OR 650

Is there any alternative to traditional food frequency questionnaire for evaluating habitual dietary intake?

¿Hay alguna alternativa al tradicional cuestionario de frecuencia de consumo de alimentos para la evaluación de la ingesta alimentaria habitual?

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ABSTRACT

Introduction: Dietary assessment methods are an important instrument for nutrition research**.** Food frequency questionnaires (FFQs) have been the most frequently used dietary assessment tool in epidemiological and intervention studies. There is a great necessity for new methods of determination of habitual dietary intake that overcome the limitations of these traditional methods.

Objectives: The objectives of the present study were to develop a new method, based on an application for mobile phones called e-EPIDEMIOLOGY, designed to record individual consumption data about a short series of foods/drinks, and to compare data collected using this tool with those obtained from a previously validated short paper FFQ.

Methods: University students over 18 years recorded the consumption of certain foods/drinks using e-EPIDEMIOLOGY during 28 consecutive days and then filled out a short paper FFQ at the end of the study period. To evaluate the agreement between both methods, Spearman's correlation coefficient, cross-classification analysis and a weighted kappa statistic were used.

Results: one hundred and nineteen participants completed the study (71.4% female and 28.6% male). The mean Spearman's correlation coefficients for food/drink group intake between the two methods was 0.73. The mean percentage of participants cross-classified into categories of "exact agreement + adjacent" was 91.6%. The average weighted kappa statistic was 0.60.

Conclusions: The results indicate that e-EPIDEMIOLOGY has good agreement with the previously validated FFQ short paper. However, it was noted that further testing of e-EPIDEMIOLOGY is required to establish its wider utility.

Key words: Epidemiologic methods. Nutrition assessment. Diet records. Surveys and questionnaires. Smartphone.

RESUMEN

Introducción: los métodos de evaluación de la dieta son importantes instrumentos para la investigación nutricional. Los cuestionarios de frecuencia de consumo de alimentos (CFCA) han sido los métodos utilizados con mayor frecuencia en los estudios epidemiológicos y de intervención. Hay una gran necesidad de nuevas herramientas que superen las limitaciones de estos métodos tradicionales.

Objetivos: los objetivos del presente estudio fueron desarrollar un nuevo método, basado en una aplicación para teléfonos móviles llamada e-EPIDEMIOLOGY, diseñada para registrar los datos de consumo individual de una serie corta de alimentos/bebidas, y comparar estos datos con los obtenidos a partir de un CFCA corto (en papel) validado previamente.

Métodos: estudiantes universitarios mayores de 18 años registraron el consumo de ciertos alimentos/bebidas usando e-EPIDEMIOLOGY durante 28 días consecutivos y cumplimentaron un CFCA corto (en papel) al final del periodo de estudio. Para evaluar

el acuerdo entre ambos métodos se utilizaron el coeficiente de correlación de Spearman, el análisis de clasificación cruzada y el kappa ponderado.

Resultados: un total de 119 participantes completaron el estudio (71,4% mujeres y 28,6% hombres). El coeficiente de correlación de Spearman medio entre ambos métodos fue 0,73. La media del porcentaje de clasificación cruzada en la categoría de "acuerdo exacto + adyacente" fue 91,6%. La media del kappa ponderado fue 0,60.

Conclusiones: los resultados indican que e-EPIDEMIOLOGY tiene buena concordancia con el CFCA corto (en papel) previamente validado. Sin embargo, son necesarias más pruebas con e-EPIDEMIOLOGY para establecer su utilidad de forma más amplia.

Palabras clave: Métodos epidemiológicos. Evaluación nutricional. Registros de dieta. Encuestas y cuestionarios. Teléfono inteligente.

INTRODUCTION

Dietary assessment methods are used for quantification of both short- and long-term (habitual) dietary intakes, and are essential tools in epidemiological investigations and intervention studies assessing relationships between diet and health in both population and clinical settings (1). Food records (or diaries), 24-hour recalls, and food frequency questionnaires (FFQs) are the three main assessment methods that are traditionally used to measure dietary intake (1-3). The strengths and weaknesses of traditional dietary assessment methods are well documented (1).

FFQs have been the most frequently used dietary assessment tool in large-scale epidemiological and intervention studies and also nutrition-related studies to determine food and nutrient intake (2-6). FFQs are practical, easy to administer and inexpensive tools that do not affect food intake patterns, and they can assess habitual dietary patterns with a single administration (4-6). Also, FFQs can be electronically self-administered (2-4) and several examples of computer-administered FFQs exist in the published literature (4,7-11). In any case, FFQs are retrospective assessment tools and require respondents to report the frequency of consumption of a predefined list of foods over a prolonged period of time (1). Therefore, FFQs depend mostly on the memory of the subject interviewed, they do not take into account intrapersonal

variation in the recording of daily food consumption during the time period of the study and they do not allow precise estimation of food portion size (12).

