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Pathways for the relationship between Diabetes Distress, Depression, Fatalism and Glycemic Control in Adults with Type 2 Diabetes

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Abstract

Background—The aim of this study was to examine the mechanism by which depressive symptoms, diabetes distress, and diabetes fatalism together influence diabetes outcomes using structured equation modeling.

Methods—615 adults with type 2 diabetes were recruited from two primary care clinics in the southeastern United States. Psychosocial factors found to be associated with diabetes outcomes were measured using validated questionnaires. Structured equation modeling (SEM) was used to investigate the relationship between diabetes fatalism, depressive symptoms, diabetes distress, self-care and glycemic control.

Results—The final model ($\chi^2(903) = 24088.91$, $p < 0.0001$, $R^2 = 0.93$, RMSEA=0.05 and CFI=0.90) showed that higher diabetes distress was directly significantly related to a decreased self-care ($r = -0.69$, $p < 0.001$) and increased HbA1c ($r = 0.69$, $p < 0.001$). There was no significant direct association between depressive symptoms or fatalism, and glycemic control or self-care.

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There was, however, an indirect association between increased depressive symptoms and increased fatalism, explained through the direct association with diabetes distress in that higher depressive symptoms (0.76, $p<0.001$) and higher fatalism (0.11, $p<0.001$) were significantly associated with higher diabetes distress.

Conclusion—Diabetes distress serves as a pathway through which depressive symptoms and fatalism impact both glycemic control and self-care. In addition, pathways between diabetes distress and both self-care behaviors and glycemic control in patients with type 2 diabetes remained separate, suggesting the need to address both psychological and behavioral factors in standard diabetes care, rather than focusing on psychological care primarily through support for self-management and treatment of depression.

INTRODUCTION

Diabetes is a significant health concern in the United States. As of 2012, the chronic metabolic disease has affected 29.1 million Americans – 9.3% of the population – deeming it the country's seventh leading cause of death. (1) In addition to increased risks of health complications, such as cardiovascular disease, stroke, kidney disease, amputations, and blindness, individuals with diabetes are also at risk for developing psychological problems. (1) As a result, along with pharmacological interventions, emphasis has been placed on screening, identifying, and counseling individuals for depression. (2) However, other psychological factors such as diabetes distress and fatalism are not directly accounted for in guidelines.

Social determinants of health are defined as the socioeconomic and psychosocial conditions in which individuals are born, work, and live that influence the presence of health problems such as diabetes. (3) Studies have shown an association between social determinants of health and diabetes outcomes. (4–6) Based on the World Health Organization framework, there exists four main categories of social determinants: material circumstances, such as availability to resources, behavior and biological factors, such as genetic and lifestyle risks, the health system itself, and psychosocial factors. (7) Depression, diabetes-related distress, and diabetes fatalism are three psychosocial factors that have been shown to individually influence diabetes outcomes. (8–10)

Depression has been studied extensively in patients with diabetes, and results have shown individuals diagnosed with diabetes are more likely to develop depression, or depressive symptoms, than non-diabetic individuals. (11–12) Depression in patients with diabetes, is directly associated with poor glycemic control, decreased adherence to treatment, increased risk of diabetes-related complications, decreased quality life, and increased mortality. (13–16) Individuals also experience similar, but fundamentally different, psychosocial concerns. As has been pointed out by Fisher et al., the clinical guidelines for depression are based on symptom-based scales, which, reflect the severity of an individual's psychological condition, but not the actual cause. (17) Diabetes distress describes the contextual and situational challenges an individual experiences regarding the management, support, and emotional stress of diabetes. (17) A series of studies found diabetes distress, rather than depression, to be significantly associated with self-management and glycemic control, supporting the

influence of diabetes distress on diabetes outcomes. (4,6,18) A third psychological factor influencing patients with diabetes is diabetes, the concept that individuals are powerless with respect to having control over the course of diabetes. (19) Fatalism has been shown to involve individuals' coping response, the illness experience, and the individual's spiritual beliefs. (19) Previous findings indicate that diabetes fatalism is also associated with poor self-care, poor glycemic control, and a decreased quality of life. (19–20)

