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The role of resilience on psychological adjustment and physical health in patients with diabetes

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Abstract

Objective—This study used a longitudinal design to investigate the buffering role of resilience on worsening HbA_{1c} and self-care behaviours in the face of rising diabetes-related distress.

Method—A total of 111 patients with diabetes completed surveys and had their glycosylated hemoglobin (HbA_{1c}) assessed at baseline and 1-year follow-up. Resilience was defined by a factor score of self-esteem, self-efficacy, self-mastery, and optimism. Diabetes-related distress and self-care behaviours were also assessed.

Results—Baseline resilience, diabetes-related distress, and their interaction predicted physical health (HbA_{1c}) at 1-year. Patients with low, moderate, and high resilience were identified. Those with low or moderate resilience levels showed a strong association between rising distress and worsening HbA_{1c} across time (r=.57, .56, respectively). However, those with high resilience scores did not show the same associations (r=.08). Low resilience was also associated with fewer self-care behaviours when faced with increasing distress (r= −.55). These correlation coefficients remained significant after controlling for starting points.

Conclusion—In patients with diabetes, resilience resources predicted future HbA_{1c} and buffered worsening HbA_{1c} and self-care behaviours in the face of rising distress levels.

Healthcare providers benefit from the knowledge and understanding of associations between psychosocial and physiological variables in patients with chronic illness. These associations can further inform treatment, prevention, and intervention protocols through a biopsychosocial perspective. In diabetes patients, a holistic view of disease can aid the prevention of a variety of debilitating physical complications that can result from consistently poor self-care behaviors and high glycosylated hemoglobin levels.

One well-known correlate of poor glycemic control and self-care is diabetes-related psychological distress (Polonsky, Anderson, Lohrer, Welch, & Jacobson, 1995, 2001; Weinger & Jacobson, 2001). Reducing diabetes-related distress has been successful through intensive, educational, or cognitive behavioral interventions (see Welch, Weinger, Anderson, & Polonsky, 2003, for review). Less is known about the personal factors that encourage successfully coping with rising levels of diabetes-related distress. Rising distress levels may accompany a diabetes patient at any stage of disease. For example, Shaban, Fosbury, Kerr, and Cavan (2006) report significant prevalence rates for moderate to severe depression and anxiety in type 1 patients living with diabetes for many years. Due to the extensive, daily nature of

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diabetes self-care, feeling "burned out" or overwhelmed is a risk for patients at any stage of their disease. However, psychosocial variables such as self-esteem, self-efficacy, self-mastery and optimism have been linked with less distress and lower glycosylated hemoglobin levels and may be good candidates for understanding the buffering the effects of distress on diabetes-related outcomes (Fournier, De Ridder, & Bensing, 2002; Johnston-Brooks, Lewis, & Garg, 2002; Rose, Fliege, Hildenbrandt, Schirop, & Klapp, 2002; Sousa, Zauszniewski, Musil, Price Lea, & Davis, 2005).

We chose to investigate the extent to which psychosocial resources protect, or buffer, individuals from the negative physical or behavioural effects of rising diabetes-related emotional distress. A buffering effect occurs when a personal or situational variable protects people from the potentially negative effects of stress (Cohen & Wills, 1985). Several variables have been investigated via the stress-buffering model in persons without diabetes, including hardiness, social support, finances, self-enhancement, and religiosity (Cohen & Wills, 1985; Kobasa, Maddi, & Kahn, 1982; Kornblith et al., 2001; Smith, Langa, Kabeto, & Ubel, 2005; Taylor, Lerner, Sherman, Sage, & McDowell, 2003; Wills, Yaeger, & Sandy, 2003). In diabetes patients, effective coping has been shown to buffer poor glycemic control in the face of chronic psychosocial stress (Peyrot & McMurry, 1992). Given the strong association of generalized stress with diabetes-related distress in the literature (e.g., Polonsky et al., 1995; Spencer et al., 2006) coupled with our primary interest in diabetes-specific outcomes (glycemic control and diabetes self-care behaviours), diabetes-related emotional distress was used as the theoretical "stress" variable in the buffering hypothesis for this study.

