



Self-management interventions for type 2 diabetes: a systematic review

E Heinrich,* NC Schaper, NK de Vries

Introduction

Patients play a central role in diabetes care because of their daily responsibility for a large number of behavioural choices and activities. More concretely, patients have to take into account their diet, exercise, medication administration, blood glucose testing, smoking behaviour and medical examinations, including inspections of eyes and feet. Such self-management is a complex activity and includes 'the ability to monitor one's condition and to affect the cognitive, behavioural and emotional responses necessary to maintain a satisfactory quality of life' (QoL).¹ Self-management is inescapable and it is a question of how, not whether, patients manage their diabetes.

Although modern care and

Summary

This paper systematically reviews published randomised controlled trials, to determine the educational focus and effectiveness of type 2 diabetes multi-component self-management interventions. PubMed, PsycINFO, Web of Science and reference lists of included studies were searched for English-language articles published 2000–2010. Descriptive information was summarised; when possible, effect sizes were calculated. Fourteen studies, described in 19 articles, were reviewed: six one-on-one interventions; six group interventions; two interventions comprising both intervention types. Four studies used learning as an intervention method; seven used learning and planning; three used learning, planning and practising. Self-management interventions seemed effective for diet, self-monitoring of blood glucose, knowledge and diabetes specific quality of life (QoL); there were mixed results for exercise and clinical outcomes. Findings showed that dietary behaviour seemed relatively easy to change with self-management interventions. Group interventions with a practise component had the greatest potential to improve metabolic control. Self-management interventions had positive effects on diabetes-specific QoL, and interventions using a collaborative learning approach improved knowledge. Multi-component self-management interventions potentially lead to clinically relevant improvements in behaviour and some clinical parameters. Further research is needed to explain the mixed effects on exercise and to identify processes underlying behaviour change.

Key words

Type 2 diabetes, self-management, intervention, education, health behaviour

Authors

Evelien Heinrich,^{1,2} MSc, PhD student
Nicolaas C Schaper,^{2,3} MD, PhD,
Professor
Nanne K de Vries,^{1,2} PhD, Professor

¹Department of Health Promotion, Maastricht University, The Netherlands

²School for Public Health and Primary Care (CAPHRI), Maastricht, The Netherlands

³Endocrinology Division, Department of Internal Medicine, University Hospital Maastricht, The Netherlands

*Correspondence to:

Maastricht University, Department of Health Promotion
c/o E Heinrich, PO Box 616, 6200 MD Maastricht, The Netherlands
e-mail: Evelien.Heinrich@gvo.unimaas.nl

Received: 27 November 2009

Accepted in revised form: 07 June 2010

education are becoming more patient-centred,² many patients find it difficult to maintain adequate self-management.³ High-quality care is therefore needed, to better support patients' self-management abilities.

Reviews of articles published before 2000 show the potential benefits of self-management interventions but provide inconsistent results for various outcome measures.^{4–6} Numerous intervention studies have focused on improving one specific self-management activity in people with type 2 diabetes (physical activity [PA]⁷ or dietary behaviour⁸, for example). However, to do justice to the complexity of daily practise, interventions are needed that focus on improving multiple self-management issues.

The objective of the present paper was to systematically review reports of randomised controlled trials (RCTs) to determine the methods and effectiveness of multi-component interventions aimed at self-management, in terms of changing behavioural, wellbeing, clinical and process outcomes for patients with type 2 diabetes. Interventions had to target at least two behaviours or had to be focused on self-management or diabetes in general.

Methods

Search methods

Trials were identified by searching PubMed, PsycINFO and Web of Science. Four key-word clusters were used: diabetes (DM2), health behaviour (*eg* lifestyle), inter-

