HHS Public Access

Author manuscript

Diabetes Care. Author manuscript; available in PMC 2015 May 21.

Published in final edited form as:

Diabetes Care. 2007 September ; 30(9): 2222–2227. doi:10.2337/dc07-0158.

Depression, Self-Care, and Medication Adherence in Type 2 Diabetes:

Relationships across the full range of symptom severity

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Abstract

Objective—We examined the association between depression, measured as either a continuous symptom severity score or a clinical disorder variable, with self-care behaviors in type 2 diabetes.

Research Design and Methods—We surveyed 879 type 2 diabetic patients from two primary care clinics using the Harvard Department of Psychiatry/National Depression Screening Day Scale (HANDS), the Summary of Diabetes Self-Care Activities, and self-reported medication adherence.

Results—Of the patients, 19% met the criteria for probable major depression (HANDS score ≥9), and an additional 66.5% reported at least some depressive symptoms. After controlling for covariates, patients with probable major depression reported significantly fewer days' adherent to diet, exercise, and glucose self-monitoring regimens ($P < 0.01$) and 2.3-fold increased odds of missing medication doses in the previous week (95% CI 1.5–3.6, $P < 0.001$) compared with all other respondents. Continuous depressive symptom severity scores were better predictors of nonadherence to diet, exercise, and medications than categorically defined probable major depression. Major depression was a better predictor of glucose monitoring. Among the two-thirds

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A table elsewhere in this issue shows conventional and Systéme International (SI) units and conversion factors for many substances.

of patients not meeting the criteria for major depression (HANDS score <9, *n* = 709), increasing HANDS scores were incrementally associated with poorer self-care behaviors ($P < 0.01$).

Conclusions—These findings challenge the conceptualization of depression as a categorical risk factor for nonadherence and suggest that even low levels of depressive symptomatology are associated with nonadherence to important aspects of diabetes self-care. Interventions aimed at alleviating depressive symptoms, which are quite common, could result in significant improvements in diabetes self-care.

Major depression is a significant problem among patients with diabetes, with an estimated prevalence of 15–20%, compared with 2–9% in the general population (1). Among patients with type 2 diabetes, major depression is associated with a 2.3-fold increase in mortality, and minor or “subclinical” depression is associated with a 1.7-fold increase (2). Depression also increases the risk of poorer diabetes-specific outcomes such as hyperglycemia (3) and an increase in diabetes complications (4).

The available literature suggests that clinically significant levels of depression are associated with a range of poorer self-care behaviors including adherence to diet (5–8), exercise (6,7), and prescribed medications (5,7,9,10). However, although depression is clinically conceptualized as a discrete comorbid illness, few researchers have investigated the possibility of a dose-response relationship between symptoms of depression and poorer self-care, favoring instead a conceptualization of depression as a discrete comorbid illness when examining its relationship to diabetes self-care behaviors.

The aim of the current study was to extend previous research by examining the relationships between depression and the full range of diabetes self-care behaviors (including diet, exercise, glucose monitoring, foot care, and medication adherence), using an analytical approach that would compare depression measured as a clinical categorical variable versus a continuous symptom severity variable. We hypothesized that major depression would be associated with poorer self-care, that depressive symptom severity would be a better predictor of poorer self-care than major depression, and that even sub-clinical increases in depressive symptoms would be associated with significant decrements in diabetes self-care behaviors.

Research Design and Methods

We surveyed patients with diagnosed type 2 diabetes who were followed in one of two outpatient primary care medical clinics between December 2001 and July 2003. The full details regarding recruitment procedures and characteristics of these participants have been described previously (11–13). Briefly, the clinical sites were a community health center serving a predominantly working class community in Revere, Massachusetts, and a hospital-based primary care internal medicine practice in Boston, Massachusetts. Eligible patients had the diagnosis of diabetes before the survey intervention period, were alive at study completion, and received continuous care at their designated clinical site, with at least one primary care visit during the study period.

Survey administration

A total of 1,648 potential participants were mailed a letter cosigned by their primary care physician and the principal investigator (J.B.M.) describing the study. Of these, 18% either opted out from further contact or were initially excluded. Of the remaining patients, 953 (72.4%) provided informed consent and completed the study survey. Of those who did not participate, ∼33% declined; 25% either did not arrive for their appointment, promised to complete the survey at home but did not, or could not be reached; and 25% either did not have diabetes or were excluded because of illness or inability to participate. The final sample consisted of 909 patients with type 2 diabetes.

