

Original

New technologies applied to food frequency questionnaires: a current perspective

P. García-Segovia¹, R. González-Carrascosa¹, J. Martínez-Monzó¹, J. Ngo² and L. Serra-Majem^{2,3}

¹CUINA group. Food Technology Department. Universidad Politécnica de Valencia. Valencia. Spain. ²Community Nutrition Research Centre of the Nutrition Research Foundation. University of Barcelona Science Park. Barcelona. Spain. ³University of Las Palmas de Gran Canaria. Las Palmas de Gran Canaria. Spain.

Abstract

The food frequency questionnaires are widely used in epidemiological researches like dietary assessment method. Traditionally, they have been self-administered in paper but the use of information and communication technologies has led to develop Internet and computerized food frequency questionnaires. It is the objective of this article to offer a global perspective of the new technologies applied to FFQ. It will be presented the purpose of the food frequency questionnaire, the number of strengths of the web-based surveys versus print-surveys and finally, a description of the manuscripts that have used web-based and computerized FFQ.

(*Nutr Hosp.* 2011;26:803-806)

DOI:10.3305/nh.2011.26.4.5154

Key words: *Internet. Computers. Questionnaires. Diet surveys.*

NUEVAS TECNOLOGÍAS APLICADAS A LOS CUESTIONARIOS DE FRECUENCIA DE CONSUMO DE ALIMENTOS: UNA PERSPECTIVA ACTUAL

Resumen

Los cuestionarios de frecuencia de consumo de alimentos son muy utilizados en investigaciones epidemiológicas como método para evaluar la dieta. Tradicionalmente, han sido autoadministrados en papel, pero el uso de las tecnologías de la información y la comunicación (TICs) ha permitido desarrollar cuestionarios de frecuencia de consumo de alimentos computerizados y a través de Internet. El objetivo de este artículo es ofrecer una perspectiva actual del uso de las nuevas tecnologías aplicadas al diseño e interpretación de los cuestionarios de frecuencia de consumo de alimentos. En el presente trabajo se resumen los objetivos de los cuestionarios de frecuencia de consumo de alimentos, las ventajas de los cuestionarios autoadministrados por Internet frente a los administrados en papel y finalmente, se describirán diferentes estudios que han usado cuestionarios de frecuencia de consumo de alimentos autoadministrados mediante el uso de ordenador o a través de Internet.

(*Nutr Hosp.* 2011;26:803-806)

DOI:10.3305/nh.2011.26.4.5154

Palabras clave: *Internet. Ordenadores. Cuestionarios. Encuestas dietéticas.*

Abbreviations

FFQ: Food frequency questionnaire.
ICT: Information and Communication Technology.

Correspondence: Purificación García Segovia.
Politechnic University of Valencia (UPV) Science Park.
Building 8E. Stairs F. Floor 0 Office. 0.2.
Camino de Vera, s/n.
46022 Valencia. Spain.
E-mail: pugarse@tal.upv.es

Recibido: 25-XI-2010.
Aceptado: 28-XI-2010.

Introduction

There are different types of dietary assessment instruments like food frequency questionnaires (FFQs), 24-hour dietary recall and so on. At this moment, food frequency questionnaires are usually used in epidemiologic studies when one works with large samples sizes, thanks to their ease of administration, minimal burden to respondents and low cost. In earlier years, the usual way of administration of the FFQs has been in-person by paper. Nowadays, the progress of the information and communication technologies (ICT) has allowed using another ways of

administration like web-based. Today, World Wide Web is being used in everyday life by an ever wider, more diverse public and it is one of the most preferred sources of nutrition information. Nowadays, computers and Internet are very accessible; data indicates that in 2008 more than the half of the Spanish homes had already personal computer and the access to Internet. In light of these considerations, web-based and computerized FFQs have been developed.

Food Frequency Questionnaire (FFQ)

Food frequency questionnaires are designed to measure "habitual" dietary intake, over a defined period of time. At present, in epidemiologic studies dietary intake is still assessed by means of food frequency questionnaires. The primary aim in these studies is often to classify individuals into groups by estimated intake and the FFQs have the ability to assign individuals correctly by nutrient intake. The FFQ includes a defined list of foods which are sometimes grouped into categories. In general, all questionnaires present a general question (Do you eat bread?) and subjects have to respond yes or no, and if confirmed, they indicate the frequency of consumption ("how often?"). In this way, the questionnaire only provides qualitative information and they are called "non-quantitative" FFQs because they do not collect information on portion size. It is possible to obtain quantitative information by asking the quantity consumed ("How much?").