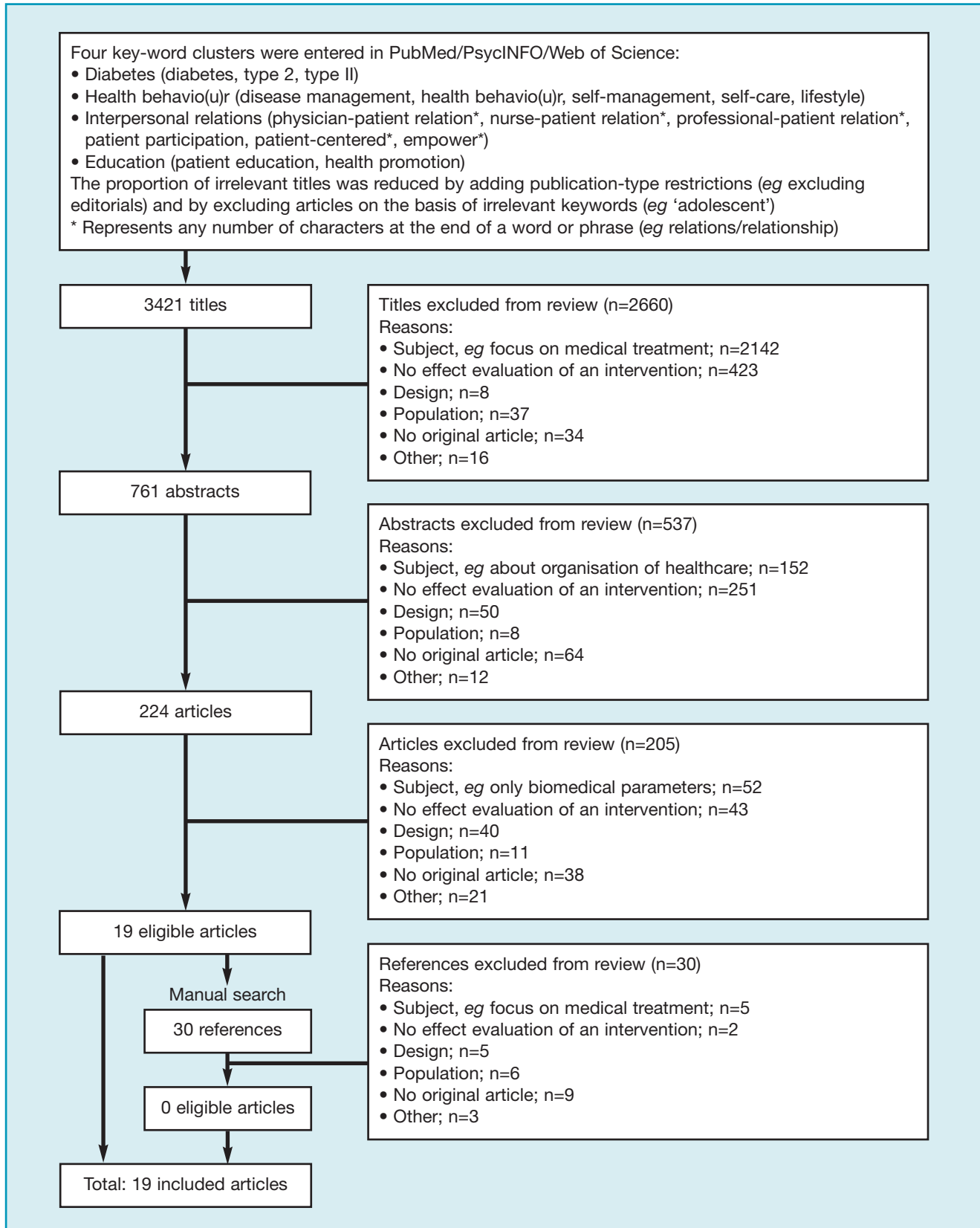


Figure 1. Selection process for the search involving studies published between January 2000–March 2010



personal relations (*eg* patient participation), and education (*eg* patient education). Figure 1 illustrates the electronic search and selection processes used. In addition to this search, reference lists of included studies and reviews were scanned manually for relevant publications. The search was undertaken in March 2010 and was restricted to articles published in English between January 2000 and March 2010.

Study selection

Studies were included if they described the outcomes of an effect evaluation of a diabetes self-management intervention; the population consisted of adults with type 2 diabetes (aged ≥ 18 years); the trial was a RCT with a pre-test/post-test design.

Studies were excluded if the intervention only focused on one self-management component; clinical parameters were the only published outcome measures (because self-management interventions are targeted at changing behaviours, which does not necessarily result in clinical improvements); the study did not describe specific results for type 2 diabetes; the control group received an alternative intervention (because these interventions might vary widely).

Specific reasons for exclusion were coded and categorised into: inappropriate subject (*eg* medical treatment), goal of the paper (*eg* protocol article), research design (*eg* single-group design), population and article category (*eg* letter to the editor), (Figure 1). The selection started with an assessment of titles and for all relevant titles, abstracts were assessed. Full articles were retrieved if abstracts were found to be relevant, when there was no abstract, or whenever there was any doubt about the relevance.

Intervention categorisation and outcome classification

The articles are arranged in order of interventions type (one-on-one versus group) Table 1 is available via the EDN online edition of this article at www.wileyinterscience.com. Outcomes were classified as behaviour; wellbeing; clinical outcomes, and process outcomes.

For every significant intervention effect, the magnitude of the effect size (ES) (Cohen's *d*) was calculated whenever possible.⁹ Effect sizes were defined as small (ES ≤ 0.32); medium (ES 0.33–0.55); and large (ES ≥ 0.56). These interpretations were based on Lipsey's guidelines for the specific domain of treatment effectiveness research in the behavioural sciences.¹⁰

Results

From the 3421 articles that were generated (Figure 1), 19 were retained for this review; these described 14 independent studies. Study characteristics, the content of interventions and the reported outcomes are summarised in Table 1. The articles are arranged in order of intervention type (one-on-one versus group).

Study characteristics

Sample characteristics differed across the studies, which were carried out in North America (n=6), the United Kingdom (n=4), Sweden (n=2), South Korea (n=1) and Thailand (n=1) (Table 1). Three of the American studies had specific target populations: African-American adults^{11,12} and Latino/Hispanic adults, who also had to meet additional criteria;¹³ three studies only included women.^{11,14,15} Sample sizes ranged from 36 to 279 (mean 127).

Eleven studies described informed-consent procedures (written informed consent n=9; verbal informed consent n=2). Three studies did not mention

informed consent, but two described ethics committee approval.

In all studies, the control group received their usual care. If the control group received diabetes information, this was restricted to information that would normally be imparted during usual care.

Six studies described one-on-one interventions,^{11,13,14,16–18} another six evaluated group interventions,^{12,19–23} and two combined both intervention types.^{24,25} In addition, there was a large variation in intervention intensity. For example, Christian and colleagues¹³ described an intervention in which patients only had a pre-intervention visit in addition to usual care, where a computer-based lifestyle assessment took place. Toobert and colleagues¹⁵ described the most intensive intervention, which consisted of a two and a half day retreat followed by six months of weekly four-hour meetings. Follow-up duration ranged from six weeks¹² to 3.8 years.²⁴

In two of the studies, patients' usual healthcare providers were involved;^{13,21} in four studies, the interventionist was a PhD student or researcher^{16–18,21} and in other studies healthcare professionals (*eg* nurses and dietitians) implemented the intervention. The intervention described by Christian and colleagues took place during usual care, after the computer-based lifestyle and motivational assessment.¹³ In all other studies, the intervention activities were additional to usual care.

