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Abstract

Under- and overreporting of dietary intake in a face-to-face context is related to age, gender and body mass index. The use of computer technology in dietetic practice is restricted to analysis of nutrient data rather than assessment of the diet. DietAdvice, a website developed to allow patients with metabolic syndrome to self-report their dietary intake, has been developed in the Illawarra region of New South Wales, Australia. Patients are recruited by their general practitioner, and use the website, and the data are electronically fed to a dietitian for an individualised dietary prescription. The aim of the present study is to describe the reporting status of patients using a pilot test of the website from November 2004 to October 2005, and determine relationships to body mass index, gender and age. Reported energy intake (EI) was compared with predicted basal metabolic rate (BMR). Patients were classified as underreporting if $EI : BMR < 2.4$. Chi-square and ordinal regression analyses were used to determine relationships to patient characteristics. Two hundred patients were recruited, of whom 57 had missing data or did not complete the assessment. Of the remaining 143 patients, 32.3% underreported their intakes, 21.7% overreported their intakes, and 46.2% were on target with their reporting. No relationships were found for age, gender or body mass index. Findings suggest that computerised dietary assessment may encourage patients to report with less bias than in a verbal dietary assessment when compared with the literature.

Keywords

bias, energy intake, internet, metabolic syndrome X, social desirability

Disciplines

Arts and Humanities | Life Sciences | Medicine and Health Sciences | Social and Behavioral Sciences

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ABSTRACT

Background: Under- and overreporting of dietary intake in a face-to-face context is related to age, gender and body mass index. The use of computer technology in dietetic practice is restricted to analysis of nutrient data rather than assessment of the diet. DietAdvice, a website developed to allow patients with metabolic syndrome to self-report their dietary intake, has been developed in the Illawarra region of NSW, Australia. Patients are recruited by their General Practitioner, use the website and the data is electronically fed to a dietitian for an individualised dietary prescription.

Aim: To describe the reporting status of patients using a pilot test of the website from November 2004 to October 2005 and determine relationships to body mass index, gender and age.

Method: Reported energy intake (EI) was compared to predicted basal metabolic rate (BMR). Patients were classified as underreporting if $EI:BMR < 1.35$ and overreporting if $EI:BMR > 2.4$. Chi square and ordinal regression analyses were used to determine relationships to patient characteristics.

Results: Two hundred patients were recruited of which 57 patients had missing data or did not complete the assessment. Of the remaining 143 patients 32.3% underreported their intakes, 21.7% overreported their intakes and 46.2% were on target with their reporting. No relationships were found for age, gender or body mass index.

Conclusion: Findings suggest that computerised dietary assessment may encourage patients to report with less bias than in a verbal dietary assessment when compared to the literature.

Keywords: bias, energy intake, internet, metabolic syndrome X, social desirability

INTRODUCTION

Computerised dietary assessment is an area of growing interest. Programs have been developed in the USA and Europe to assist dietitians with the assessment of a patient's dietary intake, though such programs are yet to be developed in Australia.¹ In Australia, the use of computer technology in dietetic practice is primarily restricted to analysis of nutrient intake profiles rather than patient self-reporting of dietary intake.¹ This means that the dietitian is required to perform the dietary assessment in a face-to-face setting and analyse the nutrient intake data before education and counselling may be provided to the patient.

The use of computer technology in the field of dietetics creates the opportunity for dietitians to spend increased amounts of time with the patient for education and behaviour change counselling. Presently there is limited time available for this in a standard consultation without compromising the quality of the dietary assessment. Furthermore, the limited time means dietary data obtained may be reviewed quickly using a ready reckoner system to estimate amounts of particular nutrients pertaining to the patient's diet. Potential inaccuracies from this practice may result in less precise dietary education.

