The effectiveness of a proactive coping intervention targeting self-management in diabetes patients

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Accepted author version posted online: 20 Sep 2013.Published online: 11 Oct 2013.

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Objective: The study's aim was to investigate psychological, behavioral and medical long-term outcomes of an existing self-management intervention targeting the development of proactive coping skills (e.g. goal setting and identifying barriers) in type 2 diabetes patients. The study aimed to replicate prior research showing the intervention's effectiveness, and to extend it by (a) adding booster sessions and (b) prolonging the period of follow-up measurement to capture long-term effects.

Design/outcome measures: A total of 141 type 2 diabetes patients were included in the intervention. The intervention employed a 5-step approach to target proactive coping skills. Psychological (e.g. proactive coping and self-efficacy) and behavioural variables (e.g. self-care, diet and physical activity) were assessed at baseline (T1), after the initial phase of the intervention (T2), after the booster phase (T3) and at follow-up (T4), comprising a total period of 15 months. Medical variables were assessed at T1 and T4.

Results: Employing piecewise Latent Growth Curve Modelling, results showed that participants improved on all psychological and behavioural variables during the initial phase and maintained these improvements over 12 months. The booster phase yielded no further improvements. Mixed findings were obtained on medical outcomes.

Conclusion: The original intervention is effective, but the added value of the booster sessions is uncertain.

Keywords: type 2 diabetes; proactive coping; self-management intervention; LGCM; Bayes

Type 2 diabetes is a serious chronic condition with a rapidly rising prevalence over the last decades. When not cautiously regulated, diabetes can lead to severe macro- and micro-vascular complications such as cardiovascular disease, blindness and foot pathology. To control their disease, patients are often advised to incorporate self-care behaviours involving regular checking of blood glucose levels, dietary adjustments and physical activity. Research has shown that, though generally highly motivated, many

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patients do not succeed in maintaining their daily routines (e.g. Wing et al., 2001). In that light, interventions that facilitate successful maintenance of behaviour change are crucial to diabetes patients' health. In the current paper, we investigate the long-term effectiveness of a prolonged self-management intervention targeting the development of proactive coping skills (Aspinwall & Taylor, 1997).

The current theory-based intervention (Beyond Good Intentions) was initially developed by Thoolen, de Ridder, Bensing, and Rutten (2008) and focuses on the development of proactive coping skills, or 'the ability to undertake efforts in advance of a potentially stressful event to prevent it or modify its form before it occurs' (Aspinwall & Taylor, 1997). The intervention is rooted in a framework of self-regulation and proactive coping theories and emphasises an anticipatory planning and problem solving perspective. Rather than being educated about the 'right' behaviour, patients are taught by means of a comprehensive 5-step plan how to (1) set small, concrete goals; (2) identify conditions and potential barriers for goal attainment; (3) come up with problem-solving strategies to deal with obstacles; (4) formulate specific action plans and (5) evaluate their progress. The intervention was previously tested in a sample of screen-detected type 2 diabetes patients and yielded significant improvements on psychological, behavioural, as well as medical outcome variables (Thoolen, de Ridder, Bensing, Gorter, & Rutten, 2009; Thoolen et al., 2007) that lasted for a period of 9 months. Moreover, participants' evaluations of the intervention were very positive, with an average rating of 8.0 (on a 10-point scale) and 85% indicating they would recommend the programme to someone else (Thoolen et al., 2008).

The current study aimed to replicate and extend the work by Thoolen and colleagues in three ways. First, the intervention was tested in a broader sample of type 2 diabetes patients. Rather than including only screen-detected patients, the current sample consisted of patients who were recruited through general practitioners and who received their diagnosis in the past 5 years. This broader sample may differ from a screen-detected sample on several aspects. For example, screen-detected patients' motivation to change their behaviour may be boosted by the shock of receiving an unexpected diagnosis (e.g. Beeney, Bakry, & Dunn, 1996). In contrast, 'established' patients' motivation might lack a sense of urgency as they feel they have already adjusted to their condition. Thus, the first aim was to establish the effectiveness of the self-management intervention in a broader and potentially more challenging sample of type 2 diabetes patients. As the intervention's effectiveness relative to a control group was already established by Thoolen et al. (2007, 2009), we provided the initial phase of the intervention to all participants in the study. Second, we aimed to examine the long-term effects of the intervention, thereby addressing the problem of behaviour change maintenance. To that end, we prolonged the follow-up period to 12 months after the end of the intervention (i.e. 15 months in total).

