

noo

National Obesity
Observatory



Review of dietary assessment methods in public health

August 2010



NOO is delivered by Solutions for Public Health

Contents

Introduction	2
Methods	3
Introduction to dietary assessment	3
Dietary Assessment Tools Developed in the UK	9
Child and Diet Evaluation Tool (CADET)	9
Day in the Life Questionnaire	11
The Synchronised Nutrition and Physical Activity Program™ (SNAP™).....	12
Five-a-day Community Evaluation Tool.....	14
Dietary Intervention in Primary Care	15
Short Form Food Frequency Questionnaire	16
Cappuccio two-item dietary questionnaire.....	18
Dietary assessment tools developed in non-UK countries	21
Child Nutrition Questionnaire.....	21
Family Eating and Activity Habits Questionnaire	23
Children’s Dietary Questionnaire.....	24
The Dietary Quality Score.....	26
Conclusion.....	28
References.....	29
Appendix A	30

Introduction

Accurate and consistent measurement of dietary intake and patterns of eating behaviour is important when evaluating the effectiveness of public health interventions to improve diet and reduce obesity. Measurement of dietary intake is complex and the most appropriate measurement method will depend on: the objectives of the surveillance; the type of data required; available resources and the population of interest. All of these factors must be considered carefully before selecting a dietary assessment tool.

The aim of this report is to provide a descriptive summary of tools to measure dietary intake and dietary behaviours. Technical details are provided on the reliability and validity of these tools where available. The report does not provide detailed information on dietary surveillance as this has been the focus of work elsewhere – see 'Dietary surveillance and nutritional assessment in England: what is measured and where are the gaps?'¹ and the MRC Diet and Physical Activity Measurement Toolkit.^a

There are several drivers behind the development of this report. The East Midlands Public Health Observatory² identified a lack of local level data relating to the diet and nutritional status of populations. There is also a lack of practical tools for public health practitioners to measure dietary intake that provide indicators of nutritional status – either to measure trends in populations, or to evaluate the effectiveness of interventions. Work carried out by the National Obesity Observatory (NOO) to develop a framework for evaluating weight management interventions attempted to address the latter point via wide ranging consultation with academics and practitioners.³ Whilst some useful tools were identified, none were sufficiently valid, reliable and practical for recommendation.

This report describes a number of tools, and these descriptions should allow public health practitioners to assess which tool may be most appropriate. It does not set out to prescribe which tools should be used for particular interventions or studies. However, when deciding which approach to take to measure diet with a particular group or population, the demographics of the population should be considered. In addition, it is important to be clear about why particular aspects of diet or dietary behaviour are being measured. It may be helpful to carry out a pilot assessment using the tool in order to test its reliability and suitability. It is also important to consider the resources, time and skills available to administer the tool and analyse the collected data. Further evaluation guidance is available in the NOO Standard Evaluation Framework.³

A supplement to this paper provides complete copies of those questionnaires that are publicly available. Permissions for questionnaire use may still be required. Where complete questionnaires could not be obtained, extracts are included to provide an insight into questionnaire layout and sample questions.

^a www.dapa-toolkit.mrc.ac.uk

Methods

A literature search was undertaken to identify available dietary assessment tools for use with adults and children in a public health setting. Details of the literature search are contained in Appendix A.

Introduction to dietary assessment

The measurement of dietary intake is complex and presents significant challenges, particularly at a group and population level. The appropriate method of measurement will depend on the objectives of the surveillance and the types of information required. For example, a policy maker may be interested in dietary intake data to measure the behavioural response to a campaign to encourage healthy eating, or to estimate the differences between the nutrient intake of particular population subgroup. In contrast, a commissioner may require more detailed information about the nutritional status of a population to determine how nutrition and dietetics services should be resourced and targeted.

In the context of public health nutrition, self-report methods are commonly used to collect food intake data. This is because they usually use fewer resources than alternative methods, such as the use of biomarkers^b or clinical indicators.^c

Assessment of food intake is potentially subject to many sources of both random and systematic error. Studies frequently rely on the accurate reporting of habitual food intake by a sample of individuals within a population. The recall ability and psychological characteristics of individuals can influence dietary reporting. For example, an individual may be aware that their diet is unbalanced and so may be reluctant to provide honest answers to questions, or their recollection of intake may simply be flawed. There is also evidence that participants may report behaviour that they perceive as socially desirable rather than accurate.

Wherever possible, it is important to identify and quantify sources of potential errors when assessing food intake, particularly when deriving nutrient intake. Errors can be minimised through careful design of the study and analyses of the data, and this should be taken into account when analysing data or interpreting existing analyses.

In principle, all tools should be tested for reliability and validity. Reliability refers to the likelihood that an instrument or tool will measure the same thing each time it is used – either with the same or a different respondent. Validity refers to how accurately the instrument reflects the actual behaviour. For example, an instrument that was developed to monitor population level nutrient intake may not be valid and reliable for evaluating change in dietary intake for a smaller group participating in a healthy eating intervention.

Self-report tools can be tested against more reliable and objective methods of assessment such as doubly labelled water to measure energy intake, or nitrogen or protein intake. Biomarkers such as these are not subject to the same sources of error

^b Biomarkers are biochemical indicators that can be assessed in blood, bodily fluids, body tissues or excreta and provide an indication of a limited number and range of nutrient levels.

^c A number of nutritional deficiencies can be identified from the physical appearance of the body when clinically examined.

and bias as self-report instruments. However, they are expensive and are usually impractical in a public health surveillance context.

Further information on dietary assessment can be found in the NOO report 'Dietary surveillance and nutritional assessment in England: what is measured and where are the gaps?'¹

Table 1 lists the eleven tools that have been identified as part of this review and outlines their main characteristics. More detailed information on each tool is provided in later sections of this report.

Table 1: Potential tools to measure dietary intake and dietary behaviour

Dietary Assessment Tool	What does it measure?	Who are the target population?	Is it a valid tool?	Is it a reliable tool?	Can it detect changes over time?	Is it accessible to the public?	Resources or expertise needed	Challenges
Child and Diet Evaluation Tool (CADET)	Dietary intake, with a main focus on fruit and vegetables.	3–7 year olds.	Yes. Highly significant correlation with 1-day semi-weighted diary but overestimates intake. Can be used to rank populations.	Yes, although there was a slight learning effect for second CADET found.	Yes. It was used in the evaluation of the National School Fruit and Vegetable Scheme.	No. Restrictions around the software and background documents but authors are happy to work with other groups.	Training needed for those administering CADET and to interpret the results. Specific software needed.	An adapted version of the questionnaire is currently being validated for use in black and minority ethnic groups. This version is not publicly available yet.
Day in the Life Questionnaire (DILQ)	Fruit and vegetable consumption in children.	7–9 year olds.	Yes. There was 70% agreement with observations taken on the same day as completion of questionnaire.	Yes. Test-retest reliability was reported as being good.	Yes. It was found to be able to detect changes in intake during a free fruit intervention in one school.	No, but it can be obtained from the authors, but there is a cost for manuals and questionnaire.	This depends on the number of children involved in the study, as analysis will become more complex as the numbers increase.	It focuses specifically on fruit and vegetable intake, which provides a limited measure of dietary intake. It does measure fluid intake.
Synchronised Nutrition and Activity Programme (SNAP™)	Dietary intake of 49 different food and drink items.	7–15 year olds.	Yes. Acceptable agreement was reported between the tool and 24-hour multiple pass recall.	This has not been formally tested.	This has not been formally tested.	A licence for its use has to be bought from the development team. This allows use of the software plus analysis of the data is undertaken by the development team.	Web-based programme so would require internet access, plus specific software. Training needed for its application and for analysis and interpretation of results.	Further testing is needed to determine its suitability for use with black and minority ethnic groups. Its ability to record habitual behaviours over longer time periods also needs to be assessed.

