A Dish-based Semi-quantitative Food Frequency Questionnaire for Assessment of Dietary Intakes in Epidemiologic Studies in Iran: Design and Development

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ABSTRACT

Background: Earlier forms of food frequency questionnaire (FFQ) used in Iran have extensive lists of foods, traditional categories and food-based design, mostly with the interviewer-administered approach. The aim of the current paper is to describe the development of a dish-based, machine-readable, semi-quantitative food frequency questionnaire (DFQ).

Methods: Within the framework of the Study on the Epidemiology of Psychological, Alimentary Health and Nutrition project, we created a novel FFQ using Harvard FFQ as a model.

Results: The following steps were taken to develop the questionnaire: Construction of a list of commonly consumed Iranian foods, definition of portion sizes, design of response options for consumption frequency of each food item and finally a pilot test of the preliminary DFQ. From a comprehensive list of foods and mixed dishes, we included those that were nutrient-rich, consumed reasonably often or contributed to between-person variations. We focused on mixed dishes, rather than their ingredients, along with foods. To shorten the list, the related food items or mixed dishes were categorized together in one food group. These exclusions resulted in a list of 106 foods or dishes in the questionnaire. The portion sizes used in the FFQ were obtained from our earlier studies that used dietary recalls and food records. The frequency response options for the food list varied from 6-9 choices from "never or less than once a month" to "12 or more times per day".

Conclusions: The DFQ could be a reasonable dietary assessment tool for future epidemiological studies in the country. Validation studies are required to assess the validity and reliability of this newly developed questionnaire.

Keywords: Dietary assessment, food frequency questionnaire, Iran, nutritional epidemiology

Original Article

INTRODUCTION

The global alarming increase in the prevalence of chronic diseases, as the most leading cause of death, has attracted

considerable attention over the past decades.[1,2] A strikingly high prevalence of chronic diseases and their risk factors has been indicated among Iranian adults.[3] Findings from numerous studies have confirmed the crucial role of life-style factors, in particular dietary intakes, on the etiology and management of chronic diseases;[4-7] however, the optimal assessment of dietary intakes as the principal challenge in this regard still remains unresolved. So far, various methods such as dietary recalls, food records, diet histories and food frequency questionnaires (FFQs) have been proposed for dietary intake assessment.[8,9] Each method has its own strengths and weaknesses.[8,9] Study objectives determine the most appropriate method of dietary assessment.[9] Recall bias, embarrassment of participants, requiring well-trained interviewers and food coding in the dietary recalls might affect its validity and utilization.[8-10] Despite the accuracy of food records, some weaknesses such as the possibility of change in the usual eating habits and the necessity of substantial training of participants cannot be excluded.[8-11] Most importantly, dietary recalls and records do not reflect participants' usual intakes.[8-10,12] To obtain long-term dietary intakes, nutritional epidemiologists have recommended the use of diet histories and FFQs.[8,9] The potential bias due to an un-standardized interview approach, time-consuming, lengthy and open-ended food lists in the diet histories, have considerably limited the application of this method.[8,13] Now-a-days, FFQs are the most widely used dietary assessment tool in large-scale epidemiological studies.[14] The acceptability of FFQs is due to several important advantages of this method, such as low cost, ease of administration, computer processing, considering within-person variation and reflecting long-term intakes.[14,15] Some characteristics of FFQs, such as their length and complexity, which is mainly due to asking for detailed information on a long list of food items, portion sizes and food preparation methods could affect the accuracy of collected information.[16-18] On the other hand, poorly designed FFQs without comprehensive food lists may lead to incorrect information and misclassification, which in turn could result in masking diet-disease relations.[16-19] Thus, the development of a comprehensive and appropriate FFQ is the cornerstone of nutritional epidemiological studies.

