Public Health Nutrition: 14(1), 168–175 doi:10.1017/S1368980010001916

Men participating in a weight-loss intervention are able to implement key dietary messages, but not those relating to vegetables or alcohol: the Self-Help, Exercise and Diet using Internet Technology (SHED-IT) study

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Submitted 25 January 2010: Accepted 13 May 2010: First published online 6 July 2010

Abstract

Objective: To describe dietary changes in men participating in an obesity intervention as part of the Self-Help, Exercise and Diet using Information Technology (SHED-IT) study.

Design: An assessor-blinded randomized controlled trial comparing Internet (*n* 34) *v.* information-only groups (*n* 31) with 6-month follow-up. Dietary intake assessed by FFQ, reporting usual consumption of seventy-four foods and six alcoholic beverages using a 10-point frequency scale. A single portion size (PSF) factor was calculated based on photographs to indicate usual serving sizes.

Setting: The campus community of the University of Newcastle, New South Wales, Australia.

Subjects: Sixty-five overweight/obese men (43 % students, 42 % non-academic general staff, 15 % academic staff; mean age 35·9 (SD 11·1) years, mean BMI 30·6 (SD 2·8) kg/m^2).

Results: The average PSF decreased significantly over time ($\chi^2 = 20·9$, df = 5, $P < 0·001$) with no differences between groups. While both groups reduced mean daily energy intake (GLM $\chi^2 = 34·5$, df = 3, $P < 0·001$), there was a trend towards a greater reduction in the Internet group (GLM $\chi^2 = 3·3$, $P = 0·07$). Both groups reduced percentage of energy from fat ($P < 0·05$), saturated fat ($P < 0·001$) and energy-dense/nutrient-poor items ($P < 0·05$), with no change in dietary fibre or alcohol ($P > 0·05$).

Conclusions: Although men reported some positive dietary changes during weight loss, they did not increase vegetable intakes nor decrease alcohol consumption, while saturated fat, fibre and Na intakes still exceeded national targets. Future interventions for men should promote specific food-based guidelines to target improvements in their diet-related risk factor profile for chronic diseases.

Keywords
Weight loss
Men
Dietary intake
Randomized trial
Nutrition

Even though the prevalence of overweight and obesity in men is high[1,2], they are less likely to perceive themselves as overweight or to attempt weight loss compared with women[3]. In a telephone survey of over 184 000 adults in the 2000 Behavioral Risk Factor Surveillance System survey, 33 % of men and 46 % of women reported trying to lose weight and men's attempts were initiated from higher BMI levels compared with women[4]. In an earlier survey of adults from the 1998 US National Health Interview, 24 % of men and 38 % of women reported weight-loss attempts[5], with the top strategies being to eat fewer calories, eat less fat and increase exercise. Interestingly, in a systematic review of online weight-loss interventions that included over 5700 subjects, less than 23 % were men[6]. Men were also less likely to join a weight-loss programme and more likely to skip meals or do nothing at all[5]. Furthermore, a cross-sectional survey of rural men and women in Iowa trying to lose weight found that men used fewer of the commonly recognized weight-loss strategies, yet reported having received greater social

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support for making dietary changes[7]. In that study, no gender differences in the percentage of energy from fat or daily servings of fruit and vegetables were found, although it is unclear how representative the adults in the particular rural setting were of the general population[7]. Men have also been reported to consume more high-fat foods and less fruit and vegetables than women[8].

Evaluation of the impact of targeted weight-loss interventions on men's eating habits is important. Men are at increased risk of cardiovascular morbidity and mortality compared with women[9] and this risk is further exacerbated by excess body weight[10]. The evidence indicates that important improvements in CVD risk factors are achievable with appropriate dietary interventions[11]. Consequently, the evaluation of dietary interventions for weight loss specifically for men has the potential to refine dietary advice and to facilitate the development of food-based guidelines. Further, knowledge of how dietary intake in men alters in response to specific nutrition advice enables the identification of areas where further support may be needed to achieve dietary goals and appropriate tailoring of individualized feedback.

The current literature provides some insight into male-specific approaches to weight loss, but there is a gap in knowledge about men's behaviours while participating in weight-loss programmes and on how their dietary intake alters specifically in response to a targeted weight-loss intervention. In 1996 Egger *et al.* reported a reduction in total fat and alcohol intakes at 1-year follow-up in men participating in a 6-week male-only intervention[12], while Andersson *et al.* reported in 2000 that men educated on adhering to a diet with 6694 kJ/d (1600 kcal/d) and losing approximately 11 % body weight after a year of treatment had more healthful dietary patterns compared with those who were not as successful[13]. Currently, comprehensive data on how men's food intake alters in response to a male-only weight-loss intervention are limited.