While some studies have investigating the mechanism by which individual psychological factors exert their influence on self-care behavior and diabetes outcomes, few studies have examined these pathways in combination. Interventions can be more effectively designed with a clear understanding of the pathways through which various psychological factors influence outcomes. For example, if depression is the pathway through which other psychological factors exert their influence, then efforts should focus on properly diagnosing and treating depressive symptoms in patients with diabetes. If, however, diabetes distress is the mechanism, interventions should be designed to directly address the underlying distress, rather than indirectly address it through treatment for depression. In addition, while patients whose distress rises to the level of clinical diagnosis of depression may be identified and treated, if distress itself is the mechanism those with less severe symptoms may not be diagnosed when the focus is on depression only. Therefore, the aim of this study was to examine the mechanism by which depression, diabetes distress, and diabetes fatalism together influence diabetes outcomes using structured equation modeling.

METHODS

Sample

615 adults with type 2 diabetes were recruited from two primary care clinics in the southeastern United States after approval by local institutional review board and the VA Research and Development committee. Eligibility patients were 18 years or older, had a diagnosis of type 2 diabetes, and were able to communicate in English. Those determined by interaction or chart documentation to have cognitive impairment due to significant dementia or active psychosis were excluded.

Those determined eligible were sent letters or approached in clinic to introduce the study and determine interest. If interested, patients were consented, after which they completed validated questionnaires which included demographic information, self-care, and psychological factors. Most recent A1c in the past 6 months was abstracted from the electronic medical record.

Demographic Variables

Previously validated questionnaires were used to collect demographic information including age, race, gender, marital status, income, education, employment, diabetes duration, and comorbidity status. (21) Comorbidity was also a continuous variable, calculated using the Charlson comorbidity index. (22) The Charlson index is a weighted index that takes both the number and the seriousness of comorbid conditions into account, with higher numbers

indicating higher expected mortality resulting from higher numbers of and more severe comorbid disease levels. (22)

Psychosocial Factors

Fatalism was assessed using the Diabetes Fatalism Scale (DFS), a 12-item scale measuring dimensions of diabetes fatalism, including emotional distress, religious and spiritual coping, and perceived self-efficacy. (23) Individual questions are scored on a 6-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Higher overall scores indicate greater fatalistic views. The DFS has good internal consistency (Cronbach's alpha 0.804). (23)

Depressive symptoms were assessed using the Patient Health Questionnaire (PHQ-9), a 9-item scale which scores each of the DSM-IV criteria for depression on a scale from 'not at all' to 'nearly every day'. (24) The PHQ-9 is a valid and reliable measure of depression severity with higher scores indicating more severe depression. (25) A PHQ-9 score of ≥ 10 has a sensitivity of 88% and specificity of 88% for major depression, with additional cut-points at 5, 10, 15, and 20 to represent mild, moderate, moderately severe, and severe depression. (24)

Diabetes distress was assessed using the Diabetes Distress Scale (DDS), a 17-item measure based on questions about disease management, support, emotional burden, and access to care. (26) Respondents score questions on a 6-point scale for the degree to which specific events cause distress. (26) DDS17 has good internal reliability (Cronbach's alpha 0.87) and validity. (27)

Outcomes

Diabetes self-care was measured using the Morisky Medication Adherence Scale (MMAS) and the Summary of Diabetes Self-Care Activities (SDSCA). (28,29) The MMAS is an 8-item scale with questions asking about forgetting, stopping, or cutting back on medications. The scale has good concurrent and predictive validity (alpha reliability = 0.61), with higher scores indicate more adherence. (28) The SDSCA is an 11-item scale with questions on the frequency of self-care activities in the past 7 days. (29) Questions ask about self-care surrounding general diet (following a healthy diet), specific diet (eating fruits/low fat foods), exercise, blood glucose testing, and foot care. (29) The SDSCA has been shown to be a valid and reliable measure of self-care activities. (29)

Hemoglobin A1c was abstracted from the medical record using the measure closest to the visit date, and within the previous 6 months.