So far, several epidemiological studies using different FFQs have been performed amongst the Iranian population. All previously used FFQs in Iranian settings have mainly been consisted of the extensive list of foods and followed a food-based design.[20-23] However, the limitations and pitfalls in the accuracy of information that is provided using such FFQs have been described before.[13] Worldwide, many epidemiological studies, including Korean,[24] Japanese,[25] Brazilian,[26] Swiss,[27] Bangladeshi[28] and Zimbabwean[29] studies have used dish-based FFQs. Typical Iranian dietary pattern is characterized by various mixed dishes, which contains several ingredients prepared in different ways. With no doubt, it is very difficult to estimate usual intake of single ingredients from various mixed Iranian dishes. To the best of our knowledge, no earlier study in Iran has used a dish-based FFQ or a FFQ with multiple-choice frequency response options. Furthermore, all previous studies in the country have used the interviewer-administered FFQs.[20-23] In the framework of the Study on the Epidemiology of Psychological, Alimentary Health and Nutrition (SEPAHAN) project,[30] we designed a dish-based machine-readable semi-quantitative food frequency questionnaire (DFQ) with multiple choice frequency response options for the first time in Iran. The aim of the present paper is to describe how this dietary assessment tool was developed.

METHODS

To develop the DFQ, we used the Harvard FFQ as a model,[31] which assesses the dietary intake of a person in the preceding 12 months. The following steps were taken to develop the questionnaire: Construction of a list of commonly consumed Iranian foods, definition of portion sizes, determining the frequency response options for each food item and finally testing the face validity of the questionnaire in a pilot setting to check for the comprehension and feasibility.

Food list construction

As the initial step, a comprehensive list of foods was prepared based on the information provided by local experienced nutritionists, considering all commonly consumed Iranian foods and mixed dishes. To avoid missing major food items, we

listed foods commonly consumed by Iranians as meal (breakfast, lunch and dinner) or snack. From the comprehensive list of foods and mixed dishes, we selected those that were nutrient-rich (such as liver), consumed reasonably often (such as different types of bread), or contributed to between-person variations (such as sausage). Owing to the high consumption of mixed dishes among Iranian population, it is difficult for people to estimate usual intake of ingredients of those dishes. In contrast to previously designed FFQs in the country,[20-23] we focused on foods and mixed dishes rather than single ingredients. For example, Iranians consume potato through several mixed dishes such broth, olviyeh (potato salad), cutlet, different stews, etc., Certainly, it is too hard to estimate total potato intake of a person by asking participants to remember the frequency consumption of potato in the preceding 12 months. Participants may get confused while trying to add their usual potato intake that comes from different sources and it is highly possible that some potato-containing dishes be forgotten or ignored. However, it would be much easier for them to make an estimate of the amount and frequency of consuming every single dish. It is generally assumed that questionnaire length has a significant effect on the survey response rate[16-18] as respondents get tired, bored and/or distracted by external factors. Furthermore, a lengthy questionnaire is less likely to be completed and returned.[14,32,33] As we attempted to design a self-administered questionnaire, we pilot tested the comprehensive list of food items/dishes among a group of individuals (n = 35) in order to exclude some foods that were consumed rarely or never. Finally, these exclusions resulted in a list of 106 food items or dishes in the questionnaire. To simplify the completion of the questionnaire, we categorized food items into five major groups: (1) mixed dishes (cooked or canned: 29 items); (2) grains (different types of bread, cakes, biscuits and potato: 10 items); (3) dairy products (dairies, butter and cream: 9 items); (4) fruits and vegetables (22 items); and (5) miscellaneous food items and beverages (including sweets, fast foods, nuts, desserts and beverages: 36 items).

Determination of potion sizes

Although portion sizes in FFQs are generally poorly estimated and do not contribute significantly to the between-person variations in dietary intakes, their quantification in a questionnaire will help better ranking of individuals in terms of their dietary intakes.[18] In the DFQ, portion sizes for food items and mixed dishes were defined based on the most commonly consumed portion size for each item among Iranian general population. To increase precision and accuracy of estimates, we attempted to provide the portion sizes of foods and mixed dishes as a unit with the same perception for all people. To reach these portion sizes, we used reported portion sizes in dietary recalls and food records in our earlier studies. Furthermore, we pilot tested the preliminary FFQ by administering it in a group of adults (n = 35) to determine the most appropriate portion size for every single food item. A group of nutrition experts also discussed about the portion sizes to finalize the most suitable choice for each food item. For example, we used "loaf" for breads, "medium-sized plate" for cooked rice, "tablespoon" for raisins and "bag" for potato chips.