Dietary Assessment Tool	What does it measure?	Who are the target population?	Is it a valid tool?	Is it a reliable tool?	Can it detect changes over time?	Is it accessible to the public?	Resources or expertise needed	Challenges
Five-a-day Community Evaluation Tool (FACET)	Intake of fruit and vegetables in adults and related eating behaviours.	Adults.	Yes. There was good correlation with a food diary but it was seen to overestimate portions consumed. It could adequately rank population groups.	This has not been formally tested.	This has not been formally tested.	Yes. It is available to download from the internet together with additional guidance on its use and analysis.	It is suitable for use by non-nutritionists. Analysis requires statistical software.	It over estimates the number of portions consumed, which is a problem where intake is very low. A regression model can be used to predict true intake.
Dietary Intervention in Primary Care (DINE)	Brief assessment of an individual's intake of total fat and dietary fibre.	Adults.	Yes. There was good agreement between the questionnaire and a 4-day semi-weighed food diary. It could adequately rank population groups.	This was not formally tested.	This was not formally tested.	No. Copyright is held by the Department of Primary Care at Oxford University. Permission must be sought from this group.	DINE questionnaire is designed for use by those with no nutritional knowledge. Additional software is not needed but this could be developed for use in larger populations.	This questionnaire was designed for use in clinical settings, and has not been validated for use in larger populations but has been adapted for use in Health Survey for England.
Short Form Food Frequency Questionnaire (SFFQ)	Assesses overall dietary quality by examining the intake of a number of different foods.	Adults.	Yes. Good agreement reported with a 217-item FFQ. Good agreement was not seen when compared with a diet recall.	This has not been formally tested.	This has not been formally tested.	No, but the authors are happy to work with other groups if they wish to use the questionnaire.	It is suitable for use by non-nutritionists but collaboration with the development group would be needed to analyse the questionnaire.	It is relatively new. Further testing is needed to determine suitability for use within different populations and with black and minority ethnic groups.

Dietary Assessment Tool	What does it measure?	Who are the target population?	Is it a valid tool?	Is it a reliable tool?	Can it detect changes over time?	Is it accessible to the public?	Resources or expertise needed	Challenges
Cappuccio Two-item questionnaire	Daily intake of portions of fruit and vegetables.	Adults.	Weak significant correlation reported with plasma and urine biomarkers.	This has not been formally tested.	This has not been formally tested.		It is suitable for use with non-nutritionists but basic training may be needed to ensure consistency.	Initially designed for use with individuals in nutritional behavioural therapy, but the authors state that it is suitable for use in larger populations.
Child Nutrition Questionnaire (CNQ)	Dietary patterns that are known to increase the risk of positive energy balance.	10–12 year olds.	Yes. Highly significantly correlated with 7-day diary, with values comparable to other studies.	Yes. There was good test-retest reliability for 10/12 scores.	This was not formally tested, although it is likely.	Yes, it can be downloaded from the internet, guidance provided in reference paper.	It should be suitable for use with non-nutritionists but basic training may be required to ensure consistency.	It was developed in Australia so it may need to be validated for use in the UK, and with black and minority ethnic groups.
Family Eating and Activity Habits Questionnaire (FEAHQ)	Environmental factors and family behaviours associated with weight gain and weight loss in children.	Parents of children aged 6–11 years.	Yes. It was reported to adequately discriminate between those with behaviours leading to weight gain and those associated with normal weight.	Yes. It shows good results for test-retest reliability if completed by parent/carer.	Yes. It was reported that weight loss in the child was associated with an improvement in scores.	It is publicly available as an appendix to the reference paper, and is available for use by any healthcare provider.	Basic training needed on the scoring system and interpretation of results.	This was developed in Israel. It is currently in use in a number of programmes in the UK but validation may be needed to ensure that it is suitable for use in the UK.

Dietary Assessment Tool	What does it measure?	Who are the target population?	Is it a valid tool?	Is it a reliable tool?	Can it detect changes over time?	Is it accessible to the public?	Resources or expertise needed	Challenges
Children's Dietary Questionnaire (CDQ)	Patterns of food intake, by assessing intake of both 'recommended' and 'discouraged' foods.	4–16 year olds.	Yes. It showed good correlation with a 7-day checklist at group level but is not suitable for use at an individual level.	Yes. Test-retest reliability was reported to be good.	Yes. It was shown to detect differences in those on a weight management programme but further testing is needed.	Yes. Information is provided in the reference paper and the authors are happy to be contacted.	It is suitable for use by non-nutritionists but assistance may be needed from the authors.	It was developed in Australia so it may need to be validated for use in the UK, and in BME groups.
Dietary Quality Score (DQS)	Quality of diet based on certain nutritional risk factors for cardiovascular disease.	Adults (developed with adults aged 30–60 years).	Yes. There was good correlation between the questionnaire and 198-item FFQ.	This has not been formally tested.	This was not formally tested but the author states that it can detect changes (personal communication).	Yes. Information is provided in the reference paper and the authors are happy to be contacted.	It should be suitable for use with non-nutritionists, and analysis should not be too difficult.	It was developed for use in an urban Danish programme and further testing may be needed for its use in the UK and with black and minority ethnic groups.

Dietary assessment tools developed in the UK

Child and Diet Evaluation Tool (CADET)

The Child and Diet Evaluation Tool (CADET)⁴ examines dietary intake in children with an emphasis on fruit and vegetable intake. The questionnaire was initially developed to evaluate the National School Fruit and Vegetable Scheme,^d which aimed to increase fruit and vegetable uptake among school children.

Overview

The CADET is a tick list record for all foods consumed over one 24 hour period with a retrospective breakfast section. There are two separate questionnaires. The first is for completion at home by the parent or carer and includes 115 foods covering snacks and meal times outside of school. It includes a section of additional questions about dietary behaviours and attitudes and socio-demographic characteristics. The second questionnaire is for completion at school by a lunch time supervisor or classroom assistant. It also includes 115 food items.

A pilot study is currently being undertaken in London examining the use of a DVD to help parents to complete the questionnaire. It is hoped that this resource will improve the accuracy of recording, and eliminate any bias due to literacy or language skills. The study is in its very early stages and no results are available currently.

The CADET requires only ticks for the items consumed, with no requirement to record quantity or weight of the food/drink item. Portion sizes are based on mean portion sizes from the National Diet and Nutrition Survey (NDNS) results for children, and are age and gender specific. This allows for analyses of average nutrient intake if a more in-depth intake is needed. It is also possible to assess intake of portions of fruit and vegetables through aggregation of food items listed on the questionnaire.

Validation and reliability

Validation of the CADET was undertaken with children aged 3–7 years. It is likely that the same questionnaire would be suitable for use with older children, although changes in attributed portion sizes would be necessary. Further validation would be needed to ensure that the questionnaire is appropriate for different age groups. It may be suitable for use in a range of public health settings, including small community settings and larger population groups. The initial validation process was undertaken in schools in the North East and Yorkshire and Humber regions. It was reported that the sample population was representative of the national distribution of primary-aged children in terms of black and minority ethnic (BME) populations, and eligibility for free school meals. Therefore, the CADET may be appropriate for use in other geographical areas, although attention should be given to the socioeconomics and demographics of the sample population. If the sample is likely to vary significantly from that of the population in which the tool was validated, further testing may be needed to ensure the questionnaire is appropriate. An adapted version of the questionnaire is being used in schools with a high percentage of children from black and minority ethnic backgrounds. Formal validation of this version has not yet been published.