The present paper aims to describe changes from baseline to 6 months in self-reported dietary intakes of overweight men participating in the Self-Help, Exercise and Diet using Information Technology (SHED-IT) study. The hypothesis was that the men in the 3-month online weight-loss intervention would improve their dietary intake to a greater extent post-intervention and at 6-month follow-up from baseline, compared with an information-only control group receiving a weight-loss package provided in a single session.

Materials and methods

The SHED-IT study investigated the effects of two weight-loss programmes for men. Men with BMI > 25–37 kg/m^2 were recruited from the campus community of the University of Newcastle, Callaghan, New South Wales, Australia. Details of the study design, including anthropometric techniques, intervention, primary (weight) and other secondary (waist circumference, BMI blood pressure, resting heart rate, physical activity) outcomes, have been reported elsewhere[14]. Briefly, sixty-five overweight or obese adult men were randomly assigned to either the SHED-IT Internet intervention group or an information-only control group. The design, conduct and reporting of the present study adhered to the Consolidated Standards of Reporting Trials (CONSORT) guidelines[15].

Intervention

All participants attended an identical face-to-face introductory session lasting 60 min led by a male Chief Investigator and received a programme handbook, the *Weight Loss Bible for Blokes*©. This session provided information on dietary modification including how to reduce portion size, decrease energy-dense/nutrient-poor foods, monitor beverage kilojoules and plan ahead, as well as how to increase physical activity, using behaviour change strategies including self-monitoring, goal setting and social support. The sessions were conducted separately for Internet and control groups. In addition to the introductory session participants in the Internet group received a single 15 min technical orientation on the free online website Calorie King™ (www.calorieking.com.au), explaining how they were to use the tools and information the website provides to self-monitor their diet and physical activity behaviours. The Calorie King website was used as an educational tool to assist men in understanding the concept of energy balance and allowed them to estimate the contribution of food intake and physical activity to changes in energy balance. Use of the website also provided an opportunity for feedback by study staff on how to improve their dietary intake and physical activity behaviours, and has been described previously[14]. Although the Australian version has modelled nutrient values using the Australian food composition database, NUTTAB 1995 (Australian Government Publishing Service, Canberra, Australia), it may contain some nutrient information from other sources. However, the purpose was to demonstrate to men the kilojoule values of the foods and beverages they consumed and the impact of regular physical activity on energy balance.

During the 3-month intervention the Internet group were advised to submit daily eating and exercise diaries for the first month, for two weeks in the second month, and for just one week in the final month. Submitted diaries were reviewed on seven occasions by members of the research team. This was completed weekly in the first month, twice in the second month and once at the end of the third month. Individualized feedback was provided in the key areas of dietary intake (kilojoule intake, saturated fat, Na and fibre) and physical activity (frequency, intensity, type and time). The control group was advised in the information session and programme handbook to self-monitor their daily diet and exercise but were given no tools to assist in the monitoring process or feedback.

Assessment of dietary intake

Dietary intake was assessed at baseline, at the end of the intervention period and at 6 months from baseline using the paper-based Dietary Questionnaire for Epidemiological Studies (DQES) FFQ, which asks respondents to report their usual consumption of seventy-four foods and six alcoholic beverages. At baseline the time span was the preceding 12 months, and at the two follow-up time points, the preceding 3 months. A 10-point frequency option ranging from 'never' to 'three or four times daily' was employed in both assessments. Portion size photographs were used to calculate a single portion size factor (PSF) to indicate whether on average a person eats the median size serving (PSF = 1), more than the median (PSF > 1) or less than the median (PSF < 1), and was used to scale the reported serving size for vegetables, meat and casseroles responses. The DQES FFQ includes additional questions about the total number of daily servings of fruit, vegetables, bread, dairy products, eggs, fat spreads and sugar, as well as asking the type of bread, dairy products and fat spreads used. This acted as a cross-reference and check to the questionnaire. Furthermore, six questions were asked about contemporary items not in the FFQ but thought to be of relevance to men and targeted in the intervention, including frequency of take-away foods, snacks, sweetened beverages and water. Nutrient intakes from the FFQ were computed from NUTTAB 1995 (Australian Government Publishing Service), using software developed by the Cancer Council of Victoria (www.cancervic.org.au). The development of the DQES FFQ[16] and validation studies using plasma biomarkers for estimating PUFA and MUFA[17] and fruit and vegetable intakes[18] have been previously reported. Additionally, its ability to predict CVD mortality in a cohort of over 40 000 adults including more than 17 000 men has been demonstrated[19]. The study was approved by the Human Research Ethics Committee of the University of Newcastle, Australia and all participants provided written, informed consent. The trial was registered with the Australian New Zealand Clinical Trials Registry, Trial No. ANZCTRN12607000481471.

