Towards nutrition education for adults: a systematic approach to the interface design of an online dietary assessment tool

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Abstract: To support nutrition-related behavioural change, a dietitian can offer tailored educational programmes based on patients' specific dietary behaviours. A model has been developed to integrate learning technologies into this process. This tool allows patients to self-report their dietary intake, creating awareness, and to receive individually tailored dietary advice from their General Practitioner (GP) via a dietitian, to assist with change. This article examines how a step-wise approach to the interface design has allowed a multidisciplinary approach to automated dietary assessment to be undertaken. Concentrating on the identification of core foods and on the questionnaire format using an outline of the diet history interview, the design features of the programme used focus groups with end users and in-depth discussion between the multidisciplinary team. The development of an online self-administered dietary assessment programme must ensure outcome goals are met whilst upholding the simplicity of the interface design to allow a larger number of patients access to the programme.

Keywords: nutrition education; evaluation studies; software design and development; primary healthcare; behavioural change; dietary assessment; learning technology.

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1 Introduction

In terms of patient education to support nutrition-related behavioural change, a dietitian can offer tailored programmes based on patients' specific dietary behaviours. However, despite the growing number of dietitians, the general public still has more confidence in the nutrition-related advice given by their General Practitioner (GP) (Maiburg *et al.*, 1999; Truswell, 2000). Yet doctors often feel that they cannot always provide the information and thus the educational intervention that is required (Maiburg *et al.*, 1999; Brug, 1999). Factors contributing to this perspective include time restrictions on patient encounters, lack of confidence (Truswell, 2000; Helman, 1997) and the limited nutrition-related training obtained during their medical school and continuing education programmes (Maiburg *et al.*, 1999). This translates to only 15%–17% of doctors reporting an interest in the area of nutrition (Helman, 1997). Attempts are being made to educate GPs about nutrition issues for their patients. However, the limited time available for professional development and the vast number of topic areas mean that such programmes cannot always address all nutrition issues or those specifically related to disease and patient profiles. GPs are also able to spend significantly less time being involved in patient education activities (Truswell *et al.*, 2003). The average consultation in Australian general practice is 14.6 minutes and in the USA is eight minutes (Nicholas *et al.*, 2003b). This timeframe does not allow for the assessment of dietary intake and in-depth discussion about food and nutrient interactions for disease management. The length of consultation is also a primary reason why many doctors opt for medical, rather than educational, intervention for their patients (Crossen *et al.*, 2001; von Ferber *et al.*, 2002; Mant, 1997; van Binsbergen *et al.*, 2003). Therefore, incorporating nutrition education into patient consultations appears to be a challenge.

When GPs do engage in nutrition counselling, they often provide generic dietary advice to their patients. This minimises the opportunity for patients to further learn about the implications of what they eat upon their health. Although many patients may be referred by their GP to a dietitian, practical limitations exist when considering this step in the management of their diseases. A large number of patients presenting to a GP may not always wish to pay to see a dietitian (Brug *et al.*, 1999; Nicholas *et al.*, 2003a). Dietitians and GPs are rarely co-located, and thus time and transportation also become considerations. Further, the process of undertaking a diet history is time consuming – often ranging from 45–60 minutes.

The study reported here sought to overcome these limitations and facilitate a clinical nutrition education partnership. The study sought to explore how learning technologies might facilitate this partnership. The intervention involves GP referral of patients to a programme which includes online collection of dietary intake data via computer in the GP surgery (or another location convenient to the patient). Data are analysed by a dietitian who tailors a dietary prescription, which is in turn communicated to and followed up with the patient through their GP.

2 Automated dietary assessment

While online dietary assessment and advice applications are available, they have limited capacity to provide individualised dietary and nutrition behaviour prescriptions (Probst and Tapsell, 2005). Computer-based dietary intake data collection brings with it advantages and disadvantages (de Leeuw and Nicholls, 1996). Advantages include less missing data, standardisation of the interview (reduced interviewer bias), provision of a stimulating interactive environment, and speed of processing. Limitations due to computer literacy and typing skills, rigidity of the interview and initial costs are disadvantages. These issues need to be taken into account when structuring systems and designing the related interface for collecting a person's dietary information. Thus, potential users are best placed to inform the design of such systems.

