Coping With Type 1 Diabetes Through Emerging Adulthood: Longitudinal Associations with Perceived Control and Haemoglobin A1c

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Abstract

Objective. This study investigated how perceived control, coping, and glycaemic control predicted one another over time in emerging adults with type 1 diabetes.

Design and main outcome measures. Emerging adults with type 1 diabetes (18-30 years old) participated in a two-wave longitudinal study spanning five years (*N*=164 at Time 1). On both time points, patients completed questionnaires on perceived control and illness-specific coping (i.e., diabetes integration, avoidant coping, and passive resignation). HbA_{1c} values were obtained from treating clinicians. We investigated the directionality of effects using cross-lagged path analysis.

Results. Higher HbA_{1c} values predicted relative decreases in diabetes integration and increases in avoidant coping five years later. Furthermore, feeling less in control over diabetes predicted the use of passive coping over time. Passive coping, in turn, predicted a relative decrease in perceived control five years later.

Conclusion. These findings indicate that tackling poor glycaemic control is not only important to avoid future medical complications but also to prevent patients from resorting to more avoidant ways of coping. Furthermore, our findings suggest that prevention and intervention efforts should include both cognitive and behavioural components, as the negative effects of low control and passive coping were found to reinforce each other over time.

Emerging adulthood; Type 1 diabetes; Coping; Perceived control; HbA1c; Longitudinal.

Type 1 diabetes is a chronic medical condition affecting about 10 in 100,000 individuals under the age of 40 every year (Weets et al., 2002). Emerging adults with type 1 diabetes are typically seen as a high-risk group in terms of physical and psychosocial functioning (Peters & Laffel, 2011). During emerging adulthood, patients are expected to take increasing responsibility for their diabetes care, which requires a complex regimen of diet, exercise, blood glucose monitoring, and daily insulin administrations (Schneider et al., 2007). However, patients also have to deal with a variety of developmental challenges, such as leaving the parental home and searching for a job (Arnett, 2000). These challenges may interfere or even detract patients from a focused commitment to diabetes care (Weissberg-Benchel, Wolpert, & Anderson, 2007). As a result, many patients experience difficulties in achieving optimal glycaemic control (Bryden et al., 2003), putting them at risk for future medical complications such as retinopathy, renal failure, and cardiovascular problems (Centers for Disease Control and Prevention, 2005). Hence, an important task for researchers and clinicians is to gain a deeper understanding of the factors that influence patients' levels of glycaemic control and to identify appropriate targets for prevention and intervention programs. In the present study, we examined the role of patients' coping strategies and feelings of control, using a long-term prospective design.

Coping strategies refer to typical, habitual ways of approaching problems, stressors, and challenges (Carver, Scheier, & Weintraub 1989). Several authors have stressed that coping strategies depend heavily on particular situational characteristics (Seiffge-Krenke, Aunola, & Nurmi 2009). Hence, the present study focuses on illness-specific coping strategies, that is, the strategies typically used by patients when confronted with stressors related to diabetes and diabetes care. Previous research has highlighted the competence that young people with type 1 diabetes display in coping with their illness (Seiffge-Krenke, 2001). An interesting concept in this context is diabetes resilience which can provide insights about why and how certain patients do well in terms of diabetes care, control, and psychosocial adjustment, whereas others tend to struggle (Hilliard, Harris, & Weissberg-Benchel 2012). Two optimal coping strategies that have been identified in prior research are tackling spirit (i.e., taking on an active role in managing one's illness with an optimistic attitude) and diabetes integration (i.e., accepting and integrating diabetes as part of the self) (Keers et al., 2006; Welch, 1994). However, some patients do not actively cope with diabetes, but tend to use avoidant coping strategies (i.e., distracting oneself and directing one's attention away from the important responsibilities of diabetes care) or passive resignation (i.e., giving in and perceiving oneself as helpless in dealing with the many challenges diabetes poses) (Keers et al., 2006; Welch, 1994). Avoidant and passive coping strategies have been linked to lower self-esteem, poorer glycaemic control, and higher depressive symptoms and diabetes-specific distress, whereas the reverse has been found for tackling spirit and diabetes integration (Luyckx, Vanhalst, Seiffge-Krenke, & Weets, 2010).