The third and more prominent extension of the current study with regard to previous work involves the addition of booster sessions. Though self-management interventions (particularly group-based programmes, Deakin, McShane, Cade, & Williams, 2005) in general appear to be rather successful in terms of resulting in behavioral change (Norris, Engelgau, & Venkat Narayan, 2001), often the initial positive outcomes cannot be maintained (Rothman, 2000; Wing et al., 2001). Recognising that the maintenance of (health) behaviour change is one of the classic challenges in intervention research, scholars as well as policy makers now often recommend adding boosters to

interventions (e.g. Brown, Garcia, Kouzekanani, & Hanis, 2002; Goodall & Halford, 1991; Newman, Steed, & Mulligan, 2004; Norris, Lau, Smith, Schmid, & Engelgau, 2002). Even though participants in the Beyond Good Intentions programme were able to maintain their initial changes, they did not show further improvement after the intervention, and Thoolen et al. (2008) reported that participants themselves indicated they would have liked to receive booster sessions. Following up on this suggestion, the current study employed a prolonged intervention that included booster sessions at 1, 3 and 6 months after the end of the initial phase. Specifically, we investigated the differential effects of two different booster conditions that will be referred to as the 'how' or 'why' boosters. The 'how' booster sessions were included as a control condition and entailed reinforcement of the protocol (i.e. the 5-step plan) that participants used in the initial phase, whereas the 'why' booster sessions provided participants with an additional self-regulatory technique to facilitate goal attainment. Specifically, in the 'why' boosters, participants elaborated on their self-management goals in view of their higher-order overarching goals (e.g. 'Why are you trying to get more exercise'; cf. Freitas, Gollwitzer, & Trope, 2004) before continuing with the usual 5-step programme. Although activating positive outcomes of changing behaviour before moving on to identifying and addressing barriers (as is done in the 5-step programme) is a promising technique to bolster commitment to personal goals (Fishbach, Shah, & Kruglanski, 2004; Oettingen, Pak, & Schnetter, 2001), to the best of our knowledge, we are the first to apply it in an intervention.

Initial analyses (Kroese, Adriaanse, & de Ridder, 2012) showed that participants evaluated the booster phase as less positive than the initial phase, and more strikingly, one fifth of initial completers did not attend any of the booster sessions. Although these analyses indicated that the booster sessions did not yield any further benefits on behavioural outcome measures based on assessments immediately prior and after the booster phase, baseline and follow-up (i.e. 6 months after the booster phase) measures are yet to be investigated. In the present paper, we provide such a complete overview of the trajectories of change during the intervention's different phases, including psychological, behavioural as well as medical measures and employing more advanced data analysis techniques, as described below.

In addition to the theoretical advances, the current study departs from traditional statistical techniques to be able to fully appreciate the development of patients' self-management skills and behaviour throughout the course of the intervention. Rather than comparing mean baseline and end-scores, we tested individual trajectories of change in three phases of the intervention (i.e. initial phase, booster phase, follow-up). The current study is one of the first in the area of health psychology to employ piecewise latent growth curve modelling (piecewise LGCM; e.g. Duncan & Duncan, 2004; Li, Duncan, Duncan, & Hops, 2001). Rather than treating individual differences as error variances, LGCM takes individual trajectories into account, thereby yielding a more reliable reflection of change over time. Additionally, the piecewise approach allows for specific interpretations of patients' development through each phase of the intervention, thus suiting our research aims.

In sum, the current paper aims to establish insight into the development of self-management skills during the initial phase, a newly developed booster phase and an extended follow up period, comprising 15 months in total. We contribute to the literature in several important ways, including (a) the replication of an effective

intervention in a different sample of diabetes patients, (b) the addition of booster sessions and (c) the use of advanced statistical techniques that allow reliable and precise estimation of intervention effects.

Method

Participants

Participants were recruited through general practitioners. A total of 160 patients participated in the study, of whom 129 returned baseline (T1) questionnaires. Participants who did not complete baseline questionnaires but who did return at least two questionnaires at later assessment points were retained in the analyses, although it is noted that no demographics (which were assessed at baseline) are available of this group ($N = 13$). Participants who completed only the baseline questionnaire were included in the analyses, but participants who completed only one questionnaire which was not the baseline ($N = 4$) were left out. Fourteen participants returned none of the questionnaires. These together with data from one participant who reported to have failed to attend any of the group sessions were also disregarded in the analyses. Hence, the current sample consisted of 141 participants of whom 128 provided data at baseline, 98 at T2 (after the initial phase), 80 at T3 (after the booster phase) and 93 at T4 (follow-up). Furthermore, medical measures were obtained at T1 ($N = 116$) and T4 ($N = 81$).

