Original Article

Can a food frequency questionnaire be used to capture dietary intake data in a 4 week clinical intervention trial?

Pauline Xie Xinying MND[1], Manny Noakes PhD[2] and Jennifer Keogh MSc[2]

[1]*Department of Nutrition and Dietetics, School of Medicine, Flinders University, Adelaide, South Australia*
[2]*CSIRO HSN, Adelaide, South Australia*

Collecting dietary data in the clinical research setting is labour intensive and can be burdensome for study participants. The aim of this study was to assess the agreement between data obtained from 2 different dietary assessment methods, a 74-item semi-quantitative food frequency questionnaire (FFQ) and 3-day weighed food records (WFR) used to estimate dietary intake over the preceding month. One hundred and fifty nine subjects, aged between 31 and 74 years (53 males, 65 females), enrolled in a clinical trial at the Commonwealth Scientific and Industrial Research Organisation, Division of Health Sciences and Nutrition, (CSIRO HSN) Adelaide, Australia. Group mean intakes and individual mean intakes estimated by the two measures were compared. One hundred and eighteen (91%) three-day WFR and their corresponding FFQ were analysed. Pearson correlation coefficients ranged from 0.22 for cholesterol to 0.78 for alcohol (median 0.41). Mean energy and nutrient intakes were within ± 20% difference. The FFQ gave lower carbohydrate intake estimates, percentage energy from carbohydrate (P <0.001) and dietary fibre (P <0.05) and gave higher percentage energy from saturated fat estimates, poly-unsaturated fatty acids (P <0.001) and mono-unsaturated fatty acids (P <0.05). Subjects were also ranked into quintiles and the quintiles cross-tabulated. The FFQ classified more than two thirds of the subjects within ±1 quintile difference for all nutrients. We conclude that this FFQ can capture similar information as WFR and may be used for estimation of dietary intakes over a relatively short time in clinical intervention trials.

Key words: food frequency questionnaire, validity, weighed food record, dietary intake, nutritional analysis, Australia

Introduction

Dietary assessment tools are used to obtain information on individual or group dietary intakes and commonly used methods are weighed food records (WFR), food frequency questionnaires (FFQ) dietary recall and diet histories.[1] The method chosen depends on the objectives of the study, the resources available and the demands of the technique[2] and should be validated in the context in which they are used. WFR provide accurate data on dietary intake[3] and thus compliance to a research protocol. However, WFR are time-consuming, requiring highly skilled interviewers and hence are resource intensive and expensive. They are burdensome for study participants who may be have difficulties complying with the rigors of daily weighing of food and may underreport their intake.[3] FFQ are retrospective and elicit information on the frequency of consumption of a specified list of foods and drinks, and may or may not include estimates of serving sizes. There has been much debate on the validity and reliability of FFQ as a measure of nutrient intake, and the situations in which it is appropriate to use them.[4-6] FFQ are much less invasive, can achieve higher response rates and are relatively inexpensive.[7]

In Australia, the Anti-Cancer Council of Victoria (ACCV) has developed a 74-item semi-quantitative self administered FFQ which can be optically scanned to provide analysis of nutrient intake data and thereby reduce intensive dietetic input. It is quick and easy to use. It was designed to sort individuals into quintiles based on estimated usual intake of food and nutrients over preceding 12 months and has been validated relative to seven-day weighed food records.[8]

The aim of this study was to assess the use of the ACCV FFQ in a clinical trial population by comparing data obtained using the FFQ and data from 3-day WFR which were being used to estimate dietary intake over the preceding month.