Over the past decade, a growing body of evidence has pointed to the importance of perceived control in dealing with normative and illness-related challenges. The concept of perceived control refers to individuals' beliefs about their capability to exert influence over their life circumstances (Infurna, Ram, & Gerstorf, 2013). In community samples, mean levels and rates of change in perceived control have even been found to predict all-cause mortality 19 years later (Infurna et al., 2013). Conceptual frameworks have suggested that perceived control facilitates health through a variety of mechanisms, including emotion regulation, engagement in health-promoting behaviours, and social support (Lang & Heckhausen, 2001). In individuals with chronic illnesses such as type 1 diabetes, perceived self-efficacy to cope with the consequences of the illness has been shown to be essential for daily self-care (Bean, Cundy, & Petrie, 2007; Johnston-Brooks, Lewis, & Garg, 2002). Patients who believe that diabetes is mainly determined by factors beyond their control may be less motivated for performing self-care activities and may lack clear and concrete goals for diabetes care, resulting in the higher use of avoidant and passive ways of coping (Hagger &

Orbell, 2003) and poorer glycaemic control (Mc Sharry, Moss-Morris, & Kendrick, 2011). Conversely, patients with stronger feelings of control tend to be more confident in their ability to manage their diabetes and to make more healthy lifestyle choices (Celano, Beale, Moore, Wexler, & Huffman, 2013). A recent meta-analysis has shown that targeting feelings of control in individuals with type 2 diabetes – by providing education about diabetes and its consequences and by encouraging patients to develop specific self-management plans and goals – led to improvements in self-efficacy and self-management skills six months later, and in glycaemic control and diabetes knowledge two years later (Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012). In sum, prior studies have demonstrated important links among perceived control, coping, and glycaemic control in individuals with type 1 and type 2 diabetes. However, longitudinal research investigating the directionality of effects is largely lacking. If specific temporal sequences can be identified, they could potentially inform prevention and intervention efforts aimed at improving patients' health outcomes.

The present study

The present study had two main objectives. First, we aimed to investigate how perceived control and coping were related to glycaemic control five years later. Although it is typically assumed that low perceived control and the use of dysfunctional coping strategies may put patients at risk for poor glycaemic control, evidence for the reverse pathway has also been found. In a recent study in adolescents with type 1 diabetes, reciprocal associations between coping and glycaemic control were uncovered (Luyckx, Seiffge-Krenke, & Hampson, 2010). More specifically, active coping was found to predict better glycaemic control one year later which, in turn, predicted a further increase in active coping over time. Furthermore, poor glycaemic control was found to predict a relative increase in avoidant coping one year later. Hence, we hypothesized that the use of dysfunctional coping strategies would not only lead to a worsening of glycaemic control over time. Poor glycaemic control was also expected to predict a relative decrease in diabetes integration and increase in avoidant coping and passive resignation, thereby constituting a negative vicious cycle. No specific hypotheses were put forward with regard to the prospective association between perceived control and glycaemic control, given the lack of previous longitudinal research.

Second, we aimed to investigate how perceived control and coping were interrelated over a period of five years. Many studies have reported cross-sectional associations between perceived control and coping in individuals with chronic conditions. Lower levels of control have typically been associated with the higher use of avoidant and passive coping strategies, lower use of active, problem-focused coping strategies, and less illness integration or acceptance (Hagger & Orbell, 2003; Lawson, Bundy, Belcher, & Harvey, 2010; Luyckx, Vanhalst, et al., 2010; Searle, Norman, Thompson, & Vedhara, 2007). Although it is typically assumed that these coping strategies are shaped by patients' perceptions of control (Leventhal, Nerenz, & Steele, 1984), the relationship between perceived control and coping might be more dynamic in nature. We hypothesized that patients' perceptions of control would not only shape their coping behaviours; the success of these coping behaviours in attaining desired outcomes was also expected to impact patients' levels of control. Unfortunately, longitudinal research addressing this issue in individuals with diabetes is lacking, leaving important developmental questions unanswered.

