New technologies applied to food frequency questionnaires: a current perspective

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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.


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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 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 populations.

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

<table>
<thead>
<tr>
<th>Author</th>
<th>Population</th>
<th>Setting</th>
<th>Information</th>
<th>Objective</th>
<th>Structure of FFQ</th>
<th>Study Design</th>
<th>Most important results and conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engle et al.1</td>
<td>Health adult volunteers (n = 50) (21-39 yrs)</td>
<td>Long Island, New York</td>
<td>To assess usual dietary intake during the last three months</td>
<td>To evaluate reproducibility and validity of a computerized, self-administered FFQ</td>
<td>- 85 foods and food grouping - How frequently - Portion size - A general questionnaire on demographic and anthropometric characteristics</td>
<td>All participants completed the self-administered FFQ once and the computerized FFQ twice</td>
<td>Reproducibility was good (Spearman correlation coefficients ranged 0.56-0.87). For validity, correlations between FFQ and food record were better than FFQ1 vs. food record. Takes about 65 minutes to administer.</td>
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<tr>
<td>Smith et al.2</td>
<td>Postmenopausal women (n = 91) (56-127 yrs)</td>
<td>Alabama (United States)</td>
<td>To estimate calcium intake during the past year</td>
<td>Comparison of a personal computer-based FFQ (OsteoCalc) with 2 other assessment tools, CalciumScoreShot and HHHQ</td>
<td>- 70 foods considered - Questions on frequency intake with 4 frequency ranges - Questions on amount of calcium consumed - A general questionnaire (age, weight, height...)</td>
<td>Each participant completed 3 questionnaires: OsteoCalc, CalciumScoreShot and HHHQ</td>
<td>Calcium intake calculated by OsteoCalc was higher than the calculated by the other two assessment tools. There was a significant difference between OsteoCalc and HHHQ.</td>
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<td>Health et al.3</td>
<td>Female students from a second-year Human Nutrition class (n = 49) (between 19 and 21 yrs)</td>
<td>Dunedin (New Zealand)</td>
<td>To estimate intake of total, non-haem iron and meat avails as dietary components which influence iron absorption (vitamin C, phytate, calcium, meat/fish/poultry, and coffee) during the past month</td>
<td>To evaluate the validity of the FFQ on comparing in results with those from WDR</td>
<td>- 206 foods intakes into 17 food group - Questions on the amount of each food consumed - Questions on the proportion of each food consumed - Questions to describe the serving size</td>
<td>All participants completed FFQ and a weighed diet record once. FFQ was completed by 22 participants a second time</td>
<td>There was a significant difference in the intakes of vitamin C, meat/fish/poultry and phytate from the WDR and the FFQ. The reproducibility was high. Participants differed in their ability to complete the questionnaires. Takes about 20 to 70 minutes to administer.</td>
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<tr>
<td>Vandevensteen et al.4</td>
<td>Belgian men and women (n = 40) (between 22 and 61 yrs)</td>
<td>Ghent (Belgium)</td>
<td>To measure fat intake during the last month</td>
<td>To evaluate the reliability and validity of the FFQ in relation to an 8-day diet record</td>
<td>- 48 questions divided into 7 categories of food items - Questions on frequency of consumption and serving sizes - A general questionnaire (age, weight, height...) was included</td>
<td>Subjects completed the questionnaire once and the FFQ twice</td>
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<tr>
<td>Marthy et al.5</td>
<td>Secondary school students (n = 18) (average of 14 yrs)</td>
<td>Ghent and Deinze (Belgium)</td>
<td>To evaluate the validity of a Web-based FFQ compared with a 5-day food record</td>
<td>- 89 foods divided into 5 food groups - Questions on frequency of consumption with 6 frequency ranges - Questions on portion size and serving sizes - A general questionnaire (age, weight, height...) was included</td>
<td>All participants had complete the Web-based FFQ and multiple food record. Some participants completed the questionnaire on the second day</td>
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<tr>
<td>Slattery6</td>
<td>American Indians and Alaskan Natives (n = 6,600)</td>
<td>Alaskan, New Mexico and Arizona</td>
<td>To collect dietary intake during the past year</td>
<td>To develop a self-administered computer-assisted FFQ that is sensitive to specific dietary patterns that exist among study population</td>
<td>- Introductory screens - Three sets of food items - Questions on frequency of consumption and serving sizes - 54 mini questions - A general questionnaire on health and lifestyle</td>
<td>Participants completed the questionnaire only once</td>
<td>Energy intake was in the range of 3,800-5,000 kcal for men and 2,800-5,000 kcal for women. The mean age of food items selected was 30% fat with a good energy intake. Takes about 45 minutes to administer.</td>
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<td>Wong et al.7</td>
<td>Asian, Hispanic, and non-Hispanic white youth boys and girls (n = 161) (between 11 and 18 yrs)</td>
<td>Utah (United States)</td>
<td>To estimate calcium intake over one month</td>
<td>To evaluate the process of developing an interactive computer-assisted questionnaire to compare the results obtained on the FFQ with those estimated from 24-hour dietary recalls</td>
<td>- 85 foods - Questions on frequency of consumption which had least four and seven frequency responses - Questions on portion size consumed</td>
<td>Each participant completed the 24-hour dietary recall and the computerized FFQ twice</td>
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FFQ: Food Frequency Questionnaire. HHHQ: Health Habit and History Questionnaire. WDR: Weighed Diet Record. DHQ: Diet History Questionnaire.
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 difficult 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 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.

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References