Survey instruments

Assessment of depression—We used the 10-item Harvard Department of Psychiatry/National Depression Screening Day Scale (HANDS) to assess symptoms of depression over the previous 2 weeks. This scale is scored from 0 to 30 with a score of ≥9 having a sensitivity of at least 0.95 and a specificity between 0.60 and 0.94 for major depression, depending on the characteristics of the sample (14). Validation studies reported by Baer et al. (14) demonstrated that the HANDS specificity and sensitivity indexes for major depression were equal to or greater than those for longer self-report measures such as the 21-item Beck Depression Inventory-II (15), the 20-item Zung Self-Rating Depression Scale (16), and the 15-item Hopkins Symptom Depression Checklist (17). As a supplement to HANDS data, electronic medical records data were also examined for depression on the problem list.

Assessment of self-care—To measure diabetes self-management, we used the Summary of Diabetes Self-Care Activities Questionnaire (SDSCA) (18,19). This scale assesses diabetes self-care over the previous 7 days in five domains: diet, exercise, self-monitoring of blood glucose (SMBG), and foot care; we modified the index by adding a question about medication adherence. For diet, the scale assesses adherence to general diet with two items and contains three additional items related to specific dietary recommendations: eating five or more servings of fruits and vegetables, eating high-fat foods, and a supplemental question about spacing carbohydrates evenly throughout the day. These items were examined separately as recommended by the authors (19) because of low interitem correlations. For medication adherence, we asked patients: “In the past 7 days, on how many days did you miss taking any one of your prescribed medicines?” For this item, we dichotomized responses into “any missed doses” and “no missed doses.” For all SDSCA scales, mean scores of items were computed so that the scale metric corresponds to number of days of the previous 7 during which a patient reported adequate adherence.

Demographic and clinical covariates

Demographic data were self-reported on the survey. Diabetes diagnosis data were collected from manual chart reviews, directly from the electronic medical record, and from billing claims (hospitalizations and hospital discharge diagnoses). Because there was little variation in racial background, we compared white patients (85% of the sample) with those of other races. Comorbidities were determined on the basis of a medical record review of listed

diagnoses and treatments (13). Charlson comorbidity scores were calculated on the basis of the presence of comorbidities in the medical record (20). Depression diagnosis and antidepressant prescriptions were abstracted from the medical record, whereas the total number of prescribed medications was obtained from survey responses. BMI data were missing for 24% of the cohort; for these patients, the mean cohort BMI was imputed.

Statistical analyses

Descriptive statistics were calculated for all study variables; all variables were approximately normally distributed. To reduce the impact of missing total HANDS scores because of incomplete questionnaires, the mean value of valid HANDS items was imputed for each participant who was missing an item if at least nine items on the HANDS were completed. This increased the number of participants with valid HANDS data from 832 to 879. Analyses in which any subject with missing HANDS data were excluded produced essentially identical results (results not shown). Statistics are based on this sample of 879 participants, although missing data for some independent variables resulted in further reductions (lowest $n = 825$) in specific multivariate analyses.

We conducted three sets of analyses to test our hypotheses. First, we used ANCOVA to test the relationship between major depression and SDSCA adherence data by comparing mean adherence scores, adjusted for covariates in the model, for those who met the HANDS criteria for probable major depression compared with those with scores below the cutoff. This test was supplemented by a logistic regression to evaluate probable depression as a predictor of medication nonadherence. In the second set of analyses we used multiple regression (for SDSCA) and logistic regression (for medication adherence) to test the relationship between the continuous HANDS total score and adherence. We then examined whether adding the probable major depression diagnosis variable to these models accounted for additional significant variance. In the third set of analyses we examined the relationship between continuous HANDS total scores and adherence in the subsample of participants with HANDS scores <9. We also conducted a logistic regression for medication nonadherence in this subsample. Multivariate analyses included all demographic and disease-related variables with significant ($P < 0.10$) relationships with the HANDS cutoff score and/or significant ($P < 0.10$) relationships with the dependent variable. In several analyses (noted below), race was also included as a covariate because of its relationship with the dependent variable. All data were analyzed using SPSS 11.0 (SPSS, Chicago, IL). The Partners Healthcare System/Massachusetts General Hospital Institutional Review Board approved the study, and all patients provided written informed consent to participate.

Results

Prevalence of depression

Patient characteristics are reported in Table 1. Nearly one-fifth of patients (19.3%) met the HANDS criteria for a probable diagnosis of major depression (HANDS score ≥9), 66.5% reported at least some depressive symptoms without meeting the HANDS criteria for probable major depression (HANDS score 1–8), and 14.2% reported no depressive symptoms (HANDS score 0). Only 59.4% of subjects with probable major depression had

depression listed in their medical records, and an antidepressant agent had been prescribed for less than half (48.8%).