^d http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_078170

The CADET is reported to be a reliable and valid dietary assessment tool.⁴ A comparison study was undertaken against a one day semi-weighed food diary. At home, parents or carers were required to estimate the portion size, or weight (using home scales) of all food and drink items consumed. At school, all food and drink options consumed during school lunches were weighed by researchers, and estimates of leftovers were also recorded. In addition, the portion size of snacks consumed at break times was estimated by researchers after discussion with the child immediately after break time.

This study indicated that the CADET can adequately rank individuals according to level of intake, with highly significant correlation reported for a range of food items and nutrients ($p < 0.0001$). The CADET was found to typically overestimate fruit intake and underestimate vegetable intake. The mean difference in total fruit and vegetable intake is reported as 45g. The authors state that it is likely that the tool is not suitable for monitoring diet-related targets in a population.

The questionnaire may be appropriate for assessing behavioural change in dietary patterns at a population level or to rank populations according to dietary intake. Nutrient intake values were similar to those obtained for the same age group in the 1997 National Diet and Nutrition Survey for this age group.

Repeatability was assessed using information collected from a subgroup of two classes of children on two different days, and the data were collected one week apart. The first CADET gave higher results by about 10%. A second food diary was also completed with the second CADET tool. The second CADET gave values slightly closer to the second diary. This implies a learning effect on completing the CADET. Correlation between the first and second CADET was not reported as good, but this is possibly due to dietary intake being recorded on two different days. Due to natural variation in individual daily intakes, results would not be expected to correlate as well with each other as with the relevant diary that was taken on the same day.

Usage

The CADET questionnaire is not available for public use as there are restrictions regarding the analysis software and background documents. The development team at Leeds University are willing to work with interested parties to utilise this resource. The questionnaire can be used by non-nutritionists but training would be needed for those administering and analysing the questionnaire. Specific analysis software (DANTE) is also required as it contains the pre-determined portion weights for each of the foods in the questionnaire.

The researchers noted that the quality of results improved if the questionnaires were administered during school time by researchers rather than school staff. This was mainly due to a lack of time by school staff rather than a need for additional skills. It is important to note that the use of additional researchers for this purpose would increase the resources and funding required for application of the questionnaire.

Reference paper

Cade JE, Frear L, Greenwood DC. Assessment of diet in young children with an emphasis on fruit and vegetable intake: using CADET – Child and Diet Evaluation Tool. *Public Health Nutrition*. 2006; 9(4): 501–8.

Day in the Life Questionnaire

The Day in the Life Questionnaire (DILQ)⁵ was developed as a supervised classroom exercise to measure fruit and vegetable consumption during the previous day among children aged 7–9 years.

Overview

This questionnaire uses the 24 hour recall method to measure consumption and uses a mixture of words and pictures to gain information. For example, the child must draw their breakfast in a pre-drawn circle and list all food items that were in their breakfast. The aim of these pictures is to aid recollection by the child and improve completion of the tool. It takes the child through their previous day and gets them to write down everything that happened. The tool does not focus specifically on fruit and vegetable intake, but on all activities in a single day.

It is important to note that the questionnaire does not measure fruit and vegetables contained in composite foods, such as pizzas and pies. The explanation for this is that it would be too difficult to estimate their contribution to the diet. Nor does the questionnaire measure drinks because it is difficult to determine whether the drinks are pure fruit juice or diluted.

The time needed to complete the questionnaire will vary depending on the child's ability and what the child actually ate the day before. It is generally undertaken in the classroom under supervision with the researcher guiding the children through the questions. The children fill in the questionnaires themselves, but are allowed to speak with one another and ask for help from additional researchers or teachers. The use of additional researchers for this purpose would increase the resources and funding required for application of the questionnaire. During testing it typically took 30–40 minutes for each class to complete the entire questionnaire. Some children completed the questionnaire more quickly than others, and these children were encouraged to draw further pictures or to colour the pictures already drawn. This was reported as being quite useful with this age group as these children did not distract others still completing the questionnaire. Most children enjoyed completing the questionnaire and most teachers found it to be appropriate for use in this age group.

Validation and reliability

The authors state that there was no gold standard method available to test the validity of the questionnaire, but an observation method was used. Individuals were trained to observe the food eaten by children throughout the school day in two city-based schools and two village-based schools. Their reports were then compared to the completed questionnaires. There appeared to be relatively good agreement between DILQ scores and observations, with 70% agreement reported by the authors. In addition, inter-rater reliability was reported to be high with levels ranging from 0.85 for fruit and 0.92 for vegetables. No value was provided for total consumption.

Four schools were involved in the testing of the questionnaire. The questionnaire was administered on two occasions two weeks apart to assess test-retest reliability. Mean daily fruit and vegetable consumption was compared for each administration for each school. No significant differences were reported for three out of the four schools. In the school where a difference was detected, it was noted that no vegetables were provided for school lunch on that day which is likely to account for the differences.

The questionnaire was found to show a significant difference in fruit intake after a 'free fruit' intervention in one of the schools, showing that it can detect changes over time. There is a need to test the sensitivity of the tool more robustly, as the testing stage only included one school using a three-day intervention.

Usage

The questionnaire is not publicly available and must be obtained from the authors in Oxford. There is an initial charge for the original copy of the questionnaire, but there is no limit on the number of subsequent copies that can be made by an organisation. The authors will also provide a user manual which explains how to use the questionnaire accurately. The authors will also analyse and interpret results. The number of children involved in the study may determine the level of expertise needed to analyse the collected data, as analysis of larger samples is more complex. This will further increase the resources and funding needed for application of this tool.

Reference paper

Edmunds LD, Ziebland S. Development and validation of the Day in the Life Questionnaire (DILQ) as a measure of fruit and vegetable questionnaire for 7–9 year olds. *Health Education Research. Theory and Practice*. 2002; 17(2): 211–20.

The Synchronised Nutrition and Physical Activity Program™ (SNAP™)

The Synchronised Nutrition and Activity Program™ (SNAP™)⁶ is a web-based programme that uses a typical 24-hour recall method to assess dietary intake and physical activity in children aged 7–15 years.

Overview

For completion of SNAP, children are taken through a typical school day and asked to choose food and drink items that they consumed, and recall physical activity undertaken in the previous 24 hours. Using specific structure of a school day was found to improve accuracy of recording in this age group. Visual memory prompts were provided by food/drink and activity images. Double data collection, collection of both physical activity and dietary data, has previously been reported to improve recall of both activity and food intake. At the end of the programme, children are reminded of all food/drink items and activities recorded and corrections can be made before final submission of the questionnaire. The interface for the programme was developed to be user-friendly to enhance engagement with the age group and improve recall and accuracy of recording.

The questionnaire includes 40 food items and 9 drink items. The food items included are based on findings from the National Diet and Nutrition Survey and previous research by the University of Teeside into the dietary intake of children. Options were reviewed and finalised by an expert panel. A free-text box was also provided for children to include any other food/drink items consumed that were not included in the list. Food and drinks were analysed by count (the number of times a particular item was selected), with no information collected on portion sizes. This approach was taken to overcome the difficulties of assessing portion sizes in children of this age. It was assumed that counts of food and drink would be an adequate proxy indicator of dietary behaviours.

