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Abstract

Objectives: To devise a measure of diet quality from a short form food frequency questionnaire (SFFFQ) for population surveys. To validate the SFFFQ against an extensive food frequency questionnaire (FFQ) and a 24 hour diet recall.

Design: Population based cross-sectional survey.

Setting: East Leeds and Bolton in Northern England.

Subjects: 1,999 adults were randomly selected from lists of those registered with a general practitioner in the study areas, contacted by mail and asked to complete a SFFFQ. Responders were sent a longer FFQ to complete and asked if they would take part in a telephone based 24h diet recall.

Results: Results from 826 people completing the SFFFQ, 705 the FFQ and 47 the diet recall were included in the analyses. The dietary quality score (DQS), based on fruit, vegetable, oily fish, non-milk extrinsic sugar and fat intake, showed significant agreement between the SFFFQ and the FFQ (kappa:0.38, $p<0.001$). The DQS for the SFFFQ and the diet recall did not show significant agreement (kappa:0.04, $p=0.312$). A number of single items on the SFFFQ predicted a 'healthy' DQS when calculated from the FFQ. The odds of having a healthy diet were increased by 27% (95%CI 9-49%, $p<0.001$) for an increase of 1 portion/day of fruit and decreased by 67% (95%CI 47-79%, $p<0.001$) for an increase of 1 portion/day of crisps.

Conclusions: The SFFFQ has been shown to be an effective method of assessing diet quality. It provides an important method for determining variations in diet quality within and across different populations.

Keywords:
Diet quality, short dietary questionnaires, diet screener, public health.

Introduction

Understanding the quality and variety of the diets of local populations is essential to assess needs and evaluate the effectiveness of subsequent interventions designed to improve dietary intake. In the UK, local health and social care organisations are often limited to collecting dietary data through health and lifestyle surveys (1, 2). Diet is just one of many topics covered in these surveys, (e.g. (3, 4)) and concerns about the impact of lengthy surveys on response rates are valid. Consequently, dietary assessment is usually based on a few questions, which, in the absence of any validated short-form assessment format, can lead to potentially spurious results. Development of a short, valid tool to incorporate within local health and lifestyle surveys, would improve confidence in the results obtained. Moreover, an established and proven method to assess diet quality in local surveys would ideally be used routinely for all surveys of this type. The information obtained from such a survey would complement the data routinely received from the Public Health Outcomes Framework on fruit and vegetable consumption, giving greater detail which could be used to guide interventions and monitor their effectiveness (5). Meaningful comparisons could be made, not only within the local population, but with other areas that also used the survey method.

Currently there are no widely used, convenient and reliable methods for assessing diet quality in a population setting in the UK. Various dietary assessment tools are used in nutrition research. These can be too time consuming, expensive and labour intensive to use in most population health surveys (6). There are some short form diet questionnaires that are used in research settings such as PrimeScreen and the Michigan healthy diet indicator. These were developed in the US, and their generalizability to UK settings is questionable, for assessing diet quality at local levels (7, 8). Other approaches focus on specific food types (9-11), specific nutrient intake (12-15), specific populations (16-19) or are used to screen patients' diets (20-23). These tools are therefore not appropriate for use in population surveys.

Local health organisations in the UK rarely have a nutritional epidemiologist, and any survey tool needs to be relatively straightforward to administer and then analyse. Short methods cannot collect meaningful data on nutrient intake. However, local health departments are primarily concerned with the quality of peoples' diets, to inform policymaking and commissioning. All local authorities areas receive data on adult fruit and vegetable intake as part of the Public Health Outcomes Framework (http://www.phoutcomes.info/). While it is acknowledged that this reflects only one part of a healthy balanced diet, is used as an indicator for a healthy diet (24). Developing a measure or score of wider diet quality may be the most appropriate way of presenting the results in a simple and informative way for policy makers, with the additional benefit that it can be used to identify differences between population groups within a local authority boundary - essential for effectively targeting services or interventions. The concept of a healthy diet score based on a short dietary assessment tool has been used successfully in other countries to categorise adults by the overall healthiness of their diets (25-30). While it is not appropriate to use these specific tools in the UK due to dietary differences, the results of these studies support the development of similar tools in the UK.