Methods

Participants and Procedure

Between January 1, 1989 and December 31, 2006, the Belgian Diabetes Registry prospectively registered 5,559 individuals with type 1 and type 2 diabetes, being a representative group of Belgian patients under the age of 40 in terms of demographic and clinical criteria (1). In 2007, a total of 1,111 individuals fulfilled the following criteria: 1) Dutch-speaking, 2) diagnosed with type 1 diabetes, 3) 18 to 30 years old, and 4) the availability of contact details. A random subsample of 500 individuals was invited to participate. After a couple of weeks, all individuals that were originally invited but did not yet respond, were sent a reminder. Five years later, in 2012, patients who participated in 2007 were contacted for follow-up (with, again, reminders being sent out after a couple of weeks). At both points in time, treating physicians were contacted to obtain HbA_{1c} values from patients' medical records. This study was approved by the Institutional Review Board at the KU Leuven and all participants signed an informed consent form. All participants who returned their completed questionnaire were given a movie ticket.

At Time 1, a total of 197 (39%) patients returned the completed questionnaires. For 164 (83%) patients, haemoglobin A1c (HbA_{1c}) values were available. In the present study, we only included those 164 patients of whom we had questionnaire data as well as HbA_{1c} values at Time 1. Demographic and clinical information on these participants is provided in Table 1. At Time 2, five years later, questionnaire data and HbA_{1c} values were available for 94 (57%) and 105 (64%) patients, respectively. No differences were observed between participants with and without complete data at Time 2 on sex [$\chi^2(1) = 1.46$, $p = .227$], age [$F(1,162) = 0.58$, $p = .447$, $\eta^2 = .00$], illness duration [$F(1,161) = 2.57$, $p = .111$; $\eta^2 = .02$], or any of the study variables at Time 1 [$F(5,154) = 0.69$, $p = .632$, $\eta^2 = .02$].

Furthermore, a non-significant Little's missing completely at random test (Little, 1988) indicated that all missing values could be reliably dealt with [$\chi^2(55) = 59.66$, $p = .310$]. Hence, we used the full information maximum likelihood (FIML) procedure provided in MPLUS 4.0 allowing us to conduct the primary analyses on all 164 participants. Once the proportion of missing data exceeds 10%, the use of FIML is typically recommended (Little, Jorgensen, Lang, & Moore, 2014). It is important to note that FIML does not impute any missing data. It estimates model parameters using all the information available in the data set (Dong & Peng, 2013). Prior research has shown that FIML is superior to other missing data methods such as list- and pairwise deletion in terms of convergence, parameter estimates, and model goodness of fit (Enders & Bandalos, 2001). Sensitivity analyses for patients who participated at both time-points resulted in virtually identical findings, further testifying to the robustness of our findings. For the preliminary analyses in SPSS 22.0, we used the expectation maximization (EM) algorithm to estimate missing values.

Questionnaires

Coping. The revised Diabetes Coping Measure (Keers et al., 2006; Welch, 1994) was used to assess tackling spirit, avoidant coping, passive resignation, and diabetes integration. Previous research has demonstrated the factorial validity (Huang, Courtney, Edwards, & McDowell, 2009; Luyckx, Vanhalst, et al., 2010) and responsiveness to change (DeVries, Snoek, Kostense, & Heine, 2003) of this coping scale. For tackling spirit (5 items), sample items include: “Most people would be a lot healthier if they followed a diabetic diet” and “My diabetes has caused me to think about life in a more positive way”. For avoidant coping (5 items), sample items include: “I am reluctant to visit my doctor for my regular diabetes check-up when I know I am in poor blood glucose control” and “I dislike reading about diabetes because it only makes me worry more.”. For passive resignation (5 items), sample items include: “I feel like just giving in to my diabetes” and “Whatever I do, diabetes complications will continue to ruin my health”. For diabetes integration (6 items), sample items include: “Diabetes makes me feel different from everyone else” (inverse coded) and “Diabetes is the worst thing that has ever happened to me”. Cronbach’s alpha was .32 and .21 for tackling spirit, .59 and .62 for avoidant coping, .75 and .74 for passive resignation, and .68 and .66 for diabetes integration at Times 1 and 2, respectively. Because of the low internal consistency of tackling spirit, we excluded this scale from all further analyses.

