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Evaluating an Internet weight loss program for diabetes prevention

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SUMMARY

Being overweight or obese is a major risk factor for developing type 2 diabetes but weight loss through lifestyle interventions can markedly reduce its incidence. The Internet provides an opportunity for the development and implementation of lifestyle intervention programs that promote self-managed behavioural change. We developed an online weight loss program emphasizing physical activity and dietary modifications and conducted a short-term qualitative evaluation of it, examining participant recruitment from the general public, website usage and satisfaction and use of self-reported health risk appraisal records. From a total of 808 registered participants who accessed the online services, 683 (84.5%) completed at least one online health risk appraisal and of those, 464 (68%) people (364 female, aged 19–70 years; 100 male, aged 20–71 years) enrolled in the weight loss program. The program was met with a high level of satisfaction by participants, with 56% of feedback respondents agreeing that the program helped them achieve their goals. The program home page, the principal arrival destination of participants, was viewed an average of 29 times per participant, suggesting that the website's services were used with a high frequency. These preliminary findings indicate that the general public will use an Internet-based weight loss program that involves physical activity and dietary behavioural interventions. Whether Internet delivery of these interventions can significantly reduce the risk for developing type 2 diabetes is worthy of further investigation. The findings have relevance for development of health promotion policies and practices.

Key words: weight loss; physical activity; health risk appraisal

INTRODUCTION

The development of effective weight loss programs is of increasing public health importance since the number (and proportion) of overweight and obese people in developed countries continues to escalate (DPP Research Group, 2002). Being overweight or obese is a major risk factor for developing type 2 diabetes (Bray, 2003). Lifestyle interventions that reduce body weight can markedly reduce the incidence of type 2 diabetes (McKay *et al*., 2001; Tate *et al*., 2001). As a public health priority, weight loss programs need not only to be effective but they must be made available and accessible to as many people as possible. Traditional behavioural weight loss programs such as the Diabetes Prevention Program (DPP) involving substantial face-to-face contact have been highly effective in reducing the risk of developing diabetes (DPP Research Group, 2002). However, such interventions can reach only a limited number of individuals who have or are at risk for diabetes.

The Internet provides a unique opportunity for the development and implementation of lifestyle intervention programs that promote self-managed behavioural change (Tate *et al*., 2003). With the number of adults accessing the Internet

increasing each year, it is important to evaluate the efficacy of Internet-mediated interventions for implementing behavioural change and for delivering meaningful health outcomes (Fotheringham *et al*., 2000; Harvey-Berino *et al*., 2002; Feil *et al*., 2003; Glasgow *et al*., 2003). It is only recently that the Internet has been used for diabetes education and self management, and to date, findings on the efficacy of Internet-based programs for weight loss have been equivocal. Tate and colleagues (Tate *et al*., 2001) reported that overweight participants who had access to an Internet behavioural weight loss program for 6 months, reported greater weight loss and changes in waist circumference than participants given access to a weight loss education-only website. They concluded that the Internet and E-mail were viable methods for delivery of structured behavioural weight loss programs which may help reduce risk for type 2 diabetes (Tate *et al*., 2001). Although not specifically targeting weight loss for diabetes prevention, Harvey-Berino and colleagues (Harvey-Berino *et al*., 2002) investigating the effectiveness of an Internet 'weight maintenance' program conducted over the Internet, found that for long-term maintenance of weight loss, the Internet program they examined was not as effective as minimal or frequent intensive in-person therapist support. These authors acknowledged that their study design was different from that of Tate *et al*. (2001) which did not mix the modes of communication delivery, and concluded that further work was needed to identify which components of an Internet program could be used to augment face-to-face communication and to improve the success of Internet-mediated weight loss programs (Harvey-Berino *et al*., 2002).