Although it is important to understand the limitations of FFQs, they are useful for measuring intakes of nutrients concentrated in relatively few foods (e.g., calcium from dairy products); they can be used to measure aspects of food use, such as consumption of fruits and vegetables, which are related to chronic disease risk; and they can be used to formulate personalized feedback in clinical interventions to promote healthful dietary change. Thus, further research to improve FFQs for both clinical and research applications is well motivated (13).

Although various studies have used FFQs of different lengths to assess the whole diet, when measuring a single nutrient or food group is of interest, short FFQs are useful. Besides, short FFQs are appropriate tools to explore factors associated with changes in the population dietary patterns (6).

Recently, certain short-term methods that use mobile technologies have been developed with promising results. In these studies, the participants completed electronic food records or 24-hour recalls based on applications for mobile phones, which allowed digital recording of all foods/drinks consumed for 1-7 days. The objective of these short-term instruments was to assess the whole diet (14-18). However, until now, no electronic long-term tools had been developed for evaluating habitual dietary intake of selected food/drink groups, benefitting from mobile technologies and serving as an alternative to traditional short FFQs (19).

The use of the Internet on mobile phones is widespread in Spain; 83% of all Spaniards have accessed the Internet using their mobile phones in the last three months (92.6% of Spaniards between 16 and 24 years of age) (20). This facilitates the introduction of new methods of evaluation of dietary intake that include mobile technology.

The objectives of the present study were to develop a new method based on an application for mobile phones called e-EPIDEMIOLOGY, designed to record individual consumption data about a short series of foods/drinks, and to compare data collected using this tool with those obtained from a previously validated short paper FFQ.

MATERIAL AND METHODS

The mobile phone application: e-EPIDEMIOLOGY

Participants downloaded the application e-EPIDEMIOLOGY to their personal mobile phones. This application permitted the recording of each participants' daily consumption of a list of foods/drinks selected for the study. This list consisted of 12 items which referred to ten different foods/drinks: fruit, vegetables, legumes, chicken/turkey, fish, red meat (lamb, beef, and pork), soft drinks, sweets, prepared foods, and alcoholic beverages. At the end of each day, the participant could access the application and register the number of standard portions that had been consumed during that day (Fig. 1).

These items were selected for the study because they provide for a wide range of consumption patterns, from daily to sporadic, for the population (21). These were also considered to be markers for healthy (fruits, vegetables, legumes, and fish) and unhealthy (soft drinks, sweets, and prepared foods) dietary habits (22).

After finishing the task on e-EPIDEMIOLOGY, the data was automatically saved and sent to the research administrator's website via wi-fi or 3G/4G, after which time the user could not access or change answers to the questionnaire.

The application used to register daily consumption of selected foods/drinks was based on a questionnaire elaborated using the FFQ from the European Health Survey (23). Standardized portions were added after testing a previous prototype of e-EPIDEMIOLOGY (results not published) and were obtained from a FFQ validated for the Spanish population (24).

Participants were instructed in the use of e-EPIDEMIOLOGY with a personal demonstration of how to use the app, as well as an estimation of standardized portion sizes, and were reminded to maintain their habitual diet. The recording of foods/drinks intake was to be completed during 28 consecutive days using the application.

The reference method: a short paper FFQ

As a reference, a short paper FFQ (Table I) was filled out at the end of the study period, through personal interviews and at the convenience of the participants.

Because both methods ask about intake over a period of 28 days, in order to make comparisons about the usefulness of each tool, it was desirable to keep foods/drinks records during the same period of time with each method (25) (Fig. 2).

All participants completed a questionnaire during this personal interview in which demographic (date of birth and gender) and anthropomorphic data were collected. The anthropomorphic data were collected using a standard procedure (with these data, body mass index (BMI) (kg/m^2) was calculated using categories defined by the WHO (26).

Also, during the personal interviews, the participants were asked how much time, on average, was necessary to complete the app each day. Participants could choose from one of the following options: approximately one minute per day/approximately two minutes per day/approximately three minutes per day/approximately four minutes per day/approximately five minutes or more per day. Ninety-four per cent of the participants selected the option "approximately one minute per day" and the remaining 6% chose "approximately two minutes per day". Thus, the research team considered that the time necessary to complete e-EPIDEMIOLOGY was about one minute per day.

The short paper FFQ utilized was based on a previously validated questionnaire used in the European Health Survey (23). Standardized portion sizes were obtained from a FFQ validated for the Spanish population (24).

Both the questionnaires used in the application and the short paper FFQs had the same items (Fig. 1 and Table I), the only difference being that in e-EPIDEMIOLOGY the questionnaire refers to daily consumption while the short paper FFQ refers to consumption during the previous 28 days.

Study subjects

This study was performed among medical and pharmaceutical students at the University of Seville (Andalusia, Spain, Southern Europe). Different events were organized at both faculties, where the research team personally presented the project to the students. Of the 183 students who were interested, 136 were eligible. One hundred and twenty students decided to participate in the study. Of these, 119 completed both the application e-EPIDEMIOLOGY and the short paper FFQ.

The period of participant recruitment spanned from October 2014 to June 2016. Participants were recruited to the study during the entire period of research, so that all seasons as well as days of the month and week were included in the sample.