There is a need to develop new dietary assessment tools in the UK that are self-administered, comparatively easy for people to complete, simple to analyse and interpret and capture the level of detail of dietary intake that is appropriate in population health and lifestyle surveys. Our research aims to develop a quick, simple, cost-effective method to collect dietary information from a large number of people. This paper describes a short food frequency questionnaire (SFFFQ) and its validation in comparison to a previously validated more comprehensive food frequency questionnaire (FFQ) and a 24 hour telephone diet recall. A DQS based on the SFFFQ is described and the components of the SFFFQ that significantly predict the FFQ's DQS are presented.

Materials/Participants and Methods

A systematic review was conducted which found that no short-form diet questionnaire had previously been developed for integration within population health surveys in the UK. A number of informative tools, including ‘PrimeScreen’ (8), the ‘Dietary Instrument for Nutrition Education (DINE) (31)’ the ‘Fruit/Vegetable/Fiber Screener’ and the ‘Fat Screener’ (32) were identified and were used to inform the development of the SFFFQ. Expert knowledge about culturally specific foods was used to tailor the tool to the UK population. The result was a 20 item non-quantitative SFFFQ which focuses on fruit, vegetables, fibre rich foods, high fat and high sugar foods, meat, meat products and fish. The SFFFQ asks about foods and drinks respondents “might have during a ‘typical’ week, over the past month” (see supplementary material for a copy of the SFFFQ) and asks respondents to tick one frequency option (ranging from ‘rarely or never’ to ‘5+ a day’) for each of the 20 items. The tool also contains questions about basic demographic information and questions about alcohol consumption and exercise.

The SFFFQ was compared against a 217 item FFQ which was used in the UK Women’s Cohort Study (33, 34). The FFQ asks how often, on average, specific amounts of each food have been eaten during the past 12 months. The FFQ is capable of assessing nutrient intake and has been validated against 4 day diet records (35).

The questionnaire data was collected between June and August 2006. Participants were UK residents in the borough of Bolton, and those living in the eastern sector of the city of Leeds. 1000 adults in East Leeds former Primary Care Trust area and 999 in Bolton were randomly selected from lists of those registered with a general practitioner and living within the study areas and were sent a preliminary postcard introducing them to the research. A week later they were sent a ‘stage one pack’ which included a copy of the SFFFQ along with a personalised introductory letter, a participant information sheet, and consent form. A freepost envelope was included to return the completed SFFFQ and signed consent. Reminder postcards were sent out one week later and as a final encouragement to join the study, a further copy of the ‘stage one pack’ was sent to non-responders after two weeks from the initial posting (36).

Five weeks after returning a completed SFFFQ, participants were sent a ‘stage two pack’ which included a copy of the longer FFQ, personalised covering letter, a freepost envelope and an invitation to take part in a telephone interview about the foods they eat. Reminder postcards and ‘stage 2 reminder packs’ followed.

To show agreement of at least 10% between the SFFFQ and the FFQ in classifying diet as poor, moderate or optimum, with a kappa coefficient of at least 0.7, 200 participants would need to complete both FFQs. Based on the findings of an earlier population survey, covering one of the same populations (37) it was assumed 20% of those contacted would consent to take part in this study and return a completed SFFFQ. It was expected that 60% of these participants would then return a completed FFQ. To obtain these numbers 1660 participants in Leeds and Bolton combined would need to be invited to take part in the study. 36.5% of those asked if they would take part in the telephone interview consented to be interviewed but due to logistical constraints only 2.5% of the total sample were interviewed.