Perceived control. Perceived control was measured with the respective subscale (6 items) from the revised Illness Perception Questionnaire (Moss-Morris et al., 2002). Sample items include: “What I do can determine whether my illness gets better or worse” and “The course of my illness depends on me". Cronbach's alpha was .70 and .85 at Times 1 and 2, respectively.

Glycemic control. Treating physicians were contacted to obtain haemoglobin A1c (HbA_{1c}) values from patients' medical records. HbA_{1c} is a commonly used measure of glycaemic control and represents the mean blood glucose concentration for the past 6 to 8 weeks. Higher HbA_{1c} values indicate poorer glycaemic control. Mean HbA_{1c} values were 7.63 (range 5.00-11.50) at Time 1 and 7.96 (range 5.83-13.90) at Time 2. Because different methods in different laboratories were used to determine HbA_{1c} values, these values were expressed as the number of standard deviations from the mean of their respective reference interval in all primary analyses (as every method has its own reference interval).

Statistical Analysis

Cross-lagged analysis with Structural Equation Modelling (SEM) was used to test directionality of effects (Kline, 2006). In the cross-lagged model being tested, all within-time associations, stability paths, and cross-lagged paths among perceived control, illness-specific coping, and HbA_{1c} were included. Cross-lagged coefficients can be interpreted as variable X assessed at Time 1 predicting relative changes (i.e., relative increases or decreases) in variable Y assessed at Time 2. Sex, age, and illness duration were controlled for by estimating paths from these variables to each variable in the model at Time 1. To evaluate model fit, we used the $\chi 2$ index, which should be as small as possible; the root mean square error of approximation (RMSEA), which should be less than .08 (< .05 is excellent); and the comparative fit index (CFI) which should exceed .90 (>. 95 is excellent) (28). Bootstrapping was performed with a total of 5,000 resamples to correct for non-normality in the data and to further ensure the robustness of our findings (Preacher & Hayes, 2008). No multivariate outliers were identified. To assess whether cross-lagged paths were invariant across sex, a multi-group analysis was performed. We compared a constrained model (with all cross-lagged coefficients set as equal across men and women) with an unconstrained model (with all cross-lagged coefficients allowed to vary across men and women). The cross-lagged paths were considered to be invariant if the difference in $\chi 2$, relative to the degrees of freedom, between both models would be non-significant ($p > .05$).

Results

Mean-Level and Correlational Analyses

First, we performed a MANOVA with sex as independent variable and the study variables at Time 1 as dependent variables. Based upon Wilks' Lambda, no significant sex differences were found [$F(5,158) = 1.41$, $p = .225$, $\eta^2 = .05$]. However, as shown in Table 2, follow-up univariate analyses indicated that women showed higher HbA_{1c} values and scored lower on perceived control as compared to men. Next, using Pearson's correlations, we found that HbA_{1c} values were negatively related to age [$r(163) = -.18$, $p = .020$] and positively related to illness duration [$r(162) = .34$, $p < .001$]. No other significant associations with age or illness duration were observed at Time 1. To assess mean-level changes across time, we conducted repeated-measures ANOVAs. As shown in Table 3, significant mean-level increases were observed for diabetes integration and HbA_{1c}, whereas significant decreases were observed for perceived control. Ancillary analyses indicated that these changes were not moderated by patients' sex. Finally, Table 4 presents all associations among the study variables at Times 1 and 2. On both time points, avoidant coping and passive resignation were positively related to HbA_{1c} and negatively related to perceived control. In contrast, diabetes integration was positively related to perceived control and negatively related to HbA_{1c}. Perceived control was negatively related to HbA_{1c} at Time 1 only.

