

Depression Increases Diabetes Symptoms by Complicating Patients' Self-Care Adherence

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PURPOSE

This study evaluated whether diabetes patients with depressive symptoms are more likely than other diabetes patients to report symptoms of glucose dysregulation, and whether this relationship is mediated by the impact of depressive symptoms on patients' adherence to their diabetes self-care regimen.

METHODS

Participants were English- and Spanish-speaking adults with type 2 diabetes. Interviewers assessed participants' depressive symptoms and diabetes-related symptoms at baseline. Self-care behaviors and diabetes symptoms were measured at a 1-year follow-up. Structural equation models were used to determine whether depression affected diabetes symptoms by limiting patients' ability to adhere to self-care recommendations.

RESULTS

An initial model identified direct effects of baseline depressive symptoms on self-care and diabetes symptoms at follow-up. The relationship between self-care behaviors and physical symptoms of poor glycemic control were assessed using a second model. Results explained the relationship between depressive symptoms at baseline and diabetes symptoms at 1 year.

CONCLUSIONS

Depressive symptoms impact subsequent physical symptoms of poor glucose control by influencing patients' ability to adhere to their self-care regimen. More aggressive management of depression among patients with diabetes may improve their physical health as well as their mental health.

At any given time, 15% to 20% of people with diabetes have a major depressive disorder compared with 2% to 9% of the general population.¹ Once patients with diabetes become clinically depressed, they are much more likely to experience subsequent depressive episodes. In one study, 79% of patients with diabetes who were diagnosed with major depression experienced additional episodes over the course of 5 years (mean=4.2 additional episodes during the course of the study).²

In addition to the important direct effect of depression on diabetes patients' quality of life, it also has been linked to a variety of diabetes-related physical problems. Depression has been associated with poorer glycemic control³ and an increase in the prevalence of diabetes complications.^{4,6} Depressive symptoms also are associated with increased gastrointestinal symptoms⁷ and symptoms of glucose dysregulation.⁸

A number of studies have noted an association between depression and diabetes patients' physical health status; however, few studies have explored the mechanisms that link these 2 variables. One possible mechanism is that levels of depression and physical symptoms of diabetes are related because depressive symptoms impede patients' ability to adhere to their diabetes self-care regimen. Several studies have shown a cross-sectional association between levels of depression and diabetes self-care. Ceichanowski and colleagues^{8,9} found that depression was associated with poorer diet, medication adherence, and physical activity levels. Similarly, Lustman and colleagues¹⁰ found that depression was associated with poorer blood glucose self-monitoring. Recent randomized trials^{11,12} found that, compared with patients receiving usual care, diabetes patients receiving a telephone-based intervention reported co-occurring reductions in physical diabetes symptoms, depressive symptoms, and self-care problems.

The results from these prior studies have provided important information, yet they have not established definitively whether self-care behaviors are the missing link mediating the relationship between depression and diabetes patients' perceived health status. One alternative explanation for this association is that depression could affect patients' perception of symptoms and lead them to attribute the physical or somatic symptoms of depression to problems with their glycemic control. Because the underlying mechanism is

unclear, it is uncertain whether diabetes educators working with diabetes patients with comorbid depression should focus on assisting them with their self-care and/or helping them to understand the relationship between depression-related cognitions and their perceptions of their diabetes health status.

The purpose of this study was to identify the role of self-care behaviors as a determinant of the poorer outcomes experienced by diabetes patients with significant depressive symptoms. Specifically, this study addressed the following questions: (1) Is a diabetes patient's level of depressive symptoms related to subsequent reporting of symptoms of glucose dysregulation? and (2) If so, is this relationship mediated by the impact of depressive symptoms on adherence to a diabetes self-care regimen? Figure 1 presents a model of the hypotheses.

METHODS

Participants

This study included 307 diabetes patients using hypoglycemic medication who were in the usual-care arm of 2 randomized trials of telephone care management with automated telephone follow-up. A more detailed description of the trials is available elsewhere.^{11,12} English- and Spanish-speaking participants were enrolled at the time of the visits to 2 county clinics (both general medicine clinics) and 4 nearby Department of Veterans Affairs (VA) clinics (3 general medicine clinics and 1 diabetes specialty clinic).