Computer-based nutrition programmes available to patients focus on either the dietary assessment process (Adelman *et al.*, 1983; Miller, 1996) or nutrition education (Brug, 1999; Beerman, 1996; Matheson and Achterberg, 1999) – very few are able to combine the two adequately. A patient's awareness of his/her diet needs to be generated before educational interventions can be meaningful. This requires the dietitian's having the full picture of the patient's dietary habits. This is difficult with currently available programmes that use closed questioning schemes (Probst and Tapsell, 2005) and assess the actual intake of the patient. Few programmes use open-ended questioning (Medlin and Skinner, 1998), an area for further exploration in the field of dietary assessment.

Automating the process of dietary assessment involves the identification of the type of assessment method to be utilised and then mapping the steps to be taken to obtain the required dietary information associated with the chosen method. A number of assessment methods exist:

1 The *food record* involves a patient's recording exactly what and how much has been eaten for a select period of days (Rebro *et al.*, 1998).

2 The *food frequency questionnaire* involves a dietitian's asking a range of questions relating to specific foods to obtain a spectrum of the patient's intake over a select period of time (Caan *et al.*, 1999).

3 In the *24-hour recall interview*, the patient is asked to report on the last 24 hours of food (types and amounts) eaten.

4 During the *diet history interview*, the patient is asked to recall his/her usual diet, including details on foods, amounts and frequency of consumption over a period of time (*e.g.*, one week, two weeks or one month) (Sasaki *et al.*, 1998).

The diet history interview allows the interviewer to capture a picture of the eating patterns of the patient. Capturing the usual intake of a person through the diet history creates awareness of the intake and allows for the development of individualised dietary advice. By tailoring advice to the specific intakes of the person, there is an increased chance of dietary change (Campbell *et al*., 1990; Campbell *et al*., 1994). Patients may learn about the food choices that are not benefiting their health and have the ability to change these choices accordingly. By tailoring advice to the individual, chances of long-term behavioural modifications are also increased (De Looy *et al*., 1992). Limitations for change will, however, depend upon the individual's current position in the Stages of Change Model (Greene *et al*., 1999). This will primarily influence their willingness to accept and act upon the recommendations given. If a patient is currently in the contemplation stage, individualised advice may be the trigger for the patient to progress to the action stage. This relationship has been identified in many dietary studies in relation to fat (Hargreaves *et al*., 1999; Greene *et al*., 1994), fibre (Glanz *et al*., 1994) and alcohol intakes.

The aim of this article is to describe the systematic approach undertaken in the design of an online dietary intake data collection tool aimed at being an initial and key step towards implementing a nutritional education programme involving GPs, dietitians and patients with metabolic syndrome – a condition which comprises type 2 diabetes mellitus, impaired glucose tolerance, being overweight/obesity, hypercholesterolemia and/or hypertension (Shaw and Chisholm, 2003). This software tool would allow patients to self-report their dietary intake, creating awareness, and to receive individually tailored dietary advice from their GP via a dietitian, to assist with change.

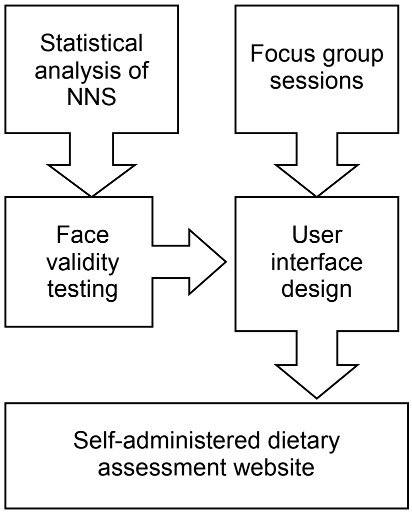
3 Methods

In order to design a software tool which allows the automation of a dietary assessment process, many stages must be undertaken. All design features of the programme were addressed through a progressive review of the programme by the multidisciplinary study team, which included statisticians, dietitians, computer technicians, instructional designers, graphic designers, web designers, general practitioners, patients and survey analysts. The reviews took the form of formal meetings and trial interactions with the potential software layouts at each stage of its design. These stages included:

1. conceptualisation of the design concept
2. focus group discussion sessions with potential users
3. the identification of core reference foods using statistical analyses of the Australian Bureau of Statistics (ABS) National Nutrition Survey (NNS) data
4. the assessment of the face validity of these foods
5. multimedia questionnaire design for the user interface.

