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DEPRESSIVE SYMPTOMS AND TYPE 2 DIABETES MELLITUS IN RURAL APPALACHIA: AN 18-MONTH FOLLOW-UP STUDY*

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Abstract

Objective—Despite high rates of diabetes and depression in rural areas, limited data exists to document patterns and predictors of depressive symptoms in rural patients with type 2 diabetes (T2DM). The purpose of this study was to assess the rates and predictors of co-morbid depressive symptoms over an 18-month period in a cohort of rural Appalachian adults with T2DM.

Methods— $N = 100$ adult T2DM patients were recruited from family medicine and endocrinology practices located in the rural Appalachian counties of southeastern Ohio and West Virginia. Data were collected using a longitudinal observational survey design.

Results—The sample consisted of predominantly White (93%) females (62%) who were married (71%), completed high school or less (48%), and had a mean age of 60 years (SD 11). Mean BDI score was 14.0 (SD 12) with 27% scoring in the moderate/severe range for depressive symptoms. A majority of patients (77%) reported depressive symptoms, at both time points, with 88% of these reporting consistent depressive symptoms in the year prior to study follow-up. Patients with depressive symptoms at Time 1 and Time 2 did not differ from other groups in the number of treatment strategies or medications used. Predictors of depressive symptoms in this group were increased diabetes treatment complexity ($OR = 2.3$), lack of home ownership ($OR = 11.4$), and decreased satisfaction with antidepressant medications ($OR = 2.0$; $\chi^2 = 28.9$, $p < .0001$).

Conclusions—Rural T2DM patients reported high rates of repeated depressive symptoms without corresponding rates of depression treatment. These patients may benefit from close

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monitoring and ongoing adjustment of their treatment for depression and diabetes by primary care providers.

Keywords

depressive symptoms; diabetes mellitus; rural

INTRODUCTION

Depression is a significant co-morbid condition among patients with diabetes and it is estimated to affect one in four patients with type 2 diabetes (T2DM) [1]. Diabetes patients have been found to be two times more likely to experience depression than non-diabetes peers [1], with studies utilizing self-report inventories reporting higher prevalence rates of elevated depressive symptoms (31%) than those using diagnostic interviews to diagnose depressive disorders (11%). Women with diabetes showed higher rates of depressive symptom prevalence compared to men (28% vs. 18%) with lower diagnosis rates found in controlled studies utilizing diagnostic interviews (26% female vs. 9% male) [1]. Risk factors associated with major depression and diabetes have been found to include female gender, high school education or less, unmarried status, cigarette smoking, increased number of diabetes complications, and HbA1c levels greater than 8.0% [2].

Depression is a serious co-morbid condition of diabetes. Depression is associated with worsened blood glucose levels [3] and diabetes complications [4], including the acceleration of coronary heart disease in women [5]. The financial and behavioral costs of depression include increased functional disability [6], decreases in adherence to self-care behaviors [7], increased medical costs [7], and greater ambulatory care use and medications [8]. Finally, co-morbid depression has been found to increase the risk of early mortality among patients with diabetes [9, 10].

Although depression is well-documented as a chronic condition in the general population [11], little is known about depression and diabetes among persons living in rural areas despite the fact that many rural communities experience comparable rates of diabetes compared to urban areas [12] and greater risk factors for co-morbid diabetes and depression including greater burden of poverty, income inequality, and unemployment [13–17]. Our group found that 31% of T2DM patients attending family medicine or endocrinology appointments in this region reported clinically significant depressive symptoms [18]. Poverty (e.g., unemployment, lack of home ownership) significantly predicted the presence and severity of depressive symptoms [18], which is consistent with findings observed in urban ethnic minority samples [19, 20].

Mental health has been rated as the fourth highest rural health priority after access to healthcare, oral health, and diabetes among state and local rural health leaders [21]. Although overall prevalence rates of mental illness are comparable in urban and rural areas, there is considerable disparity among rural residents in seeking and obtaining appropriate mental healthcare to treat common disorders [21]. With respect to depression, higher rates of suicide and suicide attempts have been found in rural compared to urban areas which have been attributed to dual disorders (e.g., major depression and substance abuse/dependence),

social stigma and limited access to treatment [21]. Multiple barriers exist in rural areas to adequately address depression in adults with T2DM including availability of care [21], poverty [22, 23], transportation [24], and stigma associated with seeking mental health services [21, 24]. The availability of specialty care (e.g., psychiatry) is considerably limited in rural areas [21]. For example, 87% of Health Resources and Services Administration-designated Mental Health Professional Shortage Areas in the United States are non-metropolitan and contain more than 30 million people [21].