Positive psychosocial factors such as the ones mentioned above can be used to identify a diabetes patient who demonstrates "resilience" in the face of increasing diabetes-related distress. Resilience is a psychosocial construct referring to an individual's capacity to maintain psychological and physical well-being in the face of adversity. Although much has been written about resilience in children and adolescents (e.g., Garmezy, Masten, & Tellegen, 1984; Masten et al., 1988; Werner & Smith, 1982), less is known about resilience in populations facing chronic illness or stress. The study of resilience in diabetes is virtually nonexistent, despite solid evidence that positive psychosocial resources influence glycemic control and quality of life (Rose et al., 2002; Sousa et al., 2005; Whittemore, Melkus, & Grey, 2005). In other areas of chronic illness, Becker and Newson (2005) found determination, perseverance, and tenacity were common among a qualitative study of elderly chronically ill African Americans, and psychological adjustment was found to be prevalent in families with HIV and cancer (Hodgkinson et al., 2006; New, Lee, & Elliott, 2006). Vedhara and Nott (1996) reported resilience predicted emotional distress in homosexual men with HIV. However, little more is known about the protective factors involved in resilience for many chronically ill populations.

One reason for the lack of research, perhaps, is that although studied in various contexts for many years, there is no universal agreement on what constitutes "resilience." In fact, distinguishing factors that define resilience and ones that promote or reduce resilience can be difficult (Kinard, 1998). Theoretically, making the distinction between personal, definitional attributes of resilience and resilient correlates or outcomes is rarely practiced, yet understanding how these fundamentally different components change and affect each other over time may lead to advancement in the understanding of resilience.

Defining resilience solely in terms of salutary medical and psychosocial outcomes in the face of stress, while commonly practiced, provides little theoretical and empirical information about the psychosocial processes that moderate and mediate resistance to stressors. For example, although many use Kobasa, Maddi, and Kahn's hardiness construct (1979) when referring to "resilience" (e.g., Baron, Eisman, Scuello, Veyzer, & Lieberman, 1996), in doing so, the distinction between predictor and outcome is often blurred. In Kobasa et al.'s study of business executives (1979), hardiness was operationalized as an outcome in terms of high life stress and low illness. However, the executives' sense of commitment, challenge, and control, the three determinants of hardiness, were also reported as the factors that mediated positive adaptation in the face of stress. Similarly, in Baron et al.'s study on children of Holocaust victims (1996), the authors cite literature describing children of survivors as being surprisingly resilient (i.e., "no pattern of maladjustment or psychopathology," p.514), while at the same time investigate stress-resilience (measured by hardiness) as a basic coping mechanism in this population. When the same term is used to refer to both an outcome and the processes that contribute to that outcome, definitional ambiguity can result.

Another potential reason for the reluctance to explore the construct of resilience in chronic illness may be that previous research has typically focused on only one or few variables thought to be protective (Rutter, 2000). This can lead to a lack of uniformity when using the term "resilience." One possible solution is to attend to whether these commonly studied individual variables may actually be measures of the same construct (Judge, Erez, Bono, & Thoresen, 2002; Ozer, 1999). In a meta-analysis of popular traits such as self-esteem, neuroticism, locus of control, and generalized self-efficacy, Judge et al. (2002) reported that a single factor explained these relationships and each individual measure accounted for only a small percentage of unique variance. When applied to studies of resilience, closely related psychosocial resources have indeed been usefully analyzed and reported as a single factor (Hull, Lehn, & Tedlie, 1991; Major, Richards, Cooper, Cozzarelli, & Zubek, 1998; Vedhara & Nott, 1996).

Psychosocial resources such as self-esteem, optimism, self-efficacy and self-mastery are commonly used in other studies involving resilience and can avoid problems of circularity (Cederblad, Dahlin, Hagnell, & Hansson, 1994; Cicchetti, Rogosch, Lynch, & Holt, 1993; Rutter, 1985; Vedhara & Nott, 1996; Wagnild & Young, 1993). Further, they have been shown to be associated with mental and physical health (Fournier et al., 2002; Johnston-Brooks et al., 2002; Rose et al., 2002; Sousa et al., 2005). Therefore, optimism, self-esteem, self-efficacy and self-mastery were proposed as resilience resources that may be protective to those facing the stressors associated with living with diabetes.

The goal of our study was to explore the buffering effect of resilience on glycemia and self-care behaviors. We expected that resilience would differentiate levels of future glycemic control and self-care behaviours and that those with higher levels of resilience would be most protected from the adverse effects of increases in diabetes-related distress.