Sex was distributed evenly with 52.3% male participants, and on average, participants were 60.4 years of age (SD = 8.6; range 39–74). Over one-third of the sample (37.5 %) had completed no or only lower education (i.e. lower vocational education or less), 38.3% completed medium-level education (high school or medium-level vocational education), and 24.2% were highly educated (college/university degree). A majority of 94.5% was born in the Netherlands. With regard to the medical background, the average Body Mass Index (BMI) was 31.2 kg/m^2 (SD = 5.7), and the mean level of Hba1c at baseline was 49.1 mmol/l (SD = 8.3), reflecting plasma glucose levels that indicate diabetes (WHO, 2011).

Procedure

The initial phase (3 months) of the intervention comprised one individual and four group sessions (6–8 participants) that took place once every two weeks and were lead by instructed trainers. The booster phase (6 months) consisted of three group sessions at 1, 3 and 6 months after the end of the initial phase. Prior to the booster phase, participants were randomly assigned to 'how' and 'why' groups. A description of the Beyond Good Intentions programme as well as the booster sessions is provided below. The protocol for each group session was standardised and written out in a trainer's manual. Prior to the start of the intervention two meetings with trainers were organised in which trainers received detailed information about the five-step plan and session procedures. It was explicitly stated that trainers should adhere to the protocol, and a researcher was present least one group session per trainer to ensure such adherence. Baseline assessments of behavioural and psychological measures as well as demographics were taken at T1, prior to the first group session. Behavioural and psychological measures were assessed again after the initial phase of the intervention (i.e. 3 months after baseline; T2), after the booster phase (i.e. 9 months after baseline; T3), and at

follow-up (i.e. 15 months after baseline; T4). The study was approved by the Medical Ethical Committee of the University Medical Centre Utrecht, and all participants signed informed consents.

Beyond good intentions

The Beyond Good Intentions programme (Thoolen et al., 2008) is a proactive coping-based self-management intervention. The programme revolves around a comprehensive 5-step approach that teaches patients to (1) set small, attainable goals; (2) recognise conditions and barriers for goal achievement; (3) find problem solving strategies for specific challenging situations; (4) formulate action plans and (5) evaluate progress. Each of the four group sessions focused on one theme relevant for successful diabetes care: eating behaviour, physical activity, medical regimes and a topic of patients' own choice (related to one of the previous three domains). In between group sessions, patients were provided with homework assignments related to the 5-step approach (e.g. keeping track of goal progress using food or exercise diaries).

Booster phase

In the booster phase, three group sessions were added to the original intervention. Participants were split into two conditions, which entailed reinforcement of the focus on small, attainable goals (i.e. a control condition repeating the protocol from the initial phase, referred to as the 'how'-condition), that was augmented with an additional technique that challenged patients to focus on their higher order goals in the 'why' condition. To illustrate, in the why-condition participants were asked to elaborate on one of their personal goals by repeatedly answering why-questions. For example, a goal could be to 'exercise twice a week', and participants would consecutively elaborate on why they want to exercise twice a week (e.g. 'to stay fit'), why they want to stay fit (e.g. 'to be able to do things with my grandchildren'), and why they want to be able to do things with their grandchildren (e.g. 'it makes me happy'; cf. Freitas et al., 2004). In the how-condition, participants followed the five-step approach as described above, which focused on detailed plans on how a goal would be achieved.

Measures

Psychological measures

Proactive coping

Proactive coping skills were measured with the Utrecht Proactive Coping Competences questionnaire (Bode, Thoolen, & de Ridder, 2008), which consists of 21 items (e.g. 'I am capable of coming up with alternatives when a solution doesnot work'; Cronbach's $\alpha = .93$ at T1) that could be answered on a scale from 1 (*not at all*) to 4 (*very capable*).

Self-efficacy

To assess self-efficacy, an adapted version of a questionnaire developed by Lorig et al. (1989) was used (cf. Thoolen et al., 2009). The scale consisted of 12 items and

assessed self-efficacy in performing a range of specific self-care behaviours (Cronbach's α = .84 at T1). Each item was phrased as 'How confident are you that you can ... [e.g. adhere to your doctor's dietary advice]' and could be answered on a scale from 1 (*not at all confident*) to 7 (*totally confident*).