Directionality of Effects

The cross-lagged model provided an excellent fit to the data [$\chi^2(21) = 19.95$, $p = .524$; RMSEA = .00; CFI = 1.00]. A total of three cross-lagged paths were significant at $p < .05$ and one cross-lagged path was marginally significant at $p < .10$, as displayed in Figure 1. Lower perceived control at baseline predicted a relative increase in passive coping strategies five years later. More passive coping strategies, in turn, predicted a relative decrease in perceived control, thereby constituting a negative vicious cycle. Finally, higher HbA_{1c} values at baseline predicted a relative increase in avoidant coping strategies and a relative decrease in diabetes integration five years later. These relationships were not moderated by patients' sex [$\Delta\chi^2(14) = 5.81$; $p = .971$]. The proportion of variance explained ranged from 22 to 43% for the different study variables at Time 2.

Discussion

The present longitudinal study assessing individuals with type 1 diabetes in the transition to adulthood investigated how perceived control, illness-specific coping, and glycaemic control predicted one another over a period of five years. Higher blood glucose levels were found to predict relative decreases in diabetes integration and increases in avoidant coping strategies five years later. Furthermore, feeling less in control over diabetes predicted the use of passive coping strategies over time which, in turn, predicted a relative decrease in perceived control five years later. Hence, passive coping and weak feelings of personal control seemed to reinforce each other over time.

Mean Developmental Trends

Over the course of the study, patients showed a worsening of glycaemic control and a decrease in perceived control. A longer illness duration has indeed been associated with poorer glycaemic control, more severe hypoglycaemic events, and poorer dietary self-care in individuals with type 1 diabetes (Austin, Senécal, Guay, & Nouwen, 2011; Chao, Whittemore, Minges, Murphy, & Grey, 2014; Craig et al., 2002). These difficulties in managing diabetes, in turn, may negatively impact patients' feelings of personal control. With increasing illness duration, patients are expected to assume more responsibility for their own self-care and are less likely to communicate about their diabetes and treatment with others (Austin et al., 2011; Chao et al., 2014). As a result, patients with longer illness duration might experience less support from their environment, potentially resulting in poorer diabetes self-care and a worsening of glycaemic control. These findings point to the importance of keeping patients with longer illness duration engaged in the necessary self-care activities. At the same time, an increase in diabetes integration was observed over the course of the study. Over time, patients may learn to accept their illness as part of their self-concept, resulting in stronger diabetes integration and maybe even personal growth (Linley & Joseph, 2004; Sparud-Lundin, Öhrn, & Danielson, 2010). However, it should be noted that the correlation between diabetes integration and illness duration, although positive, failed to reach significance. More pronounced developmental changes can be expected to emerge when using a wider temporal window (e.g., a follow-up of patients from the moment of diagnosis until late adulthood). Further, future longitudinal studies should include additional time-points to chart potential non-linear development over time.

Longitudinal Relationships Among the Study Variables

Researchers typically see coping as a determinant of patients' physical and psychosocial functioning (Leventhal et al., 1984). However, in the present study, higher blood glucose levels were found to predict relative decreases in diabetes integration and increases in avoidant coping strategies five years later and not vice versa. Hence, rather contrary to our expectations, illness-specific coping did not function as a longitudinal predictor of patients' glycaemic control. Future research should examine whether other psychosocial or contextual factors might predict such relative changes in glycaemic control over time. Lloyd et al. (1999), for instance, have found that those patients whose glycaemic control deteriorated over time were more likely to report negative stressors (e.g., interpersonal conflicts or death of a loved one), whereas those whose control improved over the follow-up period reported more positive stressors (e.g., a desired change in employment or the birth of a child). However, our findings are in line with the findings of a recent study by Luyckx, Seiffge-Krenke, et al.