Method

Participants

Patients between the ages of 18 and 75 having diabetes were recruited either by mail or during a medical appointment at the Joslin Diabetes Center (JDC) in Boston, MA. The JDC Committee on Human Studies approved the protocol and voluntary written informed consent was obtained from each participant before the study. One hundred forty-five patients completed surveys and had their glycosylated hemoglobin percentage (HbA_{1c}) assessed at baseline (BL) and 1-year later (1yr). Of the initial 145 patients, 34 were lost to follow-up at 1yr, having never returned for a clinic appointment within the study's time frame. An additional three to five participants, depending on the survey instrument, failed to complete enough items on their surveys for scoring and were also dropped in subsequent analyses. Because the attrition rate was considerable, an attrition analysis comparing demographic and key variables between the attriters and completers was conducted, and the results are presented below.

Measures

Optimism was measured by the Life Orientation Test (LOT), an eight-item self-report measure (along with four filler items) assessing generalized expectancies for positive versus negative outcomes, scored on a 5-point Likert scale (Scheier & Carver, 1985). Cronbach's alpha for the scale was .71, and test-retest reliability over the one-year period was .70. Adequate levels of convergent and discriminant validity have been reported (Scheier, Carver, & Bridges, 1994).

Self-esteem was measured using the Rosenberg Self-Esteem Scale (Rosenberg, 1965), a widely used scale assessing global self-esteem and feelings of personal self-worth. It includes 10 general statements assessing the degree to which respondents are satisfied with their lives and feel good about themselves. In our sample, Cronbach's alpha was .91 and the 1yr test-retest reliability was .72.

Self-efficacy was measured with the Confidence in Diabetes Self-care scale (CIDS, Van Der Ven et al., 2003), a questionnaire assessing diabetes-specific self-efficacy with type 1 diabetes. A modified version was administered to type 2 patients. Each item is preceded by, "I believe I can…" with the strength of this belief rated on a 5-point Likert scale. Internal consistency was high (Cronbach's alpha = .90) and 1yr test-retest reliability was .60. Examination of the factor structure indicated that the CIDS is best considered and used as a unidimensional scale (Van Der Ven et al., 2003).

Self-mastery was measured by Pearlin and Schooler's (1978) Self-Mastery Scale (SMS). This 7-item questionnaire measures the extent to which a person generally feels as though he or she has personal mastery over life outcomes. Internal consistency (Cronbach's alpha = .81) and 1yr test-retest reliability (r=.63) were adequate. Its psychometric properties have been well established (Pearlin & Schooler, 1978).

Diabetes-related emotional distress was our assessment of psychological adjustment, measured by the Problem Areas in Diabetes Scale (PAID), a 20-item measure assessing a broad range of feelings related to living with diabetes and its treatment, including guilt, anger, frustration, depressed mood, worry, and fear. Patients were asked to respond to a five point Likert scale ranging from "not a problem" to "serious problem" indicating the extent to which the statement was currently a problem to them. This scale has high internal consistency and validity (Polonsky et al., 1995; Welch, Jacobson, & Polonsky, 1997; Welch et al., 2003). Similar reliability was found in the current study, Cronbach's alpha = 0.94. One-year test-retest reliability was high (r=.82). The responsiveness of the PAID (sensitivity to change over time) is also well established (Welch et al., 2003).

Self-care behaviours were assessed with the Self-Care Inventory-Revised (SCI-R) and served as our primary behavioural outcome (Greco et al., 1990; Polonsky et al., 1995; Weinger, Butler, Welch, & LaGreca, 2005). The 10 items most related to metabolic control were selected from the 15-item measure, assessing patients' perceptions of self-care behaviours. Items were scored on a 5-point Likert scale from 1 ("never do it") to 5 ("always do it without fail"). High scores indicate more frequent diabetes self-care behaviours. The SCI-R for our sample showed high internal consistency (α = .79), test-retest reliability (r=.76) and has been used in studies assessing self-care and its association with diabetes-related distress in type 1 and type 2 diabetes (Polonsky et al., 1995; Weinger, Butler et al., 2005; Wysocki, 1996).

Glycemic Control was our assessment of physical health in diabetes patients, measured by glycosylated hemoglobin (HbA_{1c}). HbA_{1c} is the definitive measure of glycemic control over the prior 2 to 3 months and is used in all major clinical trials of diabetes (Diabetes Control and Complications Trial Research Group, 1993). Higher HbA_{1c} indicates poorer control. The JDC laboratory in Boston, MA analyzed all samples using high-performance liquid chromatography ion capture (Tosch Medics, San Francisco, CA; reference range: 4.0–6.0%). These methods conform to the Diabetes Control and Complications Trial Research Group (1993) standardized methods.

