



Effects of a tailored lifestyle self-management intervention in patients with Type 2 diabetes

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Objectives. The aim of the present study was to develop, implement and evaluate a brief intervention to improve adherence to the recommended lifestyle changes for patients with Type 2 diabetes, in particular to help patients to reduce the total amount of fat consumed and to increase lifestyle physical activity levels.

Design and method. A brief, tailored lifestyle self-management intervention for patients with Type 2 diabetes was evaluated in a randomized controlled trial. One hundred participants (aged 40–70 yrs) completed assessments at three time points—baseline, three months and one year. Participants were allocated to either an intervention group who received the brief tailored intervention including follow-up telephone calls, or a usual care control group.

Results. Results indicate that the intervention was successful in helping patients to reduce fat intake and, to a lesser extent, increase lifestyle physical activity levels. These self-reported changes in behaviour were reflected in the objective data with weight maintenance in the intervention group compared to the control group, together with a significant reduction (2 cm) in waist circumference.

Conclusions. These results provide further evidence of the effectiveness of tailored interventions for lifestyle change.

Type 2 diabetes is a major cause of premature mortality and morbidity due to cardiovascular, renal, ophthalmic and neurological disease (Bierman, 1992; United Kingdom Prospective Diabetes Study Group, 1999). The role of lifestyle and behavioural factors in the development and management of this chronic illness is now widely acknowledged. Several intervention studies have suggested that changing diet and/or exercise behaviours reduces the risk of developing diabetes in those at risk (Eriksson & Lindgarde, 1991; Knowler, Barret-Connor, & Fowler, 2002; Pan *et al.*, 1997; Tuomilehto *et al.*, 2001). Moreover, for individuals with existing diabetes, an intensive

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regimen, including medication and lifestyle change, delayed onset and progression of micro-vascular complications Diabetes Control and Complications Trial Research Group, 1993; United Kingdom Prospective Diabetes Study Group, 1998).

Social-cognitive models of health behaviour such as the self-regulatory model (Leventhal, Nerenz, & Steele, 1984), the health belief model (HBM; Rosenstock, Strecher, & Becker, 1988), the transtheoretical model of behaviour change (Prochaska & DiClemente, 1984) and perceived self-efficacy (Bandura, 1977) suggest a number of variables that have been shown to be important determinants of self-management behaviour in diabetes. These include beliefs and personal models of diabetes (Hampson, Glasgow, & Toobert, 1990), perceived severity and perceived vulnerability to complications (Weinstein, 1993), readiness or 'stage of change' (Ruggiero *et al.*, 1997), self-efficacy (Anderson *et al.*, 1995; Strecher, DeVellis, Becker, & Rosenstock, 1986), and barriers to self-management (Glasgow, 1994; Glasgow, Hampson, Strycker, & Ruggiero, 1997). In addition, in recent years there has been a rise in interest in the inclusion of a 'motivational interviewing' component to interventions. Motivational interviewing is a counselling technique, underpinned by cognitive dissonance, self-efficacy and attributions of causal control (Emmons & Rollnick, 2002; Miller, 1983; Miller & Rollnick, 2002), and is designed to augment an individual's motivation to change problematic behaviours.

The most successful lifestyle intervention programmes in Type 2 diabetes have combined dietary restriction, exercise and behaviour modification (Wing, 1993; Wing & Anglin, 1996). However, long-term maintenance of changes made remains elusive (Orleans, 2000; Wing, Voorhies, & Hill, 2000). In contrast to longer, more intensive interventions, Glasgow and colleagues have developed brief ongoing self-management interventions that can be integrated into routine patient visits and have demonstrated success in improving self-care among older patients with Type 2 diabetes up to 12 months follow-up (Glasgow *et al.*, 1997; Glasgow, Toobert, & Hampson, 1996). One limitation of the intervention developed by Glasgow *et al.* (1996) is that it only addressed diet and did not include a physical activity component. An intervention that addresses both dietary and physical activity patterns should be more effective.

A number of studies measuring physical activity outcomes show variable results. Hanefeld *et al.* (1991) demonstrated an increase in activity at five years with a didactic intervention. Among studies with shorter follow-up duration, Wood (1989) noted an increase in physical activity at four months, Glasgow *et al.* (1992) found an increase in the number of minutes of activity three months after an intensive generic intervention, and Wierenga (1994) found improved physical activity after five intervention sessions at four months. However, a number of studies report no changes in physical activity compared with control groups (Agurs-Collins, Kumanyika, Ten Have, & Adams-Campbell, 1997; Uusitupa, 1996; Wing, Epstein, Nowalk, Koeske, & Hagg, 1985).

Tailoring is a key feature of some of these interventions (Glasgow *et al.*, 1996; Kreuter & Skinner, 2000; Rimer & Glassman, 1998). Patient education programmes and materials that are customized to address the unique needs and concerns of specific patients have shown promise in changing a range of health-related behaviours (Campbell *et al.*, 1994; Kreuter, Lezin, Kreuter, & Green, 1997; Kreuter & Strecher, 1996; Skinner, Strecher, & Hospers, 1994; Strecher *et al.*, 1994). The elaboration likelihood model (Petty & Cacioppo, 1984) suggests people are more likely to thoughtfully process information when they perceive it to be personally relevant. Thus,

tailored interventions, which address an individual's specific problems and concerns, should be more likely to stimulate change than untailored interventions. Indeed, studies have found that compared to untailored messages, tailored messages are more likely to be read and remembered, saved, discussed with others and be perceived by readers as interesting, personally relevant and having been written especially for them (Brug, Steenhuis, Van Assema, & De Vries, 1996; Kreuter, 1997; Skinner *et al.*, 1994).