The inclusion criteria were the following: a) being a University of Seville student from the Medical or Pharmaceutical Schools; b) being over 18 years of age; and c) owning a mobile phone with access to the Internet and an Android operating system.

The study was performed according to directives established in the Declaration of Helsinki and the Biomedical Research Law (27), and all procedures on human beings were approved by the Research Ethics Committee at the University of Seville. Written informed consent was obtained from all participants.

All of the personal data collected in this study remained anonymous and confidential and were treated according to current Spanish legislation (28). To that end, each participant was assigned a personal alphanumeric code, so that no one, including the research team, could link personal information to the results obtained.

Codification and revision of data

For each participant, the data collected from the short paper FFQ for each of the ten foods/drinks previously mentioned were categorized. The frequency of consumption of foods/drinks items was categorized into six subgroups: “less than once a week”, “once or twice a week”, “3-4 times a week”, “5-6 times a week”, “once or twice a day” and “three times or more a day” (Table I). For the same foods/drinks, the data from the 28 days using e-EPIDEMIOLOGY were recorded as daily consumption. These data were transformed in order to include them in one of the same categories of habitual consumption included in the FFQ. This was made possible because both the short paper FFQ and e-EPIDEMIOLOGY used the same standardized portion sizes. For example, suppose that a participant consumes an average of 0.50 standard rations of red meat daily during 28 days using e-EPIDEMIOLOGY. This average consumption represents 3.50 standard portions per week (0.50 x 7 = 3.50), which would be classified in the category “3-4 times a week.”

The data collected from the short FFQ paper were manually introduced into the database by the research team. These were then reviewed in order to avoid data entry errors. Data collected from e-EPIDEMIOLOGY were saved without modifications in a separate database. Subsequently, one set of data was removed due to an obvious inconsistency: one participant had registered the consumption of 200 standardized portions of legumes in one day.

Statistical analysis

The association between dietary intake methods (e-EPIDEMIOLOGY and short FFQ paper) was assessed using Spearman's correlation coefficients (SCC).

The relative agreement between the two methods was assessed using cross-classification analysis and the weighted kappa statistic. Participants were classified by the two methods into quintiles of "exact agreement", "exact agreement + adjacent", "slight disagreement", "strong disagreement", and "extreme disagreement" (1). The inter-rater agreement of two assessment methods was analyzed by weighted kappa statistic, assigning partial credit to scores using the Stata prerecorded weights. If there was complete agreement, a weight of 1.00 was assigned. For cases cross-classified into adjacent categories, 0.80 was assigned; for cases cross-classified into two categories apart, 0.60; three categories apart, 0.40; four categories apart, 0.20; and cases cross-classified into extreme categories, 0.00. Values of kappa over 0.80 indicate very good agreement; between 0.61 and 0.80, good agreement; 0.41-060, moderate agreement; 0.21-0.40, fair agreement; and < 0.20, poor agreement (29,30). All statistical analysis was performed using STATA version MP 13.1 (Stata Corp LP, Texas, USA) and a p value < 0.05 was considered as statistically significant (31).

RESULTS

One hundred and twenty individuals participated in the study, but one participant did not complete the application and the FFQ. This individual's data were not used for posterior analysis. Of the 119 participants who completed the study, 93 individuals completed the application every day (28 days), 15 completed the application 26 days, one completed the application 25 days, nine completed the application 24 days, and one completed the application 20 days.

Among the participants, the mean age was 21.9 years; 71.4% were females and 28.6% were males. The mean BMI was 22.3 kg/m^2, with 72.3% of the participants in the healthy weight range (BMI 18.5-24.9), 16.8% being overweight (BMI 25.0-29.9), 2.5% obese (BMI > 30.0), and 8.4% underweight (BMI < 18.5) (Table II).

The mean SCC for food/drink group intake between the two methods was 0.73 (ranging from 0.57 [legumes] to 0.85 [alcoholic beverages]).

The mean percentage of individuals into categories of “exact agreement” was 61.8% (ranging from 51.3% [sweets] to 68.9% [legumes]). The mean percentage of participants cross-classified into categories of “exact agreement + adjacent” was 91.6% (ranging from 83.2% [sweets] to 97.5% [fish]). The mean percentage of participants misclassified for all food groups was 8.2% (“slight disagreement” [6.8%], “strong disagreement” [1.4%] and “extreme disagreement” [0.0%]) (1) (Table III).

The average weighted kappa statistic was moderate (k = 0.60). The weighted kappa statistic values showed good agreement for fruit, vegetables, fish, soft drinks and alcoholic beverages (k = 0.61-0.68) and moderate agreement for legumes, chicken/turkey, red meat, sweets and prepared foods (k = 0.52-0.59) (Table IV).

DISCUSSION

The present study demonstrates the development of a new method based on e-EPIDEMIOLOGY and its comparison with a validated FFQ paper short. This new method is not intended to determine the total food consumption of an individual nor the exact consumed quantity of a selected food/beverage. There are different tools, such as dietary registries or 24 hour recalls, serving that purpose (1-6). This method using e-EPIDEMIOLOGY was designed to categorize habitual foods/drinks intakes (19). It can be also used (much like the short FFQ paper with which it was compared) to identify potential deficits in nutrient consumption, to assess the relationships between diet and health, and to evaluate the effectivity of personalized measures that promote healthy lifestyle changes (13). Though this method allows for the classification of individuals into categories (much like a FFQ), it is basically a simplified 24-hour food recall, repeated many times (once per day) during a study period of 28 days. Ultimately, both methods (e-EPIDEMIOLOGY and FFQ) are very different and therefore present different measurement errors. This is the first study that develops an alternative to traditional short paper FFQ using mobile technologies (19).

The mean SCC for food group intake between the two methods was 0.73 and high correlations (SCCs ≥ 0.5) were observed for all food/drink groups. Cross-classification analysis showed that 61.8% of the participants were correctly classified into the same category and 91.6% were classified into categories of “exact agreement + adjacent”. Just 1.4% were misclassified into categories of “strong disagreement” and 0.0% were

misclassified into an opposite category. The average weighted kappa statistic was moderate (k = 0.60), with values over 0.55 in eight of the ten foods/drinks selected for the study. Despite both the cross-classification analysis and the weighted kappa statistic are still dependent on the number of categories used (30), the results indicate that e-EPIDEMIOLOGY has reasonable ranking ability for food/drink group intake estimates, and is highly comparable with the previously validated short paper FFQ. In order to limit this dependence to evaluate agreement and misclassification, the six original categories could have been reorganized into three (30). In any case, the team research has preferred to use the six original categories, instead of three, for the analysis.

However, it was noted that further testing of e-EPIDEMIOLOGY is required to establish its wider utility (19). While e-EPIDEMIOLOGY demonstrated good agreement with the short paper FFQ, some disagreement was observed between the two instruments (cross-classification analysis showed that 8.2% of the participants were incorrectly classified into 2-4 categories apart). Multiple factors could have contributed to the discrepancies observed between the two methods. Both methods have in common that they present the same difficulties in the precise estimation of portion size. Both methods use the same questions to measure the frequency of consumption. For example, both ask: "How many portions of red meat (beef, pork, lamb) have you eaten? (1 portion = approx. 150 g)". However, there are important differences between both methods. With e-EPIDEMIOLOGY, this question is answered at the end of each day during the study period, while the short paper FFQ is completed at the end of 28 days (19). This minimizes the dependence on the memory of the participant in e-EPIDEMIOLOGY in comparison to the FFQ, keeping in mind that the recollection of past consumption of foods can be influenced by more recent food consumption (32-35). Additionally, e-EPIDEMIOLOGY is not limited by the day-to-day variability in dietary intake and may accurately assess intakes of foods/drinks that are eaten infrequently. Among university students (study sample), dietary intake is variable from day-to-day, with sporadic changes in food intake (skipping meals, snacking, school events that interfere with meal time), as well as frequent dining out. These aspects interfere with the precise determination of habitual dietary intake (17), especially in the case of FFQs, where data is collected only once at the end of an extended time period.

Repeated applications of traditional short term instruments, such as dietary registries and 24-hour recalls, can modify habitual intake due to the excessive workload for participants. Any tool that provides a simple method facilitating the collection of data about dietary intake without changing behavior is an important advancement in nutritional epidemiology (17). Despite repeated use, the modification of habitual intake seems unlikely through the use of e-EPIDEMIOLOGY, due to the reduced workload that using this application presents (one minute/day) (19).

The data collected through both methods could have been analyzed on a continuous scale: with e-EPIDEMIOLOGY, by using the average value of consumption of the selected foods/beverages throughout the entire study period, and with the short paper FFQ, by assigning a reference value, for example, the mean value of foods/drinks consumed (1.5 portions/day instead of 1-2 portions/day). However, though it is possible to analyze the data on a continuous scale (using another type of statistical analysis), the research team preferred to analyze the collected data by organizing them into categories as qualitative variables. It was found that this method better fit our objective: categorizing individuals according to their habitual intake of certain foods/drinks, not being necessary the recording of the exact quantities of said foods/drinks.

One inherent limitation to most FFQs is that they are paper-based forms. Thus, errors such as skipped questions or multiple marks are common. Web-based FFQ offer straightforward solutions to these limitations of paper FFQ. Furthermore, data from paper forms must be entered into analysis software, which makes it unfeasible to provide real-time feedback in a clinical setting (13). In their most simple application, paper FFQ match web-based FFQ; this allows the flexibility of using either a paper or computerized questionnaire interchangeably, but the benefits from computer administration are limited to direct data entry, real-time error checking and rapid analysis (4,7). Other advantages include reducing paper use, postage costs, and the space, security, and organization required for paper file storage (9). Additionally, on-line methods can be used to target specific geographical population groups and can be accessed remotely (1). The research team considered that in this study the potential disadvantages of developing a web-based FFQ, in comparison with a paper-based FFQ, outweighed its potential benefits, keeping in mind two inherent characteristics of this

study: the paper-based FFQ used is very short and simple (containing only 12 items) and the sample is made up of students from the Medical and Pharmacy Schools at the University of Seville. The simplicity of the short paper FFQ reduced the chance for errors, the amount of paper consumed, and storage space issues. The relatively easy access to the sample population made it possible to complete the short paper FFQ in person, making it unnecessary to mail it. In this case, the costs associated with data entry were minimal compared with the potential costs of developing a web-based FFQ (19). In recent years, many well-established FFQs have been developed into web-based versions and there is a growing body of evidence demonstrating that data from web-based FFQs are comparable with data from printed versions (1).