Statistical Analyses

Principal components analysis and structural equation modeling were used to derive the resilience factor. Paired *t*-tests and test-retest reliability were calculated for all variables to assess stability across the 1yr period. Comparisons between attriters and completers and differences in sex and type of diabetes were analyzed by use of independent *t*-tests, χ^2 significance tests, and comparisons of correlation coefficients.

The main effects of the resilience factor, diabetes-related distress, and their interaction at baseline were tested for their prediction of 1yr HbA_{1c} levels. Baseline HbA_{1c} was entered in the first step, along with any other significant covariates of age, sex, education, type and duration of diabetes. The same procedures were used for the prediction of 1yr self-care. In post-hoc analyses, we used the upper, moderate, and lower tertiles of the resilience factor score distribution to designate low, moderate, and high groups. Repeated measures analyses of variances were used to estimate the effects of time, resilience group, and time by group interactions on HbA_{1c}, PAID, and self-care scores.

Change scores were calculated for the key variables (1yr minus BL) in order to plot the effect of change in one variable (i.e., PAID) on change in another (i.e., HbA_{1c}) for each individual. Pearson product-moment correlation coefficients were calculated to assess the association of change scores within each resilience group, and differences in these correlations were analyzed. Homogeneity of slopes tests explored potential differences in the slopes of the groups (Jackson et al., 2002; Pedhauzur, 1997). This test was run via factorial analysis of covariance, entering all covariates (including the baseline variable of interest) in conjunction with the interaction of resilience group status by the variable of interest. The interaction term was investigated for its significance and the null hypothesis of the homogeneity of slopes was rejected if the *p*-value was <.05. Change scores were also investigated using partial correlations coefficients controlling for the BL variable.

Results

Resilience Factor

Resilience resources were defined by a “Resilience Factor” (RF), derived from personal resources commonly associated with, or used to define, resilience (Cederblad et al., 1994; Cicchetti et al., 1993; Rutter, 1985; Vedhara & Nott, 1996; Wagnild & Young, 1993). These variables included optimism, self-esteem, self-efficacy and self-mastery. Development of the RF was two-fold.

First, total scores on the four scales were entered into a principal components analysis. A factor score was calculated for each participant by saving the scores as variables in the data reduction method using SPSS version 14.0 (SPSS, 2006). At baseline, 61.5% of the variance was explained by a single, unrotated component, which we designated as the “Resilience Factor” (RF). At the 1-year follow-up, 60.0% was explained by one component, demonstrating a relatively stable factor structure across time. Intercorrelation coefficients among scales are reported in Table 1 and 1yr test-retest reliability was high (r=.81). Table 1 also shows the loadings of each scale on the RF for both time points.

In addition, structural equation modeling was used to test the model fit of self-esteem, self-efficacy, self-mastery, and optimism as the components of the resilience factor. Resilience was entered as a single-factor latent variable and the four individual baseline measures were entered as observed variables. Two participant's data were dropped from these analyses because they were missing data on one of the measures. The model was a reasonable fit with the data. The χ^2 (2) = 5.42, p = NS. The fit indices were also acceptable (GFI = .98, Tucker-Lewis index = .94). The regression weights for the observed variables were as follows: self-efficacy = .38 (SE = .07), optimism = .92 (SE = .11), self-mastery = .97 (SE = .12), and self-esteem = 1.0, as one of the variables was constrained in order to obtain a model fit.

Demographic Characteristics

Demographic characteristics of the sample at baseline are presented in Table 2. There were no differences in demographic variables by sex, except that males tended to be older (t=2.09, p<.05). Patients with type 1 diabetes differed from those with type 2 diabetes in expected directions for the demographic variables: age (patients with type 2 older: t= −5.93, p<.001), duration of diabetes (patients with type 1 longer duration: t=5.40, p<.001), and HbA_{1c} (patients with type 1 higher: t=2.25, p<.05). However, all resilience attributes and associations between key variables for type 1 and type 2 patients were similar; therefore, all patients were considered together.

Attrition Analysis

Analyses were conducted to determine whether there were any differences between those who dropped out before completion of the study and those who completed both assessments. Independent t-tests, chi-squared significance tests, and comparisons of correlation coefficients revealed no differences between completers and attriters in any of the demographic characteristics or in any psychosocial, behavioural, or physiological variables (resilience, diabetes-related distress, self-care, or HbA_{1c}) at T1.

Descriptive Statistics

Means and standard deviations for psychosocial and physiological variables are presented in Table 3. Paired t-tests were used to investigate stability in averages across time. Means for resilience variables and HbA_{1c} did not change, while mean PAID scores dropped over time.

Testing the Buffering Hypothesis

The interaction effect between resilience and diabetes-related distress was examined using multiple regression analysis, with 1yr HbA_{1c} as the dependent variable and baseline HbA_{1c}, resilience factor, and diabetes-related distress entered stepwise into the model. Table 4 summarizes the effect of the resilience factor, diabetes-related distress, and their interaction on 1yr HbA_{1c}. Covariates of age, sex, type of diabetes, education, and duration of diabetes were not significant, and not included in the final models. In predictions of 1yr HbA_{1c}, there were significant main effects of BL HbA_{1c}, resilience factor, and diabetes-related distress such that higher HbA_{1c} was related to lower resilience and higher diabetes-related distress (Table 4). The interaction between resilience and diabetes-related distress was also related to 1yr HbA_{1c} after accounting for BL HbA_{1c}, resilience, and distress (β= .52, p<.001). This indicated that the interaction of higher distress with lower resilience associated with higher HbA_{1c} levels. Self-care behaviours at 1yr were also investigated as a dependent variable using the same design. Future self-care behaviours were not predicted by the resilience factor, diabetes-related distress, or their interaction (Table 4).

Comparisons of Low, Moderate, and High Resilience Groups

Post-hoc analyses were conducted by identifying those with low, moderate, and high resilience resources as defined by the tertiles of the resilience factor (RF). Of the 111 participants completing both time points, 34 participants were labeled as having "low resilience" (LO; range of RF = −2.95 to −0.29), 37 participants were labeled as having "moderate resilience" (MOD;

range of RF = −0.23 to 0.51), and 40 were labeled as having "high resilience" (HI; range of RF = 0.56 to 2.18).

First, repeated measures analyses of variances were used to examine the effects of time and resilience group status on HbA_{1c}, distress, and self-care scores. Means and *F*-statistics are presented in Table 5. These analyses revealed a significant within-subjects main effect, indicating that diabetes-related distress decreased across time. Resilience group differences were found for diabetes-related distress (HI group lowest) and self-care scores (HI group highest) across time. A trend was found for the interaction effect of time by group status on HbA_{1c}, such that the HI and MOD resilience groups improved their HbA_{1c} more than the LO resilience group (p=.08).

Second, we hypothesized that those with highest levels of resilience would be most protected from the adverse effects of increased distress. In order to test this hypothesis, we computed the correlation between change in distress and change in $HbA_{1c.}$ Any participant with missing data or with a change score outside of three standard deviations was considered an outlier and not considered in the analyses. This resulted in the exclusion of 9 HI, 3 MOD, and 6 LO participants. The correlation coefficients for change in distress with change in HbA_{1c} were .57 and .56 for the LO and MOD resilience groups respectively (both *p*'s <.01). The correlation coefficient for the HI resilience group approached zero (r= .08, p=NS), and it differed from those for the LO and MOD groups (*z*'s = 2.07, 2.11 respectively, both *p*'s <.05).

To represent the relation between change in distress and change in HbA_{1c} visually, we plotted change scores for each participant in the LO, MOD, and HI resilience groups in order to understand trends on an individual level. Trend lines were fit separately for the three resilience groups. Figure 1 depicts the LO, MOD, and HI groups on change in diabetes-related distress and change in HbA_{1c}. The slopes of the groups were different from each other as examined by testing for homogeneity of the group slopes (F(2,88) = 9.17, p<.001) (Jackson et al., 2002;Pedhauzur, 1997).

Although there was not a statistically significant interaction effect for the resilience factor and diabetes-related distress in predicting future self-care behaviours (Table 4), we explored the buffering effect of resilience on the deterioration of self-care behaviours in the face of increasing distress. Again, participants with missing data points or outlier data were excluded (total excluded: n=6 for HI group, n=4 for MOD group, n=6 for LO group). Results revealed that worsening diabetes-related distress scores were associated with worsening self-care scores more for the LO group (r= −.55, p<.01) than for the MOD or HI groups (MOD: r=−.13, HI: r= −.25; *p*'s=NS). This pattern of relations is consistent with a buffering effect on the relation between distress and self-care (differences in correlation coefficients for LO v. HI: z=−1.63, p=.05; LO v. MOD: z=−1.77, p<.05). However, the test for slope heterogeneity was not significant (F(2,89) = .27, p=NS; plot not shown).