Behavioural measures

Diabetes self-care

Diabetes self-care behaviour was assessed with the revised summary of the Diabetes Self-Care Activities measure (DSCA; Toobert, Hampson, & Glasgow, 2000). The scale consists of 10 items assessing diet, exercise, bloodglucose testing, and footcare (Cronbach's α = .65 at T1). Participants were asked to indicate for each domain 'Over the last 7 days, how often did you ...' resulting in a mean score of 0–7.

Medication adherence

The Medication Adherence Report Scale (MARS; Horne & Weinman, 1999) was used to assess the degree to which patients take their medication as prescribed (i.e. changing doses, stopping or forgetting to take medication). The scale consists of 5 items with scores ranging from 1 (*always true*) to 5 (*never true*), with higher scores indicating better adherence (Cronbach's α = .83 at T1). The questionnaire is widely used in intervention studies among patients with chronic diseases and was also employed in prior research testing the Beyond Good Intentions intervention (Thoolen et al., 2009).

Lifestyle adherence

An adaptation of the MARS (Theunissen, de Ridder, Bensing, & Rutten, 2003) was included to assess adherence to lifestyle recommendations (e.g. 'I forget to adhere to the lifestyle guidelines provided by my general practitioner'). The scale consists of 5 items with scores ranging from 1 (*always true*) to 5 (*never true*), such that higher scores indicate better adherence (Cronbach's α = .92 at T1).

Physical activity

Physical activity was assessed using the Physical Activity Scale for the Elderly (Schuit, Schouten, Westerterp, & Saris, 1997), which incorporates not only exercise but also occupational, leisure and household activities. The scale consists of 15 items and the time spent on each activity is translated into a composite score between 0 and 800 reflecting the total energy expenditure. It is noted that the measure is not restricted to elderly people, but more generally offers an assessment of a wide range of activities, including lighter activity domains that tend to be neglected in typical physical activity measures. As such, the scale is useful for getting a more complete and accurate view on physical activity and particularly appropriate to use in patients with chronic diseases.

Dietary habits

To assess dietary habits, the Kristal food habits questionnaire (Kristal, Shattuck, & Henry, 1990) was used. The 20-item scale assesses how often patients employ specific activities to reduce fat intake, including, for example, the replacement of high-fat foods and modifying meat preparation (e.g. 'When you eat chicken, how often has it been fried'; Cronbach's α = .67 at T1).

Medical outcomes

A number of medical variables were assessed by registered nurses at baseline (T1) and at follow-up (T4). From blood measures, Hba1c, triglyceride and cholesterol (HDL and LDL) were determined. *Hba1c* reflects average blood sugar levels over the past 6 weeks and is an important indicator of diabetes control.[1] Normal values should be below 48 mmol/mol. *Triglycerides*, together with cholesterol, are indicative of fat storage in the body and are often elevated in diabetes patients (American Diabetes Association, 2012). Typically, guidelines recommend to keep triglyceride levels below 1.7 mmol/l. *HDL*, then, is known as the 'good cholesterol' and should be higher than 1.0 mmol/l, whereas *LDL* is the 'bad cholesterol' which is recommended to be kept below 2.6 mmol/l (American Diabetes Association, 2012). Finally, *blood pressure* was measured, and BMI was computed by measuring patients' weight and height (BMI = weight/height^2).

Analyses

Psychological and behavioural outcomes variables were analysed using piecewise LGCM. Importantly, rather than testing mean changes over time such as done by traditional techniques (e.g. repeated measures MANOVA), LGCM allows for the analysis of individual trajectories of change. Being relieved of a number of limitations that traditional statistical techniques are facing (e.g. Curran & Muthen, 1999), LGCM has greater power to find intervention effects. For example, for a repeated measures MANOVA, the assumption is made that all covariances are equal, which is unlikely when the time intervals between different data points vary. Moreover, an important advantage of LGCM over the 'traditional' analyses of variance is that, rather than suffering from a loss of data points due to listwise deletion procedures which is a problem especially when analysing interventions with high drop-out rates, LGCM allows for all available data to be incorporated in the model. For the current study, we applied piecewise LGCM in MPlus (Muthén & Muthén, 1998–2010) to analyse the trajectories of change during the three phases of the intervention: the initial phase, the booster phase and the follow-up period. Hence, the intercept refers to the overall starting point before the intervention, the first slope parameter refers to the initial phase (denoted by β_1), the second slope parameter refers to the booster phase (denoted by β_2) and the third slope parameter refers to the follow-up phase (denoted by β_3). As participants were assigned to the how- and why-conditions only in the booster phase, the intercept as well as the slope during the initial phase were constrained to be equal for the two conditions, whereas the other two slopes were estimated for each condition separately.