Correspondence address: Dr Manny Noakes, CSIRO HSN, PO Box 10041 BC, Adelaide SA 5000, Australia
Tel: 0883038827; Fax 0883038899
Email: manny.noakes@csiro.au
Accepted 28 May 2004

Methods

Subjects

The subjects in this study were enrolled in a dietary intervention study (N =159) comparing the effects of dose and frequency of consumption of phytosterol-containing yoghurt, on serum lipids, carotenoids and phytosterols. Subject selection criteria were: age 20-75 years, body mass index (BMI) <35 kg/m^2, total cholesterol 5.0-7.5 mmol/L, triglycerides <4.5mmol/L, cholesterol-lowering medication was allowed if the type and dosage was maintained constant throughout the study. Exclusion criteria were: persons considered by the investigator to be unwilling, unlikely or unable to comprehend or comply with the study protocol and restrictions, subjects taking any supplements which could interfere with the biochemical parameters of interest, presence of diabetes, known lactose intolerance and untreated hyper/hypothyroidism. The study had ethics approval from the CSIRO ethics committee and subjects gave informed consent. The study design was a single-blinded parallel study with 4 interventions over a period of 4 weeks; subjects were matched according to their baseline cholesterol level and randomised to 1 of 4 interventions (yoghurt containing 1 or 2g phytosterols every day; 2g phytosterols on alternate days; control yoghurt with no phytosterols every day). The subjects were required to consume 140g low fat fruit yoghurt per day which provided 448kJ, 7g protein, 18g carbohydrate and 250mg calcium but not otherwise change their eating habits.

Weighed food records

Subjects were given detailed instructions on how to weigh and record their dietary intake, and an opportunity to practice before the commencement of the study; weighing scales were provided for those who did not possess one. Subjects were required to complete two 3-day WFR; each done two weeks apart. Each record was checked, in the presence of the subject, for accuracy and clarifications by a qualified dietitian.

Food frequency questionnaire

The 74-item semi-quantitative ACCV FFQ was administered at the end of the trial. The subjects were not informed when it would be administered in order to minimise recall bias. The subjects were given clear instructions to recall their dietary habits over the previous 4 weeks of the trial. The ACCV FFQ was checked for completion by a member of the clinical trial staff. The first page of the FFQ consists of 1) simple instructions on completing the questionnaire, 2) the date completed, 3) questions on the quantity of fruits, milk, bread and sugar taken daily, 4) types of vegetables consumed daily, 5) types of milk, cheese, bread and spread usually used, and 6) number of eggs taken per week. With the questions on the types of food eaten, more than one answer can be selected (e.g. question 10 asks about the type of cheese usually consumed, the subject may select more than one option if they consume more than one type of cheese) in which case, the nutrients are computed with the assumption that equal quantities of each type were consumed. The second page of the questionnaire consists of four sets of photos depicting three different serve sizes for potatoes, vegetables, steak and casserole. Each photograph shows the 25th percentile (photo A), median (photo B) and 75th percentile (photo C) of serving sizes reported by Ireland *et al*.[9] Subjects may select from 7 serving size portions: less than A, A, between A and B, B, between B and C, C, and more than C. There is also an option to select nil intake, e.g. "I never ate steak". For items that showed consistent differences in serving sizes between genders the portion size will be scaled down or up using a factor automatically used by the nutrient analysis package developed by the ACCV. The 3rd and 4th pages of the FFQ list 74 items with 10 frequency options ranging from "never" to "3 or more times per day". The list is categorised into 4 sections 1) cereal foods, sweets and snacks, 2) dairy products, meat and fish, 3) fruits and 4) vegetables. Three questions on alcohol intake are also included to find out 1) how many times, 2) how much, and 3) the maximum amount of alcohol consumed at any one time.

Nutrient analysis

The WFR were computed at CSIRO using Diet 1™ (version 4.2, 1996, Xyris® software, Brisbane) software and the NUTTAB95 food composition database. FFQ and subject barcodes were obtained from the ACCV and the completed FFQ questionnaires sent to the ACCV for analysis using software based on the NUTTAB95 food composition database.

Statistical analysis

All statistical analysis was performed using Statistical Package for Social Sciences™ for Windows (version 10.0.7, 1999, ©SPSS Inc.). The means and standard deviations (SD) of nutrient intakes were computed from the FFQ and the WFR. Pearson product-moment correlation coefficients were used to compare the questionnaire with the records. Because most nutrient intakes were skewed, all values were $\log_e$ transformed to improve normality; alcohol intake values were square-rooted to improve normality, to conform to the assumptions of tests required for Pearson correlation.