A validation study has been planned in which both methods (e-EPIDEMIOLOGY and paper FFQs), will be compared to a 3-7 day weighed food record. This will help more thoroughly evaluate the potential validity of e-EPIDEMIOLOGY as a research tool for the determination of habitual dietary intake.

Strengths and limitations

The strengths of the current study include using more than one statistical method in order to give credence to the results (30) and adequate sample size (32). Some of the characteristics of these types of mobile technologies, such as asynchrony (36-39), the ease with which privacy can be maintained (40), as well as the light workload for the participants (one minute per day), helped to increase participation. In addition, the recording of foods/drinks intake was to be completed during 28 consecutive days using the application and at the end of this period using the short paper FFQ, minimizing the likelihood of changes in dietary intake.

Limitation of this study is that the participants involved were students; the majority were women (which is actually a reflection of the proportion of male and female students enrolled in the Schools of Medicine and Pharmacy at the University of Seville) and were, therefore, representative of a convenient sample rather than a nationally representative sample.

Another possible limitation is that the access to these technologies is not universal, excluding especially vulnerable groups, such as students from poorer social strata or elderly students.

CONCLUSIONS

In conclusion, in this study, the good agreement with a previously validated short paper FFQ, using a variety of analyses, combined with the ease of use of e-EPIDEMIOLOGY, indicated its utility for classifying individuals according to their consumption of the foods/drinks selected for the study, and could be potentially valuable for use in other epidemiological studies, as an alternative to short paper FFQs. Due to the growing popularity of mobile phones among young Spaniards, this instrument is likely to be accepted by this population and could reduce some of the inherent limitations present in paper FFQs, such as dependence on the memory of participants and the impossibility of reflecting day-to-day intrapersonal variability in dietary intake. However, it was noted that further testing of e-EPIDEMIOLOGY is required to establish its wider utility.

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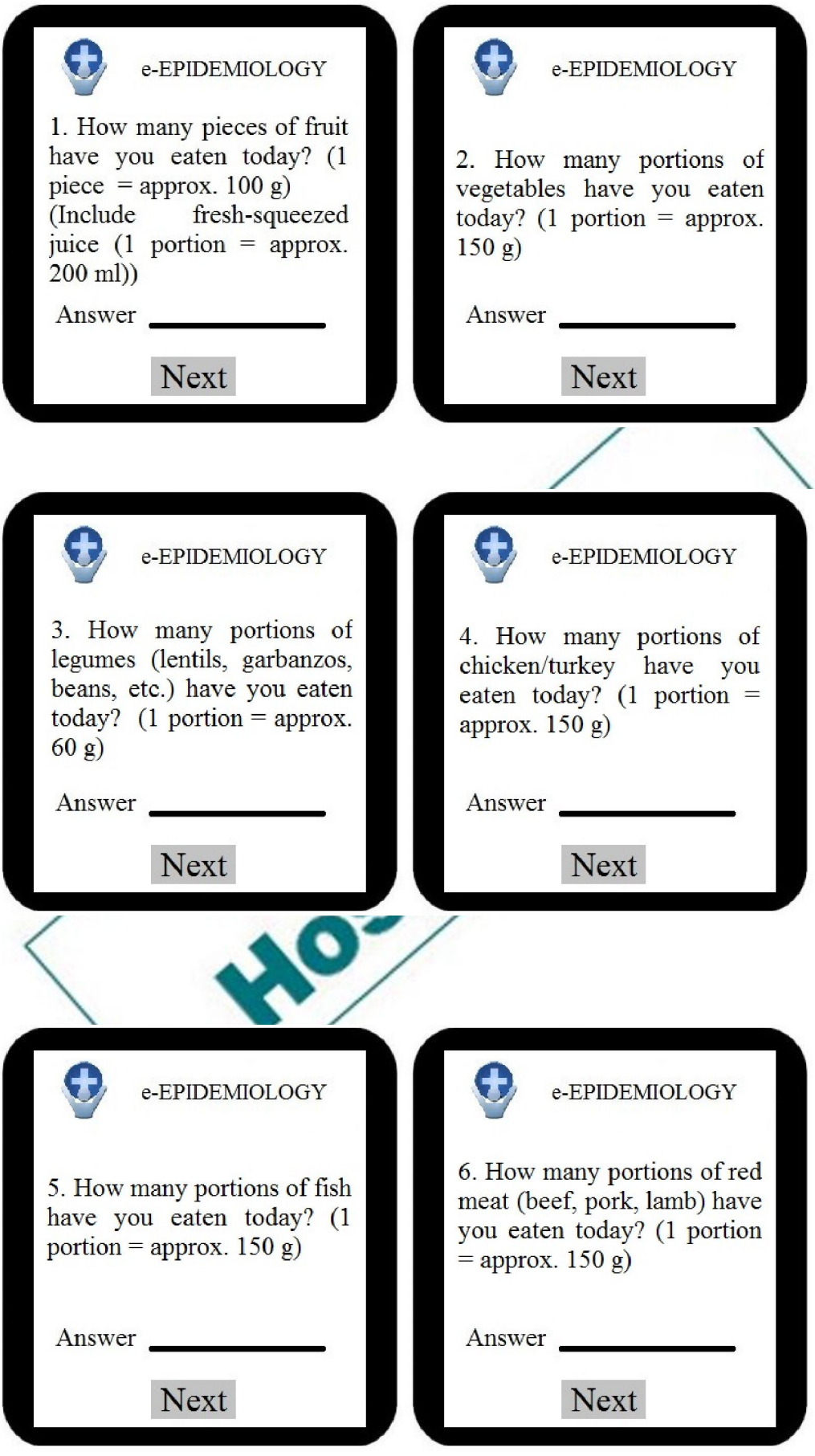
e-EPIDEMIOLOGY
1. How many pieces of fruit have you eaten today? (1 piece = approx. 100 g) (Include fresh-squeezed juice (1 portion = approx. 200 ml))
Answer
Next
e-EPIDEMIOLOGY
2. How many portions of vegetables have you eaten today? (1 portion = approx. 150 g)
Answer
Next
e-EPIDEMIOLOGY
3. How many portions of legumes (lentils, garbanzos, beans, etc.) have you eaten today? (1 portion = approx. 60 g)
Answer
Next
e-EPIDEMIOLOGY
4. How many portions of chicken/turkey have you eaten today? (1 portion = approx. 150 g)
Answer
Next
e-EPIDEMIOLOGY
5. How many portions of fish have you eaten today? (1 portion = approx. 150 g)
Answer
Next
e-EPIDEMIOLOGY
6. How many portions of red meat (beef, pork, lamb) have you eaten today? (1 portion = approx. 150 g)
Answer
Next