The studies included in our review described different intervention methods which could be categorised into three main types: 'learning' (information/education), 'planning' (create a self-management plan), and 'practising' (practise self-management behaviours). Four interventions consisted of learning only,^{11,21,22,25} seven included learning and planning,^{12–14,16–19} and three used all three methods.^{15,20,24}

Seven studies described the



theoretical background of their intervention,^{14,17-20,23,25} four described some theoretical concepts (*eg* self-efficacy) without referring to specific theories,^{12,13,22,24} and three described no theoretical foundation.^{11,16,21}

Although all studies addressed self-management, the focus of the interventions varied (Table 1). Six studies covered a broad range of diabetes-related topics including self management;^{11,14,20-22,25} five had a narrower focus on self-management behaviours,^{12,16,18,19,26} and three covered very specifically targeted lifestyle changes.^{13,17,24}

Outcomes

Ten studies reported behavioural outcomes, of which diet and PA were by far the most reported. An intervention effect on diet was observed in eight of the 10 studies, with ES ranging from 0.29¹⁴ to 1.00.¹⁶ Positive effects were found with different intervention types (in both one-on-one and group interventions). Moreover, effects were seen in different studies, regardless of the method (learning/planning/practising) used. One relatively large one-on-one intervention, specifically focused on changing lifestyle, did not find any effects.¹³ In contrast to other studies, this intervention mainly took place during usual-care consultations with one additional pre-intervention lifestyle assessment.

Concerning PA, five of the 10 studies found positive effects on PA, mostly reporting medium to large ES. A relatively small study found the largest effects.¹⁸ Effective studies did not differ from ineffective studies with respect to intervention type or method, but effective studies focused primarily on self-management behaviours^{18,19,26} and lifestyle changes.^{13,17} Three of the five ineffective studies focused on a variety of diabetes-related

topics.^{11,14,20} Furthermore, the sample sizes of effective studies were usually higher compared with the sample sizes of the ineffective studies, except for the study by Sacco *et al.*¹⁸

As in the studies with dietary outcomes, four of the five studies measuring the frequency of self-monitoring of blood glucose (SMBG) found positive effects with large ES, regardless of intervention type and method.

A limited number of studies (n=4) evaluated foot care. Again, the intervention described by Sacco *et al* was the only effective study, with a large ES (1.18).¹⁸

Five of thirteen studies observed lower glycosylated haemoglobin (HbA_{1c}) levels in the intervention group compared with the control group at post-measurement,^{15,16,20,21,25} with ES ranging from 0.26¹⁵ to 1.25.¹⁶ Four of the five effective studies included group sessions. Regarding intervention methods, learning and planning strategies were used in both effective and ineffective studies. Both of the studies where the intervention included 'practising' showed lower HbA_{1c} levels in the study group compared with the control group.^{15,20}

Body mass index (BMI)/weight was the second most-reported clinical outcome. One of the 10 studies, which evaluated a group intervention with learning, planning and practising methods, found a lower BMI in the intervention group compared with the control group,¹⁵ with a small ES (0.01). Three studies explicitly focused on lifestyle changes,^{13,17,24} of which one showed effects of diet and PA, but weight did not change.¹⁷ (Table 1 is available via the EDN online edition at www.wiley-interscience.com).

Other clinical outcomes, such as blood pressure and lipid profiles, were less frequently reported. No

effects were found on blood pressure but two studies, which used different intervention methods, found positive effects on lipid profiles. Clark *et al*¹⁷ and Toobert *et al*¹⁵ showed positive effects on diet and PA; however these behavioural changes did not alter the biomedical measures.

Beneficial effects of interventions were shown in all four of the studies that measured diabetes-specific QoL.^{11,14,15,19} In addition, two out of the four interventions resulted in better generic QoL in patients compared with those in the control group.^{11,25} Interventions that improved QoL varied in type and method.

Concerning the two most frequently measured process outcomes, four of the five studies assessing knowledge or perceived understanding of diabetes,^{11,12,19,22} and three of the five studies assessing self-efficacy^{18,19,26} reported positive effects of the intervention. Effective interventions varied in intervention type and method, but all three group interventions resulted in better knowledge levels in treated patients compared with controls.^{11,12,19,22}

Discussion

This review sought to determine the methods and effectiveness of multi-component interventions aimed at self-management for type 2 diabetes. Concerning behavioural outcomes, diet and exercise were frequently measured. The effects of self-management interventions are highly promising for making dietary changes. In contrast, the benefits of self-management interventions for exercise are more ambiguous, although interventions with a specific focus on behaviour change show potential, and the relative lack of efficacy may have been caused by limited power. Differences in effectiveness could not be attributed



to other intervention or study characteristics. Similar observations were made by Norris *et al*⁵ in their review of studies published before 2000; they were unable to establish any factor that could explain variations in effectiveness.

No conclusions could be drawn for SMBG or foot care because only a limited number of interventions have addressed these outcomes. However, interventions with SMBG as a specific topic seemed successful in improving the frequency of monitoring, regardless of intervention characteristics.

Evidence for the effectiveness of interventions on clinical outcomes was less conclusive. Group interventions with a practise component seemed to be most promising for improving metabolic control; these results are supported by earlier reviews demonstrating the potential benefits of group interventions for optimising HbA_{1c}.^{27,28} However, inconsistent results were found for lipid profiles, and no effect was found for blood pressure. This lack of effect on blood pressure is in contrast with the Cochrane review of 2005,²⁷ in which pooled analyses revealed that group-based self-management programmes resulted in blood pressure reductions. Given the heterogeneity of the various studies, it was impossible to pool effects across studies. No conclusions could be made about BMI/weight outcomes since only one of the 10 studies reporting on these parameters showed any improvements.¹⁵

Wellbeing and process measures varied widely and not all of the studies reported results for these outcome categories. Most evidence was found for the effect of self-management interventions on disease specific QoL and knowledge: disease-specific QoL instruments are known to be more sensitive to change than generic instruments.²⁹ The outcomes for knowledge are

also in line with an earlier review by Brown *et al*.⁴

In general, the various interventions seemed more effective in improving behavioural outcomes than clinical parameters. Newman *et al*. argued that researchers often incorrectly assume a simple relation between behaviour change and clinical state, because clinical parameters are usually influenced by many more factors than a specific altered behaviour.³⁰ Moreover, behavioural outcomes were mostly measured by self-reporting questionnaires, which are liable to bias.³¹ Additional explanations for the apparent lack of efficacy on clinical parameters could be that most interventions did not specifically address behaviour change, and the observation period used in several studies may have been too short.

