

Mental Health and Diabetes Control Among Vulnerable Primary Care Patients

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ABSTRACT

OBJECTIVES: Patients who have mental health conditions have greater difficulty managing diabetes. This study examined the association between mental health conditions and diabetes control, and medication adherence as a mediator in this relationship, among patients in a primary care setting affiliated with a large academic medical center.

STUDY DESIGN: Data were drawn from questionnaires completed by patients in the waiting rooms of a primary care clinic and from patient electronic health records. Variables of interest were diagnosis of any mental health condition and diabetes control, as indicated by glycated hemoglobin (A1C) levels.

METHODS: Logistic regression analyses were used to estimate the odds ratio (OR) and corresponding 95% CIs of controlled diabetes.

RESULTS: Only 19% of patients had “good” diabetes control (A1C <6.5%). Surprisingly, better medication adherence and diagnosis of a mental health condition were significantly associated with good diabetes control, even after adjusting for known confounders in multivariable logistic regression analyses (OR, 2.4; 95% CI, 1.2-4.8).

CONCLUSIONS: These findings suggest that the identification of mental health problems among patients with diabetes is critical to improving patients’ diabetes control, particularly within settings that serve highly vulnerable patient populations.

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Diabetes is a challenging disease to manage, and patients who have comorbid mental health conditions may have even greater difficulty in managing diabetes.¹⁻⁴ People with diabetes and comorbid mental health conditions routinely have less adequate self-care (eg, poorer diet, physical inactivity, poorer medication compliance, and poorer glycemic control) and poorer quality of life.⁵⁻⁷ Findings from previous research indicate that successful treatment of mental disorders, such as depression, improves patients’ diabetes control and adherence.⁷⁻¹⁰ However, mental health services are underutilized and mental health conditions are often undertreated, particularly in racial/ethnic minority groups, and treated less aggressively in patients with multiple comorbidities and patients with diabetes.^{11,12}

Untreated and/or undiagnosed mental health conditions could be related to poorer diabetes management, including medication adherence, in addition to greater levels of disability and impairment associated with poor mental health.¹³⁻¹⁵ Patients with diabetes may be more likely to seek care more regularly than patients without chronic diseases, and comprehensive healthcare settings that emphasize the integration of care may be more effective in treating mental health conditions and improving diabetes control. Nonetheless, there is relatively little research regarding

detection of and care for mental health conditions among vulnerable populations with diabetes in primary care settings. The goal of this study was to examine the association among mental health conditions, medication adherence, and diabetes control within a primary care clinic for the medically underserved.

METHODS

Setting

This study was conducted in the primary care clinic of a large urban hospital, the Center for Outpatient Health (COH) at Barnes-Jewish Hospital in St. Louis, Missouri. The clinic serves as the site for ambulatory care training for a large internal medicine residency with about 150 residents. Trainees provide primary care to the patients and have a continuous relationship with them over their 3 years of training. The COH provides a broad range of services for patient care, including mental health, social work, pharmacy, nutrition, and foot care. In 1 year of operation, 2012-2013, the COH served 16,907 unique patients; 64% were African American and 30% were white. The majority of patients seen in that year were female (67%) and between 35 and 64 years of age (59%); about 40% of patients were covered by Medicare, 40% were covered by Medicaid, and 3% were uninsured.

Data Collection

Participants in this study were recruited in the waiting rooms of the COH. Patients were approached by trained data collectors between July 2013 and April 2014. Inclusion criteria were that participants be 18 years or older, be a patient at the COH, and speak English. Surveys were administered on different days of the week and at different times of day; data collectors approached all patients in the waiting room during their shifts. Participants were asked to complete a self-administered written questionnaire and a verbally administered component. The latter component assessed health literacy and was administered by a trained data collector who recorded responses. All participants completed a verbal consent process and signed a written consent form before completing the survey. As part of the consent process, participants could opt in to have information abstracted from their electronic health record (EHR) and merged with questionnaire data. The Institutional Review Board at Washington University School of Medicine approved this study.

Approximately 26% ($n = 1111$) of patients approached were ineligible to participate because they were not patients, did not speak English, or had previously taken the survey. Among eligible participants, 44% ($n = 1380$) agreed to participate and had their consent recorded by trained data collectors. Of the 1380 patients who consented, 1010 (73%) completed the written survey. Among those with complete written surveys, 602 (60%) completed the verbally administered component and 781 (77%) opted to have data abstracted from their EHR.