Statistical analysis

Data analysis was undertaken using the JMP® statistical software package version 7·0 2007 (SAS Institute Inc., Cary, NC, USA) with differences between treatment groups being considered statistically significant at $P < 0{\cdot}05$. Main and interaction effects for all dietary outcomes over time were assessed using generalized linear modelling (GLM). Changes over time for all participants were assessed using ANOVA and regression was used to examine the variation in weight change. The power calculation was based on 80 % power to detect a significant difference ($P = 0{\cdot}05$, two-sided); a sample size of eighteen participants for each group was needed to detect a 3·0 kg difference among groups. Assuming a 20 % attrition rate, a sample of forty-five subjects was required.

Results

Of the men participating in the study, sixty-two (95 %) completed a usable FFQ at baseline, fifty-four (83 %) at 3 months and fifty-three (82 %) at 6 months. There was no significant difference ($P > 0{\cdot}05$) in follow-up rates between the Internet and control groups at 3 or 6 months.

Table 1 reports the baseline demographics of participants by intervention and control group. There were no significant differences ($P > 0{\cdot}05$) in baseline characteristics between those lost to follow-up and those retained at 6 months for age, weight or any of the secondary outcomes. Academic staff comprised 15 % of those recruited, with 42 % non-academic general staff and 43 % university students. Despite being a convenience sample, the socio-economic status was representative of the general population in the state of New South Wales, Australia[20].

Weight loss and compliance outcomes have been reported previously. Using an intention-to-treat analysis both groups lost weight, with the Internet group losing 5·3 (95 % CI −7·3, −3·3) kg at 6 months and the control group losing 3·5 (95 % CI −5·5, −1·4) kg[14].

The average PSF decreased significantly over time ($\chi^2 = 20{\cdot}9$, df = 5, $P \ll 0{\cdot}001$) from 1·5 (SD 0·4) at baseline to 1·3 (SD 0·3) at 3 months and was maintained at 1·3 (SD 0·4) at 6 months, with no difference between groups.

Table 2 reports the nutrient intakes for all men at baseline, 3 months and 6 months. There was a trend for the intervention group to have a higher total energy intake at baseline ($P = 0{\cdot}06$) which was attributed to a higher alcohol intake. Both groups reduced their mean daily energy intake over time (GLM $\chi^2 = 34{\cdot}5$, df = 3, $P \ll 0{\cdot}001$). There was a trend towards a greater energy

Table 1 Baseline characteristics of men participating in a weight-loss intervention and randomized to the control and Internet groups: Self-Help, Exercise and Diet using Information Technology (SHED-IT) study, New South Wales, Australia

	Control (*n* 31)		Internet (*n* 34)		Total (*n* 65)	
Characteristic	Mean	SD	Mean	SD	Mean	SD
Age (years)	34·0	11·6	37·5	10·4	35·9	11·1
Weight (kg)	99·2	13·7	99·1	12·2	99·1	12·8
Height (m)	1·8	0·1	1·8	0·1	1·8	0·1
BMI (kg/m^2)	30·5	3·0	30·6	2·7	30·6	2·8
Waist circumference (cm)	103·4	8·3	102·8	6·8	103·1	7·5

Table 2 Nutrient intakes of men participating in a weight-loss intervention at baseline, 3 months and 6 months post-programme: Self-Help, Exercise and Diet using Information Technology (SHED-IT) study, New South Wales, Australia