Delivery of the weight loss intervention program—rationale for Internet delivery

Due to the large number of people with lifestyle-related risk factors for type 2 diabetes, there is awareness amongst health professionals that self-management strategies are needed to enable a greater proportion of those at high risk of type 2 diabetes to reduce their risk (Glasgow and Bull, 2001; McKay *et al*., 2001). It is inevitable that the capacity of the health care system to deliver personalized and labour-intensive services which rely on repeat intervention between patient and care provider over time to elicit effective behaviour change, will be limited by a range of factors including patient access to primary healthcare professionals, the expense of service delivery, and patient awareness of and motivation to participate in such programs. With the Internet available 24 hours a day, patients can at any time make use of self-management education and physical activity and dietary interventions designed to promote long-term behavioural change, without face-to-face interactions with their primary health care provider.

One of the major public health challenges is to encourage participation in programs for weight management that will produce effective and long-term improvements in health outcomes, particularly a reduced risk for type 2 diabetes and cardiovascular disease. Our purpose was to evaluate an Internet-based weight loss program as part of a diabetes prevention initiative. The Internet was chosen as the service delivery medium due to the capacity to customize the program to suit individual needs, to provide access to the program at a time and place chosen by the participant, and to deliver the program at low cost. To this end, we developed an online weight loss program emphasizing physical activity and dietary modifications and conducted a short-term qualitative evaluation of it, examining participant recruitment, website usage and satisfaction, acquisition of self-reported health risk appraisal and other personal health data, and program success. A number of key issues were addressed: within the general community, did people show interest in the trial? Did they commit to it? Did they continue to use it? Did the program produce changes in self-reported health behaviours? Did the program produce a change in self-reported health status? Were participants satisfied with the efficacy of the Internet delivery of program? Do the results warrant a larger more detailed trial?

Description of the program: weight loss for diabetes prevention

The Weight Loss for Diabetes Prevention program was developed by Fitness2live (F2L, www.fitness2live.com.au), as part of a broader range of online health and wellbeing services. The program used was a 10 week, interactive service that enabled participants to voluntarily complete an online health risk appraisal, develop diets and exercise plans to suit their personal needs and goals, and be guided on ways to

successfully implement and maintain lifestyle behaviour change. One of the key features of the trial was that the general community had open or free access to the weight loss program. The program was self-administered by each participant, independent of the direct involvement of health-care professionals.

The exercise or diet plans were based on the individual's health status (as determined from the health risk appraisal) and customized through the use of purpose built software to meet the goals and needs of individual participants. These Internet-based software applications match appropriate foods or exercises to a series of participant responses to standard questions that prompt users towards a program that suits both their needs and current health status. The exercise and diet planners are unique in that they deliver personalized programs rather than 'one-size-fits-all' programs. Once created, an exercise or diet plan could be used as often or as seldom as the individual participant required. The use of these tools was supported by a program delivery framework that emphasized their relevance within the context of implementing and maintaining behaviour change in physical activity and diet to achieve weight loss.

An article provided by Diabetes Australia—Victoria and published on their website introduced the program and provided a direct link for prospective participants which took them to the program trial website developed and maintained by F2L.

METHODS

Recruitment of participants

In keeping with the philosophy of independent and public access to the online service by the participant and the subsequent success of this delivery method in achieving self-care and health behaviour change within a general community setting, program participants were sought from the general public primarily through promotional interviews on three Melbourne radio stations. Registration for participation in the trial was open for a 10 week period. The program was only delivered in English and was available to anyone with Internet access who was aware of the relevant promotions. All participants were involved on an opt-in basis and were free to leave at any time throughout the trial.

Data collection

Three data collection methods were used to acquire data for reviewing the effectiveness of the online program:

Internet usage data

F2L collected data on Internet usage patterns for its websites from two sources (i) F2L's 'back-end' service administration software: Webframes® (iBase Global Pty Ltd, http://www.ibaseglobal.com), and (ii) RedSheriff® (http://www.redsheriff.com), an independent third party service provider specializing in the provision of statistics regarding website user behaviour. Data collected through both sources included information on the number of unique visitors, page impressions, user sessions and frequency of use of the website in a given time period. F2L used RedSheriff to verify the accuracy of information collected internally through the Webframes® administration software.

Fitness2live database

All participant-entered data from F2L's password protected 'Wellness record' (WR), plus participant created diet and exercise plans, were stored securely on F2L's database and protected using 128 bit SSL encryption technology. No data by which an individual may be identified is used in this report.

