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Perceived health status and perceived diabetes control: psychological indicators and accuracy

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Abstract

Objective: The aim of this study is to assess the association of psychological, as well as physical and sociodemographic, indicators with patients' ratings of personal health status and diabetes control and to investigate the association of mental health and depression with errors in the perception of diabetes control. **Method:** A sociodemographically diverse sample of 623 diabetes patients was recruited from the general medicine clinics of a county health care system and a Veterans Affairs health care system. We examined three types of determinants of patients' health perceptions: physical health indicators (symptoms, comorbid diagnoses, and glycosylated hemoglobin or HbA_{1c} levels), psychological health indicators (general mental health and diabetes-related worry), and sociodemographic factors (age, race, gender, income, and education). **Results:** After controlling for patient' sociodemographic characteristics, perceived general health was associated with patients' symptom burden and emotional distress (but not with patients' HbA_{1c} levels). Perceived diabetes control additionally was associated with HbA_{1c} and diabetes-related worries. Further analyses showed that both mental health and diagnosed depression were associated with errors in personal appraisals of diabetes control, with depressed patients more often inaccurately assessing their glycemic control as poor (false-positive error) and nondepressed patients more often missing poor HbA_{1c} levels (false-negative error). **Conclusions:** Findings indicate that patients use a comprehensive model for assessing their general health and that depression may lead to more accurate assessments of *poor* glucose control.

Keywords: Diabetes mellitus; Perceived health status; Mental health; Depression; Accuracy; Diabetes control

Introduction

Individuals utilize a variety of strategies and information to appraise their physical condition [1,2]. However, little is known about the processes and sources of information that people rely on the most when determining their general health and how these processes may be similar or different in specific illnesses such as diabetes. Because patients who correctly identify their illness are more likely to receive the care they need [3,4], understanding the factors influencing patients' health perception is critical to identifying individuals who might over- or underuse health services while failing to achieve their best-possible level of health [5,6]. Accurate health monitoring and self-assessment is especially important in diabetes, where patients' health may change rapidly and patients often must adjust their self-care to address fluctuations in their physiologic well-being. If worsening health goes unnoticed, patients may fail to seek the services and treatment that they need and, as a result, run the risk of permanent functional impairment or death [7–9].

Many factors have been proposed as sources of information utilized by patients in assessing their health, including direct physical signs and symptoms, as well as external social, situational, and psychological processes, such as personal

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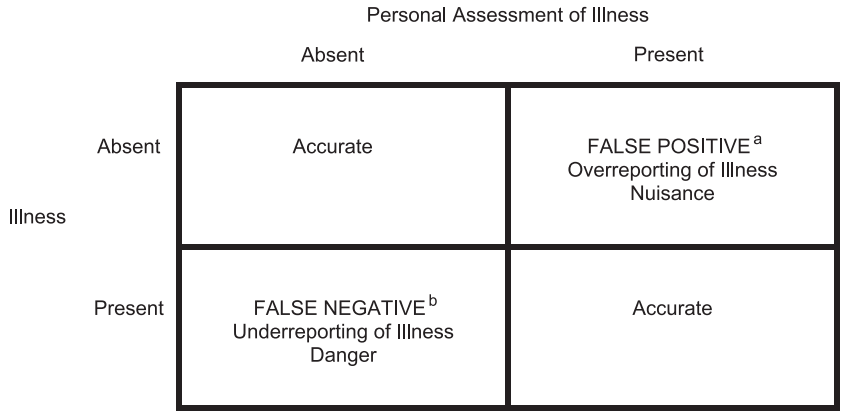
theories and beliefs [10–12]. At the core of illness perception, however, is the detection of bodily symptoms [2,13]. Without the experience of physical symptoms, patients often conclude that their health is satisfactory and carry on as usual without seeking or administering treatment [14]. This is demonstrated in certain asymptomatic conditions (e.g., hypertension or the beginning stages of some cancers), where illness often goes unidentified in the absence of routine screenings or wellness visits, potentially resulting in illness progression past treatment efficacy. Patients with Type 2 diabetes often experience few symptoms in the early stages of their illness, and roughly half of all diabetes patients in the United States are undiagnosed [15]. After diagnosis, reduced sensitivity in hands and feet due to neuropathy can increase the likelihood that sores go noticed, and without other sources of information (e.g., observation via regular feet checks), patients may risk infections or amputation.