		Time					
		Baseline (*n* 62)		3 months (*n* 54)		6 months (*n* 53)	
Nutrient	NRV	Mean	SD	Mean	SD	Mean	SD
Alcohol energy (kJ)	n/a	630	640	530	490	520	500
Food energy (kJ)	n/a	10 100	3500	7700	2600	7700	2900
Total energy (kJ)	n/a	11 100	3300	8200	2700	8200	3100
Total fat (g)	n/a	107	37	75	32	74	36
Total fat (%E)	20–35	35	5	33	6	32	5
SFA (g)	n/a	44	17	29	13	29	14
SFA (%E)	8–10	15	3	13	3	13	3
PUFA (g)	n/a	15	6	12	6	12	7
MUFA (g)	n/a	38	13	27	13	27	14
Protein (g)	EAR 52	123	36	99	38	100	40
Protein (%E)	15–25	19	2	21	4	21	3
Carbohydrate (g)	n/a	268	92	198	62	199	69
Carbohydrate (%E)	45–65	39	6	39	6	40	6
Sugars (g)	n/a	106	46	81	30	82	34
Fibre (g)	AI 30	27	10	24	9	24	9
Alcohol (g)	n/a	18	19	15	14	15	14
Alcohol (%E)	<5	5·0	5·5	5·4	4·8	5·3	4·5
Cholesterol (mg)	n/a	390	139	297	126	284	134
β-Carotene (μg)	n/a	2762	1290	2561	1490	2693	1304
Folate (μg)	EAR 320	361	124	290	94	291	117
Niacin equivalents (mg)	EAR 12	55	16	44	17	45	19
Retinol equivalents (mg)	EAR 625	907	281	735	306	728	264
Riboflavin (mg)	EAR 1·1	3·1	1·2	2·5	0·9	2·6	1·1
Thiamin (mg)	EAR 1·0	2·1	0·8	1·6	0·6	1·7	0·8
Vitamin C (mg)	AI 30	160	115	127	76	121	84
Vitamin E (mg)	EAR 10 UL 300	8·1	3·1	6·5	3·0	6·4	3·3
Ca (mg)	EAR 840	1065	376	880	285	914	301
Fe (mg)	EAR 6	18	6	14	5	14	5
Mg (mg)	EAR 350	387	117	327	104	327	111
P (mg)	EAR 580	2018	519	1615	545	1645	564
K (mg)	AI 3800	3553	1018	3017	920	3019	937
Na (mg)	AI 460–920 UL 2300	3567	1063	2688	930	2694	1047
Zn (mg)	EAR 12·0	16	5	13	5	13	5

%E, percentage of energy; n/a, not applicable.
NRV, Nutrient Reference Value: applicable to males aged 19 to 70 years[15].
EAR, Estimated Average Requirement: daily nutrient level estimated to meet the requirements of 50 % of healthy individuals and indicates the prevalence of inadequate intake.
AI, Adequate Intake: indicates the percentage of the population at potential risk. Those above this amount would have a decreased probability of nutrient inadequacy.
UL, Upper Level of Intake: highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the general population.

reduction in the Internet group (GLM $\chi^2 = 3{\cdot}3$, $P = 0{\cdot}07$). The Internet group reported a reduction in mean daily total energy from baseline by approximately 3000 and 3500 kJ/d at 3 months and 6 months *v.* 2300 and 2000 kJ/d respectively for the control group. There were no other statistically significant differences between groups, with both groups reducing mean total fat, protein and carbohydrate (g/d), percentage of energy from fat ($P = 0{\cdot}005$) and saturated fat ($P \ll 0{\cdot}001$) and increasing percentage of energy from protein ($P = 0{\cdot}009$). There was no change in dietary fibre intake, grams of alcohol or percentage of energy from alcohol ($P > 0{\cdot}05$). The variation in weight change from baseline to 6 months was not explained by reductions in portion size, total energy or fat intakes ($P > 0{\cdot}05$).

Table 3 reports the mean daily intakes of items assessed in the DQES FFQ for all participants at baseline, 3 months and 6 months. There were few baseline differences in intake between groups, with a trend towards higher red wine ($P = 0{\cdot}06$) and white wine intakes ($P = 0{\cdot}08$) in the Internet group. For the majority of foods examined, there were no differential impacts of the interventions over time. Both groups reported reductions ($P < 0{\cdot}05$) in some common foods named in the FFQ (beef, chicken, full-cream milk, white bread, egg, pasta, potato) and in many energy-dense/nutrient-poor items (sugar, crackers, sweet biscuits, cakes, meat pie, pizza, hamburger, chocolate, flavoured milk, potato crisps, jam, ice cream, salami, hot chips, tomato sauce). With respect to fruit, there was a reported increase in consumption of bananas and melon

https://doi.org/10.1017/S1368980010001916 Published online by Cambridge University Press