To date, only two studies from urban areas have examined depressive symptom or depression diagnosis recurrence in urban samples. In a mixed sample of patients with type 1 and type 2 diabetes enrolled in an urban diabetes education program, Peyrot and Rubin [24] evaluated self-reported depressive symptoms in patients at pre-program enrollment, post-program (1 week later), and at 6- and 12-month follow-up evaluations. Thirty-six percent of participants who reported depressive symptoms at either pre- or post-program also reported depressive symptoms at the 6-month follow-up evaluation. Seventy-three percent of the patients who reported depressive symptoms at *both* the pre-program and post-program continued to report depressive symptoms 6 months later. At a 12-month evaluation, 81% of patients who were positive for depressive symptoms at two time points continued to report depressive symptoms. Twelve percent of patients who did not report depressive symptoms at either baseline period reported depressive symptoms at the 6-month follow-up evaluation. The authors reported that significant predictors of persistent depressive symptoms included patients with non-insulin treated T2DM, multiple diabetes complications, and limited education (i.e., less than a high school degree). Depression treatment characteristics were not reported.

In a 5-year follow-up study of type 1 and type 2 diabetes patients drawn from an urban center and diagnosed with major depressive disorder (MDD assessed using the Diagnostic Interview Survey), Lustman [25] found that 79% ($N = 22$) of patients reported an affective illness (MDD or dysthymia) during the follow-up period. Only 10% of patients without MDD at baseline developed depression during the intervening period. Diabetes complications did not appear to differ between those with and without recurrent depression histories. Data were not available on the predictors of recurrent depression or depression treatment experiences in this small but well-characterized sample.

In sum, no studies to date have examined patterns of depressive symptoms over time among rural adults with T2DM. The current study is an 18-month longitudinal evaluation of a cohort of T2DM patients recruited from family medicine and endocrinology practices located in Appalachian counties of southeastern Ohio and West Virginia. The aims of the study were to identify the rate of self-reported depressive symptoms at follow-up among T2DM patients and the rate of depressive symptom persistence among patients reporting clinically significant depressive symptoms at baseline. In addition, the study sought to characterize the predictors of depressive symptom persistence in this cohort with respect to demographic, diabetes, and treatment history variables.

METHODS

Participants

Participants for the current study were recruited from the Psychosocial Aspects of Diabetes among Medical Patients in Appalachia Study [18]. At baseline (Time 1), 201 participants were initially recruited from family medicine and endocrinology practices of participating providers. Participants enrolled at Time 1 met eligibility criteria and consented to participate. Eligibility criteria included: diagnosis of T2DM for 1 year or longer, age 18 or older, and ability to provide informed consent. A description of the recruitment procedures for the baseline panel has been previously presented [18].

At the follow-up contact (Time 2), all participants from the baseline cohort were invited to participate in the follow-up study. A total of $N = 128$ (64%) patients responded to invitations for study participation. Of these, $N = 28$ declined participation following contact with the research assistant (22% refusal rate). Twelve participants from Time 1 were deceased or had moved out of the area in the intervening time and were not available to participate. A total of $N = 100$ (53% of possible responders) completed questionnaires and consented to release medical record data.

Informed Consent and IRB Approval

The study was approved by the Institutional Review Board at Ohio University. Appropriate procedures for research with human subjects were followed in accordance with ethical and legal standards.

Procedures

Participants completed psychosocial questionnaires that included the following variables and measures at Time 1 and Time 2.

- *Demographic characteristics* included age, ethnicity, marital status, income, educational status, work status, health insurance status, and economic resources such as employment status, total annual income, home ownership, and patient appraisal of their financial situation.
- *Medical record variables* were reviewed at Time 1 and again for the year prior to study participation at Time 2. Variables collected from these records included glycosylated hemoglobin (HbA1C; normal reference range: 4.3–5.7%), total cholesterol, BMI, diabetes complications, and prescribed medications.
- *Depression characteristics.* Participants completed the Beck Depression Inventory–II (BDI-II), a 21-item self-administered questionnaire used to assess depressive symptoms in the 2 weeks prior to administration [26]. BDI-II items have been designed to correspond with Diagnostic and Statistical Manual-IV-TR diagnostic criteria. The BDI-II has been shown to have excellent test-retest reliability ($r = 0.93$) and inter-item correlations (ranging from $r = 0.91$ to $r = 0.95$) when used in general populations [26] and diabetes samples [27]. The items are summed with total scores ranging from 0 to 63 with higher scores indicating higher levels of depressive symptoms [26]. In addition, participants were asked about the presence

of depressive symptoms for the past 12 months (e.g., “Have you felt depressed or sad much of the time in the past year?”) rated as “yes” or “no.”