Because maximum likelihood with robust standard errors and chi-square (MLR) estimators yielded negative variances, in the final analyses Bayesian estimators were applied (Lynch, 2007; Gelman, Carlin, Stern, & Rubin, 2004). Accordingly, significance levels were determined based on central credibility intervals (C.C.I.), which are the Bayesian equivalent of confidence intervals and reflect a 90% probability that a certain parameter lies in between two boundaries. When zero is not included in the central credibility interval, it can be said that the parameter (i.e. the slope) is significantly different from zero. Group differences are demonstrated when the C.C.I.'s for the two groups do not show overlap. As an indicator of model fit, we report the posterior predictive *p*-value (*PPP*), which is the Bayesian equivalent of classic fit indices such as TLI, CFI, or RMSEA. PPP-values around .50 indicate a well-fitting model (Gelman et al., 2004). In MPlus, the default settings of the Bayesian Estimator were used with regard to prior specifications, burn-in and convergence criteria (Muthén & Asparouhouv, in press).

As for the medical outcome measures, only two data points were available (T1 and T4), only one slope was computed in MPlus. Again, the intercept was constrained to be equal for the two conditions, whereas the slope was estimated separately for the how- and the why-condition.

Results

Primary outcomes: psychological variables

As can be seen in Table 1, for the initial phase, the data revealed significant positive slopes of proactive coping ($\beta_1 = .23$) and self-efficacy ($\beta_1 = .28$). This indicates that, overall, participants improved on these measures during this period. The slopes of the booster phase as well as the follow-up phase did not reach significance, showing that participants improved nor regressed during these periods. Correlations between proactive coping and self-efficacy ranged from .58 to .70 (*p*'s < .001) at the different time points.

Table 1. Standardised parameter estimates of growth curve predictions of psychological outcome variables.

Variables	How		Why		PPP
	Parameter estimate	90% C.C.I.	Parameter estimate	90% C.C.I.	
Proactive coping					.49
Intercept	6.18[*]	5.24; 7.56			
Slope initial	.23[*]	.01; .50			
Slope booster	.06	−.26; .41	.19	−.09; .50	
Slope follow-up	−.20	−.67; .20	−.10	−.48; .31	
Self-efficacy					.24
Intercept	7.31[*]	6.21; 9.20			
Slope initial	.28[*]	.04; .59			
Slope booster	−.17	−.55; .21	−.10	−.47; .24	
Slope follow-up	−.35	−.88; .03	−.21	−.59; .15	

Notes: [*]Denotes significance based on credibility interval.
PPP = posterior predictive *p*-value.

Table 2. Standardised parameter estimates of growth curve predictions of behavioural outcome variables.

Variables	How		Why		PPP
	Parameter estimate	90% C.C.I.	Parameter estimate	90% C.C.I.	
DSCA					.49
Intercept	3.50[*]	2.98; 4.30			
Slope initial	.87[*]	.56; 1.89			
Slope booster	−.14	−.60; .41	−.43	−1.04; .01	
Slope follow-up	−.08	−.59; .36	.03	−.39; .41	
Lifestyle adherence					.45
Intercept	4.17[*]	3.47; 5.22			
Slope initial	.46[*]	.24; .76			
Slope booster	−.37[*]	−.70; −.07	−.05	−.36; .25	
Slope follow-up	.09	−.30; .54	−.11	−.65; .43	
Medication adher.					.21
Intercept	7.21[*]	6.36; 8.13			
Slope initial	.34[*]	.14; .53			
Slope booster	−.43[*]	−.81; −.09	.08	−.22; .49	
Slope follow-up	.46[*]	.08; .85	.06	−.28; .32	
Food habits					.37
Intercept	7.78[*]	6.69; 9.56			
Slope initial	.74[*]	.48; 1.21			
Slope booster	−.24	−.76; .23	−.57[*]	−1.39; −.16	
Slope follow-up	−.15	−.61; .24	−.15	−.56; .20	
Physical activity					.54
Intercept	2.02[*]	1.69; 2.44			
Slope initial	.74[*]	.44; 1.30			
Slope booster	−.18	−.50; .11	.01	−.25; .28	
Slope follow-up	.11	−.26; .53	.06	−.29; .47	

Notes: [*]Denotes significance based on credibility intervals.
PPP = posterior predictive *p*-value.