There is a pressing need for evaluations of brief, practical, ongoing lifestyle self-management interventions, incorporating both dietary and physical activity components, which can be integrated into routine usual care thereby improving the reach of the intervention (Glasgow, Vogt, & Boles, 1999), which are tailored to the individual and involve the patient in the decision-making process. In addition, because Type 2 diabetes is associated with life-threatening complications and worsening control over time, interventions that reduce risk factors such as high fat diets and physical inactivity through lifestyle modification, or at the very least halt the decline, should have important long-term health benefits for this patient population.

In a randomized controlled trial, we evaluated a brief, tailored, self-management intervention to improve adherence to recommended lifestyle changes in Type 2 diabetes. This study extended previous work in two important ways. To increase the effectiveness of the intervention, two specific goals were negotiated for each patient (reduce the amount of fat consumed and increase lifestyle physical activity levels). To test the feasibility of implementing this approach and its effectiveness in a UK setting, the intervention was conducted in the UK National Health Service. Here we report on the short- and long-term effectiveness of this intervention on multiple outcomes including fat-related eating patterns, physical activity levels, physiological indices, body mass index (BMI) and waist circumference.

Method

Design

Participants were stratified by insulin use and allocated randomly to either an intervention or a usual care control group, using a computer-generated random numbers table. Outcomes were assessed immediately post-intervention (three months after baseline) and at longer-term follow-up (12 months after baseline).

Recruitment

People aged 40–70 years with Type 2 diabetes, BMI > 25, whose condition was stable but sub-optimal and who were well enough to participate in a regular walking programme, were recruited at a diabetes centre. Eligible patients, identified via the computer database, were sent an initial letter inviting them to participate. Those who replied positively underwent further screening and were given more information about the study by telephone, including information on randomization.

Measures

Profile and demographic characteristics

All participants completed a profile and demographic questionnaire which assessed marital status, housing, employment status, occupation, ethnicity, education, home ownership and age.

Outcomes

Diabetes self-management was assessed using items from the Summary of Diabetes Self-Care Activities Questionnaire (Toobert & Glasgow, 1994; Toobert, Hampson, & Glasgow, 2000). Items assessing dietary self-care activities (five items) and physical activities (three items) were rated on a 5-point scale (1 = none/never, 5 = all/always) for frequency over the past seven days. Internal reliability at baseline (Cronbach's alpha) was .69 for the diet subscale and .79 for the physical activity subscale.

Four dimensions of fat-related dietary habits were assessed using the Kristal Food Habits Questionnaire (FHQ; Kristal, Shattuck, & Henry, 1990): substituting low-fat for high-fat foods (seven items); modifying meat choices (four items); avoiding frying foods (four items); and avoiding adding fat as flavouring or seasoning to food (five items). Items were rated on a 4-point scale (1 = usually, 4 = rarely/never). Internal reliability at baseline was .70, .62, .64 and .69, respectively. The Block Fat Screener (Block, Clifford, Naughton, Henderson, & McAdams, 1989) was used to identify those individuals with a high daily intake of dietary fat. This 15-item measure has been shown to discriminate individuals on a high (40%) versus low (20%) fat diet as well as a four-day diet record. Participants responded to the question 'Over the past 3 months, how often did you eat. . .' on an 8-point scale (0 = never or less than once a month, 8 = two or more times a day) and indicated how big a serving they usually ate on a 3-point scale (1 = small, 3 = large) compared to a picture indicating a medium-sized serving.

The Physical Activity Scale for the Elderly Questionnaire (PASE; Washburn, Smith, Jette, & Janney, 1993) was used to assess the number of days and amount of time spent in leisure time, household and work-related physical activity over the past seven days. Participants responded to ten items on a 4-point scale (1 = less than one hour, 4 = more than four hours).

Weight was measured on the Soehnle electronic weighing scale, model 7300, 150 kg \times 100 g. BMI was calculated from weight (kg)/height (m²). Waist circumference was measured midway between the lower rib margin and the iliac crest, using standardized procedures, and recorded to the nearest centimeter (Van der Kooy & Seidell, 1993). Total serum cholesterol, total HDL-C, LDL-C and triglycerides were measured after an overnight fast using the Reflotron solid phase reagent system (Stahler, 1983). HbA1c was assayed using the Tosoh Haemoglobin Alc 2.2 analyser in the Clinical Pathology Laboratory, St Richard's Hospital, Chichester, Sussex, UK (normal range for HbA1c = 3.2%–6.3%).

Tailoring

The following measures were used to identify specific goals for intervention participants. Stages of change for dietary fat reduction were assessed using the Lamb and Sissons Joshi (1996) measure. This six-item instrument has been shown to discriminate respondents in terms of their fat intake. Respondents classify themselves by selecting one of six staging statements (0 = I haven't given the matter of the fat in my diet any thought at all [precontemplation], 5 = I have been consciously avoiding fat in my diet for longer than the last six months [maintenance]).

Stages of change for physical activity were assessed using the 11-item Physician-based Assessment and Counselling for Physical Activity (PACE; Long *et al.*, 1996) measure. Respondents classified themselves by selecting one of 11 staging statements (0 = I do not exercise or walk regularly now, and I do not intend to start in the near

future [precontemplation], 11 = I do vigorous exercise six or more times per week for over six months [maintenance]).

Barriers to healthy eating and physical activity were assessed using the Barriers to Diabetes Self-care Scale (Glasgow, 1994). Items assessing barriers to healthy eating (21 items) and physical activity (ten items) were rated on a 4-point scale (not at all, a little, a moderate amount, a great deal) depending on the extent to which participants felt a suggested situation prevented them from following a healthy eating plan or being physically active. Internal reliability at baseline was .85 for healthy eating and .71 for physical activity.

Individual self-efficacy for performing physical activity (one item) and cutting down on intake of high fat food (one item) was assessed, based on Lorig *et al.*'s (1996) guidelines. Participants rated, on a 10-point scale (1 = not at all confident, 10 = extremely confident), how confident they were that they could take part in moderate intensity physical activity such as brisk walking three - four times a week and cut down on their intake of high fat food.