A telephone 24 hour recall interview was conducted on a random sample of people willing to be interviewed, stratified by sex and location (East Leeds or Bolton). A pragmatic decision was made to interview 50 individuals, this was based on logistical constraints rather than a sample size calculation. A personalised letter and booklet of photos (selected from (38)) to help the participants estimate portion sizes was sent out to the participants and they were phoned within three weeks of receiving the booklet to complete the diet recall. This booklet contained 19 sets of photographs of food with differing portion sizes.

The diet recall covered a 24 hour period, up until midnight the day before the interview. It was broken down into three passes; a quick list, a detailed pass and a review (39). Information on brands, cooking and preparation methods, additions before consumption and portion sizes were recorded. The telephone interviews took place during November and December of 2006.

All nutritional analyses were carried out using the Nutritional Epidemiology Group’s in house nutrient analysis program, Diet and Nutrition Tool for Evaluation (DANTE). Diet recalls and FFQs were excluded if they reported implausible intakes of <2092 or >25104 KJ/day (<500 or >6000 Kcal/day)(this was standard practice within the research group (40)).

Participants were not excluded based on the energy intake captured by the SFFFQ as this tool was not designed to capture total energy intake.

A DQS was calculated for the SFFFQ, FFQ and 24 hour diet recall and was composed of fruit, vegetable, oily fish, fat and non-milk extrinsic sugar (NMES) intake reflecting five dietary components recognised as indicators of a healthy diet (41). NMES are sugars that are not naturally incorporated into the cellular structure of foods (42) and include sugars added to food such as fructose and glucose syrups, sugars in fruit juices/processed food and table sugar. They do not include sugar from fruit, vegetables and milk. Although the SFFFQ does not aim to capture nutrient intake it was felt that the frequency of high fat and high NMES foods on the SFFFQ could give an idea of fat and NMES intake which would be an important indication of diet quality.

Standard portion sizes (based on portion sizes used in nutrition guidelines eg. 80 grams for fruit and vegetables, the portion sizes included on the longer FFQ or UK food purchasing data) were assigned to each food item on both the SFFFQ and the longer FFQ. These portions were then multiplied by the daily frequency that was associated with each frequency response on the two FFQs giving an estimate of grams of each FFQ food item (20 for the SFFFQ and 217 for the FFQ) consumed per person per day. Those food items that were fruit, vegetables or oily fish were then summed to give an estimate of the total grams of intake for these food groups per person per day. The SFFFQ and FFQ food items were then matched to the UK food composition tables to give an estimate of the NMES and fat content of the food items and therefore the amount of NMES and fat individuals were consuming per day. This process was used to determine the grams of each of the 5 components of the DQS that each person was estimated to consume.

Scores of 1-3 were allocated for each component, with a score of three corresponding to meeting the UK dietary recommendations for that group (http://www.food.gov.uk/sites/default/files/multimedia/pdfs/nutrientinstitution.pdf, See Table 1). Thus, the minimum DQS was 5, and the maximum, indicating optimum dietary intake for these foods, was 15.

Insert Table 1 near here

Statistical analysis

SPSS was used to conduct the statistical analyses. Paired t-tests were used to compare the means of the DQS and its components as measured by the SFFFQ to the FFQ and the diet recall. Agreement between the methods was assessed using the Kappa score; the DQSs were split into tertiles for comparisons (below 8, between 9 and 11 and above 12). Agreement was considered to be very good for Kappa scores 0.81-1.00, good for those 0.61-0.80, moderate for those 0.41-0.60, fair for those 0.21-0.40 and poor for those under 0.20. Correlation between the SFFFQ and the two other methods was assessed using Spearman's rank order correlation coefficient.

For comparisons, a healthy diet was defined as having an overall DQS of over 12 measured using the FFQ. 12 was chosen as a cut-off as the average DQS was 11.4 for the FFQ, a score of 12 was therefore above average. The 20 food items of the SFFFQ were compared with the DQS of the FFQ using logistic regression. The calculated odds ratios estimated which foods on the SFFFQ were the best predictors of diet quality as measured by the FFQ; an odds ratio of over 1 indicated an increased chance of having a healthy diet if that particular food item was chosen.