Studies included in the current review varied markedly in intervention method. Concerning learning as method, only one intervention used a somewhat didactic method,²⁵ whereas the review by Norris *et al* included eight such interventions.⁵ The more collaborative approaches that we found are in line with the shift within educational interventions from didactic teaching approaches towards more patient-centred or 'empowerment' approaches.³²

Comparing intervention studies on self-management could be facilitated by standardised intervention descriptions^{33,34} and measures of behaviour change,³⁵ and better descriptions of the translation of theoretical concepts to the interventions.³⁶ Furthermore, future research should report process outcomes, and interactions between different outcomes, to obtain a better understanding of the underlying processes of change.^{5,20,37,38}

The present review had several limitations. In almost all studies reviewed, the intervention was offered on top of usual care. Extra

contact time for patients in the experimental groups may have led to an overestimation of effectiveness.⁶ Also, the quality of each study has not been assessed and rated. Furthermore, only RCTs were included, and only those published between 2000 and 2010.

In conclusion, multi-component self-management interventions are effective in changing dietary behaviour – independent of type and method – and diabetes-specific QoL. Group interventions with a practise component have the potential to improve metabolic control; and interventions using a collaborative learning approach can improve understanding of diabetes and some self-management behaviours. The fact that most interventions had medium-to-large ES on outcomes suggests that self-management interventions can potentially lead to clinically relevant improvements in behaviour and also in some clinical parameters. Since there is no difference in effectiveness between the two intervention types for behavioural outcomes (one-on-one versus group), group interventions are preferable as they are often more cost-effective. Further research is necessary to explain the inconsistent effects of self-management interventions on PA, and to investigate the processes underlying behaviour change. Finally, we suggest that in future studies investigating the effect of self-management education, the intervention should be embedded in daily care. This would enable realistic comparisons to be made between the control and intervention groups, and would facilitate the implementation of promising new strategies.

A table detailing all the studies included in this review is available via the EDN online edition at: www.wileyinterscience.com



Conflicts of interest

None.

Acknowledgement

The study described was supported by a grant from the Dr Paul Janssen Foundation.

References

- Barlow J, Wright C, Sheasby J, *et al.* Self-management approaches for people with chronic conditions: a review. *Patient Educ Couns* 2002;48:177–87.
- Funnell MM, Anderson AM. Empowerment and Self-Management of Diabetes. *Clinical Diabetes* 2004;22:123–7.
- Vermeire E, Wens J, Van Royen P, *et al.* Interventions for improving adherence to treatment recommendations in people with type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews* 2005. DOI:10.1002/14651858.CD003638.pub2.
- Brown SA. Interventions to promote diabetes self-management: state of the science. *Diabetes Educ* 1999;25:52–61.
- Norris SL, Engelgau MM, Narayan KM. Effectiveness of self-management training in type 2 diabetes: a systematic review of randomized controlled trials. *Diabetes Care* 2001;24:561–87.
- Norris SL, Lau J, Smith SJ, *et al.* Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. *Diabetes Care* 2002;25:1159–71.
- Kirk AF, Mutrie N, Macintyre PD, *et al.* Promoting and maintaining physical activity in people with type 2 diabetes. *Am J Prev Med* 2004;27:289–96.
- Glasgow RE, Toobert DJ. Brief, computer-assisted diabetes dietary self-management counseling: effects on behavior, physiologic outcomes, and quality of life. *Med Care* 2000;38:1062–73.
- Cohen J. *Statistical power analysis for the behavioral sciences*. Hillsdale, New Jersey: Lawrence Earlbaum Associates, 1988 pp19–74.
- Lipsey MW. *Design Sensitivity. Statistical Power for Experimental Research*. London New Delhi: Sage Publications, 1990 pp48–56.
- Skelly AH, Carlson JR, Leeman J, *et al.* Symptom-focused management for African American women with Type 2 diabetes: a pilot study. *Appl Nurs Res* 2005;18:213–20.
- Anderson RM, Funnell MM, Nwankwo R, *et al.* Evaluating a problem-based empowerment program for African Americans with diabetes: results of a randomized controlled trial. *Ethn Dis* 2005;15:671–8.
- Christian JG, Bessesen DH, Byers TE, *et al.* Clinic-based support to help overweight patients with type 2 diabetes increase physical activity and lose weight. *Arch Intern Med* 2008;168:141–6.
- Whittemore R, Melkus GD, Sullivan A, *et al.* A nurse-coaching intervention for women with type 2 diabetes. *Diabetes Educ* 2004;30:795–804.
- Toobert DJ, Glasgow RE, Strycker LA, *et al.* Biologic and quality-of-life outcomes from the Mediterranean Lifestyle Program: a randomized clinical trial. *Diabetes Care* 2003;26:2288–93.
- Kim HS, Oh JA. Adherence to diabetes control recommendations: impact of nurse telephone calls. *J Adv Nurs* 2003;44:256–61.
- Clark M, Hampson SE, Avery L, *et al.* Effects of a tailored lifestyle self-management intervention in patients with type 2 diabetes. *Br J Health Psychol* 2004a;9:365–79.
- Sacco WP, Malone JI, Morrison AD, *et al.* Effect of a brief, regular telephone intervention by paraprofessionals for type 2 diabetes. *J Behav Med* 2009;32:349–59.
- Steed L, Lankester J, Barnard M, *et al.* Evaluation of the UCL diabetes self-management programme (UCL-DSMP): a randomized controlled trial. *J Health Psychol* 2005;10:261–76.
- Cooper H, Booth K, Gill G. Using combined research methods for exploring diabetes patient education. *Patient Educ Couns* 2003a;51:45–52.
- Hornsten A, Lundman B, Stenlund H, *et al.* Metabolic improvement after intervention focusing on personal understanding in type 2 diabetes. *Diabetes Res Clin Pract* 2005;68:65–74.
- Adolfsson ET, Walker Engstrom ML, Smide B, *et al.* Patient education in type 2 diabetes: a randomized controlled 1-year follow-up study. *Diabetes Res Clin Pract* 2007;76:341–50.
- Toobert DJ, Strycker LA, Glasgow RE, *et al.* Effects of the Mediterranean Lifestyle Program on multiple risk behaviors and psychosocial outcomes among women at risk for heart disease. *Ann Behav Med* 2005;29:128–37.
- Gaede P, Beck M, Vedel P, *et al.* Limited impact of lifestyle education in patients with Type 2 diabetes mellitus and microalbuminuria: results from a randomized intervention study. *Diabet Med* 2001;18:104–8.
- Wattana C, Srisuphan W, Pothiban L, *et al.* Effects of a diabetes self-management program on glycemic control, coronary heart disease risk, and quality of life among Thai patients with type 2 diabetes. *Nurs Health Sci* 2007;9:135–41.
- Toobert DJ, Glasgow RE, Strycker LA, *et al.* Long-term effects of the Mediterranean lifestyle program: a randomized clinical trial for postmenopausal women with type 2 diabetes. *Int J Behav Nutr Phys Act* 2007;4:1.
- Deakin T, McShane CE, Cade JE, *et al.* Group based training for self-management strategies in people with type 2 diabetes mellitus. The Cochrane Database of Systematic Reviews 2005, Issue 2. DOI: 10.1002/14651858.CD003417.pub2.
- Duke SA, Colagiuri S, Colagiuri R. Individual patient education for people with type 2 diabetes mellitus. *Cochrane Database Syst Rev* 2009, Issue 1. DOI: 10.1002/14651858.CD005268.pub2.
- Guyatt GH, Feeny DH, Patrick DL. Measuring health-related quality of life. *Ann Intern Med* 1993;118:622–9.
- Newman S, Steed L, Mulligan K. Self-management interventions for chronic illness. *Lancet* 2004;364:1523–37.
- Bartholomew LK, Parcel GS, Kok G, *et al.* Planning health promotion programs. An intervention mapping approach, 2nd edn. San Francisco: Jossey-Bass, 2000 pp496–499.
- Glasgow RE, Anderson RM. In diabetes care, moving from compliance to adherence is not enough. Something entirely different is needed. *Diabetes Care* 1999;22:2090–2.
- Davidson KW, Goldstein M, Kaplan RM, *et al.* Evidence-based behavioral medicine: what is it and how do we achieve it? *Ann Behav Med* 2003;26:161–71.
- Abraham C, Michie S. A taxonomy of behavior change techniques used in interventions. *Health Psychology* 2008;27:379–87.
- Semaan S, Des Jarlais DC, Sogolow E, *et al.* A meta-analysis of the effect of HIV prevention interventions on the sex behaviors of drug users in the United States. *J Acquir Immune Defic Syndr* 2002;30:S73–S93.
- Michie S, Abraham C. Interventions to change health behaviours: Evidence-based or evidence-inspired? *Psychology and Health* 2004;19:29–49.
- Clark M, Hampson SE, Avery L, *et al.* Effects of a brief tailored intervention on the process and predictors of lifestyle behaviour change in patients with type 2 diabetes. *Psychology, Health and Medicine* 2004b;9:440–49.
- Cooper HC, Booth K, Gill G. Patients' perspectives on diabetes health care education. *Health Educ Res* 2003b;18:191–206.
- Barrera M, Toobert DJ, Angell KL, *et al.* Social support and social-ecological resources as mediators of lifestyle intervention effects for type 2 diabetes. *J Health Psychol* 2006;11:483–95.
- Cooper H, Booth K, Gill G. A trial of empowerment-based education in type 2 diabetes – global rather than glycaemic benefits. *Diabetes Res Clin Pract* 2008;82:165–71.