Table 3 Daily intakes (g) of specific food items from an FFQ answered by men participating in a weight-loss intervention at baseline, 3 months and 6 months post-programme: Self-Help, Exercise and Diet using Information Technology (SHED-IT) study, New South Wales, Australia

	Time					
	Baseline (*n* 62)		Baseline (*n* 62)		Baseline (*n* 62)	
Food item	Mean	SD	Mean	SD	Mean	SD
Portion size factor***	1·5	0·4	1·2	0·4	1·3	0·4
Full-cream milk***	169	216	54	114	56	131
White bread (low-fibre)*	32	55	14	36	12	30
Sugar*	10	13	7	8	6	8
Eggs*	20	16	16	11	14	10
Pasta*	91	74	62	59	65	58
Crackers, crispbreads, dry biscuits*	11	14	6	8	6	10
Sweet biscuits**	13	22	6	9	6	11
Cakes, sweet pies, tarts and other sweet pastries***	22	25	9	12	10	10
Meat pies, pasties, quiche and other savoury pastries**	28	26	15	15	17	17
Pizza*	34	36	17	17	26	39
Hamburger with a bun**	20	24	10	9	12	13
Chocolate**	19	31	7	9	10	16
Flavoured milk drink (cocoa, Milo^{TM}, etc.)*	1	2	1	1	1	1
Corn chips, potato crisps, and other extruded snacks*	10	12	5	9	6	9
Jam, marmalade, honey or syrups**	6	8	3	5	3	4
Ice cream**	21	36	10	12	9	10
Beef**	73	50	50	38	49	36
Chicken**	53	34	38	26	39	27
Corned beef, luncheon meats or salami*	8	10	5	8	4	5
Fruit juice*	150	221	71	134	68	152
Bananas***	20	19	40	40	39	36
Watermelon, rockmelon (cantaloupe), honeydew**	7	7	21	29	15	19
Total fruit (minus juice)*	189	140	253	142	242	156
Potatoes, roasted or fried (includes hot chips)*	31	28	21	35	18	20
Potatoes cooked without fat*	35	40	23	30	21	26
Tomato sauce, tomato paste or dried tomatoes***	6	5	3	3	3	3
Cucumber**	3	3	5	4	5	4

Mean intake changed significantly over time: *$P<0·05$, **$P<0·01$, ***$P<0·001$.
Changes in food items over time for all participants were assessed using ANOVA. Food items that did not change significantly were yoghurt, reduced-fat and skimmed milk; high-fibre white, wholemeal, rye and multigrain breads; all types of margarine and butter spreads; all types of hard and soft cheese, including fat reduced; all types of breakfast cereal, rice; nuts, peanut butter; yeast extracts; all legumes, tofu and soya milk; all other fruit; all other red meats, bacon, ham, sausages and frankfurters; all types of fish; all other vegetables; all types of alcohol.

and for vegetables an increase in cucumber, with no significant changes reported for total daily grams of vegetables. Although reported mean beer consumption decreased, the reduction was not significant (Table 3). There was a reduction in the consumption of fruit juice ($P=0·018$) and a trend towards an increase in total daily fruit (GLM $\chi^2=7·6$, df $=3$, $P=0·054$).

Discussion

The current study provides a comprehensive report of the impact of a weight-loss intervention on dietary intake in men. It describes in detail the self-reported dietary intake changes made by men during a 3-month weight-loss intervention and after 6 months of follow-up. We have detected some important improvements in men's dietary intake and identified that, regardless of group allocation, the key strategies used to reduce total energy intake and achieve weight loss were reducing portion size and consumption frequency of high-fat and energy-dense/nutrient-poor foods and fruit juice. While we have reported previously that men in both groups successfully reduced body weight at 6-month follow-up[14], the extent of their weight loss was not explained solely by self-reported reduction in total energy, fat intake or portion size from baseline to 6 months. However, it could be that the reported intakes were influenced by a reporting bias over time, with the subjects being better able to estimate their intake due to the repeated administration of the FFQ which helped to increase their awareness of what they usually eat. It is not likely that their weight reduction could be solely explained by physical activity. While we have previously reported that men participating in SHED-IT did increase their physical activity levels significantly[14], the increased number of steps of approximately 1000 daily, as measured by a pedometer, would not produce an energy deficit great enough to explain the mean weight loss at 6 months of 4·4 kg. Alternatively, the relatively small sample size and the large standard deviations on the mean food and nutrient intakes may have reduced the power to detect changes in eating patterns as statistically significant.