Validation and reliability

The validity of the questionnaire was assessed using a 24 hour multiple-pass recall method. For comparison between methods, dietary intake was categorised into 21 food groups e.g. diet fizzy drinks, milk, chips, crisps, fruit, takeaway foods and total energy-dense foods. The mean counts of intake of each food group were measured. The accuracy of the tool was assessed by the mean difference in these counts between methods (SNAP and 24 hour multiple-pass recall). This difference was reported as being acceptable with the difference being less than one (count of a food group) for all but three categories: confectionery and cakes, total energy-dense foods and total carbohydrate-rich foods.

As measurement agreement was calculated to within ± 1 count, food groups with smaller counts (such as pies and pasties) will have better agreement than food groups with larger counts (such as confectionery and cakes). This is important to consider when assessing results. It was also reported that SNAP typically underestimated mean counts of dietary constituents, and that the accuracy decreased with increasing counts. It is important to note that 90% confidence intervals were chosen to examine significance rather than the traditional 95% confidence intervals. The reliability of the questionnaire is currently being tested, and no results are currently available.

As part of the validation process, children were asked to complete an anonymous evaluation questionnaire. The majority of children reported that they enjoyed using SNAP and were able to complete it without great difficulty. They also made a number of suggestions which will be incorporated, when possible, into future publications of the SNAP. Completion time for the SNAP questionnaire ranged from 15 to 40 minutes, and this depended mainly on the reading ability of the child and the internet connection speed. In general, more support was required for younger children but no child was unable to complete the questionnaire. This may increase the resources and funding needed for application of the tool in younger populations.

Usage

The authors clearly state that further work is necessary to understand the suitability of the programme in different situations. It has not been appropriately tested with children from black and minority ethnic groups. The potential use of SNAP in recording habitual behaviours over longer time periods also needs to be assessed. The ability of the questionnaire to evaluate change in behaviour over time has not been tested. It is likely to be more appropriate to evaluate school-based interventions rather than those that are community based, due to the structure of the questionnaire.

The programme is not publicly available and a user licence must be obtained from the development team (www.snapproject.co.uk). Analysis is completed by the research team at Durham University and feedback is provided in the form of a written report within 4–6 weeks of study completion. The development team is willing to complete analysis to specific needs and support interpretation of results, if required.

Reference paper

Moore HJ, Ells LJ, McLure SA, et al. The development and evaluation of a novel computer program to assess previous-day dietary and physical activity behaviours in school children: The Synchronised Nutrition and Activity Program™ (SNAP™). *British Journal of Nutrition*. 2008; 99(6):1266–74.

Five-a-day Community Evaluation Tool

The Five-a-day Community Evaluation Tool (FACET)⁷ was developed on behalf of the Department of Health to assess the effectiveness of a pilot initiative to increase fruit and vegetable intakes in deprived communities. It focuses on the intake of fruit and vegetables and related eating behaviours in adults.

Overview

This questionnaire based tool has three main sections, each concerned with a different aspect of healthy eating. The initial section of the questionnaire asks respondents how often certain foods were consumed at various meal times during the previous day, with a focus on fruit and vegetables. The second section examines attitudes towards fruit and vegetable intake and knowledge of relevant health recommendations. The final section asks a number of socio-economic and demographic questions. The FACET questionnaire estimates the number of portions per day that were consumed for total fruit and vegetable intakes. Total fruit and total vegetable intakes can also be analysed separately.

FACET should be relatively easy for adults to complete, although no information is given on the usual time taken for completion. It has been designed for use in community settings, specifically to evaluate the impact of an intervention to increase awareness and consumption of fruit and vegetables in a local population. No information is provided about the source of the questions used, or if the questionnaire was tested with community groups prior to its use.

Given that the questionnaire has been designed for use in adults only, it is unlikely to be suitable for use in children. Only 4% of the study population were from minority ethnic groups, so it was not possible to identify whether the questionnaire was suitable for use with a range of ethnic groups.

Validation and reliability

Previously collected food diary data were used to assess the accuracy of the intake estimates produced from the questionnaire. FACET estimates of total fruit and vegetable intakes were significantly and positively correlated with food diary estimates ($r=0.46$), but FACET estimates were generally higher than those calculated from food diaries. The absolute difference between FACET and food diary estimates increased with increasing frequency of intake of fruit and vegetables. A regression model was derived which uses the FACET estimate to predict true intake of fruit and vegetables. The authors state that this model can be successfully used with consumption levels of up to 10 portions per day, as estimated by FACET.

FACET was reported to adequately rank respondents based on whether they reached the five-a-day target. The FACET classification of participants consuming less than five portions per day, and greater than or equal to five portions per day, agreed with the food diary classification of these same groupings for 56% of subjects. Classification was more accurate among those with high levels of consumption of fruit and vegetables than those with low intakes. In addition, respondents were grouped according to self-reported perceived fruit and vegetable intakes (very low, quite low, moderate, quite high, very high). The median FACET intake estimates increased incrementally from the very low through to the very high group, which also suggests that the FACET is suitable for ranking individuals by fruit and vegetable intake.

Sensitivity of FACET was high (88%), therefore only a small proportion of individuals who achieve the five-a-day target would be misclassified. Specificity was low (40%) indicating that FACET could misclassify a large proportion of subjects as achieving the five-a-day target, whose actual intake was low. This may partly be explained by the overestimation of fruit and vegetable intake by FACET. It is unclear whether the FACET questionnaire could be used to measure a change in intake following an intervention. Further testing would be required.

Usage

As described previously, the questionnaire was used in the national evaluation of a pilot initiative to increase fruit and vegetable intakes in deprived communities. There is no evidence to suggest it has been used in other studies. The questionnaire and guidance on its application is publicly available from the Department of Health. The FACET questionnaire was designed for use by non-nutritionists, although it is likely that some level of training will be needed for adequate application and interpretation. It is also recommended that an appropriate statistical software package is used for analysis of the collected data.

Reference paper

Ashfield-Watt PA, Welch AA, Godward S, et al. Effect of a pilot community intervention on fruit and vegetable intakes: use of the FACET (Five-a-day Community Evaluation Tool). *Public Health Nutrition*. 2007; 10(7):671–80.

Dietary Intervention in Primary Care

The Dietary Intervention in Primary Care (DINE)⁸ questionnaire was developed for use in nurse-administered health checks in general practice or worksite programmes. It was originally designed to give a brief initial assessment of an individual's intake of total fat and dietary fibre, and to guide the health professional to provide personalized dietary advice. Since its development it has been used as part of the dietary assessment element of the Health Survey for England and therefore is an important tool to include in this review. The questionnaire is designed for use with adults.

Overview

Specific foods are included in the questionnaire because they account for around 70% of the fat and fibre in the typical UK diet. The questionnaire consists of 19 questions related to frequency of intake of these foods. It is reported that it should take approximately 5–10 minutes to complete the questionnaire when conducted by an experienced interviewer. No indication is given on the time needed for self-completion. No information is provided on whether questionnaire content was validated with user groups or other professionals working in this area.

Validation and reliability

Validation was carried out against a validated four-day diet record with portion sizes described using household measures and standard photographs. The DINE questionnaire was completed via interview with a nurse, and the diary was then completed by the participant in the following four days. Analysis of the DINE questionnaire provides individual scores for fat, fibre and saturated fat which are then

categorised as low, medium or high intakes. The DINE questionnaire was reported to accurately classify individuals into these intake categories. The two assessment methods gave exact agreement of categorization for 53% of fat intake and for 52% of dietary fibre intake. The rate of gross misclassification was 6% for fat, and 5% for fibre.