Procedure

Baseline assessment

Prior to the initial assessment visit to the diabetes centre, scoring of the FHQ, the Block Fat Screener, the Barriers to Diabetes Self-care Scale, Stage of Change for dietary fat reduction, PACE and self-efficacy for performing physical activity and cutting down on intake of high fat food was completed so that the interventionist could prepare a draft of the personalized self-management plan for each participant in the intervention group. At baseline, and at all subsequent assessments, the interventionist was not informed of participants' scores on the other outcome variables.

When participants arrived at the diabetes centre, the physiological assessments (weight, waist circumference, fasting blood draw for complete plasma lipid profile and HbA1c) were conducted by an independent assessor. Patients were then given refreshments and those in the usual care control group were thanked and dismissed.

Intervention condition

Participants in the intervention condition stayed at the diabetes centre for the meeting with the interventionist to develop their personalized self-management programme to consist of one dietary and one physical activity goal. The key features of the intervention were assessment, patient participation in goal setting, selecting personalized strategies to overcome barriers, and follow-up contacts. The assessment used the self-report measures described above to assess the patient's eating patterns and level of physical activity. These measures established the patient's current lifestyle, identified the most problematic areas, and identified the patient's barriers to making lifestyle changes. This information was then used to guide discussion with the patient to help develop discrepancy between current status and desired goals. The discrepancy between a participant's stated goals and current behaviour was examined to increase motivation for change by emphasizing participant-generated benefits of change and reducing the perceived costs of change. Following the principles of brief motivational interviewing (Miller & Rollnick, 1991, 2002), ambivalence about behaviour change was explored, personal goals and self-motivational statements were elicited and a personalized programme was formulated in which manageable goals for lifestyle change were

negotiated, and specific individually tailored intervention strategies to increase self-efficacy and decrease barriers to change were developed. The patient received a copy of the goal-setting form to take home with him or her and an appointment was made for a follow-up telephone call in one week to monitor progress. He or she was then asked to complete a self-efficacy scale to indicate how confident he or she was that he or she could achieve the eating and physical activity goals that had been set. Before patients left, they received booklets reinforcing the general essentials of healthy eating and the importance of increasing physical activity. These had been specially prepared for this intervention but were not tailored to an individual's specific goals. This meeting with the interventionist lasted approximately 30 minutes.

Follow-up phone calls

Maintenance issues were addressed by follow-up telephone calls made by the same interventionist who met with the patient at the assessment visit, at one week, three weeks and seven weeks post-assessment. These calls lasted for about 10 minutes and focused on the extent to which patients had achieved their goals since last contact. Patients were reinforced or assisted in problem-solving additional strategies as appropriate.

Twelve, 24 and 52 weeks

Further full assessments, the same procedure as described above, took place for both groups at 12, 24 and 52 weeks. At 12 and 24 weeks, intervention participants again met with the interventionist and were helped to review what had worked, set further goals if they were achieving the initial goals and were helped to develop new problem-solving strategies for situations with which they had not coped successfully. Patients also received additional written materials tailored to their current concerns (e.g. focusing on lapse and relapse, key targets for changing eating and physical activity patterns). At 52 weeks, all participants met briefly with the interventionist to be thanked for their participation in the study. Implementation of the intervention is described in more detail in Clark and Hampson (2001).

Analyses

Statistical analysis was carried out using SPSS version 10 for Windows. A series of repeated measures MANOVAs with a within-subject factor of time (three levels) and a between-subject factor of group (two levels) were conducted to evaluate intervention effects on dietary behaviour, physical activity, physiological outcomes and self-care activities. Univariate ANOVAs and independent and paired sample *t* tests were conducted where appropriate on each dependent variable as follow-up tests to the MANOVAs. Familywise error rate across these tests was controlled for using Holm's sequential Bonferroni approach.

Results

Participation rate

In total, 573 patients, identified from the database as eligible to participate, were sent an initial letter of approach inviting them to participate in the study. There were 357

replies, giving an overall response rate to the initial letter of 62.3%. Of these, 57.7% ($n = 206$) were interested in participating. These 206 patients underwent further telephone screening for inclusion. Forty were excluded because they were too ill to participate. A further 66 patients declined participation. Reasons for non-participation were 'no problem with diabetes self-management' ($n = 29$), 'too busy' ($n = 9$), 'other current life stresses' ($n = 11$) and 'non-returned questionnaires' ($n = 17$). This resulted in 100 patients being randomized into the study, giving a participation rate of 60.2% of the 166 eligible patients who were interested in participating.

Participants

Participants were aged 59.5 years on average, had diabetes for approximately eight years, typically had one or more chronic illnesses besides diabetes, and 58% were men. The majority (61%) were prescribed oral hypoglycaemic tablets, with a small percentage (6%) on both insulin and tablets. The average BMI was 31 ($SD = 3.99$), waist circumference almost 103 cm ($SD = 10.35$) and HbA1c 8.4% ($SD = 1.64$). There were no significant differences between the intervention and control groups in terms of profile and demographic characteristics at baseline.

Attrition

Six participants in total were lost to final follow-up in the study, two from the intervention group (one deceased), and four from the control group (two deceased). Five of these participants were lost to the study between the six- and 12- month assessments. Statistical analysis for the 12- month follow-up data was conducted on an intention-to-treat basis (i.e. missing data was replaced with baseline scores).