Figure 1 illustrates the steps within this systematic approach. Ethics approval for the study was provided by the host institution's human research ethics committee.

Figure 1 Relationship between methods and design



3.1 Conceptualisation of design

Automation of the dietary assessment process has been considered (Probst and Tapsell, 2005), but is primarily used to address the actual (daily) rather than usual (average) dietary intake of a person. The usual dietary intake has been automated in only a few cases; and these have been limited by the complexity of the normal face-to-face interview, such as seen in the use of food models and utensils as cognitive guides (Elmstahl *et al.*, 1996) and the communication abilities of a professional interviewer (Tapsell *et al.*, 1999). The collection of dietary intake data is further complicated by tendencies of patients to over- or under-report their food intake (Bathalon *et al.*, 2000; Black and Cole, 2001; Johansson *et al.*, 1998). It has been reported that the use of a self-administered technique, whether pen-and-paper or computerised, decreases the patient bias in responding to questions, especially those of a socially undesirable nature, when an interviewer is not present (de Leeuw and Nicholls, 1996; Tourangeau *et al.*, 2000). Therefore, allowing the patient to enter his/her own dietary data into a computer system may result in a decreased bias in responses when compared with those of the face-to-face dietary interview. Where involvement of the dietitian is vital to the process is in the advice-giving stage, such that nutritional education can be tailored to each patient. This method of individualised dietary management is vital for the increasing number of patients in the population with metabolic syndrome, a lifestyle-related condition that can be managed by dietary intervention (Roth *et al.*, 2002).

3.2 Focus group discussion sessions

Before the design and development of the software tool began, potential users were recruited for focus group discussions. These sessions allowed the research team to identify issues of interface design and system functionality preferred by the population group and also to refine the initial idea to suit the lifestyles and levels of computer experience of the target population. Focus groups sessions were held at the host institution. Details of the preferred design concepts are reported in detail elsewhere (Probst *et al*., 2005).

Potential users are persons who have been diagnosed with metabolic syndrome (and/or self-identified as being 45 years of age or older and overweight). For these focus group sessions, participants were recruited from volunteers of another dietary intervention trial (Tapsell *et al*., 2004) involving patients with type 2 diabetes mellitus. All participants had consented to further contact. Participants were asked to take part in a multi-option telephone questionnaire and focus group discussion session. The telephone questionnaire was used to determine demographic information such as age, gender, level of education and computer experience, and a brief medical background. The focus groups addressed the participants' preferences for involving their GP in the nutrition management of their diabetes and their thoughts about putting a computer in the GP practice waiting rooms for dietary assessment. Five focus groups of six to eight participants were formed. A semi-structured format was used and sessions began with general questions about the participants' experiences with their GP in the nutrition management of their type 2 diabetes mellitus. The moderator also displayed images of existing nutrition software programs, software features and navigation options on a projector screen to generate discussion for the design issues of the programme. All focus groups were recorded using micro-cassette recorders.

The data obtained from the telephone questionnaires were numerically coded and analysed to determine the proportion of responses per question. Focus group data were transcribed verbatim and all transcripts were checked for accuracy by an external assistant before the coding of the data. A framework for thematic grouping was developed prior to coding in NVivo qualitative analysis software (v2.0.161, QSR International: Victoria, Australia). Data themes were based on computer use, software features, nutrition programmes and dietary analysis. Responses from the focus group sessions were used to shape the design of the dietary assessment software. This paper reports on the involvement of the GP in the area of nutrition, a topic which was coded under the dietary analysis theme.

3.3 *Statistical analysis and core food group development*

To provide the theoretical framework for the programme, existing Australian food data were analysed. The theoretical framework, or food hierarchy, for the design of this programme would include the food and nutrient database from which the assessment would be drawn. Data from the NNS of 1995 (McLennan and Podger, 1998) is a key indicator of dietary intake within the Australian population. The dietary survey was conducted with over 13 000 people within the Australian population and used a hierarchical system of categorising all of the food items reported. As the NNS is the most recent nationwide survey of dietary intake, this was used as the basis for theoretically developing the food hierarchy. This food hierarchy would become the underlying key to the programme around which all food intake questions were based. The difference between the hierarchy described in this paper and that of the NNS is the stage at which the hierarchy was developed. The current hierarchy was developed before the food data had been obtained, whereas the NNS hierarchy was developed after all food data had been collected.