Results

The number of returned dietary assessments were as follows: 826 SFFFQs, 729 FFQs and 50 diet recalls. The response rate for the SFFFQ was 41% and for those who returned the FFQ (only those completing the SFFFQ) it was 88%. A total of 60 participants were randomly selected from those who expressed an interest in taking part in the telephone interview. Of these, 50 people were interviewed. Due to the exclusion of participants returning blank FFQs and participants who recorded implausible energy intakes 705 FFQs and 47 diet recalls were included in the analysis (See figure 1).

Table 2 shows that approximately half the participants were female and the average age ranged between 53 and 62 years depending on which dietary assessment methods had been completed. The majority of subjects participated in some exercise, were non-smokers and had moderate alcohol consumption. Over 90% of participants were white and approximately 75% owned their own home. Demographic characteristics were similar for participants completing the three different dietary assessments except that there were slightly fewer smokers and a higher percentage owning their own home in those completing a diet recall.

Insert Table 2 near here

The mean DQS derived from the SFFFQ was 11.4 (SD 1.6) from a possible 15 (Table 3). For the FFQ it was also 11.4 (SD 1.7) and was 9.5 (SD 1.9) for the 24 hour diet recall. No statistically significant differences were observed for the mean DQS between the SFFFQ and the FFQ. The DQS derived from the 24- hour diet recall was significantly lower than the DQS from the SFFFQ.

The weight of the food components which had been coded to make up the DQS differed significantly between the SFFFQ and the FFQ. The FFQ estimated consumption in grams of all components to be approximately double compared to the SFFFQ, except for oily fish which gave similar gram weights (Table 3). The mean difference between the FFQ and the SFFFQ were 2.2 portions (175 grams) for fruit and 1.6 portions (126 grams) for vegetables and approximately 40 grams for both fat and NMES. The SFFFQ agreed more closely with the diet recall in estimated grams of the DQS's components with no significant differences seen in the grams of fruit (0.6 portions) and vegetables (0.1 portions) between the methods.

Oily fish was significantly lower in the diet recall while fat and NMES intake was significantly higher in the diet recall compared to the SFFFQ.

Insert Table 3 near here

The overall DQS showed fair agreement between the SFFFQ and the FFQ (0.38, p<0.001). The components of the DQS showed moderate agreement for oily fish intake (kappa 0.46, p<0.001), fair agreement for fruit (kappa 0.35, p<0.001) and vegetables (kappa 0.27, p<0.001) and poor agreement for NMES (kappa 0.20, p<0.001) and fat (kappa 0.09, p<0.001) intake between the SFFFQ and the FFQ. The DQS and its components showed poor agreement between the SFFFQ and the diet recall (ranged between 0.02 and 0.07) except for fruit intake where agreement was fair (kappa 0.20, p=0.027) (Table 4).

The components of the DQS were all significantly correlated when comparing the SFFFQ with the FFQ. Comparison of the SFFFQ with the diet recall showed weaker association with correlation coefficients only significant for fruit and vegetable intake (Table 4).

Insert Table 4 near here

A number of the individual food items on the SFFFQ significantly predict whether the participants had a healthy diet. A healthy diet is defined by having an overall DQS of over 12 measured using the FFQ. Reporting consumption of a portion per day of fruit, salad, vegetables, wholemeal bread/chapattis, whole meat (chicken or turkey), white fish (not in batter) or oily fish as measured by the SFFFQ significantly increased the odds of having a healthy diet as measured by the FFQ. Those having a portion/day of chips, crisps, sweet biscuits, ice cream, fizzy drinks, whole meat (beef, lamb, pork, ham), processed meats or battered fish on the SFFFQ were less likely to consume a healthy diet as measured by the FFQ (Table 5). Having a portion of fruit or vegetables a day on the SFFFQ increased the odds of being classified as having a healthy diet on the FFQ by 27% (fruit: 95% CI 9 to 49%, p<0.001, vegetables: 95% CI 9 to 49%, p=0.007). The odds of having a healthy diet were decreased by 67% (95% CI 47 to 79%, p<0.001) for each portion increase of crisps per day.