Outcome analyses at 12-month follow-up

Dietary behaviour

Outcome results are shown in Table 1. There was a significant interaction for dietary behaviour, $\Lambda = .72$, $F(10, 89) = 3.36$, $p = .001$, due to significant interactions for the FHQ subscale 'substituting low-fat foods', $F(2, 196) = 7.59$, $p = .001$, and the Block Fat Screener, $F(2, 196) = 6.94$, $p = .002$. Both groups showed significant improvement over time with the greatest improvement occurring between Time 1 (T1) and Time 2 (T2). However, the intervention group improved significantly more than the control group. For the 'substitute' subscale, the groups differed significantly at T2, $t(98) = -2.639$, $p = .010$, but not at T1, $t(98) = 1.256$, $p = .212$, or T3, $t(98) = -2.083$, $p = .040$. For the intervention group, significant improvements were observed between T1 and T2, $t(49) = 12.687$, $p = .000$, and T1 and T3, $t(49) = 11.792$, $p = .000$, but not between T2 and T3, $t(49) = -0.185$, $p = .854$. For the control group, there were significant improvements between T1 and T2, $t(49) = 7.373$, $p = .000$, and T1 and T3, $t(49) = 7.422$, $p = .000$, but not between T2 and T3, $t(49) = 0.692$, $p = .492$.

On the Block Fat Screener, the intervention group reported lower fat eating at T3 than the control group, $t(98) = -2.736$, $p = .007$, but the differences between the groups at T1, $t(98) = 0.765$, $p = .446$, and T2, $t(98) = -0.645$, $p = .520$, were not significant. For the intervention group, significant improvements on the Block Fat Screener were observed between T1 and T2, $t(49) = 5.206$, $p = .000$, and between T1 and T3, $t(49) = 6.034$, $p = .000$, but not between T2 and T3, $t(49) = 1.515$, $p = .136$.

Table 1. Primary outcome results

Measure	Group	T1 Baseline		T2 3-mths		T3 12-mths	
		M	SD	M	SD	M	SD
Dietary behaviour							
FHO ^a							
Substitute	Intervention	2.60	0.62	1.35 ^{**c}	0.58	1.36 ^{**d}	0.58
	Control	2.43	0.70	1.68 ^{**c}	0.68	1.62 ^{**d}	0.66
Modify meat	Intervention	1.85	0.93	1.08	0.50	1.21	0.60
	Control	1.74	0.93	1.40	0.72	1.44	0.65
Block fat screener ^a	Intervention	34.41	18.78	23.62 ^{**c}	14.13	20.97 ^{**d}	12.97
	Control	31.67	23.34	26.03	18.78	31.24	23.14
Physical activity							
PASE ^b							
	Intervention	254.30	95.23	275.78	110.05	281.35	114.84
	Control	260.05	100.31	241.36	85.60	246.60	92.82
Physical indices							
BMI (kg/m ²) ^a							
	Intervention	32.40	4.49	32.26	4.47	32.06	4.30
	Control	31.30	5.01	31.34	5.08	32.72 ^{**d}	4.77
Waist (cm) ^a							
	Intervention	104.22	10.46	102.90 ^{*c}	10.35	102.70 ^{*d}	10.25
	Control	101.25	11.44	101.87	10.86	103.60	10.63
Self-care activities							
Diet							
	Intervention	3.72	0.57	4.06 ^{**c}	0.57	3.82	0.52
	Control	3.80	0.56	3.83	0.48	3.64	0.98
Physical activity							
	Intervention	2.37	1.21	3.40 ^{**c}	1.11	3.24 ^{**d}	1.47
	Control	2.51	1.28	2.83	1.16	2.57	1.38

* $p < .01$; ** $p < .001$.

Notes: FHQ = Food Habits Questionnaire; PASE = Physical Activity Scale for the Elderly. ^ahigher scores worse; ^bhigher scores better; ^csignificant difference between T1 and T2; ^dsignificant difference between T1 and T3.

In contrast, for the control group, there were no significant differences between the means at T1 and T2, $t(49) = 1.964$, $p = .055$, T2 and T3, $t(49) = -1.947$, $p = .057$, or T1 and T3, $t(49) = -0.014$, $p = .989$. These results suggest that intervention but not control participants made significant reductions on two of the five dietary measures between the baseline and three-month assessments, and that these changes were maintained at the 12-month assessment.

Physical activity

There was no significant interaction for physical activity, $\Lambda = .951$, $F(2, 97) = 2.499$, $p = .087$.

Physical indices

There was a significant interaction for the BMI/waist variables, $\Lambda = .64$, $F(4, 95) = 12.82$, $p = .000$. Univariate analyses showed that this was due to a significant interaction for both BMI, $F(2, 196) = 35.154$, $p = .000$, and waist measurements, $F(2, 1956) = 14.254$, $p = .000$. For BMI, there were no significant differences between the two groups at T1, $t(98) = 1.272$, $p = .207$, or T2, $t(98) = 1.140$, $p = .257$, or T3,

$t(98) = -0.726, p = .470$. For the intervention group there were no significant differences between the means at T1 and T2, $t(49) = 1.225, p = .227$, at T2 and T3, $t(49) = 1.237, p = .222$, or at T1 and T3, $t(49) = 1.743, p = .088$, indicating that intervention participants maintained their BMI over the course of the study. In contrast, for the control group, BMI increased significantly between T2 and T3, $t(49) = -8.106, p = .000$, and T1 and T3, $t(49) = -6.440, p = .000$, but not between T1 and T2, $t(49) = 0.159, p = .875$.

Waist circumference did not differ significantly between the two groups at T1, $t(98) = 1.232, p = .221$, or T2, $t(98) = 0.481, p = .632$, or T3, $t(98) = -0.426, p = .671$. However, waist circumference for the intervention group significantly decreased between T1 and T2, $t(49) = 3.062, p = .004$, and between T1 and T3, $t(49) = 3.317, p = .002$, but not between T2 and T3, $t(49) = 0.434, p = .666$. For the control group, waist circumference increased significantly between T2 and T3, $t(49) = -3.380, p = .001$, and T1 and T3, $t(49) = -3.587, p = .001$, but not between T1 and T2, $t(49) = -0.807, p = .424$.