The advantages of the web-based surveys versus print-surveys

Conventional survey administration modes such as mail, in-person, telephone and central site have been practically replaced by the use of e-mail and web-based surveys. In the literature, many studies have exposed that Web-based surveys have a number of advantages over traditional mail methods. The web-based survey allows collecting data continuously, regardless of the time of day and day of week, and without geographical limitations. Furthermore, these surveys are less expensive and can be conducted in large samples. Another advantage of web-based surveys is the speed and exactness of data collection because responses from online questionnaires can be automatically stored on databases or statistical packages, saving time of data entry as well as reducing coding errors and the risk of lost data. But, they also have some disadvantages. The most cited disadvantages are sample frame and non-response bias. Another important disadvantage is that the researcher often has no way of knowing whether there is more than one respondent at one computer address, or if one respondent is completing a questionnaire from a variety of computers.

A current perspective

Some authors have worked in new technologies applied to food frequency questionnaires. In total, nine studies were selected and they were divided into two groups depend of the purpose of the study: the first group included those papers whose principal aim was validity and reproducibility of a FFQ and the second group incorporate papers whose objective was to present and describe the tool FFQ. The main characteristics, the most important results and conclusions of the studies of the first and the second group can be seen in the table I and II, respectively.

Discussion

Chronic diseases, especially cardiovascular diseases, are increasing rapidly in the western world, resulting in the inevitable rise in health expenditures. FFQs can classify individuals into groups by estimating their intake and can thus identify those who may be at nutritional risk. Recently, conventional FFQ administration modes such as mail, in-person and telephone have started to be replaced by the use of e-mail and web-based FFQ. This paper has identified studies that have developed FFQ applying new technologies showing that they can be as valid as the methods standard for certain aims and population. Moreover, self-administered web-based or computerized FFQs present more advantages than disadvantages as compared with printed-FFQs.

These reviewed manuscripts, which included participants with a wide age ranging between 16 and 72 years, show that self-administered web-based and/or computerized FFQ can be appropriate to assess dietary intake of a wide range of ages. The participants with older ages and those who had never used a computer did not have problems in completing the questionnaires. Furthermore, it is possible to develop this type of questionnaires for different target population.

The number of food items listed on reviewed FFQ ranged from 69 to 206 and they are generally classified in groups to facilitate dietary reporting. The food items were based on the common dietary habits of the study population. The participants were asked to indicate frequency of consumption, on average, for each food. Sometimes, they also had to indicate the quantity consumed to obtained semi-quantitative information. It is not easy to obtain semi-quantitative trustworthy information, we agree with authors who consider that it is necessary to include colour photographs of food items showing different portion sizes per food. The photographs can make the questionnaire more attractive, to prevent the monotony and to help the participant to select the portion size category that best fit their daily portion.

FFQs are designed to assess "habitual" intake, over a defined period of time. The time periods used