Patients with diabetes are standardly advised to use glucose testing devices, such as meters or urine testing strips, on a regular basis to self-monitor their glucose levels [16]. However, patients with diabetes also appear to have some personal ability to detect abnormal glucose levels [17,18], and the accuracy of detection of blood glucose abnormalities can be enhanced with blood glucose awareness training [19–21]. Gonder-Frederick et al. [22] have represented the complexity of blood glucose detection in their biopsychobehavioral model of hypoglycemia. According to this model, steps in the glucose-detection process include physiological change and consequences that may produce sensations that, if detected, may or may not be interpreted as symptoms of illness (i.e., hypoglycemia). Their model also supports theory suggesting that symptom detection is not only influenced by objective somatic changes and sensory stimulus intensity but also by situational and social–psychological factors [10–12].

Psychological factors such as chronic mental states of depression and acute conditions of a negative mood have been associated with more complaints of physical symptoms and illness in both healthy and ill individuals [23,24]. Mechanisms through which negative mood may contribute to the perception of illness include (1) direct influences on physiological change and susceptibility to illness, (2) influence on attention, with increased vigilance toward internal symptoms, (3) influence on perceptions of commonplace symptoms as representing illness, and (4) influence on behavior with increases in provider visits and decreases in adherence to medical advice [25].

The extent to which depression may lead to a more accurate or inaccurate detection of symptoms and perceptions of physical illness is the subject of debate. Cross-sectional data suggest that depression contributes to an overreporting of symptoms and inaccurate perceptions of poor health when compared with objective data [26]. However, overreporting physical troubles is not the only possible error that a patient can make, and it is important to investigate errors that include incorrectly assessing health as good by overlooking conditions of illness (false negative) as well as incorrectly assessing health as poor (false positive; see Fig. 1). There is some evidence that lower levels of negative affect are associated with an inaccurate *underreporting* of symptoms [27], but more research is needed to determine the role of psychological factors in false-negative errors.

For people with diabetes, bodily symptoms from negative emotions may intermingle with symptoms from physical illness, augmenting the experience of poor health. Many of the symptoms of hyperglycemia and hypoglycemia overlap with sensations that are frequently experienced as part of anxiety and depression, such as fatigue, weakness, tenseness, pounding heart, fast pulse, queasy stomach, and



Note: [a] Often the focus of attention, probably because this type of error can result in the overuse of healthcare services and may serve as a burden.
[b] A different type of error, yet one that should not be ignored as falsely asserting that illness is absent may prevent a person from taking the necessary measures to treat the illness.

Fig. 1. False-positive and false-negative errors in the assessment of illness.

changes in appetite. Therefore, even though emotional distress may improve symptom detection accuracy, many of the symptoms associated with negative affect may be misattributed to problems with blood glucose control [28,29]. Studies of the relationship between emotional states and symptoms among diabetes patients indicate that emotional distress increases sensitivity to symptom perception and that the elevated perceptions of illness are related to symptoms of emotional upset misattributed to symptoms of physical illness (e.g., poor glycemic control; [23]).

Current study

A major goal of the current study was to examine the associations between three types of potential influences on diabetes patients' perceptions of their overall health and diabetes control, i.e., physical indicators (including physiologic information and symptoms), psychological indicators (general mental health and diabetes worry), and social factors (as indicated by patients' sociodemographic characteristics). Based upon the theoretical and empirical literature (e.g., Refs. [2,4,11]), we hypothesized that patients would integrate psychological and physical information when formulating assessments of their health. Specifically, we predicted that physical indicators, such as symptoms and clinical measures of glycemic control (i.e., HbA_{1c}), would predict perceptions of general health and diabetes control. Furthermore, we predicted that global psychological factors would influence both patients' perceptions of their overall health, as well as perceptions of diabetes control. Controlling for both physical and mental indicators, we expected that there would be little additional influence of patients' sociodemographic characteristics on their health perceptions.

Another goal of the current project was to assess the relationship between depression and the accuracy of patients' perceptions regarding their diabetes control, as indicated by HbA_{1c} levels. We were particularly interested in determining the relationship between mental health and potentially detrimental errors in perceptions, whereby patients appraise their diabetes control as good, when objective physiologic measures of their blood glucose indicate that control is poor. We were also interested in whether some patients had overly pessimistic appraisals of their diabetes control in the context of objective measures indicating near-normal blood glucose levels.