Physiological outcomes

There was no significant interaction for the five physiological variables (cholesterol, HDL, LDL, triglycerides, HbA1c), $\Lambda = .893, F(10, 89) = 1.064, p = .399$.

Summary of self-care activities

There was a significant interaction for the summary of self-care activities, $\Lambda = .823, F(4, 95) = 5.101, p = .001$. Univariate analyses showed that this was due to a significant interaction for the physical activity subscale $F(2, 196) = 6.568, p = .002$. The two groups did not differ significantly at T1, $t(98) = -0.733, p = .465$, but the intervention group reported significantly more physical activity than the control group at T2, $t(98) = 2.118, p = .037$, and T3, $t(98) = 2.348, p = .021$. For the intervention group there were significant differences between T1 and T2, $t(49) = -5.517, p = .000$, and T1 and T3, $t(49) = -4.124, p = .000$, but not between T2 and T3, $t(49) = 0.676, p = .503$. For the control group, there was a significant increase between T1 and T2, $t(49) = -3.207, p = .002$, but no differences between T2 and T3, $t(49) = 1.735, p = .089$, and T1 and T3, $t(49) = -0.340, p = .735$.

Discussion

The intervention was effective in producing reported dietary change. Intervention participants made significant reductions to their fat-related eating habits between the baseline and three-month assessments, and these changes were maintained at the 12-month assessments. The intervention had less impact on physical activity, although significant improvements were obtained on one self-report measure and the means for the intervention group were in the right direction at all time points suggesting a trend towards increased physical activity levels for intervention participants.

Moreover, these changes in reports of lifestyle behaviours were confirmed in the objective measures of waist circumference, which showed a significant reduction (average of 2 cm) that was maintained at 12 months, and BMI. The control group's BMI increased significantly whereas the intervention group maintained their BMI across the follow-up period. These results extend past research by demonstrating the effectiveness

of a tailored intervention in which participants work on two goals simultaneously, and that the intervention can be implemented successfully in the NHS context.

These results have important implications for diabetes care. Fat intake of $\leq 30\%$ of total energy is recommended to assist in limiting consumption of total energy as well as saturated fat (American heart Association, 2000). However, fat reduction has been identified as the most difficult of the dietary recommendations for diabetic patients to follow (British Diabetic Association, 1992). The emphasis on specific, modest and achievable goals in this intervention proved effective. In terms of physical activity, the major public health problem of sedentary living is concentrated in the least active and unfit 20%–30% of the adult population, with an estimated increased mortality of at least twofold for this group. Although substantial diabetes and other health benefits have been reported from, for example, resistance training, physical activities of light to moderate intensity that can be built into the normal daily routine, as targeted in this intervention, may be more sustainable and may be the most effective and least costly approach for increasing energy expenditure in the largest number of people (Pescatello & Van Heest, 2000; Shephard, 1992).

Waist circumference relates closely to intra-abdominal fat mass (Pouliet *et al.*, 1994; Ross, Shaw, Martel, de Guise, & Avruc, 1993; Seidell, Oosterlee, Deurenberg, Hautvast, & Ruijs, 1988) and changes in waist circumference, as reported in the present study, potentially reflect changes in cardiovascular risk factors even in the absence of significant weight loss (Hellenius, de Faire, Berglund, Hamsten, & Krakau, 1993; Lehmann, Vokac, Niedermann, Agosti, & Spinass, 1995; Sonnichsen, Richter, & Schwandt, 1992; Wing, & Jefferey, 1995; Wing *et al.*, 1992). The finding that BMI increased significantly for the control group between the baseline and 12-month assessments is of particular concern. Because weight gain accompanies aging, and because weight gain is independently associated with coronary heart disease and stroke, prevention of weight gain should be a high priority in this population group. In this regard, the results for BMI for the intervention group compared to the control group in the present study are encouraging.

The behaviour changes did not translate into significant differences between the two groups in terms of reductions in HbA_{1c} or improvements in the other physiological measures (cholesterol, HDL, LDL, triglycerides). Studies by both Glasgow *et al.* (1989) and Johnson (1992) have found that the relations between behaviour change and physiological measures of diabetes control are at best often modest and definitely complex. There are numerous patient factors (age, gender, history of diabetes), medical status variables (insulin status, comorbidities, other medications), patient–provider interaction factors (appropriateness of regimen prescription) and issues pertaining to timing and sequence of behaviour changes and physiological change that can potentially condition and moderate these relationships. Larger scale and more complex studies are needed to address these issues and to identify subgroups of patients whose diabetes and physiological status is more and less responsive to behaviour change (Denke, 1995; Glasgow *et al.*, 1992; Wing, Shoemaker, Marcus, McDermott, & Gooding, 1990).

Further limitations of the present study include the failure to keep the interventionist entirely blind of assessments because the intervention was tailored on some of these variables. However, the interventionist needed to know the progress on the specific eating and physical activity goals in order to individualize the counselling session but was not informed of the results of all of the outcome measures. Participants in the intervention group may also have biased their self-reports to please the interventionist. However, the objective waist and BMI findings support the self-reported lifestyle improvements.

Maintenance and preventing relapse continues to be an important challenge for interventions modifying lifestyle behaviours (Marlatt & Gordon, 1985; Orleans, 2000; Wing *et al.*, 2000). Accordingly, one of the methodological strengths of the present study was the recognition that maintenance of behaviour change should be conceptualized as a process in itself rather than merely as the last step in the behaviour change process, with a shift in focus to include not only relapse prevention but also importantly, relapse management. Use of this problem-solving approach as a component of relapse prevention and management teaches participants to become their own therapists in dealing with future problematic situations. The results of the present study, which show that participants were generally successful in maintaining or even enhancing changes made over the 12-month follow-up period, suggest that this component of the intervention was successful in facilitating adherence to the difficult lifestyle changes recommended for these patients as part of their medical regimen.