Participants completed data collection while waiting for their appointments. The primary reason for incomplete surveys was inadequate time before the clinic was ready to begin the patient evaluation. There were no significant differences in gender between individuals with complete surveys and those with incomplete surveys. African Americans made up the majority (75%) of noncompleters, a statistically higher proportion than of those completing the survey (63%; $P = .003$). Survey respondents were generally similar to the underlying COH primary care clinic patient population with respect to gender, age, race, and location of residence. The study population was restricted to only those patients with a diagnosis of diabetes and nonmissing values for glycated hemoglobin (A1C), providing a final sample of 275 patients.

Outcome

The outcome of interest, diabetes control, was dichotomized using the A1C test, a blood test that measures the degree of diabetes control in the 3 months prior to obtaining the test. Test results were obtained from the most recent laboratory results in patients' EHRs. Per International Diabetes Federation guidelines, patients with A1C levels below 6.5% (or 7.8 mmol/L) were categorized as having good diabetes control.¹⁶ Patients with A1C levels of 6.5% or above were categorized as having uncontrolled diabetes.

Independent Variables

History of any mental health diagnosis was obtained from patients' EHRs and used as the dichotomous (yes/no) predictor of primary interest for this study. Because medication adherence is associated with diabetes control, we examined the effects of medication complexity on diabetes control.¹⁷⁻¹⁹ Medication adherence was assessed by the Morisky Medication Adherence Scale (MMAS-4), a validated 4-item scale.²⁰⁻²³ MMAS-4 scores range from 0 (least adherent) to 4 (most adherent). The 2 subscales of the MMAS-4, unintentional and intentional nonadherence, consist of 2 items from the MMAS-4 and were coded as dichotomous (yes/no) variables.

Covariates

Gender was a dichotomous variable coded as male or female. Race was self-reported and coded as non-Hispanic white, African American, or other. Employment status was dichotomized as working (full time, part time, and student) or not currently in the workforce (retired, disabled, unemployed, and homemaker). Marital status was coded into 3 categories: married/partnered, divorced/separated/widowed, and never married. Insurance status included 3 categories: private, uninsured, and public. Body mass index (BMI) was calculated from the most recent height and weight listed in patients' EHRs and initially was categorized according to National Institutes of Health (NIH) guidelines (underweight, BMI <18.5 kg/m²; normal weight, 18.5-24.9 kg/m²; overweight, 25-29.9 kg/m²;

obese, ≥ 30 kg/m²). However, because the majority of this sample was obese according to the NIH guidelines, BMI was dichotomized as obese or not obese. Personal history of common chronic diseases and conditions, namely diabetes, hypertension, asthma, stroke, and heart disease, was collected from EHRs. In addition, the numbers of visits each patient made to the emergency department (ED) and the COH within the past 12 months were derived from EHRs. There was not an a priori rationale, nor are there clinical guidelines, for categorizing number of visits; thus, numbers of COH and ED visits were categorized into tertiles.

Statistical Analysis

Descriptive statistics for the demographic variables, mental health variables, and chronic disease indicators were calculated in order to understand the patient population. Bivariate analysis using Pearson's χ^2 test (or Fisher's exact test due to small cell counts for some variables) examined the individual associations between diabetes control and each of our categorical predictors of interest. The association between continuous variables (age, medication adherence) and diabetes control was examined using a *t* test. Logistic regression analyses were used to estimate the odds ratio (OR) and corresponding 95% CIs of controlled diabetes. We examined the distribution of mental health diagnoses, such as depression and anxiety, in the sample and controlled for the covariates listed earlier that had been identified as key factors in previous research.²⁴⁻²⁹ The first model included mental health status and selected sociodemographic characteristics. The second model included all variables in model 1 with the addition of the healthcare utilization variables. Additionally, we examined whether medication adherence mediated the relationship between mental health and diabetes control by including the MMAS-4 score as a covariate in a logistic regression model. Because of missing data and low variability, household income and health literacy were not included in the logistic regression models. All statistical analyses were performed using SAS version 9.4 (SAS Institute; Cary, North Carolina). Statistical significance was set at $P < .05$.

RESULTS

Of the 275 patients with diabetes included in the study, 132 patients had both mental health and diabetes diagnoses (Table 1^{30,31}). Depression was the most common mental disorder experienced by those patients with a mental health diagnosis (39%). The majority of patients with comorbid mental health and diabetes diagnoses were women (72%), and this group had a mean (SD) age of 54 (10.6) years. Patients were mostly African American (68%) and reported household incomes less than \$29,999 per year (88%). Most reported that they were not currently in the workforce (87%) and received public (eg, Medicaid or Medicare) health insurance (70%). Medication complexity was not associated with poor glycemic control in our sample ($P = .729$).

Bivariate associations between diabetes control, as assessed by A1C level and diagnosis of mental health conditions, MMAS-4, and sociodemographic characteristics were examined first. As shown in Table 2, bivariate analyses indicated that the presence of mental health conditions was significantly associated with good diabetes control ($P = .03$). Overall, medication adherence was positively associated with diabetes control ($P = .01$). When examining the 2 subscales of the MMAS-4, only intentional nonadherence, which assesses whether patients stop taking medication when they feel better or when they believe the medication is making them feel worse, was significantly associated with poorer diabetes control ($P = .02$). Unintentional nonadherence was not significantly associated with diabetes control ($P = .23$). There were no significant associations between sociodemographic factors and diabetes control.

Multivariable logistic regression analysis was used to estimate the OR for the association between presence of mental health conditions and diabetes control (Table 3). After accounting for age, race/ethnicity, gender, education, and BMI (model 1), results indicated that patients diagnosed with mental health conditions were 2.3 times more likely (95% CI, 1.1-4.5) to have good diabetes control compared with patients without mental health conditions. After adjusting for health service utilization variables, specifically the number of COH visits and number of ED visits (model 2), mental health conditions were still significantly associated with good diabetes control (OR, 2.4; 95% CI, 1.2-4.8; $P = .02$). Finally, medication adherence was added to the model (model 3). For every 1-point increase in medication adherence score, patients were 53% more likely to have good diabetes control (OR, 1.53; 95% CI, 1.15-2.04). Presence of mental health conditions remained significantly associated with good diabetes control (OR, 2.7; 95% CI, 1.3-5.5; $P = .01$) without a significant change in the magnitude or direction of the association, suggesting that medication adherence only partially mediates the relationship between mental health and diabetes control (Table 3).

Finally, we tested the independent relationship between MMAS-4 and diabetes control (Table 4). Bivariate analyses revealed that there was a significant positive relationship between medication adherence and diabetes control (OR, 1.41; 95% CI, 1.09-1.84). Model 2 indicates that this relationship remained significant after adjusting for covariates (OR, 1.49; 95% CI, 1.12-1.98).

Model Selection

We selected our final model based on model fit statistics. In order to check the goodness of fit of each model, we calculated the Aikake information criterion (AIC), overall global *P* value, C statistic, and Hosmer-Lemeshow goodness of fit. Model 1 is mental health plus demographics; model 2 is mental health, demographics, and utilization; and model 3 adds MMAS-4. Only model 3 has a statistically significant global test, meaning that the independent variables are significant predictors of good diabetes control as a whole. All

Table 1. Sociodemographic Characteristics of COH Patients With Diabetes (N = 275)

Variable	Mean (SD) or n (%)	Variable	Mean (SD) or n (%)
Age, years	53.90 (10.64)	Number of outpatient visits (past 12 months)	
Mental health condition	132 (49.62%)	0-6	82 (29.82%)
Gender		7-12	95 (34.55%)
Male	76 (28.46%)	≥13	98 (35.64%)
Female	191 (71.54%)	Number of ED visits (past 12 months)	
Race		0	109 (39.93%)
White	63 (22.91%)	1	74 (27.11%)
African American	186 (67.64%)	≥2	90 (32.97%)
Other	26 (9.45%)	Chronic disease	
Education		Hypertension	239 (87.55%)
High school diploma only or lower	152 (58.24%)	Diabetes	275 (100.00%)
At least some college	109 (41.76%)	Asthma	61 (23.11%)
Annual household income		Heart disease	66 (24.00%)
<\$10,000	116 (50.43%)	Stroke	25 (9.33%)
\$10,000-\$29,999	86 (37.39%)	Insurance type	
≥\$30,000	28 (12.17%)	Private insurance	25 (9.16%)
Employment status		Public insurance	191 (69.96%)
Working	32 (12.60%)	Uninsured	57 (20.88%)
Not in workforce	222 (87.40%)	Newest Vital Sign ^a (maximum score: 6 points)	
Marital status		High likelihood of limited literacy (score 0-1)	70 (35.90%)
Married/partnered	60 (22.99%)	Possibility of limited literacy (score 2-3)	61 (31.28%)
Not married	201 (77.01%)	Adequate literacy (score 4-6)	64 (32.82%)
Body mass index		MMAS-4 ^b (range: 0-4)	
Obese (≥30 kg/m ²)	203 (73.82%)	Intentional nonadherence	225 (87.55%)
Not obese	72 (26.18%)	Unintentional nonadherence	168 (66.14%)

COH indicates Center for Outpatient Health; ED, emergency department; MMAS-4, 4-item Morisky Medication Adherence Scale.