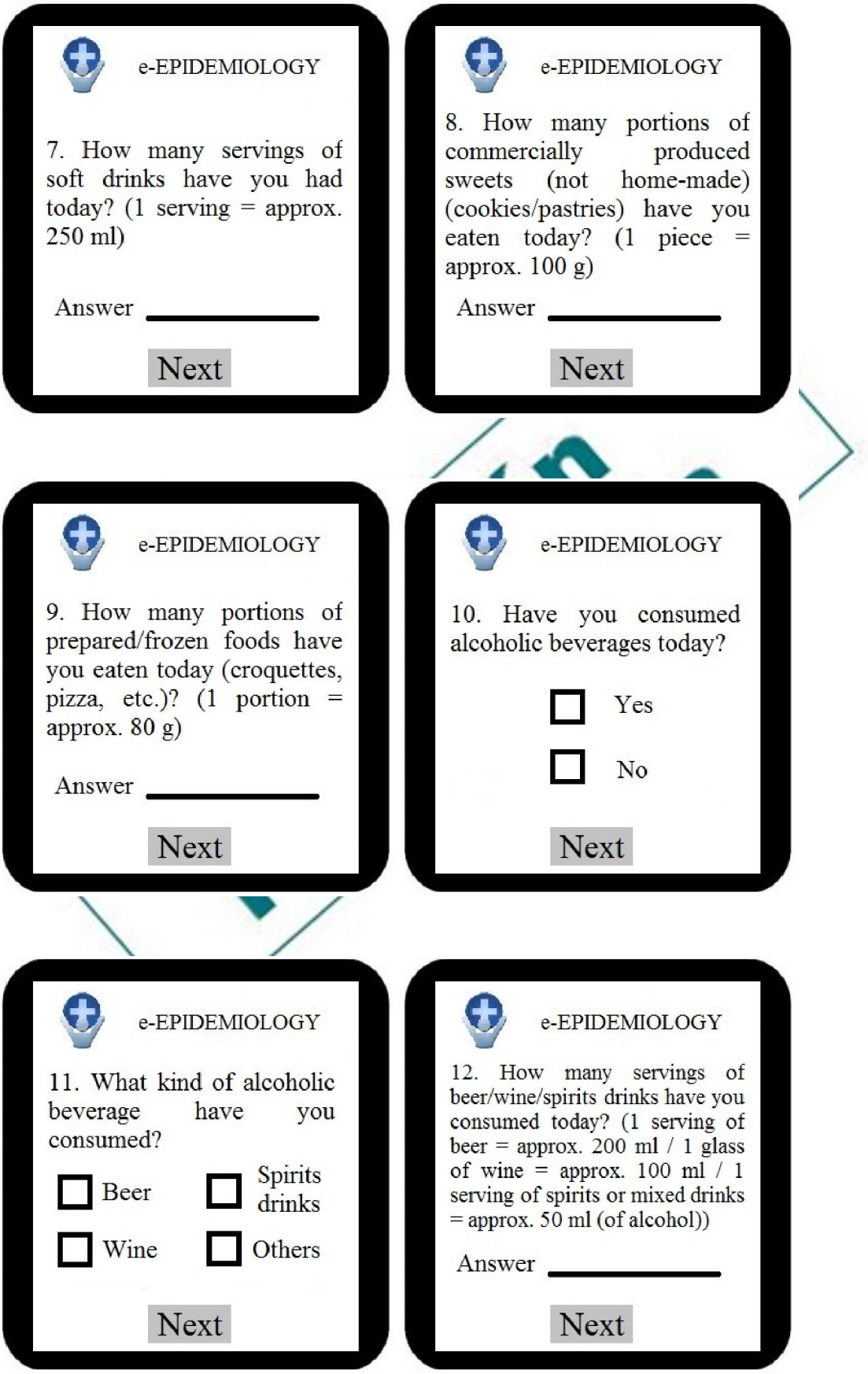
e-EPIDEMIOLOGY
7. How many servings of soft drinks have you had today? (1 serving = approx. 250 ml)
Answer
Next
e-EPIDEMIOLOGY
8. How many portions of commercially produced sweets (not home-made) (cookies/pastries) have you eaten today? (1 piece = approx. 100 g)
Answer
Next
e-EPIDEMIOLOGY
9. How many portions of prepared/frozen foods have you eaten today (croquettes, pizza, etc.)? (1 portion = approx. 80 g)
Answer
Next
e-EPIDEMIOLOGY
10. Have you consumed alcoholic beverages today?
Yes
No
Next
e-EPIDEMIOLOGY
11. What kind of alcoholic beverage have you consumed?
Beer
Spirits drinks
Wine
Others
Next
e-EPIDEMIOLOGY
12. How many servings of beer/wine/spirits drinks have you consumed today? (1 serving of beer = approx. 200 ml / 1 glass of wine = approx. 100 ml / 1 serving of spirits or mixed drinks = approx. 50 ml (of alcohol))
Answer
Next