Author, year	Sample characteristics (n; mean age; % male; mean baseline HbA1c; mean y since diagnosis; population type)	Groups: (1) Control group (2) Intervention group	Duration and follow-up	Interventions	Reported outcomes	
Skelly, 2005 ¹	41; 62 years; 0%: 9.1%: 12 years; African–Americans (rural areas)	(1) Explanation and measurements (2) Symptom-focused teaching and counselling Intervention (one-on-one)	(1) 2 pre-intervention visits, 1 telephone call, 1 post-intervention visit, (mean 3h total within ~ 9 weeks) (2) 2 pre-intervention visits, 4 bi-weekly intervention visits (max 1h), 1 post-intervention visit (mean 6h total within ~ 9 weeks) Follow-up unknown, ~ 9 weeks	Control group: 2 Pre-intervention visits: study instruments administered and demographic data collected; 1 telephone call for information about participants' self-care and medication regimen; 1 final evaluation visit Intervention group: Topics: delivered by nurse-investigator. Hyper- / hypoglycaemia symptoms; numbness and tingling in the feet; foot pain; stress, anxiety, worry; musculoskeletal aches/pains; skin symptoms. Self-care strategies related to symptoms; psychosocial strategies (coping skills, stress reduction, family support, community resources); medical management (medication, SMBG); prevention Elements: home visits for patient; collaboration with nurse. Focus on personal experiences. Story-telling, mutual goal setting, shared experiences, role-playing, problem-solving (LEARNING)	Behaviour Diet * (ES nc); PA (n=13 reported); SMBG * (ES nc); foot care –; medication adherence * (ES nc) Wellbeing QoL: mental *, social * (ES nc); distress of hyper-/hypoglycaemia symptoms: self-care* (ES nc); QoL * (ES nc); distress of neurovascular symptoms: self-care; QoL –; distress of other symptoms: self-care; QoL * (ES nc)	Clinical HbA1c –; no. of patients with decrease in HbA1c * (ES nc); Process measures Knowledge * (ES nc)
Kim, 2003 ⁶	36 (16 controls; 20 intervention group); 60 years; 30% : 8.5%: 14 years; South Korean	(1) Standard care (2) Telephone calls by nurse (one-on-one)	(2) 12-week intervention period First month >2/week; 2nd & 3rd months, weekly; average 16 telephone calls (average 25 min each) Follow-up, 12 weeks	Topics: delivered by nursing PhD student, supported by registered dietitian. Diet, exercise, medication and self-monitoring Elements: Before interventions: diabetes care booklet with information about nature of the disease; risk factors; diet; exercise; drug therapy; hypo-/hyperglycaemia management; how to record a daily log Intervention: telephone calls; education and reinforcement of topics; daily log of diet and exercise; blood glucose levels >2/day; feedback and recommendations in response to daily log; medication adjustments when necessary (LEARNING + PLANNING)	Behaviour Diet* (ES 1.00); PA –; SMBG* (ES 0.76); foot care –; medication adherence –; hypoglycaemia management – Clinical HbA1c* (ES 1.25)	
Whittlemore, 2004 ¹⁴ (pilot study)	53; 58 years; 0%: 7.7%: NR; USA population (previously participants in diabetes education; cleared for exercise by primary care provider; no complications)	(1) Standard care (2) Nurse coaching intervention (one-on-one)	(2) 6 sessions over 6 months (5 in first 3 months), 2 brief phone calls between 5th and 6th sessions Follow-up, 3 and 6 months	Topics: delivered by nurse. Diabetes knowledge, barriers, adaptation to diabetes, diet, exercise, psychosocial support Elements: education reinforcement, giving support, problem-solving, goal setting, motivational guidance. Main focus on increasing relevance/applicability of new knowledge to daily circumstances and decisions (LEARNING + PLANNING)	Behaviour Diet* (ES 0.29); PA – Wellbeing Diabetes-related distress* (ES 0.78); integration* (ES 0.41); treatment satisfaction †2* (ES nc); †3* (ES nc) Clinical HbA1c –; BMI –	

Table 1. Studies included in a systematic review of multi-component self-management interventions for type 2 diabetes

Author, year	Sample characteristics (n; mean age; % male; mean baseline HbA1c; mean y since diagnosis; population type)	Groups: (1) Control group (2) Intervention group	Duration and follow-up	Interventions	Reported outcomes	
Sacco, 2009 ¹⁸	62 (31 per group); 52 years; 42%; 8.5%; 9.5 years; USA population (77% Caucasian, 14% African-American, 8% Hispanic)	(1) Standard care (2) Telephone intervention (one-on-one)	(2) Weekly phone calls for 1st 3 months; bi-weekly phone calls for 2nd 3 months (average 17.8 min each) Follow-up, 6 months	Topics: delivered by psychology undergraduate (diabetes 'coach'). Blood sugar testing, medication management, diet/nutrition, exercise/PA, foot care, stress management. When relevant, eye examinations, dental care, influenza and pneumonia vaccination Elements: phone calls: review of weekly blood glucose readings; goal setting and attainment; implementation intentions; problem-solving skills; praising effort and positive change; informational/emotional support; enhanced motivation. No medical advice given (LEARNING + PLANNING)	Behaviour Diet* (ES 0.31); PA* (ES 1.52); SMBG -; foot care* (ES 1.18); medication adherence - Wellbeing Depression symptoms* (ES -0.32)	Process measures Knowledge -; understanding -; self-efficacy* (ES 0.41); social support health care team* (ES 0.76); reinforcement for self-care* (ES 0.69); awareness of self-care goals* (ES 0.73)
Christian, 2008 ¹³	273 (132 control group, 141 intervention group); 53 years; 34%; 8.2%; NR; USA Latino/ Hispanic population, baseline BMI ≥ 25	(1) Standard care including information packet (2) Patient self management goal setting and brief physician health life style counselling (one-on-one)	(1) 1 pre-intervention visit to hand over information packet (2) 1 pre-intervention visit, study-related usual care follow-up visits at 3, 6 and 9 months Follow-up, 9 months	Topics: delivered by physicians given 3h training on patient lifestyle-change goal sheets (to provide brief motivational interviewing counselling). Dietary habits, awareness of diet and PA, barriers to improving diet and PA Elements: computer-based assessment of motivational readiness to increase PA and make dietary changes; 4-5 page computer-generated, individualized report with feedback on barriers for change to enhance readiness, decision making and self-efficacy. Goal setting by patients. Written information on DM and achieving a healthy lifestyle. Summary of computer assessment for the physician with counselling recommendations. During regular visits, patients discussed and reviewed the change goals with physician trained in motivational interviewing counselling (LEARNING + PLANNING)	Behaviour Diet -; PA* (ES nc)	Clinical HbA1c -; weight -; total cholesterol* (ES nc); LDL* (ES nc); HDL -; triglycerides -

Table 1. Studies included in a systematic review of multi-component self-management interventions for type 2 diabetes (cont.)

Author, year	Sample characteristics (n; mean age; % male; mean baseline HbA1c; mean y since diagnosis; population type)	Groups: (1) Control group (2) Intervention group	Duration and follow-up	Interventions	Reported outcomes
Clark, 2004 ^{17,27}	100; 60 years; 58%; 8.4%; NR; United Kingdom population, baseline BMI >25. Participants typically had ≥1 additional chronic illness	(1) Standard care (2) Tailored lifestyle self-management intervention (one-on-one)	(2) 3x30 min assessment and counselling session (baseline, after 12 weeks, after 24 weeks); follow-up phone calls 1, 3 and 7 weeks after first counselling (10 min each). After 52 weeks, 1x30 min assessment Follow-up, 3 and 12 months	Topics: delivered by health psychology PhD student. Lifestyle, diet, PA. Discrepancy between current lifestyle and desired goals, barriers to lifestyle change. Phone calls discussed extent to which patients had achieved their goals, and problem-solving issues Elements: lifestyle assessment, patient participation in goal setting, selecting personalised strategies to overcome barriers. Motivational strategies used to increase motivation to change. Personalised self-management programme (1 dietary and 1 PA goal). Phone calls reinforcement, problem solving, additional strategies (LEARNING + PLANNING)	Behaviour Self-care activities: diet -; PA †* (ES 0.50); †3* (ES 0.47); PA -; activity scale for elderly - Diet: Substituting †2* (ES 0.52); †3 -; Modifying fat intake †2 -; †3* (ES 0.55) Clinical HbA1c -; BMI -; waist circumference -; total serum cholesterol -; HDL -; LDL -; triglycerides - Process measures Diet: stage of change for dietary fat reduction, †2 -, †3* (ES 0.93); barriers to healthy eating -; self-efficacy -; Stage of change for PA -; barriers to PA -; self-efficacy -
Hörnsten, 2005 ³¹	104 (60 control group, 44 intervention group); 64 years; 54%; 5.8%; NR; Swedish population, diagnosed during previous 2 years	(1) Standard care (2) Person-centred intervention aimed at personal understanding (Group)	(2) Nurses: 10 2-h sessions, 1 weekend session (16 h) Patients: 10 2-h sessions over 9 months Follow-up, 12 months	Nurse sessions: not reported. Patient sessions; first author of article was moderator. Topics: Nurses: patients' personal understanding of diabetes. Patients: any concerns about diabetes (e.g. complications, foot care, blood sugar testing, stress, benefits of exercise) Elements: Nurses: informing nurses during group sessions about research on personal understanding of illness in type 2 diabetes; reflective group discussions about how to use the patient's personal understanding of illness in care planning and consultations. Patients: open group discussions (LEARNING)	Wellbeing Overall well-being -; treatment satisfaction - Clinical HbA1c* (ES 1.05); BMI -; blood pressure - Total cholesterol -; HDL-cholesterol* (ES 0.55); LDL-cholesterol -; triglycerides* (ES 0.64); symptoms -
Adolfsson, 2007 ²²	88 (46 control group, 42 intervention group); 63 years; 59%; 7.3%; 6.6 years; Swedish population	(1) Standard care (2) Empowerment group education (Group)	(2) 4-5 group sessions, 2.5h each Follow-up, 12 months	Topics: delivered to intervention group by physician or diabetes specialist nurse. General issues concerning disease, treatment, prevention of complications, blood glucose monitoring, diet, PA, daily foot care Elements: Sharing experiences, problem solving, encouraging patients to reflect upon behavioural changes, discuss facilitators for barriers to behavioural changes (LEARNING)	Wellbeing Satisfaction with daily life - Clinical HbA1c -; BMI -; Process measures Confidence in DMI knowledge* (ES mc); self-efficacy -

Table 1. Studies included in a systematic review of multi-component self-management interventions for type 2 diabetes (cont.)

Author, year	Sample characteristics (n; mean age; % male; mean baseline HbA1c; mean y since diagnosis; population type)	Groups: (1) Control group (2) Intervention group	Duration and follow-up	Interventions	Reported outcomes	
Anderson, 2005 ¹²	239 (114 control group, 125 intervention group); 61 years; 18% ; 8.6%; 8.5 years; 96% African-American population	(1) Standard care, intervention after 6 weeks (2) Problem-based empowerment programme (Group)	(2) 6 weekly 2-h sessions Follow-up, 6 weeks	Topics: delivered by a nurse and a dietitian. Clinical parameters, self-management behaviours, lifestyle, own experiences with self-management, emotional experiences, systematic problem-solving. Elements: Giving information, asking questions, group discussions, self-directed behaviour change, reflecting on self-management experiments, goal setting (LEARNING + PLANNING)	Clinical HbA1c -; weight -; systolic BP -; diastolic BP -; serum cholesterol - Process measures Perceived understanding of DM* (ES 0.78)	Empowerment - ; overall attitude about seriousness -; positive attitude about seriousness -; negative attitude about seriousness -
Steed, 2005 ¹⁸	124 (59 control group, 65 intervention group), 60 years; 71%; 8.4%; NR; United Kingdom population with microalbuminuria	(1) Standard care (2) Diabetes self-management programme (Group)	(2) 5 weekly 2.5-h sessions; 1.2.5h booster session Follow-up: 6 weeks and 3 months (18 weeks from baseline)	Topics: delivered by diabetes specialist nurses and dietitians. Self-monitoring, diet, exercise and medication, difficulties of living with diabetes. Benefits and barriers. Problem-solving techniques. Booster: difficulties of maintaining behaviour change over time Elements: Discussions of what it is and why it is important. Didactic teaching avoided. Problem-solving and goal setting. Booster: reflection on what had been learned in previous sessions. (LEARNING + PLANNING)	Behaviour General diet, t2* (ES 0.46), t3 -; specific diet, t2* (ES 0.66), t3* (ES 0.56); PA, t2* (ES 0.34); t3* (ES 0.07); SMBG t2* (ES .88); t3* (ES 0.58); smoking -; foot care - Wellbeing Generic QoL -; diabetes QoL, t2* (ES 0.65); t3* (ES 0.40); mood - Clinical HbA1c -	Process measures Knowledge, t2* (ES 0.85); t3* (ES 0.83); self-efficacy total -; self-efficacy diet -; self-efficacy SMBG t2 -; t3* (ES 0.52); self-efficacy exercise t2 -; t3* (ES 0.32); beliefs about seriousness -; beliefs about treatment effectiveness, t2* (ES 0.65); t3 -; beliefs about personal control t2 -; t3* (ES 0.40)

Table 1. Studies included in a systematic review of multi-component self-management interventions for type 2 diabetes (cont.)