Frequency response options

Similar to the Harvard FFQ,[34] we used nine multiple-choice options (for most food items) varying from "never or less than once per month" to "12 or more times per day" to estimate average frequency of different food intakes. The frequency response options for each food item were defined separately in a row against the food list. This is in contrast to the Harvard FFQ in which the frequency response options are indicated in the top of a column for all food items.[34] For all frequency response options, we also mentioned the portion sizes repeatedly to simplify responding [Figure 1]. The number of frequency response options was not constant for all foods. For foods consumed infrequently, we omitted the high-frequency options while for highly consumed foods, the number of multiple-choice options were increased. The frequency response options for the food list varied from six to nine choices. For instance, the frequency response for tuna consumption included six options, as follows: Never or less than once per month, 1-3 times per month, 1 time per week, 2-4 times per week, 5-6 times per week and 1-2 times per day. However, for tea which is consumed more frequently, the frequency response included nine options, as follows: Never or less than 1 cup per

A.

	Never, or less than one per month	1-3 per month	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Raisins (1 oz., or small pack) or grapes (1/2 cup)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Prunes or dried plums (6 prunes or 1/4 cup)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Oranges (1)	☐	☐	☐	☐	☐	☐	☐	☐	☐

B.

Raisins	☐ never or less than 1 Tbsp per month	☐ 1-3 Tbsp per month	☐ 1 Tbsp per week	☐ 2-4 Tbsp per week	☐ 5-6 Tbsp per week	☐ 1 Tbsp per day	☐ 2-3 Tbsp per day	
Grapes	☐ never or less than 1 cluster per month	☐ 1-3 cluster(s) per month	☐ 1 cluster per week	☐ 2-4 clusters per week	☐ 5-6 clusters per week	☐ 1 cluster per day	☐ 2-3 clusters per day	☐ 4-5 clusters per day
Citrus (Orange, Tangerines, Sweet lemon)	☐ never or less than 1 per month	☐ 1-3 per month	☐ 1 per week	☐ 2-4 per week	☐ 5-6 week	☐ 1-2 per day	☐ 3-5 per day	

Figure 1: Sample of questions and layout of the Harvard food frequency questionnaire (A) in comparison with the DFQ (B). Different number of response options for each food item, including portion sizes that are more familiar to Iranians, and including the response options of consumption frequencies for each food item are among the major features that have been considered in designing the DFQ

month, 1-3 cups per month, 1-3 cups per week, 4-6 cups per week, 1 cup per day, 2-4 cups per day, 5-7 cups per day, 8-11 cups per day and ≥12 cups per day). The pilot study on 35 subjects, which was conducted to test the face validity of the DFQ, assisted us to select proper number of response options for each food item in the list.

Calculation of food and nutrient intakes from DFQ

Using the DFQ, a daily value for each item can be calculated based on food composition, specified portion size and the average of reported frequency. For example, if a person reports to consume macaroni 2-4 plates per week, we can compute the daily intake of ground beef from this item according to this formula: 0.43 (3 (average number of plates per week) divided by 7 (number of days per week)) multiplying 50 (grams of ground beef in each plate of macaroni). Moreover, other mixed dishes in this FFQ contain ground beef such as barbecue, cutlet, etc., Therefore, total ground beef intake for a participant will be calculated by the sum of his/her daily ground beef intake from different food items in the list. The food composition of mixed dishes was determined based on common recipes consumed in the country. In addition, a group of five nutrition experts collected 15 home or restaurant recipes for each Iranian mixed dish that was included the DFQ. Finally, mean values of different ingredients of a mixed dish was considered as the final food composition details of that dish. Given the seasonal variation in the dietary intakes of some fruits and vegetables, in the DFQ participants are asked to mention the consumption frequency of such items during the months that those products are widely available in the market. In the calculation of fruit and vegetables, this factor has also been taken into account.