Secondary outcomes: behavioural variables

Diabetes self-care

The development of diabetes self-care revealed a positive slope during the initial phase (β_1 = .87), and scores remained stable during the booster phase and follow-up (see Table 2).

Lifestyle and medication adherence

For both lifestyle and medication adherence, a positive slope during the initial phase was observed (β_1 = .46 and β_1 = .34, respectively). Participants in the how-condition showed regression during the booster phase (β_2 = −.37 and β_2 = −.43), but this was not found for participants in the why-condition. On medication adherence, patients in the how-condition recovered during the follow-up phase (β_3 = .46), but this was not found for lifestyle adherence. For the why-condition, no significant slopes during the follow-up phase were found for either measure, indicating stability. Interestingly, for both measures, negative correlations were found between the intercepts and slopes during the

initial phase ($r = -.68$ and $r = -.70$, respectively), suggesting that higher baseline scores on lifestyle or medication adherence were related to slower development on these measures during the initial phase of the intervention.

Food habits and physical activity

For both food habits and physical activity, again a positive slope was found for the initial phase ($\beta_1 = .74$ for both measures). On food habits, participants in the why-condition regressed during the booster phase ($\beta_2 = -.57$), whereas those in the how-condition remained stable. Neither improvement nor regression was observed during the follow-up phase. On physical activity, after the initial improvement both conditions remained stable during booster and follow-up.

Tertiary outcomes: medical measures

The analyses revealed a significant increase in HDL, and a significant decrease in LDL, reflecting a more favourable balance between 'good' and 'bad' cholesterol levels. Furthermore, participants in the why-condition showed lower systolic and diastolic blood pressure, but this effect did not reach significance in the how-condition. No effect was found on triglyceride levels or BMI. Furthermore, in the how-condition, a significant rise in Hba1c levels was observed, indicating poorer glucose control (Table 3).

Importantly – although for some (psychological, behavioural, as well as medical) outcome variables in particular phases the slope for one condition did reach significance whereas the slope for the other condition did not – the credibility intervals for the how- and why-condition had considerable overlap for all slopes (the only exception being for systolic blood pressure). Therefore, we cannot conclude that the two conditions significantly differed from each other in terms of their development during the intervention.

Missing data

As the current study suffered from missing data (e.g. 128 valid cases at T1, and 84 valid cases at T4), it was checked whether missing data could have biased the results. First, participants with and without missing data assessments were compared on base-

Table 3. Means (SD) and standardised slopes (90% credibility intervals) for medical outcomes assessed at T1 (baseline) and T4 (follow-up).

	M (SD) T1	*M* (SD) T4	Slope how	Slope why	PPP
Hba1c	49.5 (8.5)	52.1 (10.7)	.65 (.18; 1.18)[*]	.37 (−.05; .75)	.39
HDL	1.05 (.34)	1.23 (.35)	1.35 (.72; 1.83)[*]	1.67 (1.03; 2.83)[*]	.42
LDL	2.72 (1.26)	2.41 (.90)	−.56 (−1.05;−.08)[*]	−.60 (−1.04; −.21)[*]	.09
Triglycerides	1.75 (.98)	1.74 (.82)	.30 (−.14; 1.14)	−.24 (−.78; .23)	.19
BMI	31.33 (5.80)	31.13 (5.71)	.02 (−.84; .61)	−.28 (−.99; .14)	.39
Systolic bp	148 (18)	142 (15)	−.04 (−.35; .28)	−.72 (−1.17; −.42)[*]	.67
Diastolic bp	88 (10)	85 (9)	−.07 (−.68; .89)	−.97 (−2.45; −.40)[*]	.57

Notes: [*]Denotes significant slope based on credibility interval.
PPP = posterior predictive *p*-value.

line psychological and behavioural variables, relevant demographics (sex, age and education), and medical starting points (BMI and Hba1c assessed at baseline). No significant differences between these groups of participants emerged (p's > .09 with the exception of medical adherence, $p = .054$), suggesting that the statistical conclusions are unlikely to be biased due to missing values. In addition, the LGCMs for two variables (proactive coping and diabetes self-care) were re-analysed with multiple imputed datasets constructed with MICE software (Van Buuren, 2012; Van Buuren & Groothuis-Oudskoorn, 2011). Running the analyses for five imputed datasets revealed that, especially at the later time points (i.e. follow-up slopes), the variability in parameter estimates increased. Hence, as also reflected in the credibility intervals in Tables 1 and 2, it should be noted that the later slope parameters suffer from greater uncertainty, due to the missing values. Importantly, though, although some numerical differences in parameter estimates could be observed, the overall conclusions of our analyses did not change: the intervention had positive effects in the initial phase, and participants tended to remain stable during the booster phase and follow-up.