^aThe Newest Vital Sign is a quick screening test to identify limited literacy in primary care settings.³⁰

^bUse of the ©MMAS-4 is protected by US copyright laws. Permission for use is required. A licensure agreement is available from: Donald E. Morisky, ScD, ScM, MSPH, Professor, Department of Community Health Sciences, UCLA School of Public Health, 650 Charles E. Young Dr S, Los Angeles, CA 90095-1772. Each of the subscales of the MMAS-4, unintentional and intentional nonadherence, consists of 2 items from the Morisky Medication Adherence Scale.³¹

models show acceptable calibration as determined by the Hosmer–Lemeshow goodness-of-fit test. Model 3 shows acceptable discrimination with a C statistic over 0.7.³² Overall, model 3 has the lowest AIC; lowest overall *P* value; highest C statistic, demonstrating the best discrimination of the 3 models; and highest Hosmer–Lemeshow *P* value, indicating that model 3 best fits the data (Table 3).

DISCUSSION

Only 19% of patients in this sample had good diabetes control based on their tested A1C levels. Contrary to results from the majority of previous studies, the findings garnered from this study indicate that patients diagnosed with mental health conditions were more

likely to have good diabetes control. Although this finding is counterintuitive, it could be due to increased attention to patients with diabetes and mental health conditions within the primary care clinic from which study participants were drawn. Additionally, this finding could be due to patients in this sample being seen regularly and having access to comprehensive care in a single facility. Overall, the majority (70%) of patients in this patient population, not just those with mental health and diabetes diagnoses, reported more than 7 visits to the COH within a 12-month period.

Although substantial racial/ethnic differences in diabetes control have been observed in previous studies, there were no significant racial differences in level of diabetes control in bivariate analyses

Table 2. Bivariate Associations With Mental Health Conditions

Variable	χ^2	df	P
Diabetes control	4.95	1	.0261
Intentional nonadherence*	2.3	1	.1297

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or adjusted models from this study. This finding indicates that a comprehensive model of care could be effective in reducing racial/ethnic disparities in diabetes control. It is also important to note, however, that the majority of patients reported that they were not currently working (87%), and there was a significant association between employment status and number of visits to the COH. Of patients not in the workforce, 51% had at least 13 visits to the COH; among patients who were employed, only 6% had at least 13 visits to the COH.

There are substantial health and cost implications associated with comorbid mental health conditions and diabetes, as untreated mental

health conditions are known to have negative effects on diabetes outcomes.³³ Thus, the identification and treatment of mental health conditions among patients with diabetes is critical. Evidence from previous studies indicates that patients with comorbid diabetes and mental health conditions are more likely to have poorer glycemic control and receive poorer diabetes care than patients who do not have mental health conditions.^{34,35} Studies also indicate that effective mental health treatment can improve diabetes control.^{36,37} Findings from this study lend further evidence to support results from previous studies indicating that treating mental illness improves diabetes control.

The results from this study provide further support for efforts to integrate behavioral health into primary care settings, and they relate to a number of national health and healthcare priorities. For instance, the Substance Abuse and Mental Health Services Administration mental and physical health integration priorities include the reduction of disparities between the availability of services for mental health conditions compared with the availability of services for other medical conditions, including those for vulnerable patients disproportionately affected by physical health disparities, and support the coordination of care and services across systems.³⁸ This study

was set in a comprehensive outpatient health facility that serves a large number of medically underserved and underinsured patients and includes mental health services in the same facility. Integration across different healthcare settings was important for patients in this sample, as patients with mental health diagnoses in this setting often were assigned a social worker or case manager from external behavioral health agencies. These professionals helped patients navigate services, make their scheduled appointments, and follow up with medication management.

Strengths and Limitations

Strengths of this study included use of EHRs, rather than patient recall, to assess diagnosis of a mental health condition and diabetes control. There are several important limitations that should be noted when interpreting results. Diabetes control was drawn from patients’ most recent recording of A1C level

Table 3. Effects of Mental Health Conditions on Diabetes Control (A1C)