Highly significant correlation was reported between the food diary estimates and the DINE scores for all nutrients examined. Correlation coefficients for total fat, total saturated fat and total fibre were 0.51, 0.57 and 0.46 respectively. This suggests that the DINE questionnaire can be used to measure these elements of the diet with some accuracy. It is important to note that the DINE questionnaire does not provide values for total nutrient intake, but rather categorises individuals into groups based on low, medium or high intake. No information is provided on inter-rater reliability or test-retest reliability. Also, no information is provided on whether internal consistency of the sub-scales in the questionnaire was examined. This information would provide further evidence of the validity and reliability of the questionnaire.

It is reported that the tool may not be suitable for use with population groups whose diet differs significantly from the general population, such as some minority ethnic groups. It is likely that adjustments would be necessary for its use in such groups. In addition, the questionnaire was developed in 1994 and it is likely that adjustments would be needed to represent changes to the typical UK diet since then. Some adjustments have been made for its use in the Health Survey for England, but no formal validation has been reported. This is recommended if the questionnaire is to be used in wider settings.

It is important to note that this questionnaire was designed for use in clinical settings (thus it does not meet the criteria of the literature search), but due to its use in the Health Survey for England it was included in this review. The questionnaire has not been validated for use with larger population groups, which may be necessary to determine its suitability for use in community settings.

Usage

The questionnaire is designed for use by those with no nutritional knowledge. Guidance is provided on its use and interpretation. There is no need for additional analytical software, although this could potentially be developed for use in larger populations. Copyright is held by the Department of Primary Care at Oxford University, and permission to use the questionnaire must be sought.

Reference paper

Roe L, Strong C, Whiteside C, et al. Dietary Intervention in Primary Care: Validity of the DINE method for diet assessment. *Family Practice*. 1994; 11(2): 375–81.

Short Form Food Frequency Questionnaire

The Short Form Food Frequency Questionnaire (SFFQ)⁹ was developed to assess overall dietary quality by examining the intake of a number of different foods, including fruit and vegetables. It is designed for use in adults.

Overview

The questionnaire gathers information on the intake of 20 different food items, with a focus on fruit, vegetables, fibre-rich foods, high fat and high sugar foods, meat, meat products and fish. It also asks questions about alcohol consumption and exercise and collects basic demographic information. The questionnaire was designed for use with large populations. It enables classification of groups according to dietary quality so general statements can be made about particular populations and to highlight communities that may require dietary intervention. Results from the questionnaire can be used to examine the intake of specific food groups. For example, it is possible to estimate the number of fruit and vegetables consumed per day. The questionnaire cannot however, be used to assess intake of specific nutrients.

The SFFQ can also be used to examine overall dietary quality by calculation of a dietary score based on different food groups of interest. A Dietary Score has been developed based on indicators of a healthy diet: fat; NMES (non-milk extrinsic sugars); fruit; vegetables and oily fish intakes. The SFFQ does not aim to capture nutrient intake.

Scores of 1–3 were allocated for each component, with a score of “3” corresponding to the recommendations agreed by the research team for that food group. These recommendations were based on national dietary guidelines for the mentioned food groups. As there were five groups of interest with a maximum score of 3 in each group then each person was allocated a dietary score of 5–15.

Validation and reliability

A separate longer food frequency questionnaire (FFQ) consisting of 217 items was used for the validation of the SFFQ. This longer questionnaire was originally based on the semiquantitative food frequency questionnaire used in the Norfolk arm of the EPIC study (European Prospective Investigation into Cancer and Nutrition),¹⁰ and was modified for use in other studies.

The FFQ had previously been validated against four-day diet records and was reported to be capable of adequately assessing nutrient intake. A multiple-pass 24-hour dietary recall was also undertaken on a sub-sample of the study population. A diet score was calculated for each method and this was used to compare the SFFQ with the other two methods. Both correlation and agreement comparisons were made between the SFFQ and the longer FFQ, and the SFFQ and the diet recall.

The overall difference in the Dietary Score between the SFFQ and the longer FFQ was not significant. The scores from these two methods agree to a moderate extent (kappa score=0.42). The SFFQ and the diet recall did not show good agreement (kappa score=0.09). Significant correlation ($p<0.001$) was reported for all dietary components between the SFFQ and the longer FFQ. Significant correlation ($p=0.02$) was only reported for fruit and vegetable intake between the SFFQ and the diet recall. A number of reasons were reported to explain this discrepancy. Firstly, 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 SFFQ measures usual intake over the last month. Other factors that may have affected the association include the small sample size of the diet recall, the time gap between the SFFQ and the diet recall (five months), and that the diet recall was conducted over the telephone rather than as a face to face interview.

The authors suggest that the SFFQ may be a useful alternative to longer, more expensive FFQs where specific nutrient intake information is not necessary and only an indication of dietary quality is required.

Usage

The SFFQ questionnaire is relatively new and extensive testing of it has not yet been undertaken. No information is available on the reliability of the questionnaire and whether it is capable of detecting changes over time. Further testing is required to examine these elements, and to determine its usefulness with other populations.

Validation work was undertaken with an adult population sample randomly selected from GP practices in Bolton and East Leeds PCT. Validation did not examine differences by ethnic group and further testing would be needed to determine if the SFFQ is appropriate for use with different black and minority ethnic groups.

The questionnaire is not freely available for public use, although the authors state that they would welcome the opportunity to work with other groups who wish to use the tool. The dietary score is calculated using a specific analysis program developed by the research group. Its application would require support from the research team.

Reference paper

Cleghorn CL, Harrison RA, Ransley JK, et al. Can a short form food frequency questionnaire be useful to assess dietary quality in population surveys in the UK? (2010). To be submitted for publication.

Cappuccino two-item dietary questionnaire

This two-item dietary questionnaire¹¹ was developed as a short questionnaire to estimate fruit and vegetable intake. It categorises whether respondents achieve the recommended daily intake of five portions of fruit and vegetables.

Overview

The questionnaire is designed for use with for adults and is generally delivered by a trained interviewer. The following two questions are asked:

- 'How many pieces of fruit, of any sort, do you eat on a typical day?'; and
- 'How many portions of vegetables, excluding potatoes, do you eat on a typical day?'

Portion size is defined using guidelines from the British Dietetic Association and examples of typical fruit and vegetable portions are provided. Fruit juice is included if it is greater than one glass of fresh juice per day, but would count as a single portion of fruit even if more than one glass is consumed. Fruit and vegetable intake can be combined to provide overall daily intakes and can be analysed as a continuous variable or as specific intake categories, (such as less than or greater than five portions a day).

Validation and reliability

The questionnaire was tested with participants from a trial focusing on dietary counselling in primary care in South London. Thirty percent of this group were from black and minority ethnic backgrounds. The validity of the questionnaire to estimate fruit and vegetable intake was assessed through measurement of the following biomarkers:

- plasma ascorbic acid (vitamin C);
- α -tocopherol (vitamin E);
- β -carotene (vitamin A); and
- 24-hour urinary potassium excretion.

These are established biomarkers of fruit and vegetable intake. Significant associations, albeit weak, were reported between fruit and vegetable intake and urinary potassium excretion ($r=0.234$), and plasma levels of ascorbic acid ($r=0.133$) after controlling for age, sex, vitamin supplement use, smoking and BMI. High consumption of fruit and vegetables in the daily portions of fruit and vegetables was significantly associated with higher levels of urinary potassium excretion and plasma levels of ascorbic acid. Significant associations were not reported for plasma levels of α -tocopherol and β -carotene with fruit and vegetable intake.

When fruit and vegetable intakes were analysed separately, fruit intake was significantly associated with urinary potassium excretion levels and plasma levels of β -carotene and ascorbic acid. This significant association was not found when vegetable intake was analysed separately. One potential reason for this is the difficulty in accurately reporting vegetable intakes by participants. While it is relatively easy to count the pieces of fruit consumed, many people do not fully understand what constitutes a vegetable portion, especially in composite foods. This may have impacted on the accuracy of reporting of daily vegetable intakes, and alterations to the questionnaire may be necessary to improve the accuracy of vegetable intake recording.

The questionnaire was reported to have low sensitivity, as only 36% of participants that consumed five or more portions per day also had high levels of urinary potassium excretion, and 24% had high levels of plasma ascorbic acid.

It was reported that the questionnaire had high specificity as 83% of participants that consumed less than five portions per day had low levels of urinary potassium excretion, and 76% had low levels of plasma ascorbic acid. The reliability of the questionnaire has not been reported.

Usage

The questionnaire was developed for use in primary care settings but it has also been used in a number of studies evaluating changes in dietary behaviour following nutritional counselling. It was developed to be administered by a trained field worker, and therefore testing would be needed to identify if the questionnaire is suitable for self-administration. It is reported that testing may not have been conducted with a representative sample of the general population and further testing should be undertaken to ensure its suitability for use in local settings. The questionnaire has not been formally tested with black and minority ethnic populations.

The Cappuccio dietary questionnaire is short which should allow it to be completed swiftly, and appropriate examples of fruit and vegetable portions would need to be provided to improve accuracy of recording.

Reference paper

Cappuccio FP, Rink E, Perkins-Porras L, et al. Estimation of fruit and vegetable intake using a two-item dietary questionnaire: a potential tool for primary health care workers. *Nutrition, Metabolism and Cardiovascular Diseases*. 2003; 13(1): 12–9.

Dietary assessment tools developed in non-UK countries

It is important to include dietary assessment tools from non-UK countries in this review as such tools are potentially suitable for use in the UK following appropriate adjustments and validation. A number of tools developed in other countries are currently being used in the UK as part of the evaluation process of weight management interventions.

There are issues inherent to all tools that must be considered before their application in other countries. Cultural differences between countries may impact on the diet and eating habits of that population, and thus influence the behaviours of interest captured by dietary assessment tools.

Comparisons were made between the national dietary guidelines of the countries where the tools were developed, and UK dietary guidelines. No major differences were apparent. The general dietary guidelines for all countries recommended the intake of a varied diet; promoting the intake of fruit and vegetables and reducing foods high in fat, salt and sugar. Slight differences did exist between the recommended portions of certain food groups, for example fish and fish products. This is important to note if dietary assessment is based on UK national dietary guidelines.

A key issue with all the tools developed outside the UK will be the food items named in the questionnaires. All foods should be reviewed to identify those which are not appropriate for use in UK populations, and suitable replacements should be included in their place. This is especially so for branded goods which are not available in the UK.

Child Nutrition Questionnaire

The Child Nutrition Questionnaire (CNQ)¹² was developed in Australia to examine dietary patterns that are known to increase the risk of weight gain. Additionally, the questionnaire gathers information about food behaviours, attitudes, environments and knowledge. It has been developed and tested for use in children aged 10–12 years.

Overview

The questionnaire was developed to evaluate the effectiveness of a specific community weight management programme (Eat Well Be Active). This programme focuses on individual and environmental barriers to behaviour change. The programme aims to promote healthy eating and physical activity behaviours, including active play, and consumption of fruit, vegetables and water. It also supports breastfeeding.

The CNQ tool measures the consumption of sweetened beverages and noncore foods,^e plus fruit, vegetables and water. It also includes questions on the frequency of specific 'healthy' behaviours; attitudes towards the consumption of fruit and vegetables; and the day-to-day availability of fruit and vegetables.

There are 14 questions and the authors state that the questionnaire takes approximately 20 minutes to complete. A variety of different response scales are used including Likert scales and frequency scales. The questionnaire is usually completed by the child with support from a helper. Instructions on completing the questionnaire are

^e potato crisps, chocolate, lollies, muesli bar, savoury biscuits, sweet biscuits, ice-cream/ice block, hot chips, pie/pasty/sausage roll, hot dog, pizza

initially provided to a group of children, while posters depicting standard serving sizes of fruit and vegetables are displayed. The use of a helper is likely to improve the accuracy of questionnaire completion, but it does increase the resources required for its application.

Testing was undertaken in schools, and it is not clear if the CNQ would be suitable for use as a postal questionnaire for home use. Adjustments and additional validity and reliability testing would be required in such circumstances.

Validation and reliability

Validity of the questionnaire was tested using an un-weighted seven-day food diary. For each day, the food or behaviour of interest (those included in the questionnaire) were listed in the diary and respondents had to tick each time they consumed that particular food or took part in the behaviour. These diaries were then used to determine the frequency of intake – not the quantity of foods consumed.

A highly significant correlation ($p < 0.0001$) was reported for all food items in the questionnaire, with coefficient values ranging from 0.34 to 0.48. These correlation values are relatively low. The authors state that these values are comparable to similar studies. The ability of the questionnaire to detect changes in diet over time has not been reported.

Internal consistency was examined and those questions that were found to be unnecessary were removed from the final questionnaire. Good internal consistency is generally accepted as having Cronbach alpha values higher than 0.7. After modification, scope values were:

- 0.50 for healthy behaviour and fruit and vegetable availability;
- 0.74 for attitude to consumption of vegetables; and
- 0.80 for attitude to consumption of fruit.

Test-retest reliability was found to be high for 10 of the 12 questions (ranging from 0.47 to 0.66, $p < 0.00001$ level). Values < 0.4 were seen for the knowledge scores on fruit and vegetables. At the group level there was a difference in mean scores between the questionnaire and the seven-day diaries for sweetened beverages and water intake.

Usage

The questionnaire is available to download free of charge from the following site: <http://www.ijbnpa.org/content/5/1/5/additional/>

Some information is provided regarding coding of the questionnaire, but it is likely that the development team would need to be contacted for further information on coding and analysis. A suitable database would need to be developed to allow for accurate data entry, summing of the scores, and subsequent analysis.

Reference paper

Wilson AM, Margarey AM, Masterson N. Reliability and relative validity of a child nutrition questionnaire to simultaneously assess dietary patterns associated with positive energy balance and food behaviours, attitudes, knowledge and environments

associated with healthy eating. *International Journal of Behavioural Nutrition and Physical Activity*. 2008; 5: 5–16.

Family Eating and Activity Habits Questionnaire

The Family Eating and Activity Habits Questionnaire (FEAHQ)¹³ was developed in Israel to examine environmental factors and family behaviours associated with weight gain and weight loss in children. The questionnaire was designed for use in family-based weight-management interventions that emphasise changes in the environment in which they live. It was developed for use with children aged 6–11 years.

Overview

The questionnaire was designed for co-completion by parents or carers and their children. The questionnaire is self-administered with 21 main questions. Usual completion time is reported as being less than 30 minutes.

Four separate scales are used in the FEAHQ which are based on those factors most likely to be associated with weight change. These factors include:

- Activity level (4 items) – frequency with which the parents and child engage in physical and sedentary activity;
- Stimulus exposure (8 items) – presence and visibility of snacks, sweets, cakes and ice-cream in the home and the boundaries of child's autonomy in buying or taking these foods;
- Eating related to hunger (4 items) – person in family who initiates eating and also what would happen if they or the child are not hungry during meal times;
- Eating style (13 items) – examines typical eating behaviours of both the child and parents e.g. eating while watching TV or doing homework or reading, snacks between meals; second helpings; parental presence when the child is eating.