Feedback data

All participants who undertook the weight loss program were invited to provide feedback of their experience of the program through an online feedback questionnaire. Unlike the WR, which must be completed at least once for safety and service accuracy, use of the feedback survey was not mandatory. The participants were asked to comment on the factors that encouraged them to return to the website and how often they utilized interactive and non-interactive services.

Initial assessment tool: online health risk appraisal

An online health risk appraisal or WR questionnaire, with subsequent personal health scores and ratings, was developed by F2L from data compiled by the Australian Institute of Health and Welfare (AIHW). The WR was weighted to take into account a number of health status indicators including a participant's height and weight, their systolic and diastolic blood

pressures, total blood cholesterol level (mmol/L), fasting blood glucose level (mmol/L), whether they were pregnant, what medications or prescription drugs they were taking, whether they had recently undergone any surgery or had been diagnosed for cancer, type 1 or type 2 diabetes, cardiovascular disease, depression, anxiety, back pain, or migraine, or had a family history for one or more of these conditions. The WR also surveyed participant health behaviours, including how often they smoked or drank alcohol, the physical activity requirements of their occupation, their weekly intake of grains, cereals, fish, fresh fruits and vegetables, and of meats, cheese, eggs and pastries, plus their weekly participation in physical activities (such as weight training, swimming, walking, cycling, organized sport, jogging/running, stretching/yoga and aerobics). The scores and relative ratings for the WR were 90.5–100: excellent; 85.5–90: very good; 80.5–85: good; 70.5–80: moderate; 60.5–70: fair; and <60: at risk. For the latter two categories, changes to the participant's diet and exercise patterns were recommended as well as a recommendation to see a physician.

Table 1a: Number of registrants who used the website services

	Total	Female	Male
Total number of registrants	808	609	199
Registrants who completed at least one WR	683	515	168
Registrants for weight loss program	541	415	126
Registrants for weight loss plus WR	464	364	100

The total number of registrants (808) refers to all people who visited the website and subsequently registered for access to full member services. Of those registrants, 683 completed at least one Wellness record (WR). The total number of registrants for the weight loss program (541) who also completed at least one WR (464 participants) refers to the number of people on which this study was based (Table 1b).

The total number of people who registered to use the online services is presented in Table 1a and the age, weight, and height characteristics of the participants are described in Table 1b.

RESULTS

Wellness record: online health risk appraisal

The average score for participants completing their initial WR was 78.6 points for females and 77.5 points for males, which corresponded to a 'moderate' level of health and wellness for both sexes, as described in the Methods section. The spread of WR scores across the different risk categories is described in Table 2. Sixty percent of participants recorded ratings of 'moderate' or less healthy.

Blood glucose

One of the questions in the WR surveyed the participant's fasting blood glucose level (in mmol/L) as being either 'high' (above 7.0); 'moderately high' (5.6–7.0); 'normal' (4.0–5.5); 'low' (under 4.0) or 'not sure'. The range of different fasting blood glucose levels as reported in the first WR of all (464) trial registrants is presented in Table 3.

Healthy body weight

Body mass index (BMI) is a widely used measure for determining healthy body weight, compared with an individual's height. BMI is calculated by dividing a person's weight in kilograms (kg) by the square of their height in metres (m^2). For this trial, a participant's BMI score was associated with a health and disease risk rating. For a BMI (in kg/m^2) of 20 or less, the rating was 'below healthy weight/low risk'; 20–24.9, 'healthy weight/low risk'; 25–29.9, slightly above health weight/increased risk; 30–34.9, 'above healthy weight/high risk'; 35 or more, 'very high body weight-related risk of illness'. The average body weight

Table 1b: Participant characteristics of registrants who registered for use of the weight loss program and who completed WR at beginning of the program trial

	n	Age (years)	Age range (years)	Weight (kg)	Height (cm)
Female	364	41.8 ± 11.6	19–70	84.0 ± 18.1	164.3 ± 7.0
Male	100	44.3 ± 11.8	20–71	99.8 ± 17.9	177.9 ± 7.0

Values are means ± SD.