The original NNS data were assessed for errors which may effect the reporting of dietary data. This was aimed at determining the minimum number of food groups that was needed to be able to capture a reasonable ‘picture’ of a person’s usual dietary intake. Commonly consumed foods of the NNS population were then identified using a cut-off at 99% of the population. These foods could all be grouped into meals, as NNS had coded each of the items accordingly. Food associations were then analysed for those foods which were commonly eaten together. If food A was eaten with food B more than 50% of the time, they were said to be associated. For example tea was identified to be commonly consumed with milk and sugar. Cluster analysis using the Ward method, average linkage method and complete linkage method (Johnson and Wichern, 2002) to determine the similarities in nutrient composition of the NNS food groupings were employed to rearrange the NNS food groups based on a nutritional foundation. These cluster analyses were performed for all macronutrients (total energy, protein, carbohydrate, saturated fat, monounsaturated fat and polyunsaturated fat). Initially, all 497 groups (the entire data set) were clustered based on their macronutrient similarities. This cluster analysis saw the groups of foods formed including foods such as custard and pasta in one group, owing to their similar carbohydrate content. These foods, however, are not conceptually similar for the layperson, and therefore separate subcategories of the NNS underwent cluster analysis.

3.4 User interface design

The theoretical data from the food hierarchy developed through statistical analysis needed to be applied to the practical aspects of the diet history interview for the interface design of the software tool. Using an outline of a traditional diet history interview (Tapsell *et al*., 1999), the meal questions such as ‘Do you eat breakfast?’ and ‘How often do you eat breakfast?’ were mapped out based on foods consumed at breakfast, between breakfast and lunch, at lunch, between lunch and dinner, at dinner and after dinner. Sections of the food hierarchy could then be allocated to questions on each meal depending on regularity of intake per meal.

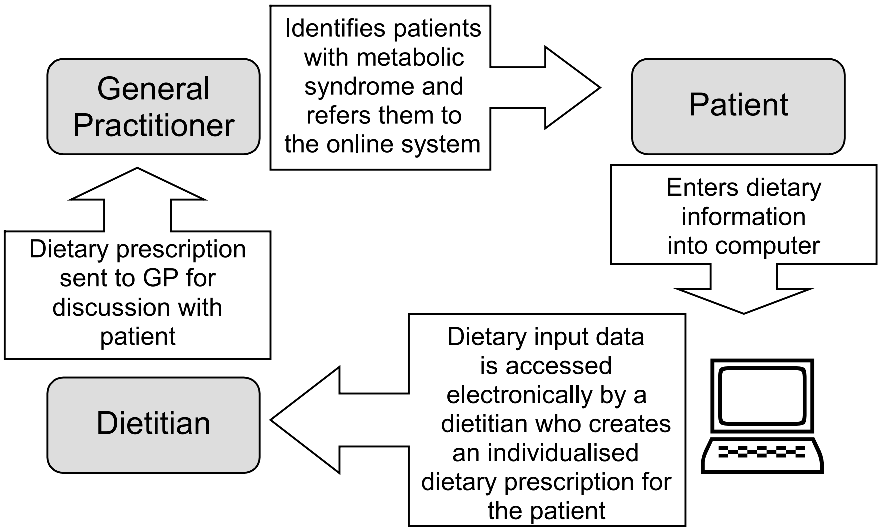
The final phase of the development of the food hierarchy would require face validity testing and the renaming of food groupings to suit the target population. This involved five dietitians and was undertaken prior to interface design initiation. These dietitians created an outline of foods they believed to be important within the diet history interview. Foods from this list were systematically merged with the statistically developed food hierarchy using a consensus method to ensure foods commonly reported in a diet history interview had been included. For example, if spaghetti bolognaise was identified by the dietitians, it could be included under pasta with a meat-based sauce. Renaming of food categories was necessary, as the NNS groups were created for data analysts to sort foods rather than for the layperson to find a food item. To ensure that individuals with minimal nutrition knowledge would be able to identify the group into which a reported food might fall, the dietitians again used a consensus method to form new group names. For example, ‘Coffee, made with milk, from ground, decaffeinated, NS as to strength’ in the NNS could become ‘Coffee’ with the option to add milk in the food hierarchy. This is important, as the programme would be used by patients and not dietitians or GPs.