Each item is individually scored based on its association with weight change. Higher numerical scores reflect less appropriate eating patterns.

Validation and reliability

Content validity was assessed by ten identified experts evaluating completeness of criteria, clarity, and suitability of scoring. Questions were modified according to comments from this group.

As the questionnaire was developed for use in Israel, food items included in the questionnaire would need to be reviewed to assess suitability for use in other countries as well as further re-validation with the appropriate population.

Internal consistency of both the overall questionnaire and each of the sub-scales was examined and findings indicate that both are internally consistent (mean $r=0.83$). Concurrent validity was also examined. This tested the questionnaire's ability to discriminate between the behaviours of obese and normal weight children. The mean scores of obese children were reported as being significantly higher than those of

normal weight children, illustrating that the questionnaire is capable of identifying those children that are more likely to have behaviours associated with weight gain or obesity.

Test-retest reliability was assessed in a pilot with the questionnaire administered on two occasions, three weeks apart. Findings indicate that the questionnaire is consistent with repeated completion ($r=0.85$; $p<0.01$). As completion of the questionnaire can be undertaken by either the parent or carer of the child, it was necessary to determine if this would introduce bias into the results. Each sub-scale of the tool was assessed with no significant differences reported. The ability of the tool to monitor behavioural changes that are related to weight loss was also examined, with the questionnaire conducted with families participating in a weight loss programme for child obesity. It was reported that weight loss in the child was significantly associated with an improvement (i.e. reduction) in questionnaire scores. This suggests that the questionnaire can be used for monitoring behavioural changes over time.

Usage

This questionnaire has been used as a dietary assessment tool within a number of commercially available child weight-management programmes in England. The questionnaire was designed for co-completion by parents or carers and their children aged 6–11 years. The different cognitive abilities of this age range may need to be considered if applied in a local area.

The FEAHQ may be suitable for use at individual and community level, but further work is needed to establish its suitability for use with larger populations. It is not clear if the questionnaire is suitable for use with different black and minority ethnic groups. It is possible that the patterns of behaviour linked with weight change are different for specific populations. Further work is needed to determine if the identified behaviours, and therefore the tool, are appropriate for use in such populations.

The questionnaire is publicly available for use by any healthcare provider. Information is provided in the reference paper on the scoring system for each of the sub-scales in the questionnaire along with guidance on interpretation of results. It is suitable for use by non-nutritionists. Basic training is provided on the scoring system and the interpretation of results.

Reference paper

Golan M, Weizman A. Reliability and validity of the Family Eating and Activity Habits Questionnaire. *European Journal of Clinical Nutrition*. 1998; 52(10): 771–7.

Children's Dietary Questionnaire

The Children's Dietary Questionnaire (CDQ)¹⁴ was developed in Australia to assess patterns of food intake in children aged 4–16 years by assessing intake of both 'recommended'^f foods and 'discouraged'^g foods. It does not measure the actual amount and type of food consumed, but focuses on the patterns of food intake.

^f Fruit, vegetables, water, reduced fat products)

^g High fat/sugar foods, sweetened beverages and full fat dairy products)

Overview

The CDQ is a 28-item semi-quantitative food frequency questionnaire that has been designed to be self-completed by parent or caregiver (with or without researcher assistance). It calculates four different food-group scores, which include:

- a fruit and vegetable score;
- a fat from dairy products score;
- a non-core foods^h score; and
- a sweetened beverages score.

A variety of different response-scales are used including Likert scales and frequency scales.

Items were included in the questionnaire based on their perceived impact on the healthfulness of a diet, and whether their intake is generally 'recommended' or 'discouraged'. Secondary analysis of nationally representative children's intake data was undertaken to identify food patterns that distinguish higher and lower quality diets. To ensure that inclusion of all types of relevant foods were included in the questionnaire and to optimise content validity, a panel of four paediatric dietary experts reviewed all items.

Validation and reliability

Parents were asked to complete a 7-day checklist alongside the CDQ to check if the tool was providing an accurate account of dietary intake. Items on the checklist mirrored the food and drink items contained in the CDQ. This process found that the questionnaire was not able to accurately distinguish positive or negative dietary risk based on CDQ scores at an individual child level. This suggests that the CDQ has validity as a tool to assess dietary patterns at a group or population level (for which it was designed) but not as an assessment of dietary intake in clinical one-to-one settings. The readability of the questionnaire was assessed by pilot testing a draft form with four parents.

The questionnaire was used in five different studies using different population groups to examine different parameters of the questionnaire. The intra-class correlation coefficient (ICC) between the first and second administrations of the questionnaire was used to examine reliability. Test-retest reliability values were significant for all subscales: 0.75 for fruit and vegetables; 0.51 for fat from dairy products; 0.55 for sweetened beverages; and 0.90 for non-core foods.

In one study, children were recruited onto a weight management programme that encouraged a change in eating patterns closer to those recommended by Australian dietary guidelines. Significant differences were reported for all sub-scales between baseline and at six months in the expected direction, i.e. an increase in fruit and vegetable score and decreases in fat from dairy, sweetened beverages and non-core foods scores. This outcome suggests that the questionnaire can be used to detect dietary change, but further testing is needed to confirm its ability to detect both direction and magnitude of change.

^h Peanut butter or Nutella, pre-sugared cereals, sweet biscuits/cakes/muffins/doughnuts/fruit pies, potato chips/crisps or savoury biscuits, confectionery/ muesli or fruit bars, chocolate, soft drink/cordial, ice-cream/Ice-blocks, pie/pasty/sausage roll, pizza, hot chips/French fries, hot dog/processed meats, takeaway

Internal consistency was assessed through item to total correlation which is a direct measure of how closely each item is associated with the subscale total score. A common recommendation is that item to total correlations should be above 0.221. This was the case for all items except for those in the sweetened beverages subscale, and three items in the non-core foods subscales. The fruit and vegetable and the non-core foods subscales were found to have relatively high measures of internal consistency ($\alpha=0.76$ and 0.56 respectively). The fat from dairy and the sweetened beverages subscales had lower measures of internal consistency ($\alpha=0.44$ and 0.13 respectively). This may be due to the fewer items (three and two, respectively) and the restricted range of responses for these two subscales, resulting from relatively low intakes of full fat dairy and sweetened beverages in the study subjects.

Usage

The questionnaire is available for public use. There are no costs associated with its use but appropriate citation would be expected. Information on the questions included in the CDQ along with information on the response scales is provided in the reference paper. While there is adequate information in the reference paper on how to analyse and interpret the questionnaire, the principal author is also willing to work with individuals who wish to use the questionnaire.

The questionnaire is based on Australian nutritional guidelines. It is likely to be valid for use in the UK, but further review and testing would be required to confirm this. No testing has been carried out on its suitability for use with black and minority ethnic groups.

Reference paper

Margarey A, Golley R, Spurrier N, et al. Reliability and validity of the Children's Dietary Questionnaire; a new tool to measure children's dietary patterns. *International Journal of Pediatric Obesity*. 2009; 4(4): 257–65.

The Dietary Quality Score

The Dietary Quality Score (DQS)¹⁵ questionnaire was developed in Denmark. It assesses the quality of adult diets based on certain nutritional risk factors for cardiovascular disease. It then categorises people into one of three groups – low, average or high dietary quality. It has been designed for use with adults.

Overview

The foods included in the DQS questionnaire were based on those most likely to be indicative of an overall healthy diet, and matched Danish dietary guidelines. Questions are included about frequency of consumption of vegetables, vegetarian dishes, fruit, fish, and the type of fats used in spreading and cooking. Each answer had an assigned score which was then used to calculate an overall dietary score, giving a broad indication of the quality of the diet. This provides an assessment of overall dietary quality and also allows identification of specific dietary elements that are of low quality.