(2010) who found that higher blood glucose levels predicted relative increases in avoidant coping and decreases in active coping one year later. Hence, these findings suggest that keeping one's blood glucose levels within the optimal range is not only important to avoid future medical complications, as emphasized in previous research (Centers for Disease Control and Prevention, 2005). Poor glycaemic control might also cause patients to lose their hope and motivation for performing daily self-care activities, after which they might resort to more avoidant ways of coping (Luyckx, Seiffge-Krenke, et al., 2010). The use of such avoidant coping strategies, in turn, has been related to a variety of psychosocial difficulties such as depressive symptoms and elevated levels of diabetes-specific distress (Hagger & Orbell, 2010; Jaser & White, 2010; Luyckx, Vanhalst, et al., 2010; Thorpe et al., 2013).

Next, a bidirectional association between perceived control and illness-specific coping was uncovered. More specifically, perceiving diabetes and diabetes treatment as being beyond one's personal control predicted a relative increase in passive coping strategies five years later. The use of passive coping strategies, in turn, predicted a relative decrease in perceived control, thereby constituting a negative vicious cycle. Given that the negative effects of dysfunctional coping and low perceived control seemed to reinforce each other over time, prevention and intervention efforts should include both cognitive and behavioural components in order to be effective in the long run (Snoek et al., 2008; van der Ven et al., 2008).

One approach to target feelings of control in individuals with diabetes is to provide education about diabetes, its complications, and the potential means by which those complications can be avoided, using videos, lectures, interactive workshops, or individualized education (Celano et al., 2013). Although such interventions have been found to be effective in improving feelings of control, diabetes-specific knowledge, diabetes self-care, and glycaemic control in individuals with type 2 diabetes, studies suggest that the effects of these interventions decrease over time (Celano et al., 2013). Hence, it is important that intervention efforts also focus on encouraging the use of active coping strategies in dealing with diabetes-related challenges. A recent meta-analysis has shown that programs which encourage patients to develop self-management plans to accomplish specific tasks (e.g., having a healthier diet and exercising regularly), can have a lasting effect on patients' perceptions of control, diabetes-specific knowledge, and level of glycaemic control years later (Steinsbekk et al., 2012). However, it should be noted that, in the present study, no prospective associations were observed between patients' feelings of control and their level of glycaemic control. When looking at cross-sectional associations, a small association between perceived control and glycaemic control emerged at Time 1. Perceived control most likely shapes patients' ways of coping with stressors which, in turn, may impact on more distal outcomes such as glycaemic control (Johnston-Brooks et al., 2002).

Limitations and Suggestions for Future Research

The present study is characterized by some limitations. First, data on perceived control and coping were collected through self-report questionnaires. Although questionnaires are most appropriate to gather information about patients' perceptions and behaviours, future studies should use other methods as well (e.g., interviews). Second, some factors might compromise the generalizability of our findings. The voluntary nature of participation might have introduced sample bias, because individuals experiencing serious problems with their diabetes could be underrepresented. Furthermore, in addition to the relatively small sample size, a substantial proportion of the data was missing at Time 2 due to drop-out. Hence, future research with other samples of emerging adults with type 1 diabetes is needed. Such research should include other chronic illnesses as well to examine the degree to which the present findings generalize across different diagnostic categories.

Third, the internal consistencies of some of the coping scales (and the scales assessing tackling spirit and avoidant coping in particular) were quite low. Hence, future research should develop and use more reliable and valid coping measures. Fourth, future research should examine the extent to which the coping strategies used by patients fit with the controllability of the specific stressor (Conway & Terry, 1992). Indeed, whereas the use of active, problem-focused strategies might be effective to deal with controllable stressors, it might be more adaptive to use other strategies (such as acceptance) to deal with stressors that are less controllable in nature. Finally, to investigate more encompassing models, the present study variables need to be related to other important health indicators such as diabetes self-care, health care use, and the presence of medical complications.