4 Results

4.1 Conceptualisation of design

In this study, the design and development of a software application for patient self-reporting of usual dietary intake (diet history) in the primary healthcare setting was chosen. Access to the automated dietary assessment self-reporting tool was to be facilitated by GPs. Patient data would then be accessible to a dietitian for the formulation of dietary advice, which in turn would be sent to the GP for discussion with the patient (Figure 2).

Figure 2 Automated dietary assessment model



In this model, the importance of the dietitian has not been de-emphasised. Rather, by patients' entering of their dietary information into the software system, the data are transferred electronically to the dietitian, who can focus on the analysis of the food intake data and development of dietary advice. This advice can then be sent to the relevant GP, allowing GPs to also have a greater involvement in the nutritional education and health of their patients. This advice is detailed enough to allow the GP to understand key concepts and is planned to be the primary focus of a repeat visit of the patient. No other studies have been identified to date addressing these concepts.

The overall design of the programme was based upon a multiple-pass system[1] using a 'drill-down' approach to obtaining more specific detail on the dietary data on a desktop computer. Outlined below, this approach allows the system to capture varying amounts of dietary information depending on the amount of time the patient is willing to or able to spend in front of the computer.

Pass 1 Meal frequency – which meals and how often they are eaten.

Pass 2 Food categories – broader groupings of foods eaten at each meal.

Pass 3 Food types – details about the groups of foods selected in Pass 2.

Pass 4 Frequency of consumption and food portion size identification.

The vertical multiple-pass approach, increasing the amount of detail about the whole day with each new pass, was selected over a horizontal multiple-pass approach, in which each meal was asked about in detail before progressing to the next. This option was selected by the study team owing to the variability of each individual patient's dietary intake. This variability is assumed to be the key predictor of the length of time spent using the programme. Therefore, collecting fewer details about the whole day will provide the dietitian with more useful data than detailed data about only part of the day.

4.2 Focus group discussion sessions

Thirty-seven participants agreed to take part in the study. Of this, 36 (97%) completed the telephone questionnaire and 33 (89%) completed the focus group discussion sessions. Twenty-four males and 12 females with an average age of 60 years (41–77 years) and a BMI of 29.6kg/m² (23.4–35.7 kg/m^2) took part in the focus group discussion sessions. The level of computer experience was variable (Probst *et al*., 2005). The few non-computer users from the focus groups had features representative of those reported in the literature (primarily older age) and allowed for standard interface development to be followed (Kressig and Echt, 2002).

The use of an online system accessible in both the office of a health professional and in the participants' home was preferred over the desktop program that could be accessible only in the GP's office. One participant's comment was illustrative of this preference: "… doesn't matter whether it's in my doctor's surgery or here, everyone connected to the Internet can log into that".

For those who did not have a computer at home or did not have internet access at home, suggested places to use the tool included the local library, diabetes centres, pharmacies or universities. Participants did not like the idea of having to go to their doctor's or other health professional's office more often than the few visits per year required for their diabetes management. Participants reported that the GP surgery as a location for the programme was not ideal owing to the number of persons with illness that would be around them. Privacy of the location was also identified as a potential factor to hindering accuracy of data entry in the GP surgery. One participant commented, "You're sitting in a waiting room. You've got 20 other people sitting there watching you type your information into a computer."

Time constraints affecting the daily routines of the person would also deter the desire to complete the programme in the doctors' office. A participant explained, "particularly if people are going to be doing it at the doctors' surgery and they don't have all the time. I mean, you've got people with children and they've got other commitments."

Many participants were concerned that their GPs know as little as they do about nutrition. It was felt that the doctors were not interested or could not find time to talk about diet. One participant thought, "… some doctors, they put it [nutrition] in the too-hard basket". The current process of dietary assessment or dietary advice provided by their doctor was seen as suboptimal and the involvement of the specialist was the most trusted form of nutritional advice. One participant explained, "[Y]our dietitians will have more influences on your diet, more than your doctor". Another participant suggested, "[A]s you mention that your blood sugar is out or they get the results, they send you to a dietitian. We're just going around in a circle, like the doctor sends me to a specialist, the specialist sends me to a dietitian."