As statistical significance might not be appropriate for assessing agreement between different dietary assessment methods, a technique described by Bland and Altman was applied.[10] It involves calculations of the mean and SD of the difference between the two methods, and the 95% limits of agreement i.e. 95% of the difference of the estimated nutrient intakes are expected to lie between the limits. Interpretation of the results relies on determining an acceptable difference between the two measures. Quintile rankings were used to classify subjects into categories and cross-tabulated. This was done to show the agreement between the classification of subjects in quintiles from the FFQ and the WFR. Under-reporting was addressed using the Goldberg cut-off ratio (energy intake: basal metabolic rate/physical activity level – EI: BMR/PAL).[11,12] A blanket PAL of 1.2 was used to calculate the individual Goldberg ratio to identify the under-reporters – under-reporters were those with a ratio of less than 0.76. Other statistical tests included paired t test, 1-way ANOVA, and chi-square tests, all of which were applied as appropriate.

Table 1. Group mean nutrient intake (mean ± SD) from 3-day WFR and FFQ

N = 118	WFR Mean	SD	FFQ Mean	SD	r†	*P**
Energy MJ	8.2	1.9	7.9	2.7	0.39	
Protein g	91.0	21.0	90.9	36.3	0.27	
Carbohydrate g	241.8	61.3	210.8	75.6	0.48	<0.001
Total Fat g	63.7	21.5	68.0	29.0	0.32	
Saturated Fat g	23.2	9.4	25.2	12.3	0.42	
PUFA[a] g	10.7	5.4	11.9	6.0	0.32	
MUFA[b] g	24.1	9.2	24.8	11.4	0.29	
Cholesterol mg	231.2	100.7	242.6	114.7	0.22	
Alcohol g	10.9	13.8	10.5	15.2	0.78	
Dietary Fibre g	25.9	9.9	23.9	9.7	0.56	<0.05
β-Carotene µg	2080.1	1773.0	2682.4	2000.0	0.44	
% E from Protein	19.1	3.4	19.5	3.4	0.42	
% E from Carbohydrate	47.2	6.4	42.9	6.4	0.43	<0.001
% E from Total Fat	28.3	5.8	31.3	5.5	0.34	
% E from Saturated Fat	10.3	2.9	11.6	3.0	0.49	<0.001
% E from PUFA[a]	4.8	2.1	5.6	2.2	0.30	<0.001
% E from MUFA[b]	10.7	2.9	11.3	2.3	0.42	<0.05
% E from Alcohol	3.6	4.2	3.8	5.4	0.77	

† Values were $\log_e$ transformed or square rooted (for alcohol) to reduce skewness and improve normality, as required by the statistical assumption of tests related to the Pearson correlation coefficient; [a]Polyunsaturated fatty acids; [b]Monounsaturated fatty acids; *Paired t test

Table 2. Cumulative Percentage Agreement between nutrient intakes derived from the 3-day WFR and the FFQ

	Percent Agreement			
	Exact	+/- 1 Fifth	+/- 2 Fifths	+/- 3 Fifths
Energy	34	69	91	97
Protein	33	73	86	97
Carbohydrate	34	70	91	98
Total Fat	31	62	88	97
Saturated Fat	35	66	86	98
PUFA	21	64	86	99
MUFA	26	60	86	97
Cholesterol	28	65	89	97
Dietary Fibre	34	78	95	100
β-Carotene	26	55	79	100
% E from Protein	28	67	87	97
% E from Carbohydrate	35	69	87	97
% E from Total Fat	28	63	87	94
Saturated Fat	37	78	95	97
PUFA	27	64	86	97
MUFA	24	62	91	97