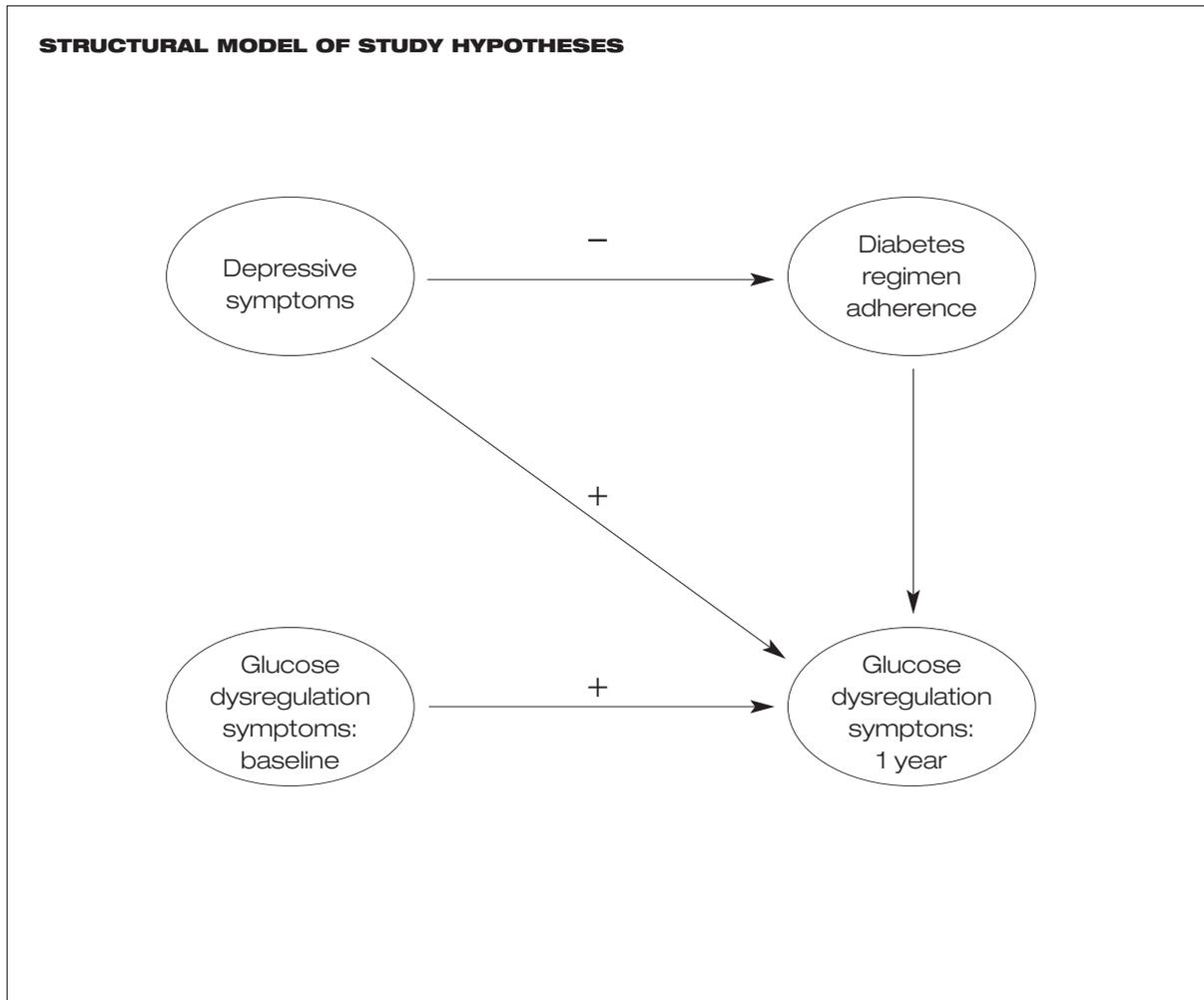
Measures and Data Collection

Participants were surveyed via telephone in their native language at baseline and 12 months later. The current study used data from depression and diabetes symptom measures that had been collected during the baseline interview. Data from self-care measures were collected at the 1-year follow-up when diabetes symptoms were measured a second time.

Depressive Symptoms

Depressive symptoms were assessed using 2 measures. The first measure was the short form of the Center for Epidemiological Studies Depression (CES-D) screener (range of scores=7-49, $\alpha=.82$ in this data set). The CES-D was supplemented with the 5-item mental health subscale from the Medical Outcomes Study 36-item Short Form (range of scores=5-25, $\alpha=.89$ in this data set).