The method of giving dietary advice utilised by other doctors was found to be the use of generic nutrition handouts or pamphlets, as has been identified in the literature. In terms of usefulness, one participant commented, "[T]he pamphlets that they just give you, they just proliferate and, there's nothing really specific in them".

Therefore, it was evident that the programme design would need to cater to the online preference to ensure patients did not have to spend more time than needed in the GP practice. This was a shift from the original design of a desktop-PC interface situated only in the GP practice. Beyond the specifics of the interface, the intervention as a whole would also need to consider how the doctor would ultimately be involved in providing the dietary prescriptions provided to the patient. The dietary advice could not be generic and would need to cater to the individual dietary intakes of each patient. Although the model would still provide the advice for the patients through the GP as planned, it was felt that copies of the advice for both the patient and the GP (for the patients' file) would be of greatest benefit and would encourage regular follow-up.

4.3 Statistical analysis and core food group development

Each of the foods in the total NNS food list was given a unique identification code allowing it to be placed within one of the ABS food groups shown in Table 1. The highest-level grouping (least detail) contained two-digit codes, followed by a subcategory with three-digit food codes, and finally a four-digit code for the lowest level of grouping. The level of a food item corresponded to an eight-digit code. A total of 497 food groupings existed. The foods eaten and recalled in the NNS were all coded through the use of meal categories from which commonly consumed food items could be drawn.

Bias calculations determined the minimum number of food groups needed and the level of error associated. When compared with the level of error of a traditional diet history interview with a dietitian, the computer would need to ask only about groups of foods rather than individual food items to achieve a similar result. The most commonly consumed food item was milk, followed by bread and potatoes. Associated foods saw milk and sugar in tea and coffee as commonly linked food items. These items were to be used as pop-up 'prompting questions' to encourage recall of the entire diet. Cluster analysis resulted in a separation of many of the NNS food groups based on fat content, resulting in a larger number of groups in total.

4.4 User interface design

Focus group results saw a change in the initial design of the programme from a desktop application to that of a web-based tool owing to the ease of accessibility to a larger number of patients. The design needed to cater to considerations that the potential users would likely be over 40 years old, at varying degrees of health, and with varied levels of computer experience and education. The navigation needed to be intuitive and a large amount of information fitted into single screens. Therefore, the organisation and clarity of the screen display were vital, as was identified in the focus group sessions. Patients indicated that they preferred to enter text information onto the screen, with radial buttons and check boxes being the next preferred items for the selection of food items (Probst *et al*., 2005). The final design primarily involved the use of check boxes. Initial prototypes determined that the number of food groups again needed to be re-evaluated, such that large groups of foods needed to be divided into smaller numbers to allow for optimal screen displays (Bergfeld-Mills and Weldon, 1987). Table 2 gives an outline of the changes to the core food group numbers throughout the programme development. The large variations seen between the original ABS food groupings and those of the current study were due to the need to differentiate between foods delivering different types of fatty acids (determined by the statistical analysis) and the need for names of food groups to be based on the food knowledge of the layperson rather than the trained professional (changed during face validity testing and interface design) in the NNS. This concept is vital to user interface development (Neilsen, 1990).

Table 1 National Nutrition Survey (NNS) food grouping structure

Category names	*No. of subcategories*	*No. of food types*
Non-alcoholic beverages	6	30
Cereals and cereal products	8	32
Cereal-based products and dishes	6	34
Fats and oils	5	22
Fish and seafood products and dishes	6	18
Fruit products and dishes	9	16
Egg products and dishes	3	7
Meat, poultry and game products and dishes	9	40
Milk products and dishes	8	47
Soup	3	11
Seed and nut products and dishes	2	4
Savoury sauces and condiments	4	17
Vegetable products and dishes	9	19
Legume and pulse products and dishes	2	5
Snack foods	4	6
Sugar products and dishes	3	9
Confectionary and health bars	3	9
Alcoholic beverages	4	13
Special dietary foods	2	6
Miscellaneous	6	12
Infant formulae and foods	4	13
Subtotal: 21	106	370
Total: 497 groups		