General discussion

The main aim of the current study was to investigate the development of psychological, behavioural as well as medical variables during the course of a self-management intervention targeting type 2 diabetes patients. In terms of psychological and behavioural outcomes, during the initial phase a positive effect was found on all variables, showing that patients on average improved on psychological (i.e. self-efficacy, proactive coping) as well as behavioural self-care measures. During the booster phase, patients tended to remain stable, although on some measures a slight relapse was observed. No clear differential patterns were distinguished between the how- and why booster sessions in this regard. Finally, patients remained stable in the follow-up phase, showing neither relapse nor further improvement.

In line with previous findings (Thoolen et al., 2007; 2009), results indicate that the intervention is effective, yielding improvements during the initial phase that were generally maintained for a period of more than a year. This suggests that the intervention's focus on the development of proactive coping skills is a promising approach to successful initiation and maintenance of diabetes patients' self-care behaviour. It should be noted, though, that the maintenance of patients' improvements in terms of psychological and behavioural measures may not be necessarily due to the addition of booster sessions; prior research showed similar maintenance effects up to 9 months after the initial phase without booster sessions (Thoolen et al., 2007). The finding that the booster sessions did not yield further improvements contradicts the widespread belief that booster sessions should be implemented to render additional benefits (e.g. Newman et al., 2004; Norris et al., 2002). Together with the fact that drop-out during the booster phase was high and patients' evaluations were not positive (Kroese et al., 2012), these findings suggest that the added value of the booster sessions is questionable.

As we found no clear differential patterns between the how- and why-condition in the booster phase, the current study suggests that introducing new techniques in the booster sessions is not more favourable than continuing the regular programme. However, before dismissing the theory-based idea that focusing on the 'why' of personal

goals may have positive outcomes in interventions, we would recommend that this approach receives further attention in future research.

Even though the booster sessions did not yield further improvements, the fact that participants generally did not show regression over the course of the 12-month period after the initial phase is, however, quite notable. While maintenance is generally problematic in intervention studies targeting behaviour change (Newman et al., 2004; Rothman, 2000), our results showed that improvements gained during the initial phase remained mostly stable. Speculating on the factors that fostered the stability of the outcomes, we suggest that focusing on the development of self-regulatory skills, rather than providing behavioural guidelines, may have facilitated the maintenance of behaviour change. The current intervention focused on the acquisition of proactive coping skills (i.e. goal setting, dealing with obstacles, evaluating progress) which – through their frequent and repeated use – are likely to contribute to the development of adaptive habits. When habits are indeed established, the wanted behaviour becomes largely automatic and thus requires little effort to maintain (Rothman, Sheeran, & Wood, 2009). Moreover, once-learned skills provide people with the opportunity to apply the techniques to a wide variety of behaviours that they want to change, fostering patient autonomy and empowerment. In line with this suggestion, the Standards of Medical Care, published yearly by the American Diabetes Association (2012), noted that the 'current best practice for Diabetes Self-Management Education is a skills-based approach that focuses on helping those with diabetes making informed self-management choices' (page S25). Hence, the current study underscores the importance of employing theory-based interventions (see also Michie, Fixsen, Grimshaw, & Eccles, 2009) and teaching skills rather than providing patients with mere behavioural guidelines.

Besides positive outcomes on psychological and behavioural measures, our study also revealed significant effects on blood pressure and cholesterol at follow-up. The improvements on cholesterol (both on lowering LDL and elevating HDL) are noteworthy, as it has recently been suggested that lowering LDL is the primary lipid target (American Diabetes Association, 2012). However, our other findings were mixed: On triglycerides and BMI, we did not find any improvements over the course of the intervention and, in fact, patients in the how-condition showed even slightly worsened Hba1c levels at follow-up compared to baseline. The fact that we were only able to assess medical variables at baseline and at follow-up and, more importantly, that medical outcomes are for a large part determined by medication, limits the interpretation of these findings in relation to the current intervention. However, noting that prior research did report successful results on medical outcomes (Thoolen et al., 2009), we are unsure why this was not replicated in the current study. Possible explanations may be found in different sample characteristics or in the fact that medical variables in the current sample were not that bad to begin with, implying the possibility of ceiling effects. Future research is needed to further investigate the intervention's potential to yield improvements in terms of medical outcomes.