- *Depression treatment experience.* Participants were asked about depression treatment experience (i.e., presence/absence of psychotherapy, antidepressant medications (and types), alternative therapies (e.g., herbal remedies, healers, pastoral counseling). Satisfaction with each type of treatment used was rated on a 5-point Likert scale (1 = Very dissatisfied; 5 = Very satisfied).

Analyses

Presence of depressive symptoms was dichotomously coded as “none/mild” or “moderate/severe” using conservative thresholds for the BDI-II total score (“moderate/severe” defined as a BDI score ≥ 20 ; “none/mild” defined as a BDI-II score ≤ 19). These higher thresholds were selected to maximize positive predictive value and sensitivity for depression in a diabetes population. Chi-square and Student’s *t*-tests were conducted to assess sample differences across time points and by depressive symptom status. Analyses of variance were conducted to evaluate mean number of treatment strategies and medications by depression symptom status over time. Participants with data at Time 1 and Time 2 were categorized by their patterns of depressive symptoms over time into four groups: never depressed, remitted, new, and persistent depressive symptoms. Logistic regression analyses were conducted using SAS version 8.2 [28] to assess predictors of depressive symptom persistence. Overall model fit was evaluated using Hosmer-Lemeshow goodness-of-fit statistic [29]. A test of discrimination of depressive symptom status was evaluated by examining the area under the ROC curve (ROC) [29].

RESULTS

Demographic characteristics for the Time 1 and Time 2 samples are shown in Table 1. At baseline, the sample was predominantly White (94%), female (60.2%), married (71%), with a mean age of 57 years with more than 50% of respondents with less than high school or a high school education. Nearly half of participants (45%) had an annual household income less than \$21,000. Time 2 data collection occurred 18 months (*SD* 4.7 months) following the baseline assessment. The subsample participating at Time 2 was representative of the baseline cohort. As anticipated, participants at Time 2 were older (mean age = 60.4 years, *SD* 11.1; $p < .009$) than those responding at Time 1. No other significant demographic differences between samples were observed. The preponderance of patients reported current health insurance coverage (96%). Ninety-one percent reported receiving care from a primary care provider (PCP) and 56% reported receiving healthcare from a diabetes specialist. Characteristics of those who did not complete Time 2 were compared to Time 2 participants and no significant differences in the subsamples were observed.

Diabetes Status/Complications

Participants at Time 2 had slightly improved glycemic control ($M_{\text{Time 1}}: 7.5$, *SD* 1.6; $M_{\text{Time 2}}: 7.1$, *SD* 1.2; $p < .04$), greater proportion of dyslipidemia (Percent_{Time 1}: 71.4%; Percent_{Time 2}: 82.7%, $p < .01$), and greater total number of medications ($M_{\text{Time 1}}: 7.7$, *SD* 3.9; $M_{\text{Time 2}}: 9.2$, *SD* 4.7, $p < .01$) than those at Time 1. At Time 2, the mean age of onset of

T2DM was 48.6 years (*SD* 11.9) and the mean duration of diabetes was 12.5 years (*SD* 10.4). Distribution of diabetes treatment at Time 2 was: 48% oral agent (OHA) treatment, 20% insulin or insulin pump treatment, 21% combination treatment (OHA and insulin), and 9% diet alone. The mean number of diabetes complications noted in the medical record was 0.77 (*SD* 1.2). On average, participants were obese [30] (mean BMI = 35.1 (*SD* 7.6).

Self-Reported Depressive Symptoms at Time 2

Sample characteristics for depressive symptoms and treatment at each time point are shown in Table 2. Participants at Time 2 did not differ from those in Time 1 with respect to mean BDI depression scores or distribution of depressive symptom severity.

At Time 2, the mean BDI score was 14.0 (*SD* 11.7) indicating mild depressive symptoms on average. Approximately 62% of all Time 2 participants reported minimal depressive symptoms (0–13), 11% mild symptoms (14–19), 11% moderate symptoms (20–28), and 16% severe symptoms (29 or higher). When the moderate and severe categories were combined (i.e., moderate/severe depressive symptom group), 27% of participants reported clinically significant levels of depressive symptoms (i.e., ≥ 20). Fifty-four percent of participants reported a 2-week period of depressive symptoms during the previous year and 29% of participants reported feeling depressive symptoms for “most of the past year.”