Insert Table 5 near here

Discussion

The SFFFQ was designed to be used in large population surveys where detailed dietary assessment is not feasible. The mean DQS for the SFFFQ and the FFQ are the same and show fair agreement. The DQS components are all significantly correlated between the SFFFQ and the FFQ, despite significant differences in the grams, (based mainly on differences in consumption frequency) of fruit, vegetable, oily fish, fat and NMES between the two measures. This indicates that although the SFFFQ is not suitable for estimating absolute dietary intake it is suitable for ranking people according to diet quality, meeting its primary objective. Classifying people on their diet quality with a simple tool will allow researchers and public health professionals to form a general understanding about diet in particular populations. This will allow them to measure trends in dietary patterns over time and identify communities that may require dietary intervention in order to decrease the prevalence of obesity and risk of chronic disease in these communities.

A useful way to summarise the results from the SFFFQ is to calculate the DQS presented in this paper. An Excel spreadsheet is provided as supplementary material to this paper which can be used for this purpose. Researchers can enter the results from their SFFFQ data collection and the DQS will be automatically calculated. This adds an additional dimension to this dietary assessment tool increasing its usefulness in larger population surveys. This score reflects important aspects of diet quality (fruit, vegetable, oily fish, fat and NMES intake) but does not cover all aspects of the UK's dietary recommendations (http://www.food.gov.uk/sites/default/files/multimedia/pdfs/nutrientinstitution.pdf). It should be noted when applying the DQS that advice to include 'plenty of starchy foods', 'some protein rich foods', 'some milk and dairy' and 'just a little saturated fat and salt' were not included in the score. Additionally, applying a dietary quality score will not capture the complexity of individuals' diets and is only appropriate for use in population level analyses. The DQS is applied universally (ie. It does not vary by age, sex or ethnicity) and it will not be appropriate for use in all contexts.

Although agreement is the most appropriate comparison for validation studies the majority of published research report associations between the methods, measured only by correlation coefficients. The correlations in dietary components between the SFFFQ and the FFQ were comparable with others reported in the literature as evidence of validity. For fruit, correlation coefficients of 0.32 to 0.71 have been reported comparing short dietary assessment questionnaires to weighed records (43), food frequency questionnaires (20, 23, 30, 44) and diet histories (28, 45). Correlation coefficients for vegetable intake ranged from 0.36 to 0.70 for other short form dietary assessment tools in the literature compared to weighed records (43), food frequency questionnaires (23, 30, 44) and diet histories (45). The measure of agreement used in this study, the kappa statistic (46), can be used to compare categorical scales, hence we split the DQS into tertiles for comparison between the tools. The kappa value comparing the SFFFQ and the FFQ was 0.38, considered to be 'fair' agreement (47). This compares well to other dietary screeners, for example, measuring fast food consumption in adolescents where a kappa of 0.03 was obtained compared to three 24h recalls (48).

The SFFFQ and the diet recall did not show good agreement or particularly good correlation. It is important to note that these two dietary assessment methods aim to measure different aspects of dietary intake. The diet recall measures actual intake for a 24 hour period and the SFFFQ measures usual intake over the last month. Other factors that may have affected the association seen includes the time lapse between measures (5 months), seasonal difference between the administration of the SFFFQ and the diet recall (49) and the small sample size of the diet recall arm. Additionally only single 24 hour recalls were conducted for these participants when repeat 24 hour recalls would have been more appropriate for estimating usual intake (50).