RESULTS AND DISCUSSION

In the present article, we described the development and design of a dish-based, machine-readable, semi-quantitative FFQ (called DFQ) for the Iranian adult population. To the best of our knowledge, this is the first time that such a dietary assessment tool has been created in the country.

In general, FFQs have been proposed as the optimal instruments for dietary intake assessments in large epidemiological studies.[14,15] Data from FFQs can be used to elucidate diet-disease relations through ranking participants based on their usual dietary intakes. As shown by earlier investigations,

this dietary assessment tool is not appropriate for estimating absolute nutrient intakes.[14] Along with all dietary assessment methods, some potential disadvantages could also be noted about FFQs including recall bias, overestimation of dietary intakes particularly for rarely-consumed and healthy-perceived foods (e.g., fruit and vegetables), bias of current intake, misclassification and bias of pre-established food listing.[8,14]

In the DFQ, we focused on compiling a comprehensive list of foods to capture total energy intake.[14] As discussed by well-known researchers in the field of nutritional epidemiology, total energy intake must be controlled for in almost all epidemiological studies.[34] Moreover, the main objective of the current study was to develop an easy-to-use FFQ for future epidemiological studies in Iran. Given that longer questionnaires may cause respondent fatigue and poorer quality of gathered information,[14,31,35,36] we focused on nutrient-rich frequently consumed foods and dishes. We also included those foods that could explain the between-person variations in diet. Earlier FFQs that have been used in Iranian epidemiological studies were developed for the Tehran Lipid and Glucose Study (TLGS),[21] the Isfahan Health Heart Program (IHHP)[37] and the Golestan Cohort Study.[22] These questionnaires included 168, 48 and 150 food items, respectively. The corresponding figure in our DFQ was 106. The difference in food items could be explained by the inclusion of food items in earlier questionnaires but dishes in the DFQ. Compared with previous Iranian FFQs, the principal discriminatory feature of DFQ was incorporating Iranian mixed dishes instead of including their ingredients. Since typical Iranian dishes usually consist of various ingredients, it is difficult for respondents to estimate their total intake of one ingredient which may be used in several mixed dishes. Inclusion of mixed dishes instead of their ingredients in a FFQ will not only facilitate participants' responding, but also will reduce the length of the questionnaire. Using the current approach of including mixed dishes instead of their ingredients could shorten the list of food items in the DFQ, shorten the time required to fill the questionnaire, decrease participants boredom and increase accuracy of dietary intake assessment. Furthermore, as cooking and other food processing methods affect the nutritional value of foods, including mixed dishes instead of food ingredients can better elucidate the relationship between diet and diseases. Some investigators believe that shortening of food list and using a unique recipe for all participants may lead to decreased accuracy and failure to estimate the total energy intake.

The frequency response section in the DFQ was composed of multiple-choice options. Although open-ended frequency responses would lead to enhanced precision and continuous variables instead of categorical ones, it has been shown that using multiple-choice frequency response options increases clarity and reduces errors.[26,38-40] However, it must be kept in mind that frequency options must be designed in a manner that covers all possible choices of consumption frequency responses in participants.[31,39] The number of options should range between 5 and 10;[14] broadened response options with less than five choices would significantly limit the discrimination capacity, while excessive options may be confusing.[14,26] Between-persons variation for frequently and rarely consumed foods is distinguished at the high and low end of the scale, respectively.[14] All previously used FFQs in Iran had open-ended frequency response options. The DFQ is the first FFQ in the country with multiple-choice frequency response options. We believe that the multiple-choice frequency response options will facilitate the completion of the DFQ as it can be filled by participants without the help of an interviewer (i.e., self-administered questionnaire). The frequency response choices in the DFQ are different from those in the Harvard FFQ. As consumption frequency of food items may vary in a broad range, we decided to include a unique set of frequency response options for each food item in the DFQ.