Table 2: Wellness record (WR) scores for all participants

Rating	Excellent	Very good	Good	Moderate	Fair	At risk
Number (and %) of females (n = 364)	5 (1.4)	46 (12.6)	98 (26.9)	177 (48.6)	37 (10.2)	1 (0.3)
Number (and %) of males (n = 100)	1 (1)	13 (13)	22 (22)	49 (49)	15 (15)	0 (0)

Data based on 464 participants who completed the online health risk appraisal (WR) that granted them access to the online programs. NB. Since the trial was promoted to the general public as a means of reducing risk of type 2 diabetes, a disease most commonly associated with a number of adverse-related lifestyle health behaviours, it is probable that those who elected to participate in the service trial would have been more likely to record a lower overall WR score than a sample of the broader general public.

Table 3: Range of different fasting blood glucose levels reported in the Wellness record

Rating	All trial participants Wellness record (n = 464)	
	Number (%) females (n = 364)	Number (%) males (n = 100)
High	24 (6.6)	13 (13)
Moderately high	42 (11.6)	20 (20)
Normal	102 (28.0)	25 (25)
Low	8 (2.2)	2 (2)
Not Sure	188 (51.6)	40 (40)

The different ratings for fasting blood glucose level (in mmol/L) were: 'high' (above 7.0); 'moderately high' (5.6–7.0); 'normal' (4.0–5.5); 'low' (under 4.0) or 'not sure'.

recorded in the first completed WR of the 464 registrants was 84.0 ± 18.1 kg (mean ± SD) for females (364/464 registrants) and 99.8 ± 17.9 kg for males (100/464 registrants). The average height was 164.3 ± 7.0 cm for females and 177.9 ± 7.0 cm for males. From these self-reported weight and height data, the average BMI was calculated at 31.1 ± 6.4 kg/m^2 and 31.5 ± 5.0 kg/m^2 for females and males, respectively (see Table 4). At the time of completing their first WR the average participant was more than 6 points above the upper limit of the healthy weight for height range, as determined by BMI (Table 4). Accordingly, the participant group was at increased risk of type 2 diabetes, as well as a range of other lifestyle-related chronic diseases.

Program use and satisfaction

From a total of 808 registered participants, 683 (84.5%) completed at least one WR, and of those 464 (68%) enrolled in the weight loss program. Given the limited promotion, the usage of the online services represented an encouraging response rate. Over the period during which the trial program was open, the website was used a total of 6058 times and 83 111 web pages were viewed.

Successfully achieving repeat interaction with participants was a key objective of this program. Based on the usage of services by all 808 registrants, the Wellness record page was accessed 1792 times, the Exercise planner 2487 times, and the Diet planner 1344 times. The program home page, the principal arrival destination of participants, was viewed an average of 29 times per participant. Although provision of feedback on program usage and satisfaction was entirely voluntary, there was a 21% response rate from the 464 weight loss program participants. Hence, the voluntary feedback was important and provided insight into the factors that influence a participant's repeat usage of the program. Some of the factors that influenced a participant's repeat usage of the program are described in Table 5. The majority of respondents (83.1%) indicated that they returned to the website 'frequently' because of direct web links embedded within the weekly E-mailed newsletter. The purpose of the E-mailed newsletter was to prompt and motivate participants to return to the program.

DISCUSSION

There is awareness amongst health professionals that self-management strategies are needed to enable a greater proportion of those at high risk of type 2 diabetes to reduce their risk. The Internet has the potential to allow patients to make use of self-management education and physical activity and dietary interventions designed to promote long-term behavioural change at any time of the

Table 4: Self-reported height and weight data represented as BMI for all 464 participants

BMI (kg/m^2)	20 or less	20–24.9	25–29.9	30–34.9	35 or more
Number (and %) of females (n = 364)	0 (0)	46 (12.6)	138 (37.9)	98 (26.9)	82 (22.5)
Number (and %) of males (n = 100)	0 (0)	4 (4)	39 (39)	38 (38)	19 (19)

Data based on 464 participants who completed the online health risk appraisal (Wellness record) that granted them access to the online programs.