To supplement these analyses and to ensure baseline data were not driving the correlations, we computed partial correlation coefficients, controlling for the baseline variable of interest. As shown in Table 6, the correlation coefficients were stronger for the LO and MOD groups than the HI group in both sets of associations. In fact, for both associations, the HI resilience group showed no significant associations and the associations of the HI group were statistically different from the LO and MOD groups (Table 6).

Discussion

Among patients with diabetes who experience worsening levels of diabetes-related distress, some are more resistant to deteriorating behavioural and physical effects than others. This study investigated resilience resources as a potential explanatory factor for these individual differences.

Although resilience is not commonly studied in patients with diabetes, a review of the resilience literature points to a few key variables that are commonly associated with, or used to define, stress-resilience. These include self-esteem (Fergusson & Lynskey, 1996; Parker, Cowen, Work, & Wyman, 1990; Werner & Smith, 1982), self-efficacy (Rutter, 1987; Sinclair & Wallston, 2004), optimism (Connor & Davidson, 2003; Segerstrom, Taylor, Kemeny, & Fahey, 1998; Taylor & Seeman, 1999), and self-mastery (Cederblad et al., 1994). These variables have consistently been associated with better health and reduced distress. Self-mastery has even been linked to lower mortality rates from all causes, including cardiovascular disease, and cancer (Surtees, Wainwright, Luben, Khaw, & Day, 2006). Individually, these positive psychosocial factors have shown promising results in predicting both mental and physical health in patients with diabetes (Fournier et al., 2002; Johnston-Brooks et al., 2002; Rose et al., 2002; Sousa et al., 2005). Thus, this study used these variables in a composite resilience factor to investigate how personal resources affect health and self-care in a diabetes sample.

The buffering model (Cohen & Wills, 1985) was used to investigate the potential for resilience to protect against negative effects of diabetes-related distress. Evidence for the buffering effect of resilience was first shown by the interaction effect of resilience and distress on the prediction of future HbA_{1c}. This effect suggests that when faced with increasing distress, individuals with higher resilience are less likely than those with fewer resilience resources to have worsening HbA_{1c} levels one year later.

When using tertile cutpoints of the resilience factor, strong associations were found for increases in diabetes-related distress with increases in glycemia in those with low and moderate level resilience scores; however, this was not found in those with high resilience. In fact, the slopes for the groups were statistically different. Though correlational in nature, the steeper slope for those in the LO and MOD resilience groups may indicate that an increase in diabetes-related distress affects HbA_{1c} adversely in those with lower resilience, while the HI resilience group may be more resistant to this change.

Moderate buffering effects were also found for associations involving self-care. In these analyses, having low resilience resulted in fewer self-care behaviours when faced with rising distress. Partial correlation coefficients indicated that increases in PAID scores were related to changes in self-care behaviors in all but the high resilience group. Taken together, these results support previous findings that psychosocial resources affect self-care (Johnston-Brooks et al., 2002; Sousa et al., 2005; Syrjala, Ylostalo, Niskanen, & Knuuttila, 2004) while expanding on these results through application of buffering model.

This study was subject to limitations. The follow-up period was limited to approximately one year for all patients. In this time frame, 23% of the sample was lost to follow-up. Although attrition analyses comparing the completers to the attriters on means and percentages at baseline were not different, results still may have been impacted from this attrition rate. Moreover, previous work has shown that patients who fail to attend scheduled medical appointments may experience negative effects on their diabetes management (Griffin, 1998). They also have lower self-esteem, optimism, self-care, and higher diabetes-related distress (Weinger, McMurrich, Yi, Lin, & Rodriguez, 2005). Loss of these participants who did not return for a follow-up appointment within approximately one year may have resulted in a better-functioning sample than is typical in the diabetes population, and may provide some explanation for why mean levels of diabetes-related distress decreased and HbA_{1c} was relatively stable in this observational study. Non-attendance may have suggested increases in diabetes-related distress over time and may have resulted in more patients with low resilience resources, and even greater differences between the low and high resilience groups versus our sample that was in consistent treatment over the course of the year.

Because the patients in our sample were varied in their years of diabetes duration (range 1–53 years) and it may be the case that those living with diabetes for a longer amount of time may have already adaptively or maladaptively adjusted to the disease, we cannot interpret these results as indicative of psychological adjustment to the illness itself. We can, however, be more confident that resilience buffers psychological adjustment over the course of living with the disease. This may be particularly important as recent data shows increased prevalence of clinically relevant anxiety and depression in patients with Type 1 diabetes (Shaban et al., 2006). In fact, this study by Shaban and colleagues (2006) reported mean duration of diabetes as 17.2 years (*SD*=12.0) which is comparable to our study sample.