Major depression and diabetes self-care

The relationship between the depression screening result and clinical and demographic factors is presented in Table 1. Table 2 presents self-care behaviors by depression status (unlikely major depression versus probable major depression) with controls for relevant covariates. Major depression was significantly associated with poorer adherence to general dietary recommendations, consuming less fruits and vegetables, less frequent spacing of carbohydrates over the course of the day, poorer adherence to exercise recommendations, and less frequent SMBG but not high-fat food consumption or foot care. With controls for the same set of covariates as in the ANCOVA models, logistic regression showed that major depression was associated with a 2.31-fold increase in the odds of missing one or more prescribed medications over the previous 7 days (95% CI 1.50–3.56, $P < 0.001$). Analyses were repeated with controls for prescription of antidepressants and produced essentially identical results.

Major depression versus depressive symptom severity

We examined continuously measured HANDS total symptom severity score as a predictor of adherence outcomes in multiple regressions and found significant associations in each of the cases for which significant ANCOVA effects were found using the HANDS cutoff score (Table 3). We then entered the HANDS cutoff score into these models to determine whether probable major depression accounted for additional variance. In the model predicting glucose monitoring, the HANDS cutoff score was a significant predictor ($\beta = -0.15$, $P = 0.006$) and reduced the HANDS continuous score to nonsignificance ($\beta = -0.05$, $P = 0.336$). However, in each additional model in which the HANDS total symptom severity score was significant in Table 3, it remained significant when the HANDS cutoff score was added, and the HANDS cutoff score failed to account for additional significant variance (data not shown). Logistic regression showed that each 1-point increase in the HANDS symptom severity score was associated with a 1.10-fold increase in the odds of missing one or more doses of prescribed medications over the previous 7 days (95% CI 1.07–1.14, $P < 0.001$). Adding the HANDS cutoff score to this model did not account for additional variance nor did it attenuate the relationship between the HANDS symptom severity score and medication nonadherence. Models controlling for antidepressant use produced nearly identical results.

Self-care among patients not meeting criteria for major depression

We also examined the relationship between HANDS total scores and adherence outcomes for patients who did not meet cutoff criterion for probable major depression (HANDS score <9, $n = 709$). In this group, increasing HANDS scores were associated with poorer adherence to general dietary recommendations, fruit and vegetable consumption, spacing carbohydrates, and exercise recommendations but not to glucose monitoring or high-fat food consumption, after adjustment for potential confounders (Table 3). For example, a difference between a HANDS score of 1 and 6 was associated with a decrease of 0.55 days/

week in self-reported exercise. Controlling for the same set of potential confounders, we also found that for each 1-point increase in the HANDS score, there was a 1.12-fold increase in the odds of missing at least one dose of medication over the previous 7 days (95% CI 1.03 – 1.22, $P = 0.007$). An additional set of analyses with controls for antidepressant use in this group (14.2%) produced essentially identical results.

Conclusions

In a large sample of primary care patients with type 2 diabetes, we found evidence of probable major depressive disorder in 19% of patients surveyed. Major depression was significantly associated with poorer diabetes self-care behaviors, including lower adherence to general diet, consumption of fruits and vegetables, spacing carbohydrates, exercise recommendations, glucose monitoring, and prescribed medications over the previous 7 days. Analyses showed that depressive symptom severity was a better predictor of each of these self-care behaviors than probable major depression, except for glucose monitoring. When both depressive symptom severity and probable major depression were examined in the same model, only probable major depression was associated with significantly decreased monitoring. Two-thirds of patients surveyed reported at least some symptoms of depression but did not meet the screening criteria for major depression. Even among these patients, symptoms of depression were incrementally related to poorer self-care behaviors, including lower adherence to general diet, consumption of fruits and vegetables, spacing carbohydrates, exercise recommendation, and prescribed medication over the previous 7 days. Symptoms of depression were not significantly related to glucose monitoring for these patients. Controlling for antidepressant use in any of these analyses did not significantly reduce these relationships.

The current study contributes to the extant literature by challenging the categorical conceptualization of major depression as a risk factor for nonadherence to diabetes self-care. Our results suggest that there is a continuous relationship between symptoms of depression and nonadherence to self-care for diabetes that is evident even at subclinical levels. This observation suggests that for patients with type 2 diabetes even mild symptoms of depression are associated with important decrements in self-care. Our results also suggest that nonadherence to SMBG may be associated only with higher levels of clinically significant depression. Previous reports have tended to focus on examining differences in self-care in patients who met the criteria for major depressive disorder compared with those who did not (7,9,10) or have compared categories of depressive symptom severity (5,6). In conceptualizing depression as a categorical variable, these researchers have overlooked the possibility of a linear relationship between symptoms of depression and poorer diabetes self-care. In one study a continuous measure of depressive symptoms was used to demonstrate a significant relationship to a composite measure of poorer diabetes regimen adherence (21), but we are unaware of any study that has focused on the relationship of subclinical symptoms of depression with diabetes self-care or that compared a categorical versus a continuous measure of depression in predicting self-care. Our findings challenge the conceptualization of depression as a discrete risk factor for nonadherence and suggest that additional research is needed to understand the role of subclinical symptoms of depression in diabetes.