Table 2 Comparison of food groupings with progression of programme development

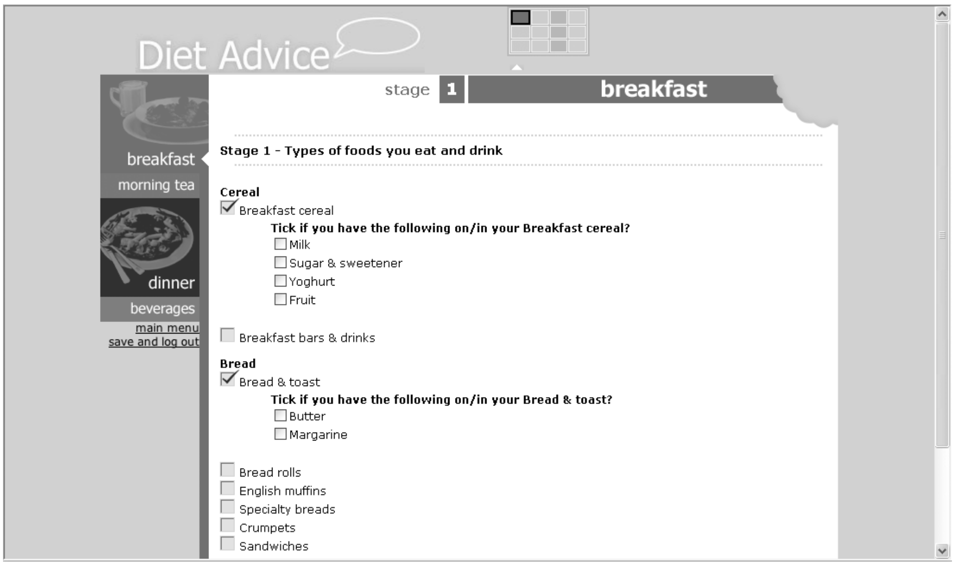
	No. of categories	*No. of subcategories*	*No. of food types*
ABS food groupings	21	106	370
Dietary assessment programme food groupings			
after statistical analysis	20	120	453
after face validity testing	20	98	432
after user interface development	19	99	437

The user interface needed to include the theoretically developed food hierarchy, yet also be understandable and user-friendly whilst overcoming the diverse needs of the end user, such as literacy, skill, knowledge and culture (Shneiderman, 2000). Owing to the age of the end user, the literature also identifies a need to maintain user interest (Kushniruk *et al*., 1997). A cognitive cue illustrates for the user his/her level of completion of the dietary intake tool (Figure 3). Changes in colours corresponding to those of the navigation bar were included in the menus. On the website, upon completion of a section, the colours change to maintain interest; for example, breakfast – orange; morning tea – blue; lunch – yellow; afternoon tea – aqua; dinner – red; supper – dark blue; and beverages – green. The challenge of using an open versus closed questioning scheme was overcome by allowing free text entry in areas of the website where further details may be required, such as patient medical conditions and food allergies. Primarily, however, the food-related questions were closed.

Figure 3 Example navigation bar for the user interface

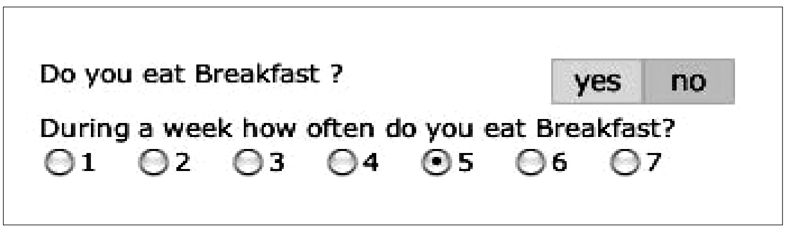
Challenges in the design and functionality of the menu and layout, owing to the dynamic nature of the survey, were also encountered. All users would have different diets; therefore, the system would need to be designed in such a way that it would adapt to each user. Designing the system so that a user could select only the meals he/she eats would save the patient's needing to read through potentially unnecessary questions. The menu and navigation system could then change to reflect the choices of the patient. The interface needed to be designed so that a broad overview of one week's food intake would be captured and, as the user progresses further through the questionnaire, the level of detail about the foods eaten would increase. One week was selected, as it would provide a snapshot of a person's intake without making a patient recall all foods eaten and potentially spend hours sitting in front of a computer screen. This technique was also thought to be useful if a user logged out partway through the questionnaire. An example of one possible layout of the user interface is given in Figure 4.