Author, year	Sample characteristics (n; mean age; % male; mean baseline HbA1c; mean y since diagnosis; population type)	Groups: (1) Control group (2) Intervention group	Duration and follow-up	Interventions	Reported outcomes	
Toobert, ^{2003¹⁵} , Toobert, ^{2005²³} , Barrera, ^{2006³⁹} , Toobert, ^{2007²⁶}	279 (116 control group, 163 experimental group); 61 years; 0%; NR; NR; USA population, all post-menopausal	(1) Standard care (2) Mediterranean lifestyle programme (Group)	(2) 2.5-day retreat, then 6 months' weekly 4h meetings Follow-up, 6, 12 and 24 months	Topics: delivered by dietitian, certified exercise physiologist, professional group leaders. Diet, PA, stress management, social support Elements: Retreat: lectures, meals, recipes, instruction in/ practice of stress management, PA training, unstructured group sessions. Weekly meetings: PA, group yoga and relaxation, dinner, support sessions. (LEARNING + PLANNING + PRACTISING)	Behaviour Diet, t2* (ES 0.43 – 0.81), t3* (ES nc), t4* (ES nc). PA, t2* (ES 0.32 – 0.66), t3* (ES nc), t4* (ES nc); stress management, t2* (ES 0.33 – 0.75), t3* (ES nc), t4* (ES nc) Wellbeing QoL: regimen-related distress t2* (ES nc); interpersonal-related distress –; physical health –; mental health –; QoL overall dimensions t2* (ES 0.18); depression –; perceived and self-monitored stress – Clinical (only reported for t2); HbA1c t2* (ES 0.26)	BMI, t2* (ES 0.01); weight t2* (ES nc); waist-to-hip ratio –; BP –; Systolic BP –; diastolic BP –; cholesterol –; triglycerides –; plasma fatty acids –; flexibility – Process measures Social support; t2* (ES 0.28 – 1.18), t3* (ES nc), t4* (ES nc); self-efficacy; t2* (ES nc), t3* (ES nc), t4* (ES nc); problem-solving strategies t2* (ES nc), t3* (ES nc), t4* (ES nc)
Cooper, ^{2003a²⁰} , Cooper, ^{2008⁴⁰}	89; 58.6 years; 56% male; 7.5%; NR; United Kingdom population	(1) Standard care (2) Educational self-management intervention (Group)	(2) 8x2h weekly sessions Follow-up, 6 and 12 months	Topics: delivered by trained specialist diabetes nurses Personal experiences, nutrition, PA/ exercise, feelings about having diabetes, lifestyle changes, self-monitoring, screening, reducing complication risks, health care professionals. Elements: exercise and relaxation; training/discussing health topics about diabetes disease process. Experimental learning, skills training; goal setting, problem-based learning, empowerment (LEARNING + PLANNING + PRACTISING)	Behaviour Diet –; PA –; SMBG, t2 –; t3* (ES nc) Clinical HbA1c t2* (ES nc), t3–; BMI –	Process measures Attitude t2* (ES nc); t3* (ES nc); perceptions of self-care treatment effectiveness t2* (ES nc); t3 –; perceptions of DM seriousness –; perceptions of personal control –

Table 1. Studies included in a systematic review of multi-component self-management interventions for type 2 diabetes (cont.)

Author, year	Sample characteristics (n; mean age; % male; mean baseline HbA1c; population type)	Groups: (1) Control group (2) Intervention group	Duration and follow-up	Interventions	Reported outcomes	
Wattana C, 2007 ²⁵	147 (72 control group, 75 experimental group); 57 years; 24%; 8.0%; 6.2 years; Thai population,	(1) Standard care (2) Diabetes self-management programme (one-on-one and group)	(2) Small group diabetes education class (120 min), four small group discussions (90 min/group), two individual home visit sessions from researcher (45 min), patient education manual Follow-up, 6 months	Topics: delivered by nurse researcher. Diet, PA, foot care, proper use of medicine, monitoring for signs/symptoms of complications, meditation techniques for stress reduction Elements: Part 1: A small group diabetes education session and 4 small group discussions to promote self-efficacy in managing diabetes, addressing above-mentioned topics. Part 2: Two home visits by principal researcher. A patient education manual was developed (LEARNING)	Wellbeing Generic QoL* (ES 0.59) Clinical HbA1c* (ES 0.41)	
Gaede P, 2001 ²⁴	149 (76 control group, 73 experimental group); 55 years; 75% ; 8.6%; NR; United Kingdom population	(1) Standard care (2) Intensive multifactorial lifestyle education intervention (diet and exercise component) (one-on-one and 2 group sessions) Smoking component (group)	(2) Diet component: 6 sessions in year 1, thereafter depending on individual (>3 per year). Exercise component: part of the 6 sessions, year 1. Smoking component: 5 meetings in 8 weeks. Additional 2 sessions after 3 and 6 months Follow up, 3,8 years (mean)	Topics: diet and exercise component delivered by clinical dietitian; group sessions involved whole diabetes team. Smoking cessation programme, deliverer not stated. Individual sessions: dietary fat intake, individual risk profile, exercise and smoking. Group sessions: diet, exercise and smoking habits combined with lifestyle attitudes, beliefs and habits. Smoking cessation programme: benefits of smoking cessation, coping with temptation, nicotine substitution Elements: Education based on patients' and spouses' needs; individual goal setting for diet, exercise and . smoking cessation. Group discussions. Demonstrations of proposed changes by serving lunch and snack. Demonstration of immediate blood glucose lowering effect of moderate PA Smoking cessation programme: education and free nicotine substitution offered (LEARNING + PLANNING + PRACTISING)	Behaviour Diet: energy intake -; carbohydrate* (ES 0.41); protein* (ES 0.24); total fat* (ES 0.66); alcohol -; saturated fatty acids* (ES 0.36); monounsaturated fatty acids -; polyunsaturated fatty acids* (ES 0.54); cholesterol* (ES .29); PA -; smoking -	Clinical Weight* (ES -0.32)

* intervention effect; - no intervention effect; †summary of sub-behaviours with the range of ES of sub-behaviours per overall behaviour; ‡summary of wellbeing sub-scales with the range of ES BMI, body mass index; DM, diabetes mellitus; ES, effect size; nc, not computable; NR, not reported; PA, physical activity; QoL, quality of life; SMBG, self monitoring of blood glucose;

Table 1. Studies included in a systematic review of multi-component self-management interventions for type 2 diabetes (cont.)