Table 5: Factors influencing repeat usage of online weight loss program based on feedback from trial participants

	Frequently	Occasionally	Not at all
Return to website			
Used E-mail newsletter links	83.1	14.5	2.4
Went directly to website	43.4	32.5	24.1
Non-interactive content			
Weekly weight loss reading list	64.6	26.8	8.5
Health news and features	57.0	31.6	11.4
Recipe library	49.4	43.0	7.6
Exercise library	32.1	42.3	25.6
Interactive applications			
Calculators (e.g. BMI)	34.6	44.9	20.5
Wellness record	28.9	56.6	14.5
Diet planner	39.0	46.3	14.6
Exercise planner	28.0	51.2	20.7
Program guides			
Weekly program guide	35.0	43.8	21.3
Exercise suggestions	37.3	45.8	16.9

Values represent percentage of users who used that service or feature 'frequently', 'occasionally', or 'not at all'. There was a response rate of 21% from the 464 participants, although it should be noted that feedback was provided on an entirely voluntary basis. These data are important because they provide useful information regarding the factors that promote (voluntary) repeat usage of the Internet for delivery of health programs.

day, without face-to-face or online interactions with a primary health care provider. Within this context, our goal was to evaluate the use of a self-administered online weight loss program that emphasized physical activity and healthy nutrition behavioural interventions. The program was fully automated, a prerequisite of making such a service available to large populations at low cost.

Evaluating the online weight loss program

An evaluation of service success in a trial such as this, where the method of service delivery is novel from a number of perspectives, is dependent on identifying a range of criteria against which the service must be assessed. One of the major questions we sought to address was whether an online weight loss for diabetes prevention program, without face-to-face or any other form of direct interaction with a health professional, would prove sufficiently interesting to the general public.

The average age of participants (41.7 years for females; 44.2 years for males) was not surprising, given that the prevalence of type 2 diabetes as well as an awareness of the risk factors associated with the disease would be greater in this age group. Nevertheless, the fact that many participants were in their 40s and beyond indicates strongly that online delivery of service is not less attractive to older individuals in the general community, and does not represent a significant barrier to participation, a finding consistent with that of Feil and colleagues (Feil *et al*., 2000).

All participants were informed that the storage of personal health data was secure and no feedback was received from participants regarding concern over privacy issues. The number of unique visitors to the trial program website and the number of people that subsequently registered for full service access indicated strong interest within the general community for participation in a self-administered program of weight loss for diabetes prevention that provides credible information and services via the Internet. Prior to the trial we also identified that the unavoidable relative complexity of interactive components of the online program might present a potential barrier, particularly given the likely age range of the participants. Of significance was the fact that participants were comfortable to participate without input from their primary healthcare

professional. Feedback from users indicated that very few participants discontinued participation because of technology-related reasons. The majority of responses received regarding reasons for discontinuation were behavioural in nature, the most common of these being the individual's lack of readiness to commit to the program. The high usage rates for interactive forms and applications suggests the service was sufficiently easy to use despite its greater underlying complexity, compared with non-interactive educational programs.

Does internet delivery promote repeated interaction?

Our results indicate a high usage rate of the online services by members of the general public who were under no obligation to actually use the services. The usage of services by all 808 registrants (Wellness record page accessed 1792 times, the Exercise planner 2487 times, and the Diet planner 1344 times) indicates that the Internet does not represent a barrier to service delivery. The program home page, the principal arrival destination of participants, was viewed an average of 29 times per participant. The high frequency of program usage was attributed to a weekly program-specific E-mailed newsletter delivered to all program participants (Table 5). It has been shown previously that adding E-mail counselling to a basic Internet weight loss intervention program significantly improves weight loss in adults at risk of diabetes (Tate *et al*., 2003). While the E-mail used in the present trial did not include counselling, E-mail was used as a reminder and motivator to prompt participants to return to the program regularly.