Methods

Participants and enrollment

Data were collected from patients with diabetes as part of two randomized trials evaluating the effectiveness of automated telephone assessments with diabetes nurse educator follow-up [30]. Patients were identified by research assistants via online and paper-based medical records and enrolled at the time of clinic visits. Patients were ineligible for the study if they were greater than 75 years of age, had a severe psychological disorder, had a life expectancy of less than 12 months, had a severe sensory impairment, or planned to discontinue receiving care from the clinic within 12 months. Of the 1500 patients identified from medical records as meeting the eligibility criteria, 28% were not approached for participation, as they failed to keep their medical clinic appointments, 17% declined participation, and 13% did not enroll for another reason. Fifty-two patients were not approached at the request of their physician. The remaining 623 patients were enrolled from general medicine and diabetes clinics within Veterans Affairs and county health care systems located in Northern California. There were no systematic differences in ethnicity, employment status, age, or insulin use between enrollees and patients who were eligible but not enrolled.

Measures

The data used in the current analyses were collected by trained interviewers as part of the patients' baseline telephone survey, prior to any exposure to the intervention under investigation in the larger study.

Perceived general health and diabetes control

We measured perceived general health by asking patients to self-assess their general health using a standard Likert scale ranging from 1 (*poor*) to 5 (*excellent*). Perceived diabetes-specific health was indexed by patient self-reported diabetes control on the same Likert response scale from 1 (*poor*) to 5 (*excellent*).

Physical health status indicators

A physical symptom index was created by summing the patients' self-reported experience of 20 symptoms over the past week. The symptom list was created with clinical co-investigators and was designed to reflect symptoms of hyperglycemia and hypoglycemia, in addition to other diabetes-related symptoms (e.g., symptoms of microvascular complications, such as retinopathy and peripheral neuropathy). Despite the intention to represent diabetes-specific symptoms, some of the symptoms (e.g., weakness or frequent urination) are experienced as part of other physical and mental conditions and thus overlap with nondiabetes ailments.

Patients' physiologic glycemic control was measured using the glycosylated hemoglobin (HbA_{1c}) blood test, which reflects glycemic control over the previous 2 to 3 months [31]. HbA_{1c} tests were conducted by a single laboratory and had a normal range of 4.7% to 6.4%. HbA_{1c} was analyzed as a continuous variable and was also dichotomized into "poor" (>8%) and "advisable/good" (≤8%) categories. Patients face a greater risk of complications when HbA_{1c} levels exceed 8% [32], with a level of 7% or lower considered desirable [33]. In general, the American Diabetes Association recommends an HbA_{1c} level <7% and

that reassessment of treatment should occur when HbA_{1c} levels are >8% [7].

Comorbidities were assessed by patients selecting conditions from a list developed in conjunction with the study's clinical co-investigators. The list included stroke, hypertension, heart attack, high cholesterol, atherosclerosis or ischemic heart disease, chronic lung disease, and congestive heart failure. Diabetes complications also were assessed, with patients self reporting secondary complications, such as nephropathy, hyperglycemic coma, neuropathy, and retinopathy. Self-reported diagnoses were used rather than medical record diagnoses to better reflect patient perceptions and assessments and to obtain a more complete enumeration of conditions than medical record review over a limited period of time (i.e., past 12 months) would provide.

Psychological measures

General mental health was measured using the Mental Health subscale of the SF-36 [34]. In this five-item scale, patients indicated how often (1=*always*, 5=*never*) over the past week they experienced feelings such as nervousness, happiness, depression, calmness, and peacefulness. This scale had a reliability of .84 in this sample and has been used extensively in prior community- and clinic-based studies. Patients' scores were standardized on a 0 to 100 scale, with lower scores indicating greater anxiety and depression. The mean score on the mental health subscale for the general U.S. adult population is 74.7 (S.D.=18.0). The mean score for the current sample was 71.6 (S.D.=21.4). To more specifically assess depression, patients were asked to report whether they had received a diagnosis of depression from a trained professional (i.e., doctor or nurse) in the previous 6 months.