Demographic characteristics by depressive symptom status were examined. Patients who reported moderate/severe depressive symptoms had fewer years of education ($\chi^2 = 18.9$, $p < .0003$), lower household income ($\chi^2 = 8.5$, $p < .04$), were less likely to own their own homes ($\chi^2 = 4.4$, $p < .04$), and more likely to report difficulty making ends meet ($\chi^2 = 15.5$, $p < .0004$) than those reporting none/mild depressive symptoms. Examination of differences in diabetes outcomes by depressive symptom status indicated that patients with moderate/severe depressive symptoms had a younger age of diabetes onset ($t = 2.3$, $p < .03$) and were more likely to be smokers ($\chi^2 = 6.2$, $p < .01$) compared to their counterparts with none/mild depressive symptoms.

Depression Treatment Characteristics

At Time 2, nearly half of patients (47%) reported experience with one or more types of depression treatment within the past year including antidepressant medications (47%; mean number of antidepressant medications = 0.98, *SD* 1.85), mental health professionals (16%), alternative healers (e.g., pastors, faith healers; 5%), and herbal remedies (4%). The majority of participants rated general satisfaction with most forms of treatment (i.e., 72% for antidepressant medications; 75% mental health providers; 50% herbal remedies) with the exception of alternative healers (40%).

Evaluation of prescribed antidepressants noted in the medical record indicated that 24% of participants were prescribed a mean number of 1.3 (*SD* 0.5) antidepressant medications. These patients represented 48% of those with moderate/severe depressive symptoms at Time 2. Four percent of participants were prescribed anxiolytic medications and one participant (1%) was prescribed antipsychotic medication.

Depressive Symptom Patterns

Patterns and predictors of depressive symptoms were assessed by comparing BDI scores at each time point. Among those who reported depressive symptoms at Time 1 and completed Time 2, 77% ($N = 17$) reported depressive symptoms 18 months later (persistent depressive symptom group). Of those participants who reported persistent depressive symptoms, 88% ($N = 15$) reported feeling depressed or sad much of the time in the preceding year. Twenty-three percent ($N = 5$) of those with depressive symptoms at Time 1 no longer reported clinically significant depressive symptoms at Time 2 (remitted depressive symptom group). Of the 78 participants who did report none/mild depressive symptoms at Time 1, 10 (13%) were categorized as having clinically significant depressive symptoms at Time 2 (new depressive symptom group) and 68 (87%) continued to endorse none/mild depressive symptoms (never depressed group).

Predictors of Depressive Symptom Persistence

Logistic regression analyses were conducted to identify predictors of depressive symptom recurrence (i.e., persistent vs. non-persistent; shown in Table 3). Preliminary analyses were conducted to identify significant predictors of depressive symptom persistence among demographic, diabetes, and depression treatment variables collected at Time 1. Significant predictors in the respective models were lack of home ownership, greater complexity of diabetes treatment, greater number of antidepressant medications, and lowered satisfaction with antidepressant treatment.

In the final model, all variables including gender and current depression treatment status (Time 2) were entered into the model simultaneously. Results indicated that increased complexity of diabetes treatment ($OR = 2.3$; 95%CI: 1.1–4.9), lack of home ownership ($OR = 11.4$, 95%CI: 1.7–75.9), and decreased satisfaction with antidepressant medications ($OR = 2.0$; 95%CI: 1.2–3.5) significantly predicted recurrent depressive symptoms ($\chi^2 = 27.9$, $p < .0001$, $R^2 = .26$; Hosmer-Lemeshow Goodness of Fit $\chi^2 (7, N = 96) = 1189$, $p = .10$; ROC = .85).

DISCUSSION

The results of this study demonstrated a significant level (27%) of co-morbid diabetes and depressive symptoms among rural Appalachian clinic patients comparable to average prevalence estimates in studies using self-report questionnaire assessment methods [1]. Moreover, this rate was consistent with cross-sectional rates observed in our prior research at Time 1 (i.e., 31%) [18].

In the current study, 77% of participants who reported depressive symptoms at Time 1 reported recurrent depressive symptoms at Time 2. These findings are consistent with those found in urban samples reported by Peyrot and Rubin [24] at 6- and 12-month follow-up (73%) and Lustman [25] using MDD as the diagnostic category. However, this is the first study to examine depressive symptom patterns in a rural sample. The absence of diagnostic interview data in which specific onset and offset periods could be recorded does not permit us to determine whether participants were reporting separate or continuous episodes of

depressive symptoms from Time 1 to Time 2. However, the majority (88%) of participants with significant depressive symptoms at both time points reported feeling consistent depressive symptoms for most of the past year, which suggