine years, in which observation was used as the reference ($k=0.54$ and 0.58).¹ A computer program for food intake that was developed for Belgian schoolchildren aged 11 to 14 years and validated using a 24-hour recall survey furnished kappa values of 0.57 and 0.81 for fruit and greens, respectively.⁵

Future studies should test the validity of the PDFQ in contexts outside of school and among younger schoolchildren, and should also assess the nature of the information bias when self-answered questionnaires are applied among this age group. Overreporting may occur because of the inclusion of socially desirable (healthy) foods or foods of preferred flavor (sweets). On the other hand, underreporting may result from the omission of less healthy foods, according to nutritional recommendations, and ingredients that are inside preparations (greens).^{1,3,5}

In conclusion, the PDFQ presented good reproducibility and external validity. Because of its simplicity and brevity, it is a practical instrument that is available for use in epidemiological studies, thus making it possible to carry out food consumption analyses on the meals of the previous day, among schoolchildren aged eight to ten years.

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