Author	Population	Setting	Information	Objective	Structure of FFQ	Study Design	Most important results and conclusions
Engle et al. ¹	Health adult volunteers (n = 50) (49.3 ± 9.6 years)	Long Island, New York	To assess usual dietary intake during the last three months	To evaluate reproducibility and validity of a computerized, self-administered FFQ	- 85 foods and food grouping - How frequently - Portion size - A general questionnaire on demographic and anthropometric characteristics	All participants completed seven-day food records once and the computerized FFQ twice	Reproducibility was good (Spearman correlation coefficients ranged 0.56-0.87). For validity, correlations between FFQ2 and food record was better than FFQ1 vs. food record. Takes about 45 minutes to administer
Smith et al. ²	Premenopausal women (n = 91) (38.4 ± 12.7 years)	Alabama (United States)	To estimate calcium intake during the past year	Comparison of a personal computer-based FFQ (OsteoCalc) with 2 other assessment tools, Calcium Score Sheet and HHHQ	- 70 foods item considered - Questions on frequency intake with 4 frequency ranges - Questions on the amount of each food consumed - A general questionnaire (age, weight, height,...) was included	Each participant completed 3 questionnaires: OsteoCalc, Calcium Score Sheet and HHHQ	Calcium intake calculated by OsteoCalc was higher than the calculated by the other two assessment tools. There was significant difference between OsteoCalc and HHHQ.
Health et al. ³	Female students from a second-year Human Nutrition class (n = 49) (Between 19 and 31 years)	Dunedin (New Zealand)	To estimate intake of total, non-haem, haem and meat iron as well as dietary components which influence iron absorption (vitamin C, phytate, calcium, meat/fish/poultry, tea and coffee) during the past month.	To study the validity of an iron FFQ by comparing its results with those from WDR [*]	- 206 food items sorted into 17 food groups - Questions on frequency of consumption for that meal - Questions to describe the serving size	All participants completed iron FFQ and weighed diet records one time. FFQ was completed by 22 participants a second time	There was significant difference in the median intake of haem iron, meat iron, vitamin C, meat/fish/poultry and phytate from the WDR and from the adjusted iron FFQ. Its repeatability was high. Participants did not have difficulties to complete the questionnaire. Takes about 10 to 20 to 70 minutes to administer
Vandelamonte et al. ⁴	Belgian men and women (n = 86) (between 22 and 61 years)	Ghent (Belgium)	To measure fat intake during the last month	To evaluate the reliability and validity of the FFQ in relation to a diet record	- 48 questions divided into 7 categories of food items - Questions on how frequently consumed - Questions on how much food was included - A general form (age, weight, height,...) was included	Subjects completed a diet recording once and the FFQ twice	Means for total fat intake and for percent energy fat were no significant differences between the computerized fat intake questionnaire and 7-day diet records. The results indicate that the questionnaire had an acceptable reliability and validity. Participants reported ease of use
Mathys et al. ⁵	Secondary school students (n = 104) (average of 14 years)	Ghent and Deize (Belgium)	To study the dietary habits during the past month	To assess the validity and reproducibility of a Web-based FFQ by comparison with a 3-day food record	- 69 food items divided into 15 food groups - Questions on frequency of consumption with 6 frequency ranges - Questions on the portion size consumed - A general questionnaire (age, weight, height,...) was included	All participants had to complete the Web-based FFQ and 3 days of estimated food record. Some participants completed the questionnaire once again	In 6 of the 15 food groups were not significantly different between the two methods. Adequate reproducibility there were significant differences in only two food groups. FFQ underestimated some food groups and overestimated others. Take about 30 to 40 minutes to administer
Slattery ⁶	American Indians and Alaskan Natives (n = 6,604)	Alaskan, New Mexico and Arizona	To collect of dietary intake during the past year	To develop a self-administered computer-assisted DHQ that was sensitive to unique dietary patterns that exists among study population.	- Introductory screen - Three screen more to select items, frequency of consumption and serving sizes - 54 main questions - A general questionnaire about health and lifestyle	Participants completed the questionnaire only one time	Energy intake values were > 8,000 kcal and < 800 kcal for men and > 6,500 kcal and < 600 kcal for women. The average number of food items selected was 70 for people with acceptable energy intake. Takes about 36.4 minutes to administer
Wong et al. ⁷	Asian, Hispanic, and non-Hispanic white youth (boys and girls) (n = 161) (between 11 and 18 years)	Utah (United States)	To estimate calcium intake over 1 month	To explain the process of developing an interactive computerized questionnaire and to compare the results obtained on the FFQ with those estimated from 24-hour dietary recalls	- 80 food items - Questions on frequency of consumption which had between four and seven frequency responses - Questions on portion consumed	Each participant completed the 24-hour dietary recall and the computerized FFQ twice	Higher correlations for females, for the group of 15-18 years and for Hispanic participants between the two methods. There was significant difference between the first and the second FFQ. The computerized FFQ was found to be reliable in estimating calcium intake among a young multiethnic population in the United States

*FFQ: Food Frequency Questionnaire. †HHHQ: Health Habits and History Questionnaire. ‡WDR: Weighed Diet Record. †DHQ: Diet History Questionnaire.