Another limitation of this research, common to all studies attempting to validate dietary assessment, is that the reference methods do not reflect true intake. As the FFQ and the SFFFQ are likely to have similar errors the correlations seen may have been an overestimation of the correlation between the SFFFQ and the true intake (6). The FFQ looks at consumption over the past 12 months while the SFFFQ looks at consumption over the previous month. The FFQ had ten difference consumption frequency options available for respondents to tick ranging from 'never' to '6+ per day'. The SFFFQ had eight frequency options ranging from 'rarely or never' to '5+ a day' for more commonly consumed items and six options for less commonly consumed items ranging from 'rarely or never' to '7+ times a week'. The different reference periods and the different categories used between the two methods may have contributed to the different intakes seen. Additionally the respondents (40% of total sample) may differ from the representative population they are selected from;

they may be a more motivated population which may reduce our ability to generalise the findings to the UK population. However the comparisons between the SFFFQ and the FFQ were made on a large sample of people and were compared using both agreement and correlation, factors identified as important components of validation studies (51).

A number of comparable studies using measures of diet quality based on short dietary assessment tools have been conducted internationally. An American study which developed a Healthy Eating Index based on food intake, nutrient intake and dietary variety found the tool to significantly correlate with various biomarkers from r=0.24 for lutein to 0.41 for alpha-carotene (correlation was not significant for lycopene or cholesterol). The authors concluded that it was a useful tool to describe diet patterns in women (25). A Recommended Food Score was developed from 23 of the 62 items on a FFQ designed in the US. This was a simple calculation based on whether these "healthy" foods were consumed at least once a week and the Recommended Food Score was shown to be inversely associated with mortality in women (26). A similar approach to the DQS of this study was taken in Denmark with a DQS based on fruit, vegetable, fat and fish intake. It was deemed to be an appropriate tool to classify individuals into high, average and low diet quality as it was shown to be associated with a high diet quality as measured by a 198 item FFQ and the absolute risk of ischemic heart disease (30). These studies and the current result support the proposal of a DQS based on a short dietary assessment tool being used to summarise diet quality.

Having a portion per day of certain food types significantly predicted whether a participant had a healthy diet as measured by the FFQ. Reporting consumption of oily or white fish, salad or whole chicken/turkey were especially strongly associated with a healthy diet. Participants reporting daily consumption of chips, processed meats or battered fish were significantly less likely to have a healthy diet. This finding highlights individual food items that are more strongly associated with a healthy diet, information that could be useful for the future development of short dietary assessment methods. It suggests that populations could be ranked on their diets based on the result of just a few questions when resources for population health surveys are even more limited. Additionally, the four food items that were not significantly associated with a good DQS may be able to be removed from the SFFFQ allowing it to be shortened further: 'Fruit juice (not cordial or squash)'; 'Beans or pulses like baked beans, chick peas, dahl';' Fibre-rich breakfast cereal, like Weetabix, Fruit 'n Fibre, Porridge, Muesli'; 'Cheese / yoghurt'.

A worthwhile focus for future research would be assessing if the instrument was sensitive enough to capture change over time as would assessing whether the SFFFQ DQS shows agreement with other measures of dietary quality or could be used to predict other risk factors for chronic disease.

The results of this validation study show that using the SFFFQ in large population surveys instead of a longer, more time consuming and expensive FFQ may be appropriate in studies that do not require nutrient intake information but only require an indication of diet quality. The SFFFQ is a quick and easy and therefore cheap dietary assessment tool that could be used in situations where the use of longer and more expensive dietary assessment tools are not feasible. The DQS based on fruit, vegetable, oily fish, NMES and fat intake was found to be a useful tool in ranking diet quality.