Figure 1.



Hypothesized mediational relationship between depressive symptoms and symptoms of glucose dysregulation.

Both scales have good reliability and validity,^{13,14} and both were coded so that higher scores indicated greater affective distress.

Diabetes Self-Care Adherence

Diabetes self-care adherence was assessed using measures of medication adherence, diet, and patients’ ability to follow self-care recommendations.

A modified version of Morisky’s Medication Adherence Scale was used to assess participants’ adherence to prescription drugs.¹⁵ This scale consists of 3 yes/no items that ask if the individual sometimes forgets to take medications, stops taking medications when feeling better, or stops taking medications when feeling worse. A prior study demonstrated a strong correlation between patients’ medication adherence scores and their physiologic health status.¹⁵

A 3-item scale was created to measure the extent to which participants ate foods that are consistent with dietary guidelines for people with diabetes. The items assessed how often a patient might “eat later than you should or skip a meal,” “eat foods you should avoid,” and “omit foods you should eat.” Responses ranged from 1=never to 5=always. The scale had an α of .62, and scores were strongly correlated with participants’ risk of nutrition-related health problems. For example, compared with participants in the highest (ie, best) third of the distribution for this measure, participants in the lowest third were more than twice as likely to be severely obese as measured by their body mass index (19% vs 9%, respectively; $P<.001$) and more likely to have diagnoses of hyperlipidemia (58% vs 45%, $P=.016$) and atherosclerosis (25% vs 14%, $P=.012$).

Characteristics of Study Participants (N=307)

Variable	% of Sample	Mean (SD)
Sociodemographics		
Race/Ethnicity		
Hispanic/Latino	31.0	
Caucasian	45.0	
African American	12.0	
Other	12.0	
Female gender	28.6	
Income <\$15 000	62.0	
Age, y		57.6 (10.6)
High school education or less	51.0	
Clinical characteristics		
Insulin use	36.5	
Obese (BMI >30g/m ²)	53.9	
Comorbid hypertension	67.7	
Comorbid hyperlipidemia	52.0	
Study variables		
CES-D		11 (4.0)
SF-36 MHSS		14 (7.0)
Hyperglycemic symptoms		1.9 (1.6)
Hypoglycemic symptoms		1.5 (1.6)
Microvascular symptoms		0.76 (0.83)
Dietary behavior		10.5 (2.43)
Medication adherence		2.3 (0.8)
General adherence		19.7 (4.7)

CES-D=Center for Epidemiological Studies Screener for Depression; SF-36 MHSS=Mental health subscale score of the Medical Outcomes Studies 36-Item Short Form, reverse-coded so that higher scores indicate greater distress.

a 5-item scale ($\alpha=.72$ in this data set) measuring general adherence to self-care recommendations was created for the study by a panel of diabetes experts. The items in this scale measure the extent to which patients perceived concordance between their self-care and their clinician's recommendations. The measure displayed adequate discriminant validity as it was found to be positively correlated with the medication adherence measure ($r=0.34$, $P<.001$) and negatively related to the measures of unhealthy eating ($r=-0.31$, $P>.001$), hypoglycemic symptoms ($r=-0.17$, $P<.01$), and microvascular symptoms ($r=-0.16$, $P<.01$).