Table II
Summary of selected studies on applying new technologies in FFQs (Group II)

Author	Information	Objective	Structure of Program
Domingo et al. ^a	To assess a series of pollutants and nutrients	To explain the design and the functioning of a computer program called RIBEPEIX	<ul style="list-style-type: none"> – Main : a general questionnaire (weight, age, sex) – Data screen: computerized FFQ – Risk screen: participants obtained information about their consumption of pollutants – Benefits screen: the intakes corresponding to EPA^a and DHA^b – Screen called “Making changes in your usual fish consumption?”
Martí-Cid et al. ^a	To estimate different chemical contaminants and to assess a long series of micro-and macronutrients	To give details of the functioning of a computer program called RIBEFOOD	<ul style="list-style-type: none"> – Main screen – Nutrients screen – Screen pollutants screen – Screen called “Change consumption”

^aEPA: Eicosapentaenoic acid.

^bDHA: Docosahexaenoic acid.

in the selected studies were the previous year, previous three months and the previous month. In the literature there are other studies that have used other periods of time like the previous six. It is not prudent to use a very short period of time, for example, the previous day because it has the disadvantage of not capturing the seasonal variation of foods available. For the other hand, when a longer period of time is used, participants have more difficulty to remember their dietary intake.

The principal aim of these studies was to evaluate validity and the reproducibility by means of a test-retest design. Although the validity is estimated by comparison with food records, 24-hour recalls and diet history, some authors like Engle and Cade are agreeing on there is no accepted “gold standard” for assessing dietary individual intake by which to judge the validity of other methods.

FFQs are the dietary assessment method most used in epidemiologic research. For this type of researches it would be very important to have a set of web-based and computerized FFQs, among which there could select those more adapted to every research. This would suppose an important saving of time and money because web-based or computerized FFQs present more advantages than printed FFQs. But there are not many studies about the applications of ICT in FFQ, for this reason, it is necessary to develop new computerized and web-based FFQs and to improve the FFQs already developed to be able to obtain more and better information.

As result of this work, at the Polytechnic University of Valencia was started the development of a new self-administered semi-quantitative Internet-FFQ to assess total daily dietary intake among university students.

Acknowledgements

González-Carrascosa, R. has a predoctoral scholarship from Generalitat Valenciana (Spain).

References

1. Engle A, Lynn LL, Koury K et al. Reproducibility and comparability of a computerized, self-administered food frequency questionnaire. Lawrence Erlbaum Associates, Inc. 1990; 13: 281-92.
2. Smith BA, Morgan SL, Vaughn WH, et al. Comparison of a computer-based food frequency questionnaire for calcium intake with 2 other assessment tools. *J Am Diet Assoc* 1999; 99: 1579-81.
3. Health A-LM, Skeaff CM, Gibson RS. The relative validity of a computer food frequency questionnaire for estimating intake of dietary iron and its absorption modifiers. *Eur J Clin Nutr* 2000; 54: 592-9.
4. Vandelanotte C, Matthys C, De Bourdeaudhuij I. Reliability and validity of a computerized questionnaire to measure fat intake in Belgium. *Nutr Res* 2004; 24: 621-31.
5. Matthys C, Pynaert I, De Keyzer W, et al. Validity and reproducibility of an Adolescent Web-Based Food Frequency Questionnaire. *J Am Diet Assoc* 2007; 107: 605-10.
6. Slattery ML, Murtaugh MA, Schumacher MC et al. Development, Implementation and Evaluation of a Computerized self-administered diet history Questionnaire for Use in studies of American Indian and Alaskan Native People. *J Am Diet Assoc* 2008; 108: 101-09.
7. Wrong SS, Boushey CJ, Novotny R, Gustafson DR. Evaluation of a Computerized Food Frequency Questionnaire to Estimate Calcium Intake of Asian, Hispanic, and Non-Hispanic White Youth. *J Am Diet Assoc* 2008; 108: 539-43.
8. Domingo JL, Bocio A, Martí-Cid R et al. Benefits and risks of fish consumption Part II. RIBEPEIX, a computer program to optimize the balance between the intake of omega-3 fatty acids and chemical contaminants. *Toxicology* 2007; 230: 227-33.
9. Martí-Cid R, Bocio A, Llobet JM et al. Balancing health benefits and chemical risks associated to dietary habits: RIBEFOOD, a new Internet resource. *Toxicology* 2008; 244: 242-48.