To date, the dietary intakes of men during weight loss have rarely been reported in the literature and have never been reported comprehensively in the context of weight-loss interventions. Studies in adults do not always report the dietary intake data separately by sex, presumably

https://doi.org/10.1017/S1368980010001916 Published online by Cambridge University Press

because the number of men in the study is too few. Consequently there are few previous studies with which to compare our results. In a male-only weight-loss intervention in Australia, participants reported reduced total fat and alcohol intakes[11]. However, that study used only a brief questionnaire to assess diet and this may explain differences with our findings as men in SHED-IT using a comprehensive FFQ did not report a significant reduction in alcohol consumption as a percentage of total energy, by total grams consumed per day or by types of alcohol consumed such as beer and wine. In 2000, using repeated 24 h recalls and after a year of treatment, Andersson *et al.* found in sixty-three obese men that, for those losing the most weight (mean 14·2 kg), energy intake along with nutrient-poor snacks decreased while the percentage of energy from what the authors described as 'good quality hot meals' increased. However, detailed information about other food items was not reported[13].

Cross-sectionally, men in general have been shown to report lower intakes of fruit and vegetables, higher intakes of total fat and food choice profiles that are less healthy than women[21]. This has been attributed to different health beliefs, different attitudes to eating and dieting, poorer nutritional knowledge[21] or potentially a differential reporting bias. Wardle and co-workers[8,22] also reported on the food choice behaviours of young adults in twenty-three countries and demonstrated that men were less likely to report eating fruit or high-fibre foods or to avoid high-fat foods or limit salt.

The DQES FFQ has been used previously to examine fat intakes in men and demonstrated that saturated fat intakes were excessive[17]. In a study of over 41 000 adults, including over 17 000 men (mean age 55 years, mean BMI 27 kg/m^2), the median daily energy intake was 9700 kJ (interquartile range 7900, 12 000 kJ) with approximately 13 % of total energy from fat; of this, 40 % was saturated fat[17]. The high saturated fat intakes in the current study are consistent with this. Importantly, the DQES FFQ has also been shown to predict mortality from CVD[19] and consequently suggests the men participating in SHED-IT are also at increased risk.

Despite making and sustaining dietary improvements at 6 months that were congruent with the recommendations made in the information session and programme handbook, dietary intakes still did not meet a number of the national dietary recommendations[23]. At 6 months post-intervention, the dietary intakes of men who had lost weight were still too high in saturated fat and Na and low in K, folate and vitamin E. Although there was a trend towards a small increase in fruit intake, there was no increase in vegetable consumption, use of reduced-fat dairy products or use of higher-fibre breads. A small decrease in alcohol intake was observed but this was not statistically significant and some intakes were still in excess of the target upper limit of 5 % of total energy intake[24]. This is important given that overweight men have increased CVD risk profiles including hyperlipidaemia and hypertension and may not seek nutritional advice which would usually focus on reducing Na, total fat and saturated fat intakes and on increasing fruits, vegetables and fibre[25].

There are some limitations in the present study. The level of burden was not balanced between groups because the control group was not instructed to keep a paper-based food and exercise diary. The higher participant burden for the online group may have compromised potential between-group differences. The use of an FFQ to estimate usual intake rather than an estimated food record is a limitation as this does reduce the range of foods evaluated. However, it is not common that both these dietary assessment methods would be used in a large study due to participant and analytic burden. FFQ can be useful when reporting intakes at the group level[26] but may not be sensitive enough to detect all of the modifications in dietary intake at an individual level; hence the dietary assessment may be underpowered, meaning the results presented are a worst-case scenario. That we have detected changes in the desired direction is encouraging and future studies could include a validation of reported intakes. We felt that having a dietary assessment tool with relatively low respondent burden was important in order to facilitate compliance in the men. It is of note that the DQES FFQ does not include some food items commonly consumed by men such as soda, but the assessment tool has been used in a large survey with men and the reported baseline dietary intakes in the current study are consistent with this previous report[17]. In addition, the control group was not a 'no treatment' group, rather a minimal intervention group who received standardized weight-loss advice in the form of an information session and booklet. This no doubt attenuated the differences between groups and explains the control group's successful weight loss and potentially why greater differences in dietary intake were not found. The lack of intervention effect could also be explained by the fact that less than 50 % of the Internet participants complied with the recommended online treatment component[14], measured by self-monitoring of diet through the website. Further studies should explore strategies to improve online compliance, which would address a current omission in the literature[6]. That less than 50 % of men complied with the recommended online self-monitoring instructions is comparable with other studies that have reported poor usage levels and poor engagement in the expected activities[6]. The fact that only 15 min was spent on explaining the use of the website may explain the low level of compliance with the website. Increasing the time spent educating men on website use and allowing men to engage with the website during the information session may be a worthy programme modification. Strategies that reduce the amount of time taken to self-monitor dietary intake and physical activity may contribute to enhanced compliance and success in future targeted interventions for overweight men. Internet-based programmes for men may also need to consider additional intervention components, such as telephone prompts, email reminders, text messaging or face-to-face sessions to provide opportunities for additional support and to ensure that men understand fully what is required. Further, the degree to which people comply with self-monitoring instructions in face-to-face or other interventions may be even lower.