Diabetes Symptom Burden

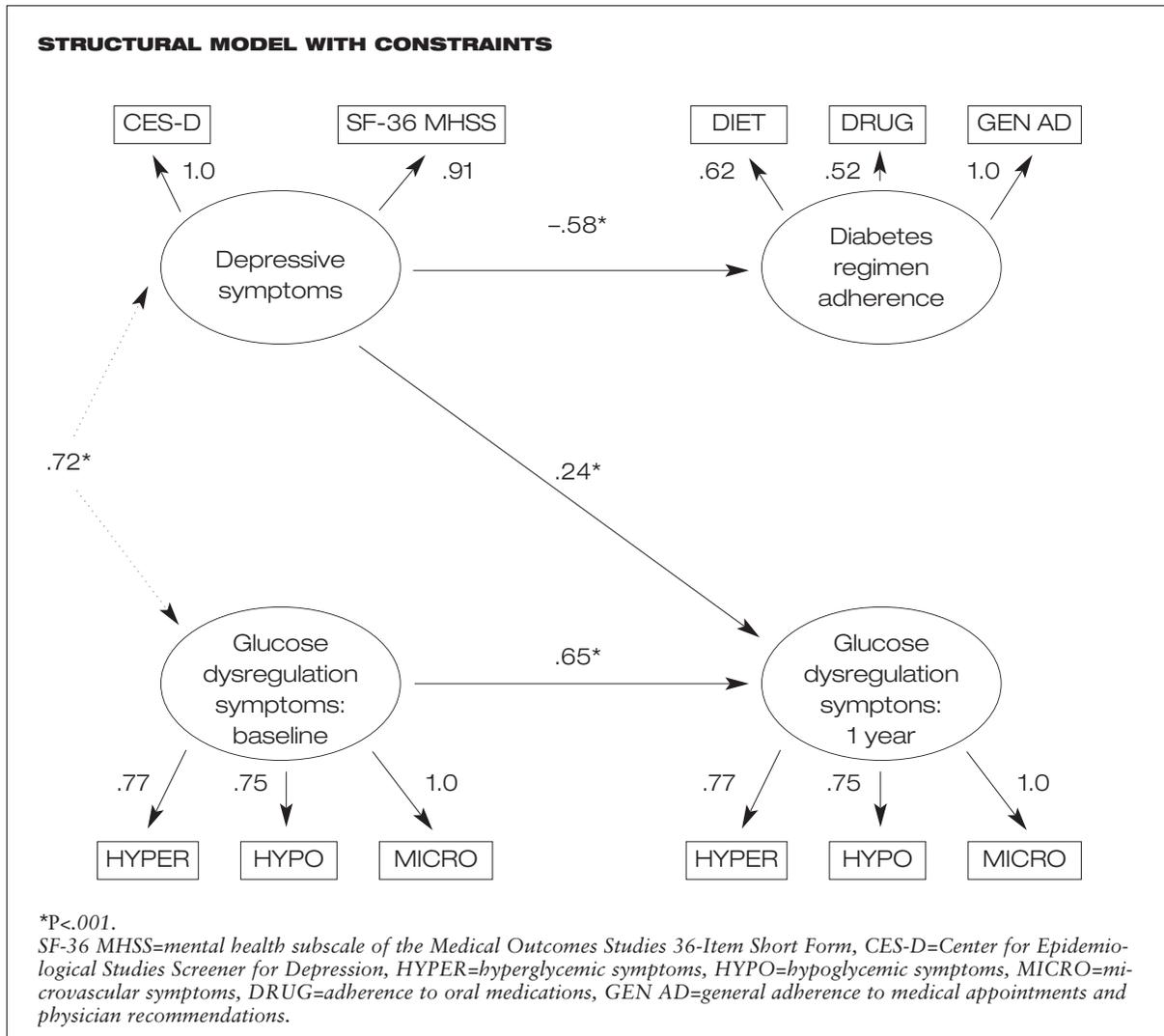
Symptoms of glucose dysregulation were measured using participants' reports of whether they experienced diabetes-related symptoms during the prior week in the following 3 areas: hyperglycemia (eg, "frequent

urination at night"), hypoglycemia (eg, "shakiness or weakness"), and microvascular problems (eg, "pain in the calf muscles when walking").

Data Analysis

Structural equation modeling (SEM)¹⁶ was used to evaluate the conceptual model with the 3 variables of interest (ie, depressive symptoms, diabetes self-care adherence, and diabetes symptoms) (Figure 1). The goal of SEM is to test the relationships among factors that cannot be directly observed (ie, latent variables such as diabetes patients' mental health and self-care adherence) based on the relationships among groups of measured indicators for each latent construct (eg, patients' responses to mental health functioning questions or questions about recent medication-taking behavior). Using the approach suggested by Anderson and Gerbing,¹⁷ we first evaluated whether the indicators for each of the latent variables in this study (ie, the measurement

Figure 2.



model) adequately reflected the underlying domains. We then tested whether the impact of depressive symptoms on self-care behavior mediated the relationship with diabetes-specific symptoms. This evaluation was accomplished by comparing the extent to which models that did and did not assume a mediational role for self-care fit the available data.¹⁸

RESULTS

Characteristics of Participants

Because patients were drawn from 2 systems of care, the sample was sociodemographically diverse (see the Table). Fifty-five percent of participants were non-white, 29% were female, 62% had incomes of less than \$15 000 per year, and 51% had a high school education or less. From a clinical perspective, 37% of participants used insulin, 54% had a body-mass index of at least 30, and most patients had 1 or more diabetes complications.