Variable	Model 1 (up to BMI)	Model 2 (add utilization variables)
	OR (95% CI)	OR (95% CI)
Mental health condition	2.258 (1.135-4.494)	2.366 (1.170-4.785)
Age	1.024 (0.992-1.058)	1.019 (0.985-1.054)
Race/ethnicity (reference: white)		
African American or other	1.389 (0.634-3.046)	1.399 (0.625-3.128)
Gender (reference: female)		
Male	1.574 (0.762-3.253)	1.429 (0.681-2.998)
Education (reference: at least some college)		
High school diploma only or lower	0.843 (0.442-1.608)	0.816 (0.418-1.591)
BMI (reference: nonobese)		
Obese (≥30 kg/m ²)	1.106 (0.534-2.291)	1.014 (0.482-2.131)
Number of outpatient visits (past 12 months) (reference: 0-6)		
7-12		2.140 (0.882-5.191)
≥13		1.817 (0.743-4.442)
Number of ED visits (past 12 months) (reference: 0)		
1		1.073 (0.484-2.378)
≥2		0.680 (0.304-1.524)

A1C indicates glycated hemoglobin; BMI, body mass index; ED, emergency department; OR, odds ratio.

Table 4. Effects of Mental Health Conditions on Intentional Nonadherence^a

Variable	Model 1 (up to BMI)	Model 2 (add utilization variables)
	OR (95% CI)	OR (95% CI)
Mental health condition	0.533 (0.226-1.254)	0.579 (0.240-1.395)
Age	1.036 (1.000-1.073)	1.035 (0.998-1.073)
Race/ethnicity (reference: white)		
African American or other	0.471 (0.154-1.444)	0.426 (0.135-1.346)
Gender (reference: female)		
Male	1.158 (0.449-2.988)	1.139 (0.429-3.021)
Education (reference: at least some college)		
High school diploma only or lower	0.953 (0.419-2.167)	0.969 (0.416-2.260)
BMI (reference: nonobese)		
Obese (≥ 30 kg/m ²)	0.801 (0.317-2.024)	0.733 (0.279-1.925)
Number of outpatient visits (past 12 months) (reference: 0-6)		
7-12		2.293 (0.836-6.288)
≥ 13		2.022 (0.766-5.338)
Number of ED visits (past 12 months) (reference: 0)		
1		1.374 (0.461-4.099)
≥ 2		1.018 (0.396-2.618)

BMI indicates body mass index; ED, emergency department; OR, odds ratio.

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in the EHR. There could be differences in the recency of laboratory tests to obtain A1C levels across patients in this sample. Additionally, because patients who were missing A1C values were not included in the analysis, selection bias may have been introduced into the sample and patients in this sample may have been more successful at managing their diabetes and their mental health condition. Similarly, patients who did not have any information in their EHR about mental health problems (eg, diagnoses; medications; *International Classification of Diseases, Ninth Revision* codes) were coded as having “no” mental health conditions. This could mean that the diagnosis of mental health conditions in this sample may have been under- or overestimated. Patients with a mental health condition could have had a diverse group of mental health conditions, with differing levels of severity and impairment from and different types of mental illness. Further, this patient population had regular access to primary medical care, with a mean of 9.27 visits to the primary care clinic per year. Additionally, the COH is a comprehensive outpatient health facility that includes mental health services through another clinic in the same building. This access level could differ from that of individuals in the broader community and those in other urban

areas throughout the country who might not have access to such comprehensive primary medical care. It is likely that results from this underserved sample are not generalizable to other populations.

CONCLUSIONS

Results from this study provide a number of future research directions. First, an in-depth examination of the specific factors that lead to better diabetes control among patients with diabetes and comorbid mental health conditions in this primary care setting is necessary. The COH offers multiple specialties within the same facility that are likely helpful to patients with diabetes and mental health conditions, including endocrinology, psychiatry, and podiatry, in addition to support from diabetes educators and social workers to help patients connect with services in the community. Information from this study could provide evidence to support integrated care practices in other primary care clinics. Future studies should also determine the initial age of mental health diagnosis and the duration of symptoms when patients are first identified in urban primary care settings.

Other needs include determining whether diagnosis of mental disorders resulted in effective treatment among patients in this setting and discovering how long it takes for patients to seek treatment and/or fill drug orders.

Although the patients in this sample were socially and economically vulnerable, the facility had several structural advantages that could make the integration of mental health care in general healthcare settings easier. For instance, a noteworthy finding from this study was that medication complexity was not associated with poorer diabetes control in bivariate analyses. This may be another indicator of strong patient-provider interactions in this facility and COH providers' ability to help patients manage their diabetes. As mentioned earlier, the COH is a comprehensive outpatient health facility that includes mental health services in the same building, so patients do not have to travel to different facilities to seek care for different health conditions. Additionally, coordination of care across different services and health-care providers likely helped to support patients' ability to adhere to medication regimens and attend appointments. This approach is likely effective for patients who have mental health conditions and are managing chronic diseases such as diabetes.

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