While the present findings may be limited by small sample size and consequently low statistical power, or by the limitations of the FFQ, they do indicate that men volunteering for a weight-loss study are able to implement some dietary recommendations successfully irrespective of group allocation with brief but specific advice. Further, they suggest that men need support to improve their diet quality which could in turn reduce their diet-related CVD risk. It appears that men participating in a weight-loss programme will remove some foods from their diets in order to lose weight, but may be more focused on reducing their overall intake rather than trying to improve their overall eating patterns.

Conclusions

We have shown that men volunteering to participate in a sex-specific weight-loss study can successfully improve some aspects of their diet with minimal advice on diet and exercise, with or without additional feedback, and maintain these improvements for up to 6 months. Key strategies utilized included reductions in portion size and decreases in the consumption of energy-dense, nutrient-poor and high-fat foods. However, men did not increase their vegetable intakes, decrease their alcohol consumption or use higher-fibre breads or reduced-fat dairy products, and consequently did not meet national targets for fibre, saturated fat and Na. The current study provides evidence that men need additional strategies or more extensive advice and support to facilitate dietary changes in order for them to fully benefit from diet-related CVD risk reduction. While future studies should be powered to detect differences in dietary intake as a primary outcome, it is recommended that weight-loss interventions for men target specific food-based guidelines and provide support for men to alter their dietary intakes in line with population strategies to reduce CVD risk factors.

Acknowledgements

This work was supported by the University of Newcastle (Strategic Pilot Grant G1087848 to P.J.M., R.C. and D.R.L.). The authors declare that they do not have any conflicts of interest. P.J.M., D.R.L., R.C. and C.E.C. obtained funding for the research. All authors contributed to developing the protocols and reviewing, editing and approving the final version of the paper. The trial was implemented by P.J.M., D.R.L. and C.E.C.; J.M.W. and R.C. provided advice and guidance on the strategies and conduct of the randomized controlled trial. D.R.L. and R.C. were responsible for data collection. C.E.C. conducted the analysis and drafted the first version of the manuscript. P.J.M. is the guarantor and accepts full responsibility for the conduct of the study and the integrity of the data; C.E.C. accepts full responsibility for the accuracy of the data analysis. The authors wish to acknowledge the project manager, Mr David Went, and the research assistants, Elroy Aguiar and David Gibson. They also thank all study participants.