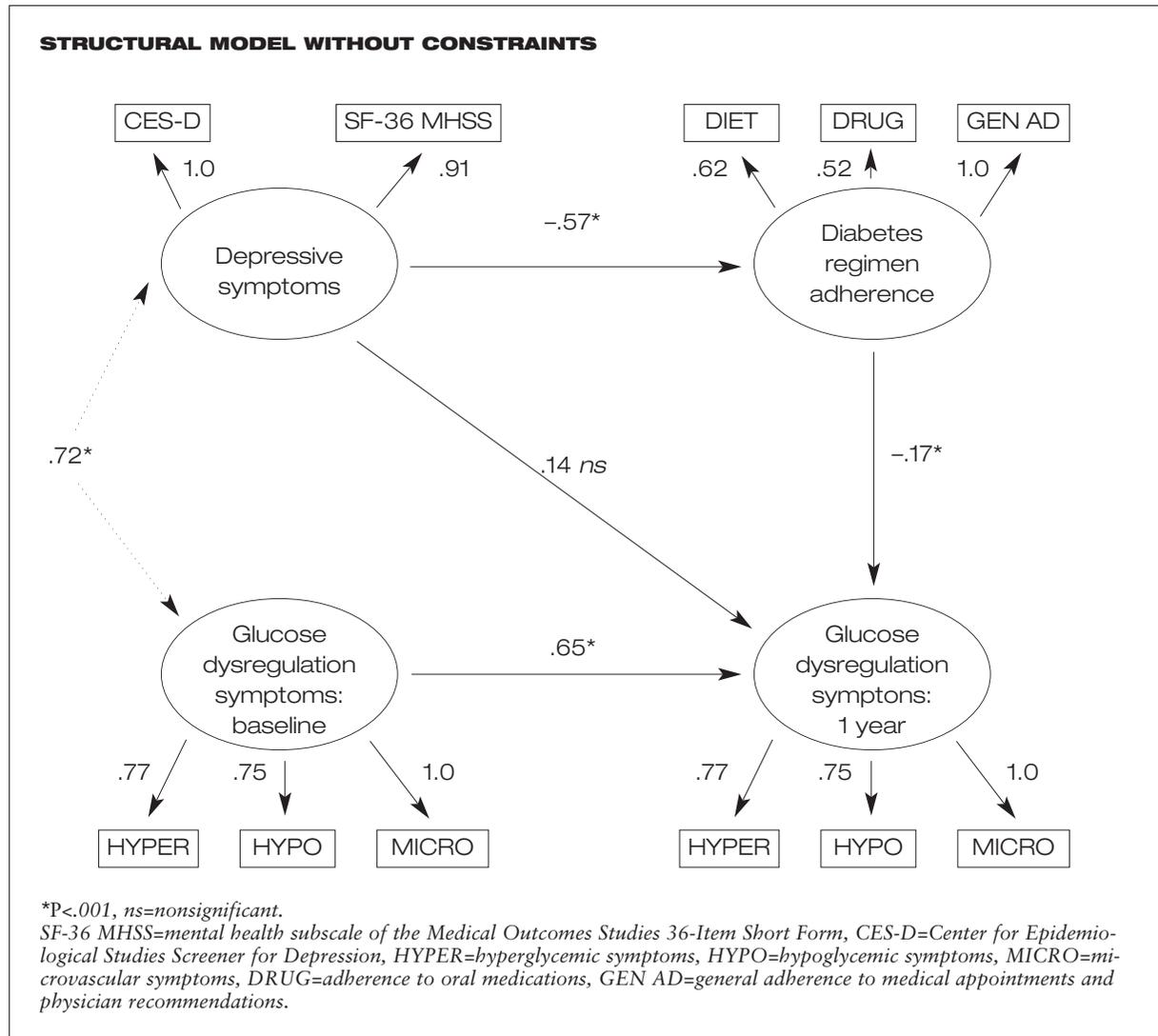
Measurement Model

Analyses indicated that the observed variables fit the latent variable model very well (details available from the authors on request). All factor loadings were substantial, statistically significant, and in the expected direction. This finding suggests that the measures used in this study are good indicators of diabetes self-care, depressive symptoms, and diabetes-related symptoms.