There are several strengths to the current study, which improve upon the methodology of previous reports. We analyzed a large primary care sample to examine the relationship between depression and a complete set of self-care behaviors that are important for the management of type 2 diabetes, using a well-validated measure (the SDSCA). With one notable exception (7), other studies have tended to focus on either medication adherence (9,10) or a less complete subset of self-care behaviors (5,6) or have used measures of diabetes self-care with unknown reliability and/or validity (8,21). We also relied on a sensitive, well-validated, screening instrument (14) to measure depression and examined the impacts of both probable major depression and subclinical symptoms of depression on diabetes self-care behaviors. Previous reports compared tertiles (5) or quartiles (6) on a depression symptom checklist, used less sensitive screening instruments (7,10), or relied on claims data to establish diagnosis, which may not accurately reflect depression symptoms at the time of self-care measurement (9). Although previous methods have differed, the convergence of evidence supports a robust relationship between symptoms of depression and poorer self-care in patients with diabetes. The results from the current study suggest that the relationship between depression and poorer diabetes self-care is incremental and apparent even at levels that would be considered subclinical from a diagnostic perspective.

Our results must be interpreted in the context of the study design. In particular, the cross-sectional nature of the data does not allow for causal inferences. Future longitudinal and experimental work is needed to elucidate issues of directionality and causality in these relationships. In addition, self-care and adherence behaviors were measured via self-report, which may overestimate true levels of adherence, and the lack of racial and ethnic heterogeneity precluded us from fully examining the role of these factors in our findings.

There are at least four important implications of our findings. First, meeting the screening criteria for probable major depression is associated with important decrements in diabetes self-care behavior. For example, even after controlling for potential confounders, patients meeting the screening criteria for major depression reported nearly 1 full additional day of nonadherence to general dietary recommendations, exercise, and SMBG over the past week compared with those who did not meet the cutoff criterion. They were also more than twice as likely to report missed doses of prescribed medication than those who did not meet the HANDS cutoff criterion. Second, overall depressive symptom severity may be more important for diabetes self-care than whether or not an individual meets the criteria for major depression. Our results suggest that as depressive symptom severity increases, adherence to a variety of self-care activities decreases, regardless of the presence of major depression. SMBG appears to be an exception to this suggestion, as significant associations with nonadherence were only seen at clinical levels of depression. Third, low levels of depressive symptoms are highly prevalent among patients with type 2 diabetes in a primary care setting and are associated with poorer adherence to diet, exercise, and medication. This finding should broaden our current understanding to recognize that even low levels of depression-related symptoms can have a significant negative impact on patients' diabetes self-care behaviors. Finally, the results suggest that major depression may be under-recognized in primary care samples of patients with type 2 diabetes, as <60% of patients who screened positive for major depression in our study had depression listed in their medical record. Although our comparison to depression diagnosis from the medical record

has certain methodological limitations (e.g., symptoms at screening may not have been present previously, providers may have been reluctant to document depression in patients' records, and so on), our findings are consistent with previous reports (22). There is debate about the utility and costs of screening for depression in the primary care setting (23). However, our findings showing that even subclinical depressive symptoms are associated with nonadherence and previous findings showing that subsyndromal depression is associated with adverse health outcomes such as functional impairments (24) and cardiac mortality (25) underscore the need for increased attention to depression in these patients.

Improvements in treatment for depression are also needed. Reports suggest that the provision of treatment to depressed patients with diabetes is often inadequate, with approximately one-third of depressed diabetic patients receiving an adequate dose of pharmacotherapy and only 6.7% receiving an adequate number of psychotherapy sessions (22). Improvements in the provision of available effective treatments for major depression are needed. Novel approaches to investigating the role of subclinical symptoms of depression in patients with type 2 diabetes may also be valuable. As of yet, it is unclear whether interventions that reduce symptoms of depression could improve diabetes self-care, but there is recent evidence supporting this possibility (26). Efforts to reduce barriers to effective diabetes management should include both increased screening for depression in the primary care setting and increased recognition that even subclinical symptoms of depression may negatively impact diabetes self-care behaviors.