Our study is one of the first in the area of health psychology to employ piecewise LGCM to evaluate the development of patients during an intervention (but see also Vinkers, Adriaanse, Kroese & de Ridder, 2013). Whereas LGCM has started to find its way into the developmental psychology literature, papers reporting intervention studies in health psychology seem to lag behind in this regard. An important advantage of the method is that individual trajectories are taken into account, thereby creating larger

power to find intervention effects. It is important to obtain the most accurate effects to reliably assess an intervention's potential for implementation outside research settings, and therefore statistical techniques that allow for such improvements are of great value. With this paper, we hope to contribute to the dissemination and stimulation of advanced statistical methods within applied research settings.

In spite of the merits of this paper, some limitations of our study should also be noted. First of all, our study suffered from patient dropout, which is a common problem in intervention studies (e.g. Vinkers, Adriaanse, & de Ridder, 2013). Next to the fact that, despite repeated reminders, a large number of participants failed to return their questionnaires at each measurement point, those that were retained in the study did not necessarily attend all group sessions (see also Kroese et al., 2012). Importantly, though, we found that having missing data were not predicted by any patient characteristics, thereby suggesting that our results are unlikely to be biased due to the dropout of patients. It should nonetheless be noted that a re-analysis of our data using imputed datasets showed that the presence of missing data introduced uncertainty in the results for the later time points, which should accordingly be regarded with caution. On a related note – as attendance is a prerequisite but not a guarantee for receiving the treatment as planned – it is important for future research to systematically evaluate both patients' as well as providers' adherence to the intervention protocol to ensure fidelity of delivery (see e.g. Hardeman et al., 2008).

Second, the initial phase of our study did not include a control condition. A previous randomised controlled trial of the current intervention showed that participants in the control condition did not change on any of the variables, indicating that the improvements found in the experimental condition were indeed due to the intervention rather than reflecting mere measurement effects (Thoolen et al., 2007, 2009). Hence, based on ethical considerations, we chose to refrain from recruiting an additional group of patients that would only be burdened with filling out questionnaires. However – although the main purpose of the current paper was to assess patients' development over time during the intervention, rather than comparing start and end points – the interpretation of the intervention's effectiveness in terms of its final outcomes should be considered with caution as we cannot say what the outcomes would be for a control group that received no intervention.

In addition to addressing the drop-out issue, for example, by making the intervention attractive to a wider audience, we foresee two other important directions for future research. First, a natural question that follows from the theoretical underpinnings of interventions based on proactive coping skills is in what way the improvements on psychological and behavioural measures are interrelated. That is, theoretically, it would be inferred that changes are first established on psychological factors, with behavioural effects following as a consequence of the former. Cross-lagged models including multiple measurement points of each factor could provide insights into the relations between different variables and their development.

A second direction for future research would be to apply the current intervention to different populations, especially those that may not be particularly skilled in terms of proactive coping. For example, in the current intervention, it was found that, at baseline, obese diabetes patients reported to have lower proactive coping skills compared with non-obese patients. Importantly, however, both groups showed equal and significant improvements over the course of the intervention (Kroese, Adriaanse,

& de Ridder, 2013). Given the promising findings thus far, it seems worthwhile to continue the investigation of the effectiveness of self-management interventions in different target groups.

Altogether, notwithstanding the limitations outlined above, the current paper provides a relevant addition to the health psychology literature in two ways. First, we showed the long-term effectiveness of a theory-based intervention focusing on proactive coping skills in type 2 diabetes patients. Although the booster sessions did not yield further improvements, the 15-month stability of our findings is notable. Second, we applied a novel statistical technique to the analysis of the intervention effects, allowing for more accurate interpretations of patients' development over time. We conclude that a focus on proactive coping skills comprises a promising approach to improving self-management behaviour among type 2 diabetes patients, which deserves continued attention in the coming years.

Funding

Note

1. Blood glucose levels were also assessed, but based on reports from the medical lab indicating that not all patients had in fact abstained from eating prior to the blood withdrawals, we were not convinced of the reliability of these data. Therefore, we only considered Hba1c levels, which reflect blood glucose levels over a period of six weeks and in that way constitute a more accurate measure of patients' average blood sugar control.

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