Inaccuracies of estimated nutrient intake may not only be the result of hastened analysis methods but may also result from reporting bias from the patients themselves. Underreporting is highly dependant on memory, social desirability, lack of awareness of food and portion sizing and reluctance to disclose foods and/or amounts eaten.² Reporting of dietary intake is also strongly influenced by the characteristics of the patient. Patients who are overweight have been found to modify their dietary intake when reporting face-to-face with a dietitian.²⁻⁴ Energy may be underreported by as much as 50% by these

individuals.⁵ Underreporting is also influenced by gender and age,⁶ with older females underreporting to a higher degree than their younger counterparts and males of the same age.⁴ The primary nutrients affected are energy,^{7, 8} fat,⁸ saturated fat⁸ and carbohydrate,⁹ with protein less affected.⁵ Reporting of alcohol intake is also significantly affected by underreporting.^{8, 10}

The use of computing technology for the interview process may decrease underreporting by decreasing the social desirability bias resulting from face-to-face interviewing.¹¹⁻¹³ Patients are not faced with the need to 'impress' the dietitian with their healthy eating pattern,⁵ but rather are more likely to report their true dietary intake. The use of computers, therefore, may be a means to improve the reporting of patients.

DietAdvice, a website allowing patients to self-report their dietary intake, has been developed in the Illawarra region of NSW, Australia¹⁴. To pilot test this program in practice, patients were recruited by their General Practitioner (GP), and entered their dietary intake via a website. The data was electronically fed to a dietitian who then developed an individualised dietary prescription using the 'dietitians interface' of the program. The use of internet technology allowed patients to use the website in the privacy of their own home and at a time convenient to them.

Findings from other studies with the DietAdvice website,¹⁵ suggest that computerised dietary assessment may encourage patients to report with less bias than in a verbal dietary assessment. The aim of the study reported here is to describe the accuracy of energy intakes reported by patients using the website from November 2004 to October 2005 and to determine whether relationships exist between reporting status and patient characteristics - age, gender, body mass index (BMI).

METHODS

The computers with the DietAdvice website were set-up in 14 GP practices in the Illawarra region of NSW, Australia. For the pilot study, patients with or at risk of metabolic syndrome were targeted as metabolic syndrome encompasses a number of Australia's leading diseases states that may be modified by dietary change. (The website could, however, be applicable to most diet-related conditions). Doctors within each of the practices were requested to recruit patients to the website who were either

- Over the age of 45 years who would benefit from dietary advice related to body weight and heart health, or
- Under the age of 45 years and having at least one factor of metabolic syndrome as defined by the International Diabetes Federation 2005¹⁶ (type 2 diabetes, overweight, hypercholesterolaemia, hypertension).

Consenting patients used the website either in the GP practice or in a location convenient to them.

The DietAdvice website is based on a multiple-pass approach in which patients are first asked questions about their demographic information. Next, the meals eaten by the patient are identified and then food based questions are asked to determine broad areas of food intake for each identified meal. Following this further details about the food items is requested and finally the portion size and frequency of consumption is determined.¹⁷ The website is based on automation of the diet history interview. Patient information is uploaded into the 'dietitians interface' in which the patients BMR is determined using the

Schofield equation, BMI is calculated and food intake data is analysed for nutrient composition using a modified version of the AUSNUT database.¹⁸

Self-reported demographic data from each of the patients was uploaded from the website into SPSS for Windows (v12.0.1, 2003: Lead Technologies, Chicago, USA). Age was categorised into <35 years, 36-55 years and >56 years. BMI was calculated and categorised into normal (18.5 – 24.9kg/m²) overweight (25.0 – 29.9kg/m²) and obese (>30.0 kg/m²). Dietary information from the website was uploaded using the ‘dietitians interface’. This ‘dietitians interface’ converted the reported food intake into nutrient data. Nutrient data was also imported into SPSS for Windows. Reported energy intake (EI) was compared to predicted basal metabolic rate (BMR) for all patients. Patients were classified as underreporting if EI:BMR<1.35,¹⁹ overreporting if EI:BMR>2.4^{20, 21} and on-target is between 1.35 and 2.4. Chi-square analyses and ordinal regression were conducted to determine relationships between BMI, gender and age with reporting status.

Ethics approval was granted by the Human Research Ethics Committee of the University of Wollongong. The research conducted conforms to the provisions of the Declaration of Helsinki. Informed consent was obtained from all participants verbally upon recruitment and then electronically through the website and anonymity has been ensured by coding of all identifiable information.