Diabetes-related worry was assessed using the Worry scale of the Diabetes Quality of Life Measure (DQOL), originally developed and used in the Diabetes Control and Complications Trial [35,36]. The Worry scale consists of five items with good reliability [35]. Using a five-point Likert scale, where 1=*always* and 5=*never*, patients indicate their worry about having diabetes, passing out, complications from diabetes, and the effects of diabetes on their body and on their social life.

Statistical analyses

Statistical analyses were conducted in a two-phase process. In the first phase, bivariate and multivariate analyses were conducted to assess the association of patient characteristics with patient ratings of health status and diabetes control. Hierarchical linear regression analysis was used to predict perceived general health and perceived diabetes control by force entering patient characteristics in Step 1 (i.e., age, sex, race, income, marital status, and education) and physical and emotional variables in Step 2 (i.e., comorbidities, diabetes complications, years with diabetes, insulin use, HbA_{1c}, physical symptoms, mood, and diabetes worry).

In the second phase, bivariate correlations were conducted to assess the association of mental health and measures of diabetes control. Further analyses involved a categorical variable created by substantiating perceived diabetes control (good/adequate, poor) with HbA_{1c} levels (good/adequate, poor), to obtain four diabetes control accuracy groups (accurate poor, accurate good/adequate, inaccurate poor, and inaccurate good/adequate). Chi-square analyses were conducted, crossing accuracy groups with depression diagnoses.

Results

Sample description and perceived health

Study participants were sociodemographically diverse, with over half ethnic minorities (30% Hispanic/Latino, 12% Black/African American, 12% Other, 46% White/Caucasian), 43% married, 30% female, 49% having some college education, and 37% earning less than US$10,000 per year. Only 8% of the sample reported an annual income of US$35,000 or more, with none reporting an income level over US$75,000/year. The average age of the study sample was 58 years (S.D.=10.5). On average, participants reported 1.9 (S.D.=1.4) comorbid chronic illnesses and had a mean perceived general health of 2.7 (S.D.=1.0). Over half (59%) of the sample reported using oral hypoglycemic agents alone, 23% reported using insulin alone, and 10% of the patients reported using both insulin and oral hypoglycemics. The average HbA_{1c} for the group was 8.3% (S.D.=1.7%), with 49.3% of all participants having an HbA_{1c} of 8% or higher. The mean reported perceived diabetes control score was 2.9 (S.D.=1.1).

Perceived health bivariate relationships

General health

In the bivariate analyses, participants who were male, white, nonpoor, married, and who had some college education perceived themselves to be in better health (Table 1). In addition, individuals using insulin to control their diabetes reported worse general health than did those using only oral hypoglycemic medication. Better perceived health was associated with fewer comorbidities and diabetes complications, lower HbA_{1c} levels, and fewer physical symptoms. Lower scores on the general mental status index and diabetes-related worries were associated with lower perceived general health (refer to Table 2).

Perceived diabetes control

Similar to the associations found for perceived general health, patients reporting better diabetes control tended to be male, white, and using only oral hypoglycemic medication.

Table 1
Average perceived health and diabetes control by sociodemographic and health variables

	n	Perceived general health	Perceived DM control
Gender		$P<.001$	$P<.01$
Male	421	2.76	3.04
Female	187	2.41	2.00
Race		$P<.01$	$P<.001$
White/Caucasian	275	2.80	3.12
Hispanic/Latino	188	2.48	2.71
Other	145	2.59	2.88
Household income		$P<.01$	NS
<US$10,000 annual	232	2.49	2.88
>US$10,000 annual	336	2.78	3.01
Education level		$P<.05$	NS
Some college	293	2.76	3.01
No college	326	2.56	2.88
Marital status		$P<.01$	$P=.06$
Married	263	2.81	3.04
Not married	356	2.54	2.87
Insulin		$P<.05$	$P<.05$
Yes	200	2.53	2.79
No	408	2.71	3.00

Neither income nor education levels were associated with perceived general health, and the association between reported diabetes control and marital status was only marginally significant (Table 1). As expected, higher levels of HbA_{1c} were associated with reports of poorer perceived diabetes control, and insulin users reported poorer diabetes control relative to nonusers. Physical symptom reports and diabetes complications were negatively associated with perceived diabetes control, but comorbidities were unrelated to perceived control. Negative emotions and diabetes-related worry were associated with poorer diabetes control ratings (see Table 2).

Perceived health multivariate analyses

As shown in Table 3, the strongest predictors of perceived general health (as determined by β values) were patients' emotions, physical symptoms, and number of comorbidities. These relationships were significant after controlling for patients' sociodemographic characteristics and insulin use. Diabetes-related worry was only a marginally significant predictor of perceived general health ($P<.10$). Patient characteristics (entered in Step 1) explained only 4.6% of the variance in perceived general health, whereas the addition of physical and psychological variables (Step 2) increased the explanatory power to 26.5% ($\Delta R^2=.219$, $P<.001$).

Table 2
Correlations between measures of perceived and actual measures of overall health and diabetes control

			Perceived health	
Measure	M	S.D.	General	DM control
HbA_{1c}	8.34	1.75	−.10*	−.28***
Acute symptoms	4.87	3.88	−.42***	−.38***
Comorbidities	1.88	1.44	−.16***	−.06
Diabetes complications	0.84	0.96	−.18***	−.13**
Years with diabetes	9.83	9.11	−.05	−.01
Mental health	71.59	21.42	.41***	.33***
DM Worry	2.31	1.00	−.35***	−.36***

* $P<.05$.
** $P<.01$.
*** $P<.001$.

Table 3
Summary of regression analysis adjusting for patient characteristics on physical and psychological variable predictors of perceived general health and diabetes control

Variable	Perceived general health βs	Perceived DM control βs
Patient characteristics		
Age	−.008	−.038
Gender	.037	.033
Race	.032	.033
Income <US$10,000	−.002	.091*
Married	.051	.048
College education	.011	.016
Physical and psychological variables		
Insulin use	−.058	−.017
Years with diabetes	−.013	.043
Comorbidities	−.132**	−.043
Diabetes complications	.001	−.017
HbA_{1c}	−.040	−.241***
Total Sx	−.195***	−.199***
Mental health	.261***	.121*
Diabetes worry	−.087†	−.160**
R^2	.265	.250

Standardized βs reported.
* $P<.05$.
** $P<.01$.
*** $P<.001$.
† $P<.10$.

The strongest predictors of perceived diabetes control were HbA_{1c}, physical symptoms, diabetes-related worry, emotion, and income (see Table 3). These associations were significant when controlling for other sociodemographic and health-status indicators. It is interesting to note that, whereas negative mood and physical symptoms were predictors of both perceived general health and diabetes control, additional factors that are related to perceptions of diabetes control include HbA_{1c} levels and diabetes worry. The addition of physical and emotional variables (entered in Step 2; $R^2=.250$) to patients' sociodemographic characteristics (entered in Step 1; $R^2=.042$) contributed to a significant increase in the amount of variance explained in perceived diabetes control ($\Delta R^2=.209$, $P<.001$).

Mental health and the accuracy of diabetes control perceptions

Overall, general mental health was associated with fewer reported symptoms ($r=-.50$, $P<.001$) and better perceived diabetes control ($r=.33$, $P<.001$). However, mental health was not associated with actual HbA_{1c} levels ($P>.10$). The

strong relationship between mental health and perceived diabetes control, but not actual objective measures of diabetes control, suggests that psychological factors may be associated with inaccuracies in perceptions of diabetes control.

One-way analyses of variance showed an association between mental health and accuracy of perceived diabetes control [$F(1,527)=13.43$, $P<.001$]. Post hoc comparisons showed that patients with poor glycemic control who *incorrectly* identified their diabetes control as good reported better mental health ($M=75.31$, S.D.=19.0) compared with patients who *accurately* rated their diabetes control as poor ($M=65.73$, S.D.=23.0). In addition, patients who had adequate HbA_{1c} levels and inaccurately assessed their glycemic control as poor reported poorer mental health ($M=61.89$, S.D.=24.3) than did patients who accurately rated their diabetes control as good ($M=76.11$, S.D.=18.4). Overall, patients who accurately identified their diabetes control as poor reported poorer psychological functioning than did patients who accurately identified their diabetes control as good.