Figure 1. Twelve screen captures of the application e-EPIDEMIOLOGY.

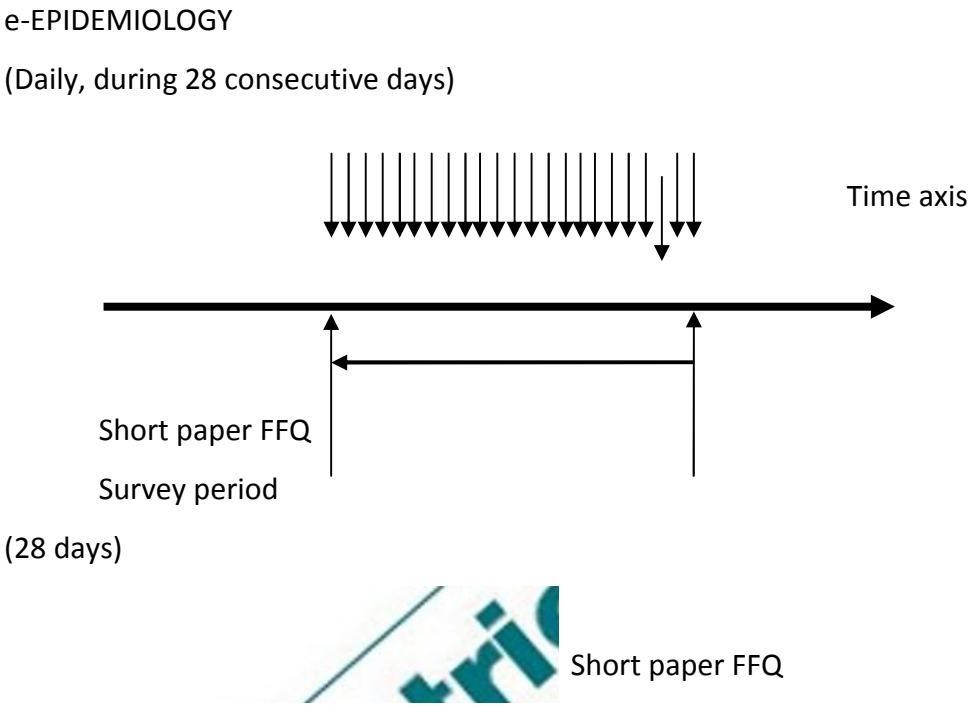

Figure 2. Process of assessment using e-EPIDEMIOLOGY and short paper FFQ. FFQ: Food frequency questionnaire.

Table I. Short paper FFQ, with weights/measurements of standardized portions of selected foods/drinks

1. How many pieces of fruit did you habitually consume in the last 28 days? (1 piece = approx. 100 g) (Include fresh-squeezed juice [1 portion = approx. 200 ml])	Categories[a]
2. How many portions of vegetables did you habitually consume in the last 28 days? (1 portion = approx. 150 g)	Categories[a]
3. How many portions of legumes (lentils, garbanzos, beans, etc.) did you habitually consume in the last 28 days? (1 portion = approx. 60 g)	Categories[a]
4. How many portions of chicken/turkey did you habitually consume in the last 28 days? (1 portion = approx. 150 g)	Categories[a]
5. How many portions of fish did you habitually consume in the last 28 days? (1 portion = approx. 150 g)	Categories[a]
6. How many portions of red meat (beef, pork, lamb) did you habitually consume in the last 28 days? (1 portion = approx. 150 g)	Categories[a]
7. How many servings of soft drinks did you habitually consume in the last 28 days? (1 serving = approx. 250 ml)	Categories[a]
8. How many portions of commercially produced sweets (not home-made) (cookies/pastries) did you habitually consume in the last 28 days? (1 piece = approx. 100 g)	Categories[a]
9. How many portions of prepared/frozen foods have you habitually eaten (croquettes, pizza, etc.) in the last 28 days? (1 portion = approx. 80 g)	Categories[a]
10. Have you consumed alcoholic beverages in the last 28 days?	Yes No

11. What kind of alcoholic beverages have you consumed in the last 28 days?	- Beer - Wine - Spirits/mixed drinks - Others
12. How many servings of beer/wine/spirits or mixed drinks did you consume in the last 28 days? (1 serving of beer = approx. 200 ml; 1 glass of wine = approx. 100 ml; 1 serving of spirits or mixed drinks = approx. 50 ml [of alcohol])	Categories[a]

[a]The different categories were: less than once a week; once or twice a week; 3-4 times a week; 5-6 times a week; once or twice a day; three times or more a day. FFQ: Food frequency questionnaire.

Table II. Characteristics of participants in the study

Participants who completed the study, n	119
Age, years, mean (SD)	21.9 (3.2)
Gender, n (%)	
Female	85 (71.4)
Male	34 (28.6)
BMI, kg/m^2, mean (SD)	22.3 (3.1)
BMI, kg/m^2, n (%)	
Underweight	10 (8.4)
Normal range	86 (72.3)
Overweight	20 (16.8)
Obesity	3 (2.5)

SD: Standard deviation; BMI: Body mass index.

Table III. Spearman's correlation coefficient and cross-classification analysis derived from e-EPIDEMIOLOGY and the short paper FFQ

Comparison		Agreement (%)				
	SCC	Exact agreement[a]	Exact agreement + adjacent[b]	Slight disagreement[c]	Strong disagreement[d]	Extreme disagreement[e]
Fruit	0.81[f]	64.7	89.1	8.4	2.5	0.0
Vegetables	0.84[f]	63.0	92.4	7.6	0.0	0.0
Legumes	0.57[f]	68.9	95.8	3.4	0.8	0.0
Chicken/turkey	0.67[f]	59.7	90.8	6.7	2.5	0.0
Fish	0.72[f]	68.1	97.5	2.5	0.0	0.0
Red meat	0.69[f]	63.0	93.3	5.9	0.8	0.0
Soft drinks	0.77[f]	55.5	86.6	12.6	0.8	0.0
Sweets	0.73[f]	51.3	83.2	11.8	5.0	0.0
Prepared foods	0.61[f]	63.0	95.8	3.4	0.8	0.0
Alcoholic beverages	0.85[f]	60.5	90.8	8.4	0.8	0.0
Average	0.73	61.8	91.6	6.8	1.4	0.0

[a]Exact agreement: % of cases cross-classified into the same category. [b]Exact agreement + adjacent: % of cases cross-classified into the same or adjacent category. [c]Slight disagreement: % of cases cross-classified two categories apart. [d]Strong disagreement: % of cases cross-classified 3-4 categories apart. [e]Extreme disagreement: % of cases cross-classified into extreme categories. [f]$p < 0.001$. SCC: Spearman's correlation coefficient; FFQ: Food frequency questionnaire.

Table IV. Percentage agreement, percentage expected agreement, and weighted kappa statistic derived from e-EPIDEMIOLOGY and the short paper FFQ

Comparison	*Agreement (%)*	*Expected agreement (%)*	*Weighted kappa*
Fruit	90.3	70.3	0.67[a]
Vegetables	91.1	72.2	0.68[a]
Legumes	91.0	81.1	0.52[a]
Chicken/turkey	89.6	75.0	0.58[a]
Fish	91.4	78.1	0.61[a]
Red meat	88.9	72.6	0.59[a]
Soft drinks	88.2	69.9	0.61[a]
Sweets	85.7	68.0	0.55[a]
Prepared foods	89.5	77.2	0.54[a]
Alcoholic beverages	87.6	62.6	0.67[a]
Average	-	-	0.60

[a] $p < 0.001$. FFQ: Food frequency questionnaire.