A related concern is that to date there has been a reliance on very intensive interventions delivered in tertiary care settings by leading experts and multidisciplinary teams with highly selected, motivated and uncomplicated patients. While this type of research has produced important information on what is possible to accomplish under ideal circumstances with the patients most ready to change, it does not tell us what types of interventions will appeal to patients, health care professionals and health care settings, be practical to implement when applied under real-world conditions with limited resources and diverse, and appeal to less motivated patient groups.

Key features of the intervention described are that a highly personalized intervention, which addresses important influences on lifestyle self-management in Type 2 diabetes, can be conducted in a brief period of time and can therefore potentially be integrated into routine patient care in general practice, thus reaching a broader audience. Thus, while the observed impact of the intervention might be characterized as modest, if implemented and well accepted on a population of adults with diabetes as part of routine care, this could result in substantial aggregate impact. This approach could also be extended to other patient groups who would benefit from lifestyle changes, for example those with coronary heart disease or arthritis. However, the participation rate achieved in this study reflects not only the difficulty of recruiting patients to this type of intervention, but also the more general reluctance of these population groups to engage in such health promotion initiatives.

In conclusion, this intervention focused on cardiovascular disease risk factors (high fat diets, physical inactivity and central abdominal obesity). Therefore, it addressed the leading cause of death for people with Type 2 diabetes and the source of the majority of health care costs for this group. The positive effects of this brief, tailored intervention are important for the care of individuals with Type 2 diabetes as well as other patient groups who would benefit from lifestyle changes.

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References

- Agurs-Collins, T., Kumanyika, S., Ten Have, T., & Adams-Campbell, L. (1997). A randomized controlled trial of weight reduction and exercise for diabetes management in older African-American subjects. *Diabetes Care*, *20*, 1503-1511.
- American Heart Association (2000). Dietary Guidelines Revision 2000: A statement for healthcare professionals from the Nutrition Committee of the American Heart Association. *Circulation*, *102*, 2284.
- Anderson, R. M., Funnell, M. M., Butler, P. M., Arnold, M. S., Fitzgerald, J. T., & Feste, C. C. (1995). Patient empowerment. Results of a randomized controlled trial. *Diabetes Care*, *18*, 943-949.
- Bandura, A. (1977). Self efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*, 191-215.
- Bierman, E. L. (1992). Atherogenesis in diabetes. *Arteriosclerosis and Thrombosis*, *12*, 647-656.
- Block, G., Clifford, C., Naughton, M. D., Henderson, M., & McAdams, M. (1989). A brief dietary screen for high fat intake. *Journal of Nutrition and Education*, *21*, 199-207.
- British Diabetic Association (1992). Dietary Recommendations for People with Diabetes: An update for the 1990s. Nutrition Subcommittee of the British Diabetic Association's Professional Advisory Committee. *Diabetic Medicine*, *9*, 189-202.
- Brug, J., Steenhuis, I., Van Assema, P., & De Vries, H. (1996). The impact of a computer-tailored nutrition intervention. *Preventive Medicine*, *25*, 236-242.
- Campbell, M. K., DeVellis, B. M., Strecher, V. J., Ammerman, A. S., DeVellis, R. F., & Sandler, R. S. (1994). Improving dietary behavior: The effectiveness of tailored messages in primary care settings. *American Journal of Public Health*, *84*, 783-787.
- Clark, M., & Hampson, S. E. (2001). Implementing a psychological intervention to improve lifestyle self-management in Type 2 diabetes. *Patient Education and Counseling*, *42*, 247-256.
- Denke, M. A. (1995). Cholesterol-lowering diets: A review of the evidence. *Archives of Internal Medicine*, *155*, 17-26.
- Diabetes Control and Complications Trial Research Group (1993). The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *New England Journal of Medicine*, *329*, 977-986.
- Emmons, K., & Rollnick, S. (2002). Motivational interviewing in health care settings: Opportunities and limitations. *American Journal of Preventive Medicine*, *20*, 68-74.
- Eriksson, K. F., & Lindgarde, F. (1991). Prevention of Type 2 (non-insulin dependent) diabetes mellitus by diet and physical exercise: The six year Malmo feasibility study. *Diabetologia*, *34*, 891-898.
- Glasgow, R. E. (1994). Social-environmental factors in diabetes: Barriers to diabetes self-care. In C. Bradely (Ed.), *Handbook of psychology and diabetes* (pp.335-349). Chur, Switzerland: Harwood Academic.
- Glasgow, R. E., Hampson, S. E., Strycker, L. A., & Ruggiero, L. (1997). Personal-model beliefs and social environmental barriers related to diabetes self management. *Diabetes Care*, *20*, 556-561.
- Glasgow, R. E., Toobert, D. J., & Hampson, S. E. (1996). Effects of a brief office-based intervention to facilitate diabetes dietary self-management. *Diabetes Care*, *19*, 835-842.
- Glasgow, R. E., Toobert, D. J., Hampson, S. E., Brown, J. E., Lewinsohn, P. M., & Donnelly, J. (1992). Improving self-care among older patients with Type II diabetes: The 'sixty something' study. *Patient Education and Counseling*, *19*, 61-74.
- Glasgow, R. E., Toobert, D. J., Riddle, M., Donnelly, J., Mitchell, D. L., & Calder, D. (1989). Diabetes-specific social learning variables and self-care behaviors among persons with Type II diabetes. *Health Psychology*, *8*, 285-303.
- Glasgow, R. E., Vogt, T. M., & Boles, S. M. (1999). Evaluating the public health impact of health promotion interventions: The RE-AIM framework. *American Journal of Public Health*, *89*, 1322-1327.