As generally portion sizes are poorly estimated, the inclusion of portion sizes in FFQs is still controversial.[11] It seems that the large percentage of between-persons variation could be explained by consumption frequency, rather than portion sizes. Estimating portion size of foods is difficult for most participants.[41,42] However, it is important to recognize that calculation of absolute nutrient intake is impossible when information on portion sizes is not available.[40] Some investigators have suggested to use the commonly consumed portion sizes for calculating nutrient intakes in case of missing portion sizes in a FFQ. This method has

apparently resulted in reasonable estimates of nutrient intakes. For example, the correlations of nutrient intake obtained from FFQs with and without portion sizes were over 0.9.[43] Presumably, inclusion of pre-specified portion sizes make questionnaire easier to complete by respondents. It has been proposed to include the most frequently consumed or traditional portion sizes in FFQs.[26] This is what we have followed in designing the DFQ. Although earlier FFQs in Iran have included portion sizes, this information was mostly based on serving sizes recommended by the U.S. Department of Agriculture Food Guide Pyramid, not on the most frequently locally used portion sizes.

As previously mentioned, the DFQ is a machine-readable questionnaire. For this purpose, we developed an optical mark recognition (OMR) system that can distinguish the selected answer for each food item in the scanned pictures of questionnaires. Furthermore to convert selected consumption frequency responses option to exact intake of a food item, appropriate software was developed. Results from the pilot study showed the very high accuracy of the developed computerized systems. For large epidemiological studies, using this system will have a crucial role in reducing the expenses (e.g., staff, time) and errors that are inevitable while extracting data manually.

Various approaches have been used to assess the performance of FFQs including classic validation study and evaluation of the ability to predict expected diet-diseases correlation.[37] Although, a classic validation study has not been conducted for the DFQ so far, we have recently indicated several established relationships between dietary factors and diseases using this tool.[44-47] Such findings can be interpreted as qualitative support for the validity of a questionnaire.[38]

CONCLUSIONS

The DFQ could be an appropriate dietary assessment tool for future epidemiological studies in Iran. However, before its application in large epidemiological studies, the validity and reliability of this newly developed FFQ should be assessed among different Iranian populations.

REFERENCES

1. Yach D, Hawkes C, Gould CL, Hofman KJ. The global burden of chronic diseases: Overcoming impediments to prevention and control. JAMA 2004;291:2616-22.
2. Samb B, Desai N, Nishtar S, Mendis S, Bekedam H, Wright A, *et al*. Prevention and management of chronic disease: A litmus test for health-systems strengthening in low-income and middle-income countries. Lancet 2010;376:1785-97.
3. Esteghamati A, Meysamie A, Khalilzadeh O, Rashidi A, Haghazali M, Asgari F, *et al*. Third national surveillance of risk factors of non-communicable diseases (SuRFNCD-2007) in Iran: Methods and results on prevalence of diabetes, hypertension, obesity, central obesity, and dyslipidemia. BMC Public Health 2009;9:167.
4. Hu FB. Diet and lifestyle influences on risk of coronary heart disease. Curr Atheroscler Rep 2009;11:257-63.
5. Walker KZ, O'Dea K, Gomez M, Girgis S, Colagiuri R. Diet and exercise in the prevention of diabetes. J Hum Nutr Diet 2010;23:344-52.
6. Foroughi M, Akhavanzanjani M, Maghsoudi Z, Ghiasvand R, Khorvash F, Askari G. Stroke and nutrition: A review of studies. Int J Prev Med 2013;4:S165-79.
7. Kastorini CM, Milionis HJ, Esposito K, Giugliano D, Goudevenos JA, Panagiotakos DB. The effect of Mediterranean diet on metabolic syndrome and its components: A meta-analysis of 50 studies and 534,906 individuals. J Am Coll Cardiol 2011;57:1299-313.
8. Freudenheim JL. A review of study designs and methods of dietary assessment in nutritional epidemiology of chronic disease. J Nutr 1993;123:401-5.
9. Hammond KK. Assessment: Dietary and clinical data. Krause's Food and Nutrition Therapy. 12th ed. Pennsylvania, US: Elsevier; 2008. p. 383-410.
10. Buzzard M. 24-hour dietary recall and food record methods. In: Willett W, editor. Nutritional Epidemiology. 2th ed. Oxford, New York: Oxford University Press; 1998. p. 50-74.
11. Fehily AM. Epidemiology for nutritionists: 4. Survey methods. Hum Nutr Appl Nutr 1983;37:419-25.
12. Russell-Briefel R, Caggiula AW, Kuller LH. A comparison of three dietary methods for estimating vitamin A intake. Am J Epidemiol 1985;122:628-36.
13. Kristal AR, Peters U, Potter JD. Is it time to abandon the food frequency questionnaire? Cancer Epidemiol Biomarkers Prev 2005;14:2826-8.
14. Willett W. Food frequency methods. In: Willett W, editor. Nutritional Epidemiology. 2th ed. Oxford, New York: Oxford University Press; 1998. p. 74-100.
15. Subar AF. Developing dietary assessment tools. J Am Diet Assoc 2004;104:769-70.
16. Molag ML, de Vries JH, Ocké MC, Dagnelie PC, van den Brandt PA, Jansen MC, *et al*. Design characteristics of

food frequency questionnaires in relation to their validity. Am J Epidemiol 2007;166:1468-78.
17. Wolk A, Bergström R, Adami HO, Ohlander EM, Bruce A, Holmberg L, *et al*. Self-administered food frequency questionnaire: The effect of different designs on food and nutrient intake estimates. Int J Epidemiol 1994;23:570-6.
18. Cade JE, Burley VJ, Warm DL, Thompson RL, Margetts BM. Food-frequency questionnaires: A review of their design, validation and utilisation. Nutr Res Rev 2004;17:5-22.
19. Bingham SA, Luben R, Welch A, Wareham N, Khaw KT, Day N. Are imprecise methods obscuring a relation between fat and breast cancer? Lancet 2003;362:212-4.
20. Esmaillzadeh A, Azadbakht L. Major dietary patterns in relation to general obesity and central adiposity among Iranian women. J Nutr 2008;138:358-63.
21. Esfahani FH, Asghari G, Mirmiran P, Azizi F. Reproducibility and relative validity of food group intake in a food frequency questionnaire developed for the Tehran Lipid and Glucose Study. J Epidemiol 2010;20:150-8.
22. Malekshah AF, Kimiagar M, Saadatian-Elahi M, Pourshams A, Nouraie M, Goglani G, *et al*. Validity and reliability of a new food frequency questionnaire compared to 24 h recalls and biochemical measurements: Pilot phase of Golestan cohort study of esophageal cancer. Eur J Clin Nutr 2006;60:971-7.
23. Mohammadifard N, Omidvar N, Houshiarrad A, Neyestani T, Naderi GA, Soleymani B. Validity and reproducibility of a food frequency questionnaire for assessment of fruit and vegetable intake in Iranian adults. J Res Med Sci 2011;16:1286-97.
24. Park MK, Kim DW, Kim J, Park S, Joung H, Song WO, *et al*. Development of a dish-based, semi-quantitative FFQ for the Korean diet and cancer research using a database approach. Br J Nutr 2011;105:1065-72.
25. Kobayashi T, Tanaka S, Toji C, Shinohara H, Kamimura M, Okamoto N, *et al*. Development of a food frequency questionnaire to estimate habitual dietary intake in Japanese children. Nutr J 2010;9:17.
26. Ferreira MG, Silva NF, Schmidt FD, Silva RM, Sichieri R, Guimarães LV, *et al*. Development of a food frequency questionnaire for adults in a population-based sample in Cuiabá, Mid-Western region of Brazil. Rev Bras Epidemiol 2010;13:413-24.
27. Marques-Vidal P, Ross A, Wynn E, Rezzi S, Paccaud F, Decarli B. Reproducibility and relative validity of a food-frequency questionnaire for French-speaking Swiss adults. Food Nutr Res 2011;55:5905.
28. Sudo N, Sekiyama M, Watanabe C, Bokul AT, Ohtsuka R. Gender differences in food and energy intake among adult villagers in North Western Bangladesh: A food frequency questionnaire survey. Int J Food Sci Nutr 2004;55:499-509.
29. Merchant AT, Dehghan M, Chifamba J, Terera G, Yusuf S. Nutrient estimation from an FFQ developed for a Black Zimbabwean population. Nutr J 2005;4:37.
30. Adibi P, Keshteli AH, Esmaillzadeh A, Afshar H, Roohafza H, Bagherian-Sararoudi H, *et al*. The study on the epidemiology of psychological, alimentary health and nutrition (SEPAHAN): Overview of methodology. J Res Med Sci 2012;17:S292-8.
31. Stark A. An historical review of the Harvard and the National Cancer Institute Food Frequency Questionnaires: Their similarities, differences, and their limitations in assessment of food intake. Ecol Food Nutr 2002;41:35-74.
32. Burley V, Cade J. Consensus document on the development, validation and utilization of a food frequency questionnaire. The Fourth International Conference on Dietary Assessment Methods; 2000 sep 17-20; Tucson, Arizona (USA).
33. Kuskowska-Wolk A, Holte S, Ohlander EM, Bruce A, Holmberg L, Adami HO, *et al*. Effects of different designs and extension of a food frequency questionnaire on response rate, completeness of data and food frequency responses. Int J Epidemiol 1992;21:1144-50.
34. Willett WC, Howe GR, Kushi LH. Adjustment for total energy intake in epidemiologic studies. Am J Clin Nutr 1997;65:1220S-8.
35. Pietinen P, Hartman AM, Haapa E, Räsänen L, Haapakoski J, Palmgren J, *et al*. Reproducibility and validity of dietary assessment instruments. II. A qualitative food frequency questionnaire. Am J Epidemiol 1988;128:667-76.
36. Thompson FE, Byers T. Dietary assessment resource manual. J Nutr 1994;124:2245S-317.
37. Mohammadifard N, Sarrafzadegan N, Nouri F, Sajjadi F, Alikhasi H, Maghroun M, *et al*. Using factor analysis to identify dietary patterns in Iranian adults: Isfahan Healthy Heart Program. Int J Public Health 2012;57:235-41.
38. Willett W, Lenart E. Reproducibility and validity of food-frequency questionnaires. In: Willett W, editor. Nutritional Epidemiology. 2th ed. Oxford, New York: Oxford University Press; 1998. p. 101-47.
39. Dehghan M, Al Hamad N, Yusufali A, Nusrath F, Yusuf S, Merchant AT. Development of a semi-quantitative food frequency questionnaire for use in United Arab Emirates and Kuwait based on local foods. Nutr J 2005;4:18.
40. Cade J, Thompson R, Burley V, Warm D. Development, validation and utilisation of food-frequency questionnaires-A review. Public Health Nutr 2002;5:567-87.