Validation and reliability

The DQS questionnaire was validated against a 198-item FFQ. The results indicated that the questionnaire can adequately assess dietary quality. A higher DQS (higher dietary quality) was significantly associated with lower intake of total and saturated fat, and a higher intake of carbohydrate, fibre, various vitamins and minerals, fish, fruit, vegetables and whole-grain products. Correlation coefficients between the DQS and the 198-item FFQ varied considerably between dietary components. There was also a significant negative association with waist circumference and the Copenhagen Risk score (a coronary risk score for myocardial infarction) when adjustments for sex and age were made. When adjustments were made for smoking, physical activity levels and education, associations with HDL-cholesterol and waist circumference did not remain. The authors state that the lack of association for HDL-cholesterol may be linked to smoking and physical activity levels, which may have a stronger impact on HDL levels than dietary factors. In addition, the DQS showed no association with BMI. No explanation is suggested as to why this might be.

There is no report of the scales used within the DQS questionnaire being formally measured, and it is not clear whether items would correlate directly with each other. For example, three points are awarded for daily intake of more than five portions of vegetables, but three points are also awarded for no intake of fats. It is not clear if these factors are linked directly and whether a similar value should be awarded to both.

It is likely that each dietary factor will have a different impact on cardiovascular disease risk, and scores should be weighted accordingly. However, this may be difficult to determine and apply simply. The questionnaire was designed to provide a broad overview of dietary quality in a large population, and to categorise into groups with overall healthy, average, or unhealthy diets. It is not suitable for measuring specific nutrient intakes and is not recommended for an in-depth dietary assessment. No information is provided on the test-retest reliability of the questionnaire. There is some evidence that the questionnaire can detect change over time (personal communication) but this information is yet to be published.

Usage

There are only eight items to complete in this tool so it is likely that it would be relatively straightforward to complete. However, no indication is given on how long the questionnaire should take.

Analysis should also be straightforward and it is likely that specific software would not be needed. The questionnaire was developed for self-completion by adults aged 30–60 years in an urban Danish population. It is unclear if such a questionnaire could be translated for use in other populations, and it is likely that it would need to be validated and adjusted for use in the UK. The questionnaire is available for use, but no specific guidance is available. The principal author is willing to work with researchers wishing to use the questionnaire.

Reference paper

Toft U, Kristoffersen LH, Lau C, et al. The Dietary Quality Score: validation and association with cardiovascular risk factors: the Inter99 study. *European Journal of Clinical Nutrition*. 2007; 61(2): 270–8.

Conclusion

When evaluating dietary or weight management interventions, it is essential that changes in patterns of dietary intake and dietary behaviour over time can be measured. The use of an appropriately developed and tested measurement tool will enhance the likelihood of the accurate detection of any such change.

A number of tools have been developed for dietary assessment in interventions and studies with children and/or adults. The most appropriate tool will depend on the purpose for which it is required and each has merits, associated problems and practical issues which will need to be considered when selecting one method above another

It is important to remember that tools have been developed and tested for specific purposes with particular population groups. Therefore, the validity and reliability of a tool will not remain the same when used with an alternative population group.

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Appendix A

A literature search was undertaken to identify available dietary assessment tools for use with adults and children in a public health setting. The search strategy was intentionally broad and criteria for inclusion were:

- purpose of tool was dietary intake measurement or dietary behaviour measurement;
- intended for use at a community or population level;
- short-form questionnaire format that is suitable for use in public health settings;
- testing of validity and/or reliability had been undertaken with the target population, and
- designed for use in developed countries.

The literature search conducted for this report was limited to the PubMed database as this is the most relevant and comprehensive database to identify all published articles on the development of new dietary assessment tools. The search time-period was limited to ten years (December 1999 – December 2009) as any tools developed before this time are likely to require updating due to changes in food manufacturing processes, formulation of foods, and trends in consumption.

The following search terms were used in separate searches:

- dietary AND assessment, and
- diet* AND assess* AND tool.

The search was limited to English language only, as translations would not be possible within the specified time period.

The initial searches returned more than 6000 published journal articles. The titles of all of these were assessed for relevance. If they met the inclusion criteria, the abstracts were obtained and examined further. Only those articles that specifically examined the development of a dietary assessment tool for use in public health at a group or population level, or that evaluated intervention efficacy at group or community level were considered for inclusion in the review. Dietary assessment tools that had been developed for use in clinical settings or primary care settings were not included. The references were also examined for possible inclusion in the review. Additional tools were identified during discussions with authors of the previously identified tools.

Dietary assessment tools that were developed for use in developing countries were not included in the final review. In such countries, the main focus of tools was identification of malnutrition risk which was not the focus of this review. In addition, it was likely that the population groups of these countries would be very different from the typical UK population.

Physiological differences between populations means that elements of the traditional diet may have different effects on disease and are likely to require a different focus for dietary assessment tools. It is also likely that differences in levels of income, education, and living/housing standards will have an important effect on habitual dietary intake, as will issues related to accessibility and availability of food in different populations

A number of dietary assessment tools were not included in the review as the questionnaire was felt to be too long for practical use in public health settings. For example, the Australian Child and Adolescent Eating Survey (ACAES) FFQ¹ contained 120 items plus 15 supplementary demographic questions. Such questionnaires were felt to be impractical for use in small local populations, and unsuitable for evaluating interventions due to the resources that would be required for their implementation. In addition, it is likely that the detail provided by such a questionnaire is in excess of what is required for population monitoring, targeting of resources in local areas, or evaluating interventions.

The search identified 11 dietary assessment tools that met the specific criteria. For six of these, the main focus was children or their families. The remainder related specifically to adults. For each, the main reference paper was assessed to determine:

- whether the tool was valid and reliable;
- the main target population of the tool;
- where the tool had been developed and its suitability for use in the UK;
- which elements of diet it measures;
- time and effort required from the respondent;
- method of administration;
- studies in which the tool had been used;
- resources needed for its application and subsequent analysis; and
- accessibility of the tool for use in public health settings.

If insufficient information was available in the reference paper, the lead author was contacted to answer the above questions.

Reference

1. Watson JF, Collins CE, Sibbritt DW, et al. Reproducibility and comparative validity of a food frequency questionnaire for Australian children and adolescents. *International Journal of Behavioural Nutrition and Physical Activity*. 2009; 6:62–9.

Reader information

Title	Review of dietary assessment methods in public health
Author(s)	Kath Roberts Sarah Jane Flaherty, East Midlands Public Health Observatory
Reviewer(s)	Louis Levie, Food Standards Agency Sheela Reddy, Department of Health Dave Jenner, East Midlands Public Health Observatory
Editor	Di Swanston, National Obesity Observatory
Publication date	August 2010
Target audience	Researchers and academics working in the field of nutrition and obesity. Obesity/ physical activity/ nutrition professionals in: central government; regional government; local authorities; Primary Care Trusts; Strategic Health Authorities. Public Health Observatories.
Description	The aim of this report is to provide a descriptive summary of tools available to measure dietary intake and dietary behaviour in a range of interventions. Technical details are provided about the reliability and validity of these tools where available.
How to cite	Roberts K, Flaherty SJ. Review of dietary assessment methods in public health. Oxford: National Obesity Observatory, 2010
Contact	National Obesity Observatory www.noo.org.uk info@noo.org.uk
Electronic location	http://www.noo.org.uk/NOO_pub/briefing_papers
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