Analysis

Structured equation modeling (SEM) was used to investigate the relationship between diabetes fatalism, depressive symptoms, diabetes distress, self-care and glycemic control in adults with type 2 diabetes. Figure 1 shows the hypothesized model, where diabetes fatalism, depressive symptoms, and diabetes distress each have separate direct paths to glycemic control, and indirect paths to glycemic control, through self-care. A sample of 615 adults provided the sample size necessary to maintain 80% power while estimating coefficients and

standard errors. (30, 31) A 20:1 ratio (subjects to variables) is recommended to provide stability of parameter estimates, while minimizing over-saturation of the model. (30, 32)

Analyses were performed using Stata version 13, using the maximum likelihood estimation procedure and the 'mlmv option', which retains variables rather than using listwise deletion. First, descriptive statistics were run to ensure normality and linearity. Secondly, a series of confirmatory factor analysis (CFA) models were used to estimate the latent factors. Finally, an SEM model was used to test the relationships between variables. Alpha statistics and factor analysis was used to examine loading, and CFA was conducted using principal component factor analysis. SEM parameters were evaluated based on direction and magnitude of path coefficients. Goodness of fit was evaluated using the root mean square error of approximation (RSMEA) and comparative fit index (CFI) since the chi2 statistic is sensitive to large sample sizes. (33) For RSMEA values lower than 0.05 indicate a good fit and 0.08 indicate a reasonable fit. For CFI a value of 1 indicates a perfect fit, 0.9 indicates adequate fit and 0.8 indicates marginal fit. (33) Analyses were conducted using standardized estimates to allow comparison between variables in the model.

RESULTS

Demographic characteristics are shown in Table 1. In this sample, the mean age was 61 years, mean years of education were 13.4, and mean hours of employment per week were 12.5. On average patients had been diagnosed with diabetes for 12 years, and had a Charlson Comorbidity score of 25.7. 65% of the sample was non-Hispanic black, 62% were men, and 50% were married.

Latent Variables

Descriptive information on variables used for the SEM model are shown in Table 2, including mean and standard deviation values for fatalism, diabetes distress, depressive symptoms, glycemic control, and self-care variables. Correlations among the variables are shown in Table 3. Latent variables were created for depressive symptoms, diabetes distress, and fatalism using the individual questions in the measurement scales. A latent variable for self-care was created using the scores for the individual self-care variables including medication adherence, general diet, specific diet, exercise, blood sugar testing, and foot care. All measured variables had significant loading onto latent variable at the $p < 0.001$ level, alpha statistics were high (over 0.61), and variables loaded onto one factor with significant loading for all variables, supporting individual latent variables for depressive symptoms, distress, fatalism, and self-care. Factor loadings ranged from 0.28–0.68 for self-care, from 0.12–0.91 for fatalism, from 0.52–0.90 for depressive symptoms, and from 0.38–0.82 for diabetes distress.

Structural Model

Direct, indirect, and total effects for the final model are shown in Table 4, and the final model is presented in Figure 2. The final model ($\chi^2(903) = 24088.91$, $p < 0.0001$, $R^2 = 0.93$, $RMSEA = 0.05$ and $CFI = 0.90$) shows that higher diabetes distress is directly significantly related to a decreased self-care ($r = -0.69$, $p < 0.001$) and increased HbA1c ($r =$

0.69, $p < 0.001$). There was no significant direct association between depressive symptoms or fatalism, and glycemic control or self-care. There was, however, an indirect association between increased depressive symptoms ($r = 0.60$, $p < 0.001$), and increased fatalism ($r = 0.20$, $p < 0.001$) with increased glycemic control. There was also an indirect association between increased depressive symptoms ($r = -0.52$, $p < 0.001$) and increased fatalism ($r = -0.27$, $p < 0.05$) with decreased self-care. This indirect association is explained through the direct association with diabetes distress in that higher depressive symptoms (0.76, $p < 0.001$) and higher fatalism (0.11, $p < 0.001$) were significantly associated with higher diabetes distress.

DISCUSSION

While we hypothesized each psychological factor was individually related to self-care and glycemic control (Figure 1), our final trimmed model shows that diabetes distress was the most significant pathway through which fatalism and depressive symptoms negatively influence diabetes outcomes (Figure 2). Furthermore, though we hypothesized the psychological factors indirectly influenced glycemic control through self-care, there exists two separate pathways by which diabetes distress influences outcomes, that is, by its direct relationship with self-care behaviors and its direct relationship with glycemic control in individuals with type 2 diabetes. These findings are significant in further explaining the relationship between psychosocial factors, such as fatalism, depressive symptoms, and diabetes distress, and the health outcomes of patients with diabetes. Based on these results, interventions should be developed to directly address diabetes distress, rather than just addressing mental health disorders such as depression or anxiety. While clinicians and researchers have called for consideration of emotional distress beyond depressive symptoms in treatment for patients with diabetes (17), this is the first study to our knowledge that tested hypothesized pathways through structured equation modelling.

Our results demonstrate that while depression and fatalism are important factors, with an indirect relationship on health outcomes, diabetes distress may have a more direct relationship with both glycemic control and self-care behaviors. This is a novel finding that contributes to previous research supporting the importance of addressing diabetes distress, above and beyond addressing depressive symptoms in patients with diabetes. As diagnosis of depression is symptom based, the context of diabetes and emotional distress of individuals managing life stressors associated with the diagnosis may be a major factor in elevated depressive symptoms. (17) As a result, these findings support the recommendation to address the emotional distress related to diabetes care in regular care, rather than only treating patients if depressive symptoms reach a threshold. For example, fatalism was indirectly associated with both glycemic control and self-care, with direct associations to both distress and depression. Whether fatalism leads directly to distress or works through depression may depend on the individual; however, addressing the emotional distress underlying fatalistic attitudes could influence either pathway.

Furthermore, this study shows that the impact of distress on self-care and glycemic control may be twofold and separate. A study by Fisher et al. found that three separate interventions aimed to reduce diabetes distress through improving self-management led to improvement in self-care behaviors, though no change in HbA1c. (34) Conversely, in a meta-analysis of

randomized controlled trials of psychological interventions to improve glycemic control in patients with type 2 diabetes, Ismail et al. found that both glycemic control and psychological distress were improved with psychological intervention. (35) Healthcare providers must acknowledge the importance of psychosocial determinants such as diabetes distress, depressive symptoms, and fatalism on diabetes outcomes separate from the influence on self-care alone. The current standard of care for psychosocial assessment includes routine screening for psychological disorders and psychosocial problems as part of self-management education and support. (2) In addition, routine screening for depression is recommended. (2) It may be important, however, to implement routine psychological screening as part of standard diabetes care, addressing not only depression, but diabetes related distress, and treating individuals in a more holistic manner with support for self-management, treatment of depression, and efforts to reduce diabetes distress. More work should be done to better understand whether diabetes fatalism is a trait or a state, so that effective interventions can be designed to address fatalism in the clinical setting. Understanding the mechanism by which these psychosocial variables influence diabetes outcomes, and how each presents itself in a clinical encounter will be useful in tailoring interventions in order to address the individual's specific psychological and behavioral needs.

This study has limitations that should be acknowledged. First, data was collected in a cross-sectional manner, therefore, cannot speak to causality or direction of effect. While SEM can be used to elucidate pathways, further work should investigate longitudinal data to understand direction of effect. Secondly, participants were located in the southeastern United States. While, it is not expected to differ based on region or country, future work should be conducted elsewhere to validate these findings. Finally, additional factors can influence the latent and measured variables and may further explain relationships.

In conclusion, based on a sample of adults with type 2 diabetes, diabetes distress serves as the pathway through which depressive symptoms and fatalism impacted both glycemic control and self-care. In addition, pathways between diabetes distress and both self-care behaviors and glycemic control in patients with type 2 diabetes remained separate, suggesting the need to address both psychological and behavioral factors in standard diabetes care, rather than focusing on psychological care primarily through support for self-management and treatment of depression.

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Figure 1.
Hypothesized Model of Influence of Diabetes Distress, Fatalism, and Depression on Glycemic Control

Figure 2. SEM Model of Influence of Diabetes Distress, Fatalism, and Depression on Glycemic Control

Note: Coefficients are standardized path coefficients.