RESULTS

Two hundred patients were recruited by October 2005 (approximately 70% participation rate),²² of which twelve patients had not started using the website or had account errors (Fig 1). Of the remaining 188 patients, the website was used in the GP

practice by 24 patients (12.8%), with 110 (58.5%) preferring to use the website at home and a further 54 (28.7%) using the website in other locations such as at work or at a relatives house. Patients with a higher BMI were significantly more likely to use the computer at home or elsewhere rather than at the GP practice ($P=0.04$).

Demographic data for the remaining 188 patients was available. Sixty-three (33.5%) male and 125 (66.5%) female patients used the website. The majority of patients using the website were overweight (Table 1). Two patients' demographic data for age, height, weight and BMI needed to be excluded due to typographical errors. A broad range of patients used the website ranging from 19 to 79 years of age (mean 49 years). They reported being overweight ($n=137$, 72.6%), with self-reported values translating to a mean BMI within the obese range ($BMI>30.0\text{kg/m}^2$). They also reported more than one medical condition (Table 1), and from this 117 (62.2%) would fit the defined condition of metabolic syndrome.¹⁶

At the time of this study missing or incomplete data was found for 57 of the 200 patients. No significant relationships were found for age, gender or BMI and stage of completion. Of the remaining 143 patients who completed their dietary assessment, 32.3% under-reported their intakes, 21.7% over-reported their intakes and 46.2% were on target with their reporting. No relationships were found for the reporting status with BMI ($p=0.19$), gender ($p=0.77$) or age ($p=0.58$) (Table 2).

DISCUSSION

Use of computer technology in the field of dietetics not only has the ability to speed up the interview and analysis process, but it appears also to encourage patients to report their intakes more accurately when compared with values in the literature. This pilot study

found that under-reporting was less common than being on target or over-reporting. Limiting the amount of face-to-face contact during the diet history interview process appears to encourage reporting of more food items rather than less. Within the study limitations there was no association of reporting status with age, sex or BMI. In addition, allowing the patients to complete the assessment in the comfort of their own home may further encourage accurate reporting. Findings show that patients with a higher BMI, a group known to underreport their food intakes,²⁻⁴ were more likely to use the computer at home than in a public setting.

Studies using automated dietary assessment technology are not yet widely available. Using a three-day multiple pass 24-hour recall, Jonnalagadda et al. (2000) found men to underestimate regardless of reporting period and women to be influenced by the recording circumstances.²³ A similar study by Yanek et al. (2000) also using automated 24-hour recall technology found 88% of users reported low energy levels.²⁴ These results differ from the findings of this study (only 32% underreported). This may primarily be due to the different assessment methods, as the Yanek study used telephone based computer-assisted interviewing. However both the participants in the Yanek study and in this study had a mean BMI of 32kg/m² (ie. obese). The results in the Yanek study did not improve when completing the multiple pass computerised assessment in person (91% underreporting) despite intensive training of the participants in portion size estimation. This may suggest that a longer reporting period is more effective when using computerised assessment methods. As automated dietary assessment is an emerging field of dietetics, no studies using automated diet history studies were identified for comparison. Face-to-face diet history assessments, however, found 48% of non-obese subjects were underreporting their

intakes²⁵ while, overweight subjects were found to decrease their reported energy intake (kilojoules) with each 1 point increment (kg/m^2) in BMI²⁶. However, due to the methodological differences between studies, a further study has been designed in which face-to-face diet histories are specifically compared with automated diet histories using the same population group.

Double the number of females to males used the website from a wide range of age groups. This may be due to willingness to volunteer for a diet related study. Females are also known to underreport their food intakes.⁶ Furthermore older females are more likely to underreport than younger females.⁴ This study, despite having a large proportion of females and a mean age of 49years, did not see any significant links to reporting status.

Reporting when using the computer appears not to be related to the patient characteristics of BMI, gender and age as is seen in a diet history with a dietitian.^{2-4,6} However, it must be noted that biased self-reporting of height (overestimation) and weight (underestimation) data is common which may have affected the BMI data of this patient group²⁷. Furthermore, the findings of this study were limited to patients with metabolic syndrome. This may have affected the range of different ages and range of different BMIs (primarily lower) available for comparison within the analysis. Further studies would be required to determine whether the findings of this study can be applied to other groups.