41. Faggiano F, Vineis P, Cravanzola D, Pisani P, Xompero G, Riboli E, *et al*. Validation of a method for the estimation of food portion size. Epidemiology 1992;3:379-82.
42. Hunter DJ, Sampson L, Stampfer MJ, Colditz GA, Rosner B, Willett WC. Variability in portion sizes of commonly consumed foods among a population of women in the United States. Am J Epidemiol 1988;127:1240-9.
43. Hernandez-Avila M, Master C, Hunter D, Buring J, Phillips J, Willett W, *et al*. Influence of additional portion size data on validity of a semi-quantitative food frequency questionnaire. Am J Epidemiol 1988;128:891.
44. Esmaillzadeh A, Keshteli AH, Feizi A, Zaribaf F, Feinle-Bisset C, Adibi P. Patterns of diet-related practices and prevalence of gastroesophageal reflux disease. Neurogastroenterol Motil 2013; 25:831-e638.
45. Esmaillzadeh A, Keshteli AH, Hajishafiee M, Feizi A, Feinle-Bisset C, Adibi P. Consumption of spicy foods and the prevalence of irritable bowel syndrome. World J Gastroenterol 2013;19:6465-71.
46. Barak F, Falahi E, Keshteli AH, Yazdannik A, Esmaillzadeh A. Adherence to the DASH diet in relation to obesity among Iranian female nurses. Public Health Nutr 2013; [In Press].
47. Zaribaf F, Falahi E, Barak F, Heidari M, Keshteli AH, Yazdannik A, *et al*. Fish consumption is inversely associated with the metabolic syndrome. Eur J Clin Nutr 2013; [In Press].

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