References

1. Dunstan D, Zimmet P, Welborn T *et al.* (2001) *Diabesity and Associated Disorders in Australia 2000: The Australian Diabetes, Obesity and Lifestyle Study (AusDiab).* Melbourne: International Diabetes Institute.
2. Lobstein T, Rigby N & Leach R (2005) EU Platform on Diet, Physical Activity and Health. International Obesity Task Force (IOTF) Briefing Paper, prepared in conjunction with the European Association for the Study of Obesity (EASO). http://ec.europa.eu/health/ph_determinants/life_style/nutrition/documents/iotf_en.pdf (accessed September 2009).
3. Lemon SC, Rosal MC, Zapka J *et al.* (2009) Contributions of weight perceptions to weight loss attempts: differences by body mass index and gender. *Body Image* **6**, 90–96.
4. Bish CL, Blanck HM, Serdula MK *et al.* (2005) Diet and physical activity behaviors among Americans trying to lose weight: 2000 Behavioral Risk Factor Surveillance System. *Obes Res* **13**, 596–607.
5. Kruger J, Galuska DA, Serdula MK *et al.* (2004) Attempting to lose weight: specific practices among US adults. *Am J Prev Med* **26**, 402–406.
6. Neve M, Morgan PJ, Jones PE *et al.* (2010) Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: a systematic review with meta-analysis. *Obes Rev* **11**, 306–321.
7. Nothwehr F, Snetselaar L & Wu H (2006) Weight management strategies reported by rural men and women in Iowa. *J Nutr Educ Behav* **38**, 249–253.
8. Wardle J, Griffith J, Johnson F *et al.* (2000) Intentional weight control and food choice habits in a national representative sample of adults in the UK. *Int J Obes Relat Metab Disord* **24**, 534–540.
9. Gelber RP, Gaziano JM, Orav EJ *et al.* (2008) Measures of obesity and cardiovascular risk among men and women. *J Am Coll Cardiol* **52**, 616–619.
10. Gelber RP, Kurth T, Manson JE *et al.* (2007) Body mass index and mortality in men: evaluating the shape of the association. *Int J Obes (Lond)* **31**, 1240–1247.
11. Van Horn L, McCoin M, Kris-Etherton P *et al.* (2008) The evidence for dietary prevention and treatment of cardiovascular disease. *J Am Diet Assoc* **108**, 287–331.
12. Egger G, Bolton A, O'Neill M *et al.* (1996) Effectiveness of an abdominal obesity reduction programme in men: the GutBuster 'waist loss' programme. *Int J Obes Relat Metab Disord* **20**, 227–231.
13. Andersson I, Lennernäs M & Rössner S (2000) Meal pattern and risk factor evaluation in one-year completers of a weight reduction program for obese men – the 'Gustaf' study. *J Intern Med* **247**, 30–38.
14. Morgan PJ, Lubans DR, Collins CE *et al.* (2009) The SHED-IT randomized controlled trial: evaluation of an internet-based

weight loss program for men. *Obesity (Silver Spring)* **17**, 2025–2032.
15. Altman DG, Schulz KF, Moher D *et al*. (2001) The revised CONSORT statement for reporting randomized trials: explanation and elaboration. *Ann Intern Med* **134**, 663–694.
16. Ireland P, Jolley D, Giles G *et al*. (1994) Development of the Melbourne FFQ: a food frequency questionnaire for use in an Australian prospective study involving an ethnically diverse cohort. *Asia Pac J Clin Nutr* **3**, 19–31.
17. Hodge AM, Simpson JA, Gibson RA *et al*. (2007) Plasma phospholipid fatty acid composition as a biomarker of habitual dietary fat intake in an ethnically diverse cohort. *Nutr Metab Cardiovasc Dis* **17**, 415–426.
18. Hodge AM, Simpson JA, Fridman M *et al*. (2009) Evaluation of an FFQ for assessment of antioxidant intake using plasma biomarkers in an ethnically diverse population. *Public Health Nutr* **12**, 2438–2447.
19. Harriss LR, English DR, Powles J *et al*. (2007) Dietary patterns and cardiovascular mortality in the Melbourne Collaborative Cohort Study. *Am J Clin Nutr* **86**, 221–229.
20. Australian Bureau of Statistics (2008) SEIFA: Socio-Economic Indexes for Areas. http://www.abs.gov.au/websitedbs/D3310114.nsf/home/Seifa_entry_page (accessed June 2010).
21. Westenhoefer J (2005) Age and gender dependent profile of food choice. *Forum Nutr* **57**, 44–51.
22. Wardle J, Haase AM, Steptoe A *et al*. (2004) Gender differences in food choices: the contribution of health beliefs and dieting. *Ann Behav Med* **27**, 107–116.
23. National Health and Medical Research Council (2003) Dietary Guidelines for Australian Adults. http://www.nhmrc.gov.au/_files_nhmrc/file/publications/synopses/n33.pdf (accessed January 2010).
24. National Health and Medical Research Council (2006) *Nutrient Reference Values for Australia and New Zealand; Including Recommended Dietary Intakes*. Canberra: NHMRC.
25. Brunner EJ, Rees K, Ward K *et al*. (2007) Dietary advice for reducing cardiovascular risk. *Cochrane Database Syst Rev* issue 4, CD002128.
26. Willett W (1998) *Nutritional Epidemiology*, 2nd ed. New York: Oxford University Press.