Despite these limitations, the present study demonstrated the longitudinal interplay among perceived control, illness-specific coping, and glycaemic control, using state-of-the-art statistical techniques. Low perceived control and the use of passive coping strategies were found to reinforce one another over time. In addition, glycaemic control was found to predict diabetes integration and the use of passive coping strategies five years later. We hope that the present findings can inform future longitudinal studies focusing on the physical and psychosocial functioning of individuals with type 1 diabetes in an attempt to set up a knowledge base for designing prevention and intervention efforts.

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Table 1

Demographic and Clinical Characteristics of the Participants at Times 1 and 2

	Time 1 (*N* = 164)	Time 2 (*N* = 94)
Sex		
Men	70 (43%)	34 (36%)
Women	94 (57%)	60 (64%)
***M* age (*SD*)**	23.48 (3.70)	27.82 (3.61)
Working status		
Studying	56 (35%)	10 (11%)
Full- or part-time work	88 (54%)	74 (79%)
Unemployed	18 (11%)	9 (10%)
Marital status		
Living with parents	61 (37%)	15 (16%)
Single	30 (18%)	15 (16%)
In a relationship/Married/Co-habiting	71 (44%)	61 (67%)
Divorced	2 (1%)	1 (1%)
Children		
Yes	21 (13%)	33 (35%)
No	143 (87%)	60 (65%)
***M* Illness duration (*SD*)**	7.29 (5.30)	12.29 (5.36)
Insulin administration type		
Injections	143 (88%)	67 (72%)
Pump	20 (12%)	26 (28%)

Table 2

Univariate ANOVAs, Means, and *F*-Values for Sex at Time 1

Variables	Sex		*F*-value (η^2)
	Men	Women	
	M (*SD*)	*M* (*SD*)	
Perceived control	4.22 (0.49)	4.06 (0.53)	4.10* (.02)
Illness-specific coping			
Passive resignation	2.03 (0.86)	2.25 (0.95)	2.21 (.01)
Avoidant coping	2.59 (0.97)	2.78 (0.94)	1.45 (.01)
Diabetes integration	2.97 (0.87)	2.84 (0.91)	0.88 (.00)
HbA_{1c}	5.20 (3.15)	6.27 (3.53)	4.06* (.02)

Note. HbA_{1c} values are expressed in SD relative to the mean of their respective reference intervals. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 3

Repeated-Measures ANOVAs, Means, and *F*-Values

Variables	Time 1 *M* (*SD*)	Time 2 *M* (*SD*)	*F*-value (η^2)
Perceived control	4.13 (0.52)	4.02 (0.52)	8.14** (.05)
Illness-specific coping			
Passive resignation	2.16 (0.92)	2.21 (0.81)	0.90 (.00)
Avoidant coping	2.70 (0.96)	2.78 (0.91)	2.12 (.01)
Diabetes integration	2.90 (0.89)	3.05 (0.77)	11.36** (.07)
HbA_{1c}	5.81 (3.41)	6.25 (2.92)	4.80* (.03)

Note. HbA1c values are expressed in SD relative to the mean of their respective reference intervals. *p< .05. **p< .01. ***p< .001.

Table 4

Within-Time Correlations Among Study Variables at Times 1 and 2

Variable	2.	3.	4.	5.
1. Perceived control	-.19*/ -.25**	-.37***/ -.71***	.27**/ .29***	-.17*/ -.13
2. Avoidant coping	---	.55***/ .54***	-.47***/ -.51***	.33***/ .52***
3. Passive resignation		---	-.48***/ -.66***	.42***/ .38***
4. Diabetes integration			---	-.17*/ -.26**
5. HbA_{1c}				---

Note. The first coefficient is for Time 1, the second for Time 2.

**p*< .05. ***p*< .01. ****p*< .001.

Figure 1.

Cross-lagged path model linking perceived control, coping, and HbA_{1c}. Within-time correlations and paths from the control variables (sex, age, and illness duration) are not presented for reasons of clarity. All path coefficients are standardized.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.