- Hampson, S. E., Glasgow, R., & Toobert, D. J. (1990). Personal models of diabetes and their relations to self-care activities. *Health Psychology, 9*, 632-646.
- Hanefeld, M., Fischer, S., Schmechel, P., Rothe, G., Schulze, J., Dude, H., Schwanabeck, U., & Julius, U. (1991). Diabetes intervention study: Multi-intervention trial in newly diagnosed NIDDM. *Diabetes Care, 14*, 308-317.
- Hellenius, M. L., de Faire, U., Berglund, B., Hamsten, A., & Krakau, I. (1993). Diet and exercise are equally effective in reducing risk for cardiovascular disease. Results of a randomized controlled study in men with slightly to moderately raised cardiovascular risk factors. *Atherosclerosis, 103*, 81-91.
- Johnson, S. B. (1992). Methodological issues in diabetes research: Measuring adherence. *Diabetes Care, 15*(Suppl. 4), 1658-1667.
- Knowler, W. C., Barret-Connor, E., & Fowler, S. E., for the Diabetes Prevention Program Research Group (2002). Reduction in the incidence of Type 2 diabetes with lifestyle intervention or metformin. *New England Journal of Medicine, 346*, 393-403.
- Kreuter, M. W. (1997). *Towards more effective health communication: Comparing effects of tailored, personalized and untailored messages in a randomized trial*. Annual Meeting of the American Public Health Association, Indianapolis, IN.
- Kreuter, M. W., Lezin, N., Kreuter, M., & Green, L. (1997). *Community health promotion ideas that work*. Massachusetts: Jones & Barlett.
- Kreuter, M. W., & Skinner, C. S. (2000). What's in a name? *Health Education Research, 15*, 1-4.
- Kreuter, M. W., & Strecher, V. J. (1996). Do tailored behavior change messages enhance the effectiveness of health risk appraisal? Results from a randomized trial. *Health Education Research, 11*, 97-105.
- Kristal, A. R., Shattuck, A. L., & Henry, H. J. (1990). Patterns of dietary behavior associated with selecting diets low in fat: Reliability and validity of a behavioral approach to dietary assessment. *Journal of the American Dietetic Association, 90*, 214-220.
- Lamb, R., & Sissons Joshi, M. (1996). The stage model and processes of change in dietary fat reduction. *Journal of Human Nutrition and Dietetics, 9*, 43-53.
- Lehmann, R., Vokac, A., Niedermann, K., Agosti, K., & Spinaz, G. A. (1995). Loss of abdominal fat and improvement of the cardiovascular risk profile by regular moderate exercise training in patients with NIDDM. *Diabetologia, 38*, 1313-1319.
- Leventhal, H., Nerenz, D., & Steele, D. J. (1984). Illness representations and coping with health threats. In A. Baum, S. E. Taylor, & J. E. Singer (Eds.), *Handbook of psychology and health* (pp. 219-252). Hillsdale, NJ: Erlbaum.
- Long, B. J., Calfas, K. J., Wooten, W., Sallis, J. F., Patrick, K., Goldstein, M., Marcus, B. H., Schwenk, T. L., Chenoweth, J., Carter, R., Torres, T., Palinkas, L. A., & Heath, G. (1996). A multisite field test of the acceptability of physical activity counselling in primary care: Project PACE. *American Journal of Preventive Medicine, 12*, 73-81.
- Lorig, K., Stewart, A., Ritter, P., Gonzalez, V., Laurent, D., & Lynch, J. (1996). *Outcome measures for health education and other health care interventions*. Thousand Oaks, CA: Sage.
- Marlatt, G. A., & Gordon, J. R. (Eds.). (1985). *Relapse prevention*. New York: Guilford.
- Miller, W. (1983). Motivational interviewing with problem drinkers. *Behavioural Psychotherapy, 11*, 147-172.
- Miller, W. R., & Rollnick, S. (1991). *Motivational interviewing: Preparing people to change addictive behavior*. New York: Guilford.
- Miller, W. R., & Rollnick, S. (2002). *Motivational interviewing: Preparing people to change addictive behavior* (2nd ed.). New York: Guilford.
- Orleans, C. T. (2000). Promoting the maintenance of health behavior change: Recommendations for the next generation of research and practice. *Health Psychology, 19*(Suppl. 1), 76-83.
- Pan, X. R., Li, G. W., Hu, Y. H., Wang, J. X., Yang, W. Y., An, Z. X., Hu, Z. X., Lin, J., Xiao, J. P., Zheng, H., Zhang, H., Bennett, P. H., & Howard, B. V. (1997). Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance. *Diabetes Care, 20*, 537-544.