Acknowledging these limitations, we feel that our results demonstrate that positive psychosocial resources can buffer the effects of rising distress levels on self-care behaviours and glycemic control in a diabetes population. Thus, assessment of resilience resources may be useful in cognitive behavioural interventions targeting coping with stress, improving self-care behaviours, or maintaining proper glycemic control. Future research of resilience in diabetes patients promises to advance our understanding of the psychological and biological processes that mediate stress-resistance while working toward the ultimate goal of improving mental and physical health in these patients.

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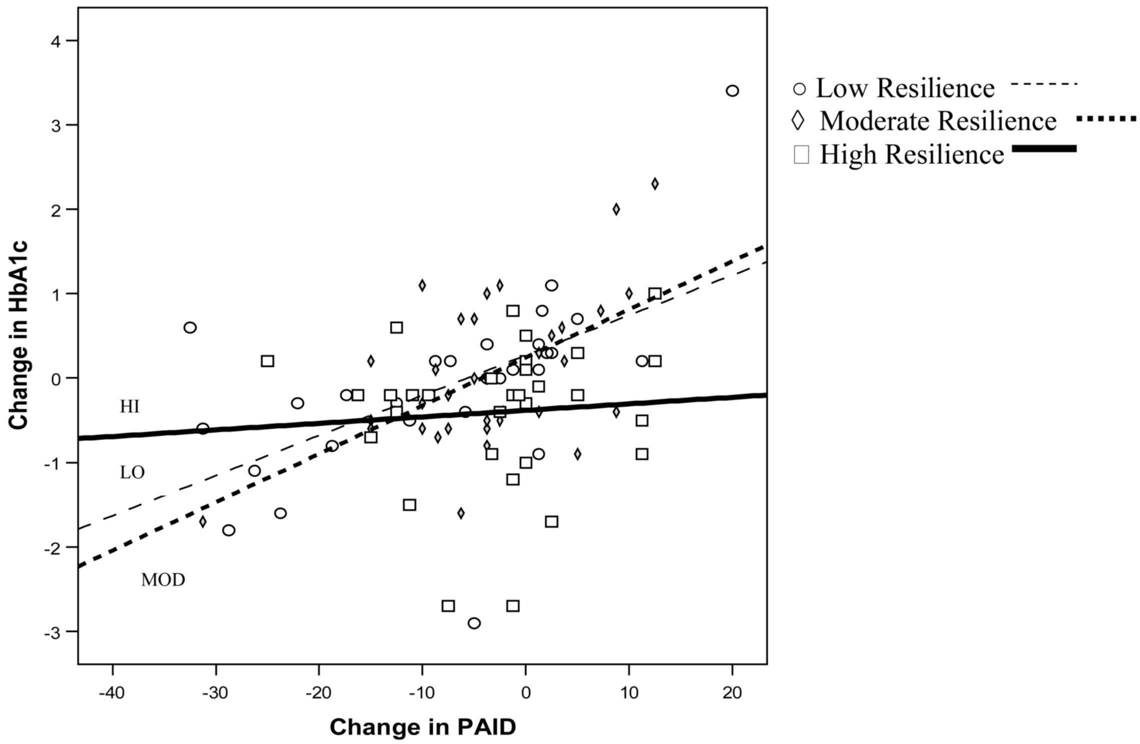

Figure 1.
Change in Diabetes-related Distress (PAID) and Change in HbA_{1c} for Low (LO), Moderate (MOD), and High (HI) Resilience Groups

Table 1

Intercorrelation Coefficients and Factor Loadings of Variables Comprising the Resilience Factor at BL and 1yr: Self-efficacy (CIDS), Self-esteem (SE), Self-mastery (SMS), and Optimism (LOT)

					Factor Loading	
	CIDS	**SE**	**SMS**	**LOT**	**BL**	**1yr**
CIDS	--	.39	.42	.28	.62	.56
SE	*.30*	--	.57	.60	.83	.80
SMS	*.35*	*.53*	--	.61	.85	.86
LOT	*.27*	*.58*	*.69*	--	.82	.85

Note. Correlation coefficients at Baseline (BL) are non-italicized (upper diagonal) and correlation coefficients at 1-year follow-up (1yr) are italicized (lower diagonal). All correlation coefficients are significant (p<.01).