To our knowledge, this trial represents the first weight loss program delivered entirely online without the direct intervention of a health professional to participants recruited from the general community. The service achieved a level of compliance among participants that was at least comparable to those associated with more traditional, face-to-face service delivery methods (Tate *et al*., 2001, 2003; Glasgow *et al*., 2003).

Limitations of the study

Clearly, the design of this study was reliant upon self-reported anthropometric and physiological/biochemical and behavioural data from all registrants and evaluating the validity and reliability of this data (especially the self-reporting of body weight) is known to be prone to reporting bias, such as social desirability or recall (Booth *et al*., 1996). These issues were difficult to control given that the trial was reliant upon, and promoted, participation from the general public. It should be noted that participants were under no obligation nor were they given specific direction to provide feedback regarding their participation or to resubmit personal health data to the WR beyond their initial completion of the tool. Response rates should be considered in light of this.

Summary

Our preliminary findings indicate that Internet delivery of a weight loss program for diabetes has the capacity to raise the general public's awareness of health, wellness and illness prevention, and most importantly, subsequently to motivate participants to act on that awareness. The success of the online program, in terms of adherence and compliance, was not dependent on access to traditional, face-to-face interaction with health care providers nor to online counselling via E-mail. The results provide evidence that online automated delivery (of these programs) may be successful as a stand alone intervention, as well as being a viable adjunct to traditional service delivery (Tate *et al*., 2001). Whether these improvements in health behaviours can be translated to improvements in health status and then sustained in the longer term warrants further investigation.

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REFERENCES

Booth, M. L., Owen, N., Bauman, A. and Gore, C. J. (1996) Relationship between a 14-day recall measure of leisure-time physical activity and a submaximal test of physical

work capacity in a population of Australian adults. *Research Quarterly of Exercise and Sport*, **67**, 221–227.
Bray, G. A. (2003) Evaluation of obesity. Who are the obese? *Postgraduate Medicine*, **114**, 19–27.
Diabetes Prevention Program (DPP) Research Group (2002) The Diabetes Prevention Program (DPP). *Diabetes Care*, **25**, 2165–2171.
Feil, E. G., Glasgow, R. E., Boles, S. and McKay, H. G. (2000) Who participates in Internet-based self-management programs? A study among novice computer users in a primary care setting. *Diabetes Education*, **26**, 806–811.
Feil, E. G., Noell, J., Lichtenstein, E., Boles, S. M. and McKay, H. G. (2003) Evaluation of an Internet-based smoking cessation program: lessons learned from a pilot study. *Nicotine and Tobacco Research*, **5**, 189–194.
Fotheringham, M. J., Owies, D., Leslie, E. and Owen, N. (2000) Interactive health communication in preventive medicine. *American Journal of Preventive Medicine*, **19**, 113–120.
Glasgow, R. E. and Bull, S. S. (2001) Making a difference with interactive technology: considerations in using and evaluating computerized aids for diabetes self-management education. *Diabetes Spectrum*, **14**, 99–106.
Glasgow, R. E., Boles, S. M., McKay, H. G., Feil, E. G. and Barrera, M. (2003) The D-Net diabetes self-management program: long-term implementation, outcomes, and generalization results. *Preventive Medicine*, **26**, 410–419.
Harvey-Berino, J., Pintauro, S. J. and Gold, E. C. (2002) The feasibility of using Internet support for the maintenance of weight loss. *Behavioral Modifications*, **26**, 103–116.
McKay, H. G., King, D., Eakin, E. G., Seeley, J. R. and Glasgow, R. E. (2001) The diabetes network internet-based physical activity intervention: a randomized pilot study. *Diabetes Care*, **24**, 1328–1334.
Tate, D. F., Wing, R. R. and Winett, R. A. (2001) Using Internet technology to deliver a behavioral weight loss program. *Journal of the American Medical Association*, **285**, 1172–1177.
Tate, D. F., Jackvony, E. H. and Wing, R. R. (2003) Effects of Internet behavioral counseling on weight loss in adults at risk for type 2 diabetes: a randomized trial. *Journal of the American Medical Association*, **289**, 1833–1836.