Structural Model

As can be seen in Figure 2, depressive symptoms at baseline significantly predicted the baseline-to-1-year change in symptoms of glucose dysregulation ($\beta=.24$, $P<.001$). However, when self-care adherence was allowed to predict symptoms of glucose dysregulation at 1 year (Figure 3), the relationship between depressive symptoms and glucose dysregulation was no longer

Figure 3.



significant ($\beta = .14, P > .05$). This finding suggests that depressive symptoms have little direct impact on diabetes-related symptoms above and beyond their impact on patients' self-care behaviors. The model specified in Figure 3 accounted for 33% of the variance in diabetes self-care adherence and 74% of the variance in symptoms of glucose dysregulation at the 1-year follow-up.

CONCLUSIONS AND IMPLICATIONS FOR DIABETES EDUCATION

These results suggest that although diabetes patients' level of depressive symptoms is related to subsequent symptoms of glucose dysregulation, this relationship can be explained by how depressive symptoms interfere with patients' ability to adhere to a diabetes self-care regimen. The results have clear clinical implications for diabetes educators working with patients who have comorbid depression. Not only is depression management

meaningful from the perspective of a patient's quality of life, but it also appears to have implications for a patient's ability to attain diabetes self-care goals. The importance of addressing patients' affective state is magnified when one considers comorbid illnesses such as hypertension or hyperlipidemia, because depressed patients with diabetes also are likely to have difficulty managing the self-care regimen required for those conditions. Although assessment of depression in a primary care setting presents a challenge in today's time-constrained medical environment, the costs to the patient and the healthcare system of failing to identify depression among diabetes patients may be substantial. The case for vigorous screening to identify depression in patients with diabetes is made even more compelling by the fact that effective psychotherapeutic and pharmacological treatments exist and may improve patients' glycemic control.¹⁹⁻²¹

These analyses are interesting when viewed in light of the main findings from the trials in which these data were gathered. Compared with participants receiving usual care, intervention participants reported better diabetes self-care (ie, more frequent glucose self-monitoring and foot inspection, and better medication adherence), fewer glucose dysregulation symptoms, and better glucose control.¹¹ Additional analysis¹² demonstrated that intervention participants reported fewer depressive symptoms and greater self-management and self-efficacy than usual care participants. The findings from the current study provide a theoretically plausible way to organize the results of the 2 sets of outcome reports. Specifically, the beneficial effects of the intervention on participants' level of depression may have resulted in better adherence to their self-care regimen, leading to better glycemic control and, ultimately, fewer diabetes symptoms.

Some limitations of this study deserve comment. The data include samples of VA patients and county clinic patients. The extent to which the findings apply to other populations is yet to be determined. Further, these study measures were based on self-report, and it is possible that depressed mood may have influenced participants' subjective appraisal of their behaviors and their somatic symptoms. It would be helpful if future studies verified the current model using objective measures of self-care behaviors (ie, glucose testing counters, or insulin or oral medication counting devices). Unmeasured factors such as changes in self-efficacy and social support may have influenced the results. To understand these issues, this study should be replicated using different samples and the collection of multiple waves of data to more clearly disentangle the

temporal relationship between self-care adherence and symptoms of glucose dysregulation. Inclusion of a third wave of data would enhance the ability to assess causality and allow for the testing of competing mediational models.

The current findings suggest a plausible and empirically verifiable conceptual framework for understanding how depressive symptoms, diabetes physical symptoms, and self-care behaviors are interrelated. The model suggests that depressive symptoms may exert an effect on subsequent somatic symptoms by interfering with patients' ability to adhere to their self-care regimen and underlines the importance of identifying and treating depression in patients with diabetes. Many reliable but brief screening tests for depression are available,²² and diabetes educators should consider regular screening for depressive symptoms among their patients. However, identification of depression is only the first step in helping patients better manage both their mental and physical health problems. Patients with depression frequently are poorly managed in primary care, and many fail to adhere to depression management plans.^{23,24} Fortunately, studies have demonstrated that depression care management improves patients' outcomes.²⁵ An ongoing trial is evaluating the impact of aggressive depression care management among patients with comorbid diabetes.²⁶

Effective diabetes education should include attention not only to patients' physical health and self-care but to their mental health as well. With appropriate linkage to mental health specialty care and systems for insuring appropriate follow-up, diabetes educators may play a vital role in insuring that patients with diabetes and depression receive the care they need.

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