Tables

Table 1: Components that make up the Dietary Quality Score and their cut-offs

Score allocated:	1	2	3
Fruit	<= 2 servings/wk	>2 servings/wk and < 2 servings/day	>= 2 servings/day
Vegetables	<=1 servings/day	1 – 3 servings/day	>= 3 servings/day
Oily Fish	No intake	0 – 200g/wk	>= 200g/wk
Fat *	>= 1 ½ x UK recommendations (127.5g/day)	1 – 1 ½ x UK recommendations	<= UK recommendations (85g/day)
NMES	>= 1 ½ x UK recommendations (90g/day)	1 – 1 ½ x UK recommendations	<= UK recommendations (60g/day)

*Recommendations for fat were based on 35% of total energy of the Estimated Average Requirements for women and men: 9351 kJ/d (2235 kcal/d)

Table 2: Demographic information of the participants

	SFFFQ (N=826)		FFQ (N=705)		Diet Recall (N=47)	
	Leeds (N=421)	Bolton (N=405)	Leeds (N=358)	Bolton (N=347)	Leeds (N=23)	Bolton (N=24)
Female (%)	54.9	54.8	56.7	54.5	52.2	45.8
Age (yrs), mean (sd)	53(19)	54(20)	54(19)	56(19)	54(18)	62(16)
Alcohol consumption: drinks more than 21 units/wk (%)	7	9	7	8	0	17
Reports some exercise in the last week (%)	86	86	87	87	87	92
Current smokers (%)	22	16	20	14	9	13
Owns their own home (%)	72	75	74	76	87	75
White ethnic group (%)	95	92	96	96	96	96

Table 3: Average Dietary Quality Scores (range: 5-15) and component weights

	SFFFQ (N=826)		**FFQ** (N=705)		**Diet recall** (N=47)		**FFQ - SFFFQ** (N=705)		**Diet recall - SFFFQ** (N=47)	
	Mean	SD	Mean	SD	Mean	SD	Mean difference (95% CI)	p-value*	Mean difference (95% CI)	p-value†
Overall DQS	11.4	1.6	11.4	1.7	9.5	1.9	0.1 (0.0, 0.2)	0.241	-2.1 (-2.8, -1.5)	<0.001
Fruit(g)	156	145	332	328	121	150	175 (153, 196)	<0.001	-51 (-104, 2)	0.058
Vegetables(g)	144	115	270	177	153	146	126 (114, 138)	<0.001	6 (-42, 53)	0.811
Oily Fish(g)	10	13	12	14	4	12	1 (0, 2)	0.01	-6 (-11, -2)	0.009
Fat(g)	47	28	90	40	72	26	45 (42, 47)	<0.001	26 (17, 34)	<0.001
NMES(g)	49	41	91	56	73	44	43 (40, 47)	<0.001	24 (9, 40)	0.003

*P-values from paired t-test comparing SFFFQ and FFQ

† P-values from paired t-test comparing SFFFQ and diet recall

Table 4: Correlation and Agreement between the SFFFQ and the FFQ and the SFFFQ and the Diet Recall

	Comparing the SFFFQ and the FFQ (N=705)				Comparing the SFFFQ and the Diet Recall (N=47)			
	Spearman's Rank Correlation Coefficient	**p-value**	**Kappa***	**p-value**	**Spearman's Rank Correlation Coefficient**	**p-value**	**Kappa***	**p-value**
Overall DQS†			0.38	<0.001			0.04	0.312
Fruit(g)	0.61	<0.001	0.35	<0.001	0.35	0.017	0.20	0.027
Vegetables(g)	0.49	<0.001	0.27	<0.001	0.33	0.022	0.06	0.314
Oily Fish(g)	0.56	<0.001	0.46	<0.001	0.03	0.842	0.02	0.406
Fat(g)	0.43	<0.001	0.09	<0.001	0.22	0.144	0.07	0.233
NMES(g)	0.45	<0.001	0.20	<0.001	0.15	0.302	0.07	0.275

*Overall DQS split into tertiles for kappa comparison

†Correlation co-efficient cannot be calculated for DQS as this has been converted to a categorical variable