Table 2

Means (*M*) or Percentages, Standard Deviations (*SD*), and Ranges of Demographic Variables at Baseline; n=145

Variable	% or *M*	*SD*	Range
Age (yrs)	49.4	15.1	18–77
Education (yrs)	15.3	2.9	8–20
Baseline HbA_{1c} (%)	7.8	1.4	4.6–13.2
Duration of DM (yrs)	18.9	13.2	1–53
Sex (% female)	57		
Ethnicity (% Caucasian)	88		
Type of DM (% Type 1)	63		

Table 3

Means (*M*), Standard Deviations (*SD*), and Paired *t*-test of Physiological and Psychosocial Variables at Each Time Point

	Baseline		1-year follow-up			
Variable	***M***	***SD***	***M***	***SD***	**n**	***t***
HbA_{1c}	7.83	1.40	7.72	1.36	111	1.65
Resilience Factor						
Self-esteem	75.78	19.08	78.74	17.91	107	−1.54
Self-efficacy	82.30	11.64	83.56	10.53	108	−.25
Optimism	62.53	17.29	64.04	17.16	108	−.26
Self-mastery	66.27	17.90	64.04	17.16	108	1.65
Self-care	37.33	6.27	37.43	7.64	108	1.17
PAID	32.80	20.82	26.04	20.09	106	3.61***

Note. PAID=Problem Areas in Diabetes Scale.

*** $p<.001$.

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Table 4

Regressions of 1-Year HbA_{1c} and Self-care Scores on the Resilience Factor (RF), Diabetes-related Distress (PAID), and their Interaction Effects at Baseline (BL)

		1-year HbA_{1c}			1-year Self-care	
Step	**Variable**	**Unst. β**	**Stand. β**	**Variable**	**Unst. β**	**Stand. β**
1[a]	BL HbA_{1c}	.67	.69***	BL Self-care	.88	.80***
2	BL RF	−.52	−.39**	BL RF	.41	.06
3	BL PAID	.02	.24**	BL PAID	.04	.13
4	RF × PAID	.01	.52***	RF × PAID	−.01	−.08

Note. 1yr HbA_{1c}: F (4,104) = 38.09, p<.001; 1yr self-care: F (4,100) = 36.05, p<.001.

[a]Covariates of age, sex, education, duration and type of diabetes were not significant and not included in the final models.

** p<.01,

*** p<.001.

Table 5

Repeated Measures Analysis of Variance (ANOVA) for HbA_{1c}, Diabetes-related Distress (PAID), and Self-care

		M* ± *SD		***ANOVA***
	Resilience Group	**BL**	**1yr**	***F* (df)**
HbA_{1c}	LO	8.15 ± 1.46	8.19 ± 1.52	Time: (1,108) = 2.35
	MOD	7.50 ± 1.18	7.48 ± 1.32	Group: (2,108) = 2.56[a]
	HI	7.99 ± 1.51	7.53 ± 1.19	Interaction: (2,108) = 2.60[a]
PAID	LO	52.44 ± 19.83	43.04 ± 20.41	Time: (1,103) = 13.50***
	MOD	28.20 ± 14.90	25.26 ± 17.45	Group: (2,103) = 36.25***
	HI	18.06 ± 13.31	12.57 ± 9.06	Interaction: (2,103) = .61
Self-care	LO	35.68 ± 6.32	37.04 ± 6.38	Time: (1,104) = 1.00
	MOD	39.05 ± 4.93	38.39 ± 7.04	Group: (2,104) = 2.81[b]
	HI	38.89 ± 7.02	38.03 ± 7.30	Interaction: (2,104) = 1.94

[a] $p=.08$,

[b] $p=.07$

*** $p<.001$

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Table 6

Partial Correlation Coefficients for Low (LO), Moderate (MOD), and High (HI) Resilience Groups

		Resilience Groups			*z*-statistic for:	
Association	**Controlling for:**	**LO**	**MOD**	**HI**	**HI vs. LO**	**HI v. MOD**
Δ PAID – Δ HbA_{1c}	BL HbA_{1c}	.50**	.62***	−.24	2.76**	3.60***
Δ PAID – Δ Self-care	BL Self-care	−.49**	−.42*	−.09	−1.67*	−1.42[a]

Note. PAID = Problem Areas in Diabetes Scale; BL = Baseline

[a] p=.08

* p<.05,

** p<.01,

*** p<.001