Results

Of 159 subjects who completed the study, 145 completed the FFQ. 5 FFQ were incomplete and were rejected. Due to the time constraints, not all the WFR were computed. One hundred and eighteen 3 day WFR were paired with their corresponding FFQ and analysed. Gender distribution was 53 males and 65 females, 55% and 45% respectively and mean age was 58 years (± 9), range 31 to 74 years, with a mean BMI of 26.1 (± 3.3). Table 1 shows the means and the corresponding SD estimated by the FFQ and the 3-day WFR for energy intake and for 10 selected nutrients. Pearson correlation coefficient and significance testing from paired t test are also presented. All nutrient estimates by the FFQ are within ± 20% of the estimates produced by the mean of the 3-day WFR. The group means obtained for all nutrients were comparable with the exception of carbohydrate and percent energy from carbohydrate. The inter-individual variability, as measured by the SD, was higher for the FFQ than the corresponding values given by the WFR method. The only exceptions were dietary fibre and percentage energy from total fat, which showed lower variability in the FFQ. The Pearson correlation coefficient, r, ranged from 0.22

Table 3. 95% limits of agreement between WFRs and FFQ according to Bland and Altman[8]

	WFR Mean	FFQ Mean	Mean difference (WFR-FFQ)	95% limits of agreement	
Energy MJ	8.2	7.9	0.3	-4.9	5.5
Protein g	91.0	90.9	0.1	-75.2	75.4
CHO g	241.8	210.8	31.0	-112.0	174.1
Total Fat g	63.7	68.0	-4.3	-101.7	15.9
Sat Fat g	23.2	25.2	-2.0	-25.5	21.5
PUFA g	10.7	11.9	-1.2	-14.3	12.0
MUFA g	24.1	24.8	-0.7	-25.5	24.0
Cholesterol mg	231.2	242.6	-12	-277	254
Alcohol g	10.9	10.5	0.4	-23.0	23.8
Fibre g	25.9	23.9	2.0	-17.0	20.9
β-Carotene µg	2080	2682	-602	-2103	2990
% E from Protein	19.1	19.5	0.4	-7.7	6.8
% E from Carbohydrate	47.2	42.9	4.3	-8.9	17.4
% E from Total Fat	28.3	31.3	-3.0	-16.0	10.0
Saturated Fat	10.3	11.6	-1.3	-7.1	4.6
PUFA	4.8	5.6	-0.8	-5.8	4.2
MUFA	10.7	11.3	-0.6	-6.9	5.6
% E from Alcohol	3.6	3.8	-0.2	-8.2	7.8

Table 4. Percentage of under-reporters distinguished by the FFQ and the WFRs

	FFQ	WFR
% Under-reporters (using PAL 1.55)	45	31
% Under-reporters (using PAL 1.2)	16	6

for cholesterol to 0.78 for alcohol (median = 0.41). There were significant differences between estimates of carbohydrate (P <0.001), dietary fibre (P<0.05), percent energy from carbohydrate (P <0.001), percent energy from saturated fat (P <0.001), polyunsaturated fatty acids (PUFA) (P <0.001) and monounsaturated fatty acids (MUFA) (P <0.05) from the two methods.

Across the 4 groups, there were no significant differences in the nutrient intakes measured by both methods. Table 2 shows the cumulative percentage agreement between nutrient intakes estimated from the WFR and the FFQ. The percentage allocated to the same quintile varied from 21% for PUFA to 35% for saturated fat and energy from carbohydrate. Less than 6% of subjects were grossly misclassified. The FFQ was able to classify more than two thirds of the subjects within ±1 quintile difference.

According the Bland and Altman, the 95% limits of agreement between the FFQ and the WFR are presented in Table 3. The mean nutrient intakes varied by less than 20%, but the inter-individual variation was very large. The difference in the group mean energy intake estimated by both methods, for example, was only 3.8%, but at the individual level, the difference ranged from –4.9 to 5.5 MJ in 95% of the population. Energy intake difference versus mean energy intake estimated by the 2 methods is shown in Figure 1. The limits of agreement were around 5MJ on either side of the mean, a figure too large to suggest use of the FFQ for individual dietary assessment.

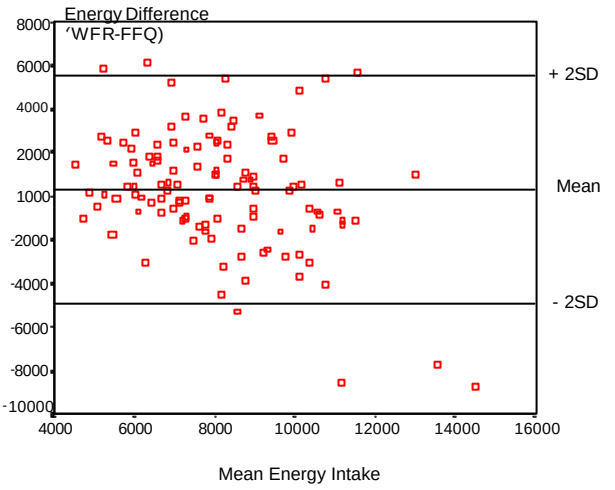

Figure 1. Energy intake difference against mean energy

The percentage of under-reporters identified by the FFQ and the WFRs are shown in Table 4. Using the Goldberg cutoff ratio,[11,12] the FFQ and the WFR reported 16% and 6% under-reporters respectively. There were no significant differences in gender, age and BMI in under-reporting in this population (data not shown). Statistical analysis performed after exclusion of under-reporters in both methods showed no significant differences.

Discussion

The key findings of this study were that all nutrient estimates by the FFQ are within ± 20% of the estimates produced from the mean of the 3 day WFR and that the group means obtained for all nutrients were comparable with the exception of energy, carbohydrate and percent energy from carbohydrate. In the present study mean energy and nutrient intakes were within ± 20% difference, which is similar to the findings of a previous validation study of the same ACCV FFQ in a study of 63 premenopausal women.[8] The correlations observed were also similar to the present study. Pearson correlation coefficients

of all nutrient intakes in this study were comparable to those found in studies conducted in the Italy, Japan and Denmark.[13-15] Tjønneland *et al*., (1991) in a study of 144 subjects comparing a self administered FFQ (92 foods and 40 portion-size photographs) and two 7 day WFR, reported correlations ranging from 0.17 for vitamin A to 0.71 for calcium, for a selected group of 14 nutrients. On average, 70% of subjects were classified in the same (+/- 1) quintile.[15] In a study of 395 subjects Declari *et al.*, (1996) compared a 77 item FFQ with two 7 day dietary records and found higher correlation in all nutrient intakes, compared to the present study, with the highest and lowest correlations found in percent energy from fat (r = 0.35) and percent energy from alcohol (r = 0.78) respectively.[13] Similar to our findings, the correlation for β-carotene was low and for alcohol was high. Shimizu *et al.*, (1999) in a study of 117 subjects comparing a 169 item FFQ with 3 day food records and four 24hr recalls reported correlations comparable to our findings.[14] The German part of the EPIC study compared twelve 24hr dietary recalls with values from two FFQs (158 food items) and found higher correlations compared to our findings.[16]

The inter-individual variation in almost all nutrient intakes was higher with the FFQ than with the WFRs. This is similar to findings by Tjønneland et al and Decarli *et al.*,[13,15] suggesting that perception of intake may add additional variability to the FFQ data. The under-estimation of carbohydrate observed is of concern particularly given the comparable results observed for other nutrients suggesting that some key foods may be missing from this FFQ. It has a truncated upper range of frequency categories (3 or more times) which may have reduced the intakes of some high carbohydrate foods e.g drinks, rice, pasta, potatoes and biscuits. It does not include some common food items such as soft drinks or some popular low fat snack items e.g muesli bars which may also have influenced the results seen for carbohydrate. Serve size used in data analysis may also be an influential factor. The design of the FFQ was such that there were photographs for serve size information for potatoes, vegetables, steak and casserole, but no serve size information was obtained for cereals, snacks and sweets. The FFQ did not allow subjects with the same frequency of intake but different portion sizes to choose from a variety of portion sizes; hence reducing the sensitivity of the FFQ. All of these factors may have contributed to the underestimation of carbohydrate. The database that both the FFQ and WFRs were analysed with was developed more than 7 years ago, and since then portion sizes of some foods have changed. For example, a slice of bread in the database weighs 28g, while a slice of commonly available bread weighs 35-45g. Because the FFQ was optically scanned and the results computer-generated, the serve size for a slice of bread would be significantly smaller than what would have been recorded in the WFRs. This may also have contributed to the lower estimated intake of carbohydrate by the FFQ. This under-estimation of carbohydrate resulted in an overestimation of percent energy from saturated fat, PUFA and MUFA when absolute intakes of fatty acids were comparable to that estimated by the WFRs.

Overall, the FFQ was able to classify more than two thirds of subjects within ±1 quintile difference, a finding that is similar to that reported by Hodge *et al.*, 2000 in a validation study using the same FFQ, and also studies conducted by Tjønneland *et al.*, 1991 (>70%) and Pietinan *et al.*,(72%).[15,17] This implies that FFQs are good tools to use for classifying subjects into quintiles of intake. It must, however, be born in mind that this result does not show the agreement between the absolute values estimated by the two methods.

To measure the agreement between the two methods, the Bland and Altman method was applied.[10] The analysis makes no assumption that one method is superior to another; it merely measures the level of agreement. From Figure 1, the variation (shown by the SD) around the mean was very large, as much as 5MJ, although the mean difference was near zero. Table 3 shows the 95% limits of agreement for all nutrients – all of which have variations too large to suggest the use of the FFQ to evaluate individual dietary intake. This means that the FFQ cannot replace the WFR for the assessment of an individual's intake in this population. This was similar to the findings from a validation study carried out by Hodge *et al*.[8]

In order to test the ability of the ACCV FFQ to assess group nutrient intake in the context of the present study, the subjects' mean nutrient intakes compared were compared according to the 4 dietary intervention groups. No significant differences were found between the groups, suggesting that this FFQ was comparable in assessing group intake when compared to WFR. The results remained the same after exclusion of under-reporters.

It is interesting to note that although the correlation of alcohol intake from the two methods was the highest (r = 0.78) among the other nutrients, the ACCV FFQ identified 20% more subjects who drink alcohol than did the WFR. Subjects who do not drink alcohol on a regular basis (e.g. only on social occasions) could account for this finding. This suggests that a FFQ may be more appropriate for nutrients that are not consumed on a regular basis, such as alcohol.[18] Another nutrient that might be better captured by the FFQ is β-carotene. Studies have shown that the longer the WFRs are kept, the better the correlation between β-carotene estimated by the WFRs and the biochemical measurement. The FFQ in this case may give a more accurate figure as it covers a greater time period. If plasma β-carotene was available it would be possible to see which gave better correlation. One of the strengths of this study is that the subjects were not required to adhere to prescribed diets; the nutrient intakes thus reflect their usual diet. However the need for regular consumption of yoghurt may have altered their dietary intake somewhat. Also, the act of recording or weighing may in itself introduce dietary changes by increasing consciousness of what is being eaten, so it is likely that a FFQ may be a better tool to assess usual dietary intake.[19] On the other hand, FFQ rely on perception of intake rather than actual intake which could potentially introduce errors.

Efforts were made to ensure accurate recording of the food records – weighing scales were provided for those without accurate weighing apparatus, a 1-day practice record was conducted before the actual recording, and the

records were checked by either a dietitians or student dietitian with the subjects for accuracy and clarification. From observation, none of the subjects had any difficulty completing the questionnaire. Few validation studies have attempted to identify under-reporters,[20] as did this study, although no significant differences were found after exclusion of under-reporters.

In conclusion all nutrient estimates by the FFQ are within ± 20% of the estimates produced from the mean of the 3 day WFR and that the group means obtained for all nutrients were comparable with the exception of energy, carbohydrate and percent energy from carbohydrate. It is appropriate to use this FFQ to estimate group intake in clinical trial populations however it cannot be used instead of WFR for estimation of an individual's dietary intake.

Acknowledgements

We wish to acknowledge the support of Associate Professor Lynne Daniels and Dr Elaine Bannerman from the Department of Nutrition and Dietetics, School of Medicine, Flinders University of South Australia.

References

1. Baghurst KL, Baghurst PA. The measurement os usual dietary intake in individuals and groups. Transactions of the Menzies Foundation 1981; 3:139-160.
2. Marr JW. Individual dietary surveys: purposes and methods. World Rev Nutr Diet 1971; 13:105-164.
3. Bingham SA, Cassidy A, Cole TJ, Welch A, Runswick SA, Black AE, Thurnham D, Bates C, Khaw KT, Key TJ, Day NE. Validation of weighed records and other methods of dietary assessment using the 24 h urine nitrogen technique and other biological markers. Br J Nutr. 1995 Apr; 73 (4): 531-50.
4. Baghurst KI. The food frequency technique and its relevance to population surveys in Australia - a commentary. Aust J Nutr Diet 1992; 49: 101-3
5. Horwath CC. Food frequency questionnaires: A review. Aust J Nutr Diet 47, 71-76. 1990.
6. Smith W, Mitchell P, Reay EM, Webb K, Harvey PW. Validity and reproducibility of a self-administered food frequency questionnaire in older people. Aust NZ J Public Health 1998; 22: 456-63.
7. Wheeler CE, Rutishauser IHE O'Dea K. Comparison of nutrient intake data from two food frequency questionnaires and weighed records. Aust J Nutr Diet 1995; 52: 140-148.
8. Hodge A, Patterson AJ, Brown WJ, Ireland P, Giles G. The Anti Cancer Council of Victoria FFQ: relative validity of nutrient intakes compared with weighed food records in young to middle-aged women in a study of iron supplementation. Aust NZ J.Public Health 2000; 24:576-83.
9. Ireland P, Jolley D, Giles G, O'Dea K, Powles J, Rutishauser I, Wahlqvist ML, Williams J. Development of the Melbourne FFQ: a food frequency questionnaire for use in an Australian prospective study involving an ethnically diverse cohort. Asia Pac J Clin Nutr 1994; 3: 19-31.
10. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet 1986; 1: 307-10.
11. Black AE. The sensitivity and specificity of the Goldberg cut-off for EI: BMR for identifying diet reports of poor validity. Eur J Clin Nutr 2000; 54:395-404.
12. Goldberg GR, Black AE. Assessment of the validity of reported energy intakes - review and recent developments. Scand J Nutr 1998; 42: 6-9.
13. Decarli A, Franceschi S, Ferraroni M, Gnagnarella P, Parpinel MT, La Vecchia C, Negri E, Salvini S, Falcini F, Giacosa A. Validation of a food-frequency questionnaire to assess dietary intakes in cancer studies in Italy. Results for specific nutrients. Ann Epidemiol 1996; 6:110-8.
14. Shimizu H, Ohwaki A, Kurisu Y, Takatsuka N, Ido M, Kawakami N, Nagata C, Inaba S. Validity and reproducibility of a quantitative food frequency questionnaire for a cohort study in Japan. Jpn J Clin Oncol 1999; 29: 38-44.
15. Tjonneland A, Overvad K, Haraldsdottir J, Bang S, Ewertz M, Jensen OM. Validation of a semiquantitative food frequency questionnaire developed in Denmark. Int J Epidemiol 1991; 20: 906-12.
16. Bohlscheid-Thomas S, Hoting I, Boeing H, Wahrendorf J. Reproducibility and relative validity of energy and macronutrient intake of a food frequency questionnaire developed for the German part of the EPIC project. European Prospective Investigation into Cancer and Nutrition. Int J Epidemiol 1997; 26 Suppl 1: S71-S81.
17. Pietinan P, Hartman AM Haapa E. Reproducibility and validity of dietary assessment instruments. A self-administered food frequency questionnaire with a portion size picture booklet. Am J Epidemiol 1998; 128: 655-666.
18. Giovannucci E, Colditz G, Stampfer MJ, Rimm EB, Litin L, Sampson L, Willett WC. The assessment of alcohol consumption by a simple self-administered questionnaire. Am J Epidemiol 1991; 133: 810-7.
19. Margetts BM, Cade JE, Osmond C. Comparison of a food frequency questionnaire with a diet record. Int J Epidemiol 1989; 18: 868-73.
20. Brunner E, Stallone D, Juneja M, Bingham S, Marmot M. Dietary assessment in Whitehall II: comparison of 7 d diet diary and food-frequency questionnaire and validity against biomarkers. Br J Nutr 2001; 86: 405-14.