This study found that patients using the computer appear to be more willing to report all foods eaten to the computer than to a dietitian. From observations of patients using the computer in this study, underreporting appeared to be influenced by computer troubles/errors rather than a bias of the reported food items. For example, some patients were only entering information for one meal due to troubles with the internet connection.

This was then be managed by the dietitian reviewing the patients' reported food intake to determine whether whole meals, for example, appear to be missing, and telephone the patient. It could then be determined whether the patient did only consume a limited intake or whether computer or website concerns were the reason for the limited foods being reported. For patients whose dietary information was incomplete, the dietitians requested the patient complete the questionnaire within a given time period. For some patients however, despite completing the questionnaire their information was still not correct. Therefore, computer problems may be seen as a limitation of automated technologies.

Overreporting, conversely, appears to be influenced by the patient reporting all foods eaten, rather than their usual intake (data not shown). The limited face-to-face contact during the dietary interview decreases the social desirability bias²⁸ which may influence reporting when seeing a dietitian. It is reasonable to assume that the patient feels comfortable at the computer and as they work through the list of foods in the website, each food acts as a prompt. Rather than limiting the reported foods to those eaten most often, the patient may reports all foods consumed with less attention to the frequency of consumption in a week long timeframe. This would result in a higher reported nutrient intake as the frequency of consumption section of the website may not be accurately completed. Although this limits the accuracy of the reporting, the dietitian would still be able to determine patterns of intake and develop a more accurate dietary prescription than they would for a patient who has not reported enough food items. A future study has been planned to specifically look at the degree of reporting accuracy when using the DietAdvice website.

The use of a computer to assist dietitians in their consultations may allow for added time to be spent face-to-face educating and counselling patients toward dietary change. This is especially important with the growing incidence of metabolic syndrome worldwide.^{29,30} Although the automation provided by computers will be useful in the field of dietetics, the professional judgement and expertise provided by the dietitian themselves cannot be automated.³¹ Computers should therefore be used as an adjunct to dietary consultations rather than a replacement.

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TABLES**Table 1** Self-reported medical conditions from website users (n=188)

<i>Variable</i>	
Age yrs, mean±SD (range)*	49.1±14.6 (19-79)
Weight kg, mean±SD (range)*	91.8 ± 8.9 (46-158)
Height cm, mean±SD*	166.7±9.6
BMI kg/m ² , mean±SD*	32.6±6.5
Hypercholesterolaemia, n(%)	82 (43.6)
Hypertension, n(%)	83 (44.1)
Impaired Glucose Tolerance/Impaired Fasting Glucose, n(%)	21 (11.2)
Insulin resistance, n(%)	9 (4.8)
Overweight, n(%)	137 (72.9)
Other medical condition, n(%)	19 (10.1)
Type 2 diabetes mellitus, n(%)	42 (22.3)

* Data excluded for N=2 due to typographical errors

Table 2 Cross tabulation of reporting status with age, BMI and gender

	<i>Underreporting</i>	<i>On target</i>	<i>Overreporting</i>	<i>p-value (χ^2)</i>
Age category				
<35 years	9 (33%)	14 (52%)	4 (15%)	0.58
36-55 years	17 (27%)	28 (45%)	17 (27%)	($\chi^2=2.86$)
>56 years	20 (37%)	24 (44%)	10 (19%)	
Total	46 (32%)	66 (46%)	31 (22%)	
BMI category				
Normal BMI ^a	3 (50%)	2 (33%)	1 (17%)	0.19
Overweight BMI ^b	13 (27%)	29 (59%)	7 (14%)	($\chi^2=6.08$)
Obese BMI ^c	30 (34%)	35 (40%)	23 (26%)	
Total	46 (32%)	66 (46%)	31 (22%)	
Gender				
Male	17 (35%)	23 (47%)	9 (18%)	0.77
Female	29 (31%)	43 (46%)	22 (23%)	($\chi^2=0.54$)
Total	46 (32%)	66 (46%)	31 (22%)	

^a 18.5-24.9kg/m², ^b 25.0-29.9kg/m², ^c >30.0kg/m²

FIGURES

Figure 1 Number of patients for which demographic and nutrient information was available