Depression

Further follow-up analyses were conducted to investigate depression more specifically. Diabetes diagnoses were crossed with diabetes control accuracy groups (accurate good/adequate, accurate poor, inaccurate good/adequate, and inaccurate poor). Chi-square analyses showed that 21.3% of patients with diagnosed depression estimated their glycemic control to be poor when it was adequate, whereas only 12.8% of patients without depression made this error. Close to 27% of patients without diagnosed depression (26.7%) made a false-negative error (determining DM control was good when it was actually poor), whereas only 14.7% of depressed patients made this same error (Fig. 2). In sum, patients with diagnosed depression were more accurate in detecting poor glycemic control, whereas non-depressed patients were more accurate in detecting good/adequate HbA_{1c} levels.

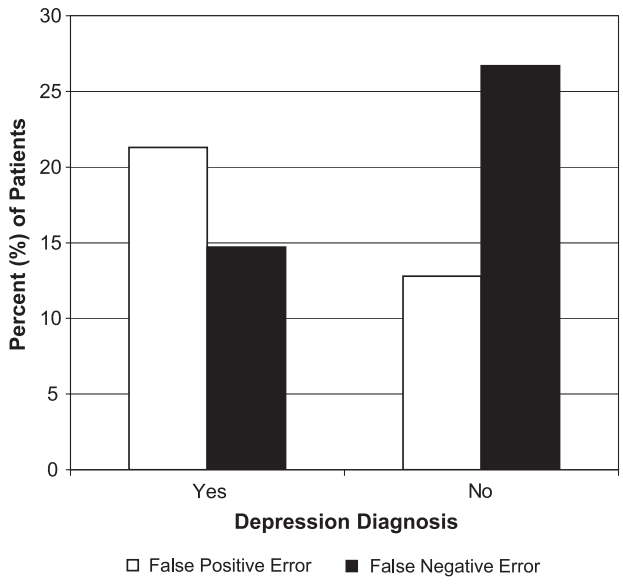


Fig. 2. Percent of diabetes patients making false-positive (inaccurately rate diabetes control as poor) and false-negative errors (inaccurately rate diabetes control as good/adequate) as a function of depression.

Discussion

In this study, we found that diabetes patients incorporate a variety of perceptions, emotions, and information into their assessments of their overall health and diabetes control. As expected, the experience of symptoms was strongly related to participants' evaluations of their health status, and an indicator of their emotional status further strengthened the predictive power of the model. When all these domains, as well as sociodemographic variables, were included, approximately one quarter of the variance was explained in self-ratings of general health and diabetes control. The strongest predictors of perceived general health were patients' physical symptoms and emotional status. More physical symptoms, along with greater negative affect, were associated with poorer ratings of physical health. The strongest predictors of perceived diabetes control included physical symptoms, HbA_{1c}, and worry related to diabetes, suggesting that diabetes patients utilize more specific information in determining diabetes control than overall health.

These analyses indicate that patients with diabetes utilize a global and extensive model in perceiving their health and diabetes control, accessing a variety of objective measures and subjective factors. This may reflect the fact that psychological symptoms are, at least, as important to them as their physiologic well-being is. Striking is the finding that emotional distress was a strong predictor for ratings of health, even when taking into account physical and sociodemographic variables. Reports of feeling "good" or "bad" in reference to physical health may be as much a reflection of psychological symptoms as of physical condition [37]. Negative emotion can directly contribute to physical symptoms (e.g., fatigue, tenseness, heart palpitations, and upset stomach), which may explain the poorer ratings of physical health for those with greater emotional distress [25]. In addition, negative emotion can contribute to a focus on physical sensations and a more pessimistic outlook on one's condition, thus contributing to poorer perceptions of overall health. The finding that diabetes worry was associated with poorer perceived diabetes control provides support for the self-regulation theory of Leventhal et al. [25], suggesting that worries associated with a physical illness are likely to lead a patient to view symptoms as more problematic, thus resulting in more cynical appraisals of a health condition.

Whereas both psychological and physiological factors were important in perceived general and diabetes control, HbA_{1c} was not significantly associated with perceptions of overall health. One interpretation of this finding is that

patients may assign diabetes equal weight to other existing illnesses, or they may even perceive diabetes care and outcomes as unimportant in contributing to health status. Given that poor diabetes control over time is related to comorbidities and is a significant risk factor for mortality in the future, it is surprising that HbA_{1c} was not more strongly related to perceptions of general health. If diabetes control is perceived by patients as nonessential for health status and functioning, then education and interventions should target these inaccurate beliefs. This is highlighted by research showing that health beliefs regarding the seriousness of diabetes are associated with self-management [38].