Acknowledgments

This study was supported by a grant from Pfizer with additional support from Aventis and the Massachusetts General Hospital Clinical Research Program. The efforts of J.S.G. and S.A.S. on this manuscript were supported by a grant from the National Institute of Mental Health (1R01MH078571-01). J.B.M. is supported by an American Diabetes Association Career Development Award. R.W.G. is supported by a Career Development Award (NIDDK K23 DK067452) from the National Institute of Diabetes and Digestive and Kidney Diseases. E.W. is supported by a career development award (1 K02 HS014010) from the Agency for Healthcare Research and Quality.

J.B.M. has received research grants from GlaxoSmithKline, Wyeth, and sanofi-aventis and serves on safety or advisory boards for GlaxoSmithKline, Merck, and Lilly.

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Abbreviations

HANDS	Harvard Department of Psychiatry/National Depression Screening Day Scale
SDSCA	Summary of Diabetes Self-Care Activities Questionnaire
SMBG	self-monitoring of blood glucose

Table 1

Patient characteristics

Demographics and health variables	Overall sample	HANDS cutoff score comparisons		
		Unlikely major depression (HANDS score <9)	Probable major depression (HANDS score ≥9)	*P* value
n	879	709	170	0.002
Female sex	422 (48)	322 (45)	100 (59)	0.002
Marital status: married or cohabiting	466 (54)	394 (56)	72 (43)	0.003
Clinic site: hospital based	535 (61)	449 (63)	86 (51)	0.002
White race	731 (86)	590 (86)	141 (86)	0.954
Education				
Less than high school diploma	191 (22)	142 (20)	49 (29)	
High school diploma, its equivalent, or some college	480 (55)	388 (55)	92 (55)	0.008
Four years of college or advanced degree	203 (23)	176 (25)	27 (16)	
Age (years)	66.22 ± 12.4	67.40 ± 12.08	61.29 ± 12.87	<0.001
BMI (kg/m^2)	31.37 ± 6.75	30.70 ± 6.18	34.19 ± 6.18	<0.001
Years of diabetes	9.52 ± 7.14	9.60 ± 7.06	9.21 ± 7.46	0.525
Charlson comorbidity	3.06 ± 1.80	3.00 ± 1.75	3.28 ± 1.98	0.099
Total medications	4.36 ± 4.95	4.03 ± 4.64	5.75 ± 5.90	<0.001
Insulin (yes)	233 (26)	177 (25)	56 (33)	0.034

Data are *n* (%) or means ± SD. Statistical comparisons are between patients with scores above or below the HANDS cutoff using χ^2 or Student's *t* test as appropriate.

Table 2

Mean number of days in the prior week that patients followed diabetes self-care behaviors, by HANDS cutoff score

	Unlikely major depression (HANDS score <9)	Probable major depression (HANDS score ≥9)	*P* value
General diet	4.65 ± 0.09	3.81 ± 0.18	<0.001
Spacing carbohydrates	3.51 ± 0.10	2.60 ± 0.22	<0.001
Exercise	2.81 ± 0.09	1.96 ± 0.19	<0.001
Glucose monitoring	3.63 ± 0.10	2.82 ± 0.22	0.001
Fruits and vegetables*	3.87 ± 0.10	3.20 ± 0.22	0.006
High-fat foods	2.34 ± 0.07	2.54 ± 0.15	0.241
Foot care*	3.51 ± 0.10	3.28 ± 0.22	0.348

Data are adjusted mean ± SE number of adherent days over the previous week. All models are adjusted for clinic site, sex, education, age, marital status, total medications, BMI, Charlson comorbidities, and prescription of insulin.

*These models also contained race (white vs. other) as an additional covariate.

Table 3
Change in self-care adherence rate by each increment in HANDS scores

	HANDS total score in overall sample		HANDS total score in subclinical subsample	
	Change in adherence (days/week)	***P* value**	**Change in adherence (days/week)**	***P* value**
Fruits and vegetables*	−0.15	<0.001	−0.16	<0.001
General diet	−0.21	<0.001	−0.17	<0.001
Spacing carbohydrates	−0.19	<0.001	−0.14	<0.001
Exercise	−0.17	<0.001	−0.11	0.004
Foot care*	−0.07	0.070	−0.05	0.186
Glucose monitoring	−0.07	0.044	0.04	0.257
High-fat foods	0.02	0.591	−0.02	0.537

Data are standardized β. All models are adjusted for clinic site, sex, education, age, marital status, total medications, BMI, Charlson comorbidities, and prescription of insulin.

*These models contained race (white vs. other) as an additional covariate.