Figure 4 Sample user interface for breakfast



Rather than using a separate help manual, instructions are given to the user at the beginning of the programme, including sample questions (Figure 5) and visual displays of the navigation tools, as requested by the focus group participants. If a user logged out and returned the following day, the data would be saved and, upon returning to the website, the user would be taken back to the point at which he/she left the questionnaire. The design also allows segments of the interface to be 'switched off' at any time and therefore to be excluded from questioning. This is possible owing to the inclusion of two different applications, one for the user questionnaire and one for administrative management of data. The advantages of such an approach allow modification of the administrative application without disturbing the users of the patient application. Similarly, the data is not static, they will be constantly changing and refined, allowing the team to quickly and easily modify the food hierarchy. These modifications will be instantly seen by anyone using the website.

Figure 5 Sample question layout included in instructions



5 Discussion

The development of a self-reported dietary assessment programme must ensure the outcome goals of the programme are met whilst upholding the simplicity of the interface design for the user, as identified in the focus groups (Probst *et al*., 2005). The complexity of the diet history interview when performed face-to-face with a dietitian formed many challenges for design. Beginning with statistical analyses of existing survey data and focus groups, an interface that would be useful and understandable to those assessing their diets can be developed.

A step-wise approach to the interface design has allowed a multidisciplinary approach to automated dietary assessment to be undertaken. The entire team was involved in the review process of each stage, followed by groups of team members from similar areas working in their specialist field to develop key components of the design.

The original conceptual model for the assessment, of having a desktop programme located on a computer in the GPs waiting area, was not found to be the preferred method of delivery for the automated diet history. The current design was decided on as it has been common practice for health assessment programmes. An online tool allows for a broader range of patients to have access to the automated diet history.

Although it was found that no studies presently exist that identify the number of GPs who refer patients to the dietitian, this study has found the process does exist and is being utilised by some doctors for the management of lifestyle diseases such as diabetes. This study has shown that the patients are not entirely happy with the current practices of GPs with respect to nutrition. Therefore, by developing the automated diet history website, this study will enable GPs to learn more about nutrition through their need to interact not only with the dietitian who will be giving them the dietary prescription for the patient, but also with the patient through involvement in the education process related to basic nutritional concepts.

6 Conclusion

The outcomes of this study will allow the development of an online self-assessment nutrition programme and allow greater participation of the GP in the area of nutrition. The employment of the internet as the medium for the programme allows an increased number of patients access to the assessment tool. This will not only shorten the burdensome process of face-to-face diet history assessment for the dietitian, allowing more time to be spent on dietary advice, but it will also allow the doctors to focus on the patients who are in need of dietary intervention and do not traditionally receive any, owing to various restrictions.

The use of a computer-assisted interview for the assessment of dietary intake will not only aid in the time efficiency of the dietitian, it will also enable the initial assessment process to be standardised, allowing for greater depth of individualised advice for the patients. This article has shown that the development of such a tool can incorporate the workings of a number of different disciplines. The framework of the programme was developed under group consensus and from the results of the focus groups with the end users; the food hierarchy resulted from the combined workings of statisticians, survey analysts and dietitians; and the user interface involved the workings of the computer technicians, instructional designers, graphic designers and web designers with the dietitians, to ensure that the final product was an automation of the diet history interview containing all vital foods and questions in a user-friendly manner. The development of such technology utilising the process of self-reporting will assist a number of health professionals, including the GP, as patients can have access to the programme and to the dietitian without the need for additional clinic visits. This concept will be particularly useful in remote locations, where access to the dietitian is limited, or in lower socioeconomic communities, where the cost of visiting a dietitian may lessen their significance to the patients' health.

7 Future work

The website is currently undergoing laboratory testing with potential users to evaluate the interaction of the user with the computer interface and questioning sequence. Questions and food groups will then be modified as needed (construct validity). Following testing, an interface for the dietitians will be designed to analyse the output data from this patient user interface. Dietary advice protocols will also be developed to standardise the process through which the dietary advice is generated. Upon completion of the two key interfaces, the programme can then be implemented in the GP practices to examine the model involving the GP, the patient and the dietitian. This final phase will allow the programme to be validated against a traditional form of dietary assessment (criterion-related validity).

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Note

1 Multiple-pass system: Areas of questioning are asked about in increasingly more detail as the user progresses through the programme.