We also found that a significant number of patients were inaccurate about their glycemic control and that these misperceptions were related to their overall mental health status. General mental health was associated with a higher probability of making false-negative errors in perceived diabetes control. Patients with less anxiety and less depression were more likely to inaccurately perceive their diabetes control as good, when their HbA_{1c} measures were at levels of clinical concern according standards outlined by the ADA [7]. These findings parallel the depressive realism hypothesis and research showing that people with dysphoria tend to make more accurate judgments of events than their more positive counterparts do [39,40]. Depressed patients were not without error, however, and the current study showed that patients who had poorer mental health were more likely to inaccurately determine that their glycemic control was poor, when it actually was adequate according to recent standards (8% or below; ADA). This also parallels research showing that depressed individuals may overestimate negative outcomes or experiences [41]. Overall, depressed patients tended to have a more pessimistic view of their diabetes control, whereas nondepressed individuals were more often overly optimistic.

Whereas physician assessments of health are considered to be the gold standard, longitudinal data show that patient assessments of health are also very good predictors of health outcomes [4,42]. The current study measures the accuracy of diabetes perceptions in the acute sense and shows that people with depression are more likely to detect poor diabetes control. This enhanced sensitivity to problematic glycemic levels points to greater potential for intervention and better health outcomes in patients with depression and anxiety. However, longitudinal data suggest that depression and negative emotion are indeed associated with poorer glycemic control and more diabetes-related complications [41,43].

Data from the current study suggest that the poor long-term outcomes related to depression may not be so much a result of inaccuracies in the detection of poor diabetes control as of other factors, such as low self-efficacy and less effective coping strategies [24]. For example, depression and anxiety are associated with low perceptions of control and more palliative coping [44]. More work is needed to assess self-efficacy and to develop interventions that capitalize on accurate appraisals of poor health by more anxious and depressed patients. Given that patients with poorer mental health are more sensitive to poor diabetes control, patients should be trained in active problem-solving strategies (vs. more passive responses) for application during conditions of poor health. Self-efficacy is likely to improve with diabetes education [45], which is likely to improve adherence and glycemic control [46,47]. Conversely, although a more positive mental status is associated with better long-term health outcomes, more research is needed to understand the role of positive emotions in the assessment of glycemic control and whether false-negative errors do carry consequences for those who require immediate care.

Whereas this study provides important insight to understanding the perceptions of health and diabetes control, conclusions are bound by certain limitations. Specifically, the cross-sectional nature of the data prevents discussion of the direction of causality, and causality in general. For example, despite the theoretical guidance of the analysis of diabetes worry and perceived health, it is difficult to say whether diabetes worry is a predictor of perceived control or whether patients are worried because they know or believe that their diabetes control is poor. Further longitudinal and experimental research is needed to determine directionality and the mechanisms that are responsible for the emotion–health perception link. Although findings for depression and diabetes accuracy perceptions were corroborated by similar findings for general mental health, self-reported depression may be unreliable, and more research is needed using professional clinical assessments of depression. The sample consisted of patients who kept their clinic appointment, and inclusion of no-shows in future research may lend an important assessment of patients among the extremes of health assessments (e.g., my health is so good, I do not need to go to my appointment; I am so sick, I cannot make it to my appointment). Although insulin use and years with diabetes were not related to health appraisals, it is possible that patients with Types 1 and 2 diabetes differ in respect to illness assessments, and this should be investigated in further work. In addition, the goal of the current study was to assess psychological, as well as physical, factors that are associated with perceptions of health. Further empirical work is needed to determine the role of other psychological and observational factors in personal health assessment, with the intent of improving the predictive power of the model.

In sum, the current study provides an important look into the mind of the patient and helps to identify psychological, as well as physical, factors that are important in patient ratings of perceived health. Furthermore, findings from the current study suggest that patients with negative emotion are more sensitive to conditions of poor health, whereas patients feeling positive are more likely to inaccurately rate their diabetes control as good. The increased vigilance to poor diabetes control by patients with greater depression and anxiety may serve as an important point by which to design

interventions to translate awareness into action and improve health outcomes.

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