- Pescatello, L. S., & Van Heest, J. L. (2000). Physical activity mediates a healthier body weight in the presence of obesity. *British Journal of Sports Medicine*, *34*, 86-93.
- Petty, R., & Cacioppo, J. (1984). The effects of involvement on responses to argument quantity and quality: Central and peripheral routes to persuasion. *Journal of Personality & Social Psychology*, *46*, 69-81.
- Pouliet, M.-C., Despres, J.-P., Lemieux, S., Moorjani, S., Bouchard, C., & Tremblay, A. (1994). Waist circumference and abdominal sagittal diameter: Best anthropometric indexes of abdominal visceral tissue accumulation and related cardiovascular risk in men and women. *American Journal of Cardiology*, *73*, 460-468.
- Prochaska, J. O., & DiClemente, C. C. (1984). *The transtheoretical approach: Crossing traditional boundaries of change*. Homewood, IL: J. Irwin.
- Rimer, B. K., & Glassman, B. (1998). Tailoring communications for primary care settings. *Methods of Information in Medicine*, *37*, 171-178.
- Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social learning theory and the health belief model. *Health Education Quarterly*, *15*, 175-183.
- Ross, R., Shaw, K. D., Martel, Y., de Guise, J., & Avruc, H. L. (1993). Adipose tissue distribution measured by magnetic resonance imaging in obese women. *American Journal of Clinical Nutrition*, *67*, 470-475.
- Ruggiero, L., Glasgow, R. E., Dryfoos, J. M., Rossi, J. S., Prochaska, J. O., Orleans, C. T., Prokhorov, A. V., Rossi, S. R., Greene, G. W., & Reed, G. R. (1997). Diabetes self-management: Self-reported recommendations and patterns in a large population. *Diabetes Care*, *20*, 568-576.
- Seidell, J. C., Oosterlee, A., Deurenberg, P., Hautvast, J. G., & Ruijs, J. H. (1988). Abdominal fat depots measured with computed tomography. *European Journal of Clinical Nutrition*, *42*, 805-815.
- Shephard, R. J. (1992). A critical analysis of work-site fitness programs and their postulated economic benefits. *Medicine, Science, Sports and Exercise*, *24*, 354-370.
- Skinner, C. S., Strecher, V. J., & Hospers, H. (1994). Physicians' recommendations for mammography: Do tailored messages make a difference? *American Journal of Public Health*, *84*, 43-49.
- Sonnichsen, A. C., Richter, W. O., & Schwandt, P. (1992). Benefit from hypocaloric diet in obese men depends on the extent of weight loss regarding cholesterol, and on a simultaneous change in body fat distribution regarding insulin sensitivity and glucose tolerance. *Metabolism*, *41*, 1035-1040.
- Stahler, F. (1983). 'Real-time' clinical chemistry. In A. E. Eng, & P. Garcia Webb (Eds.), *Clinical biochemistry, principles and practice*. Plenary lectures and symposia after Second Asian and Pacific Congress of Clinical Biochemistry.
- Strecher, V. J., DeVellis, B. M., Becker, M. H., & Rosenstock, I. M. (1986). The role of self-efficacy in achieving health behavior change. *Health Education Quarterly*, *13*, 73-91.
- Strecher, V. J., Kreuter, M., Den Boer, D. J., Kobrin, S., Hospers, H. J., & Skinner, C. S. (1994). The effects of computer-tailored smoking cessation messages in family practice settings. *Journal of Family Practice*, *39*, 262-270.
- Toobert, D. J., & Glasgow, R. E. (1994). Assessing diabetes self-management: the summary of diabetes self-care activities questionnaire. In C. Bradley (Ed.), *Handbook of psychology and diabetes* (pp. 351-375). Chur, Switzerland: Harwood Academic.
- Toobert, D. J., Hampson, S. E., & Glasgow, R. E. (2000). The summary of diabetes self-care activities measure: Results from seven studies and a revised scale. *Diabetes Care*, *23*, 943-949.
- Tuomilehto, J., Lindstrom, J., Eriksson, J. G., Valle, T. T., Hamalainen, H., Lanne Parikka, P., Keinanen-Kiukkaanniemi, S., & Laakso, M., for the Finnish Diabetes Prevention Study Group (2001). Prevention of Type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *New England Journal of Medicine*, *344*, 1343-1350.
- United Kingdom Prospective Diabetes Study Group (1998). Reduction in the incidence of Type 2 diabetes with lifestyle intervention or metformin. *Lancet*, *352*, 837-853.

- United Kingdom Prospective Diabetes Study Group (1999). Quality of life in Type 2 diabetic patients is affected by complications but not by intensive policies to improve blood glucose or blood pressure control (UKPDS 37). *Diabetes Care*, *22*, 1125-1136.
- Uusitupa, M. (1996). Early lifestyle intervention in patients with non-insulin dependent diabetes mellitus and impaired glucose tolerance. *Annals of Medicine*, *28*, 445-449.
- Van der Kooy, K., & Seidell, J. C. (1993). Techniques for the measurement of visceral fat: A practical guide. *International Journal of Obesity*, *17*, 187-196.
- Washburn, R. A., Smith, K. W., Jette, A. M., & Janney, C. A. (1993). The Physical Activity Scale for the Elderly (PASE): Development and evaluation. *Journal of Clinical Epidemiology*, *46*, 153-162.
- Weinstein, N. (1993). Testing four competing theories of health-protective behavior. *Health Psychology*, *12*, 324-333.
- Wierenga, M. (1994). Lifestyle-modification for weight control to improve diabetes health status. *Patient Education and Counseling*, *23*, 33-40.
- Wing, R. R. (1993). Behavioural treatment of obesity. *Diabetes Care*, *16*, 193-199.
- Wing, R. R., & Anglin, K. (1996). Effectiveness of a behavioral weight control program for blacks and whites with NIDDM. *Diabetes Care*, *19*, 409-413.
- Wing, R. R., Epstein, L. H., Nowalk, M. P., Koeske, R., & Hagg, S. (1985). Behavior change, weight loss and physiological improvements in Type II diabetic patients. *Journal of Consulting and Clinical Psychology*, *53*, 111-122.
- Wing, R. R., & Jefferey, R. W. (1995). Effect of modest weight loss on changes in cardiovascular risk factors: Are there differences between men and women or between weight loss and maintenance? *International Journal of Obesity*, *19*, 67-73.
- Wing, R. R., Jefferey, R. W., Burton, L. R., Kuller, L. H., Thorson, C., & Folsom, A. R. (1992). Change in waist-hip ratio with weight loss and its association with change in cardiovascular risk factors. *American Journal of Clinical Nutrition*, *55*, 1086-1092.
- Wing, R. R., Shoemaker, M., Marcus, M. D., McDermott, M., & Gooding, W. (1990). Variables associated with weight loss and improvements in glycemic control in Type II diabetic patients in behavioral weight control programs. *International Journal of Obesity*, *14*, 495-503.
- Wing, R. R., Voorhies, C. C., & Hill, D. R. (2000). Supplementary issue: Maintenance of behavior change in cardiorespiratory risk reduction. *Health Psychology*, *19*(Suppl. 1), 1-91.
- Wood, E. R. (1989). Evaluation of a hospital-based education program for patients with diabetes. *Journal American Dietetic Association*, *89*, 354-358.

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