Overall Model Fit: $\chi^2(903)=2408.91$, $p<0.001$; $R^2=0.93$, RMSEA=0.052, CFI=0.900

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 1

Sample Demographic Characteristics (n=615)

	mean± standard deviation or %
Age	61.3±10.9
Education	13.4±2.8
Employment Hours	12.5±19
Diabetes Duration	12.3±9.1
Charlson Comorbidity Score	25.7±2.2
Race	
White	33.0
Black	64.9
Other	2.1
Sex	
Women	38.4
Men	61.6
Marital Status	
Never married	11.2
Married	49.7
Separated/Divorced	28.2
Widowed	10.9
Income	
<\$10,000	20.2
\$10,000–\$14,999	11.3
\$15,000–\$19,999	10.1
\$20,000–\$24,999	10.4
\$25,000–\$34,999	14.7
\$35,000–\$49,999	13.8
\$50,000–\$74,999	10.1
\$75,000 or more	9.4
Site	
MUSC	51.2
VAMC	48.8

Table 2

Descriptive Characteristics of Structural Equation Model Factors

Factors	Mean Values $\pm$ Standard Deviation
Fatalism	34.0 $\pm$ 9.5
Diabetes Distress	1.6 $\pm$ 0.7
Depressive Symptoms	6.1 $\pm$ 6.0
Glycemic Control (HbA1c)	7.9 $\pm$ 1.8
Self-Care	
Medication Adherence	5.9 $\pm$ 2.0
General Diet	4.7 $\pm$ 2.0
Special Diet	4.0 $\pm$ 1.6
Exercise	2.6 $\pm$ 2.2
Blood Sugar Testing	4.6 $\pm$ 2.5
Foot Care	4.3 $\pm$ 2.5

Table 3

Pairwise Correlations for Glycemic Control, Quality of Life, Self-Care Behaviors, Fatalism, Diabetes Distress, and Depressive Symptoms

	1	2	3	4	5	6	7	8	9	10
1. HbA1c	–	–	–	–	–	–	–	–	–	–
2. General diet	–0.12 [*]	–	–	–	–	–	–	–	–	–
3. Specific diet	–0.07	0.36 [*]	–	–	–	–	–	–	–	–
4. Exercise	–0.10 [*]	0.29 [*]	0.15 [*]	–	–	–	–	–	–	–
5. Blood sugar testing	0.09 [*]	0.21 [*]	0.19 [*]	0.11 [*]	–	–	–	–	–	–
6. Foot care	0.03	0.22 [*]	0.22 [*]	0.12 [*]	0.28 [*]	–	–	–	–	–
7. Medication adherence	–0.20 [*]	0.28 [*]	0.26 [*]	0.13 [*]	0.17 [*]	0.23 [*]	–	–	–	–
8. Fatalism	0.08 [*]	–0.06	–0.06	–0.09 [*]	–0.01	–0.09 [*]	–0.07	–	–	–
9. Diabetes distress	0.27 [*]	–0.33 [*]	–0.23 [*]	–0.18 [*]	–0.10 [*]	–0.07	–0.36 [*]	0.31 [*]	–	–
10. Depressive symptoms	0.16 [*]	–0.26 [*]	–0.18 [*]	–0.21 [*]	–0.07	–0.05	–0.30 [*]	0.26 [*]	0.66 [*]	–

^{*} p<0.05. Abbreviations: HbA1c=Hemoglobin A1c

Table 4

Standardized Direct, Indirect, and Total Effects for Relationship of Self-Care Behaviors, Depressive Symptoms, Diabetes Distress, and Fatalism on Glycemic Control

	Direct Effects	Indirect Effects	Total Effects
Self-Care Behaviors			
→Depression	−0.25	−0.52 ***	−0.77 ***
→Diabetes Distress	−0.69 ***	—	−0.69 ***
→Fatalism	0.05	−0.27 ***	−0.22 ***
Depression			
→Fatalism	0.25 ***	—	0.25 ***
Diabetes Distress			
→Depression	0.76 ***	—	0.76 ***
→Fatalism	0.11 ***	0.19 ***	0.31 ***
Glycemic Control			
→Self-Care	−0.10	—	−0.10
→Depression	−0.15	0.60 ***	0.45 *
→Diabetes Distress	0.69 ***	0.07 ***	0.76 ***
→Fatalism	−0.04	0.20 ***	0.16 *

*
p<0.05,

**
p<0.01,

p<0.001

Note: Significant direct effects indicate direct association between variables. For example, increased diabetes distress is associated with poorer glycemic control (i.e., higher glycosylated HbA1c). Significant indirect effects indicate pathway through which variables influence self-care behaviors, diabetes distress, and glycemic control.