Table 5: Logistic Regression analysis of individual SFFFQ items for predicting a Healthy Diet[*] as measured by the FFQ

Food item (portion size)	Contributes to which DQS category[†]	OR (95% CI) per portion/day (N=705)	OR (95% CI) per 100g/day (N=705)	P-value
Fruit (fresh/tinned) (80g)	Fruit	1.27 (1.09 – 1.49)	1.35 (1.11 - 1.64)	<0.001
Fruit juice (not cordial or squash) (145g)		0.86 (0.65 – 1.15)	0.90 (0.74 - 1.00)	0.104
Salad (not garnish added to sandwiches) (80g)	Vegetable	2.05 (1.50 – 2.79)	2.45 (1.66 - 3.61)	<0.001
Vegetables (tinned / frozen / fresh but not potatoes) (80g)	Vegetable	1.27 (1.09 – 1.49)	1.35 (1.11 - 1.64)	0.007
Chips / fried potatoes (167g)		0.01 (0.00 – 0.05)	0.07 (0.05 - 0.16)	<0.001
Beans or pulses like baked beans, chick peas, dahl (184g)		0.69 (0.34 – 1.42)	0.82 (0.55 - 1.21)	0.306
Fibre-rich breakfast cereal, like Weetabix, Fruit 'n Fibre, Porridge, Muesli (71g)		1.15 (1.00 – 1.32)	1.22 (1.00 - 1.48)	0.105
Wholemeal bread or chapattis (45g)		1.25 (1.05 – 1.49)	1.65 (1.00 - 1.11)	0.012
Cheese / yoghurt (99g)		1.00 (0.82 – 1.21)	1.00 (0.82 - 1.22)	0.960
Crisps / savoury snacks (25g)		0.33 (0.21 – 0.53)	0.01 (0.00 - 0.08)	<0.001
Sweet biscuits, cakes, chocolate, sweets (91g)		0.40 (0.28 – 0.57)	0.37 (0.25 - 0.54)	<0.001
Ice cream / cream (110g)		0.21 (0.09 – 0.51)	0.24 (0.11 - 0.54)	<0.001
Non alcoholic fizzy drinks/pop (not sugar free or diet) (161g)		0.20 (0.10 – 0.37)	0.37 (0.25 - 0.54)	<0.001
Whole meats: Beef, Lamb, Pork, Ham - steaks, roasts, joints, mince or chops (111g)		0.51 (0.27 – 0.99)	0.55 (0.30 - 0.99)	0.048
Whole meats: Chicken or Turkey – steaks, roasts, joints, mince or portions (not in batter or breadcrumbs) (128g)		2.44 (1.15 – 5.15)	2.01 (1.12 - 3.60)	0.024
Processed meats/ meat products: Sausages, bacon, corned beef, meat pies/pasties, burgers (80g)		0.04 (0.01 – 0.13)	0.02 (0.00 - 0.08)	<0.001
Processed meats/ meat products: Chicken/turkey nuggets/twizzlers, turkey burgers, chicken pies, or in batter or breadcrumbs (170g)		0.05 (0.01 – 0.41)	0.18 (0.05 - 0.59)	0.003
Fish: White fish in batter or breadcrumbs – like 'fish 'n chips' (160g)		0.12 (0.02 – 0.82)	0.27 (0.24 - 0.99)	0.018
Fish: White fish not in batter or breadcrumbs (119g)		14.97 (3.00 – 73.07)	9.72 (2.52 - 36.83)	0.002
Fish: Oily fish – like herrings, sardines, salmon, trout, mackerel, fresh tuna (not tinned tuna) (90g)	Oily fish	40.56 (12.30 – 131.64)	61.20 (16.26 - 226.40)	<0.001

[*]A Healthy Diet is defined as having an overall DQS of over 12 measured using the FFQ

[†]All food items contribute to the total fat and NMES DQS categories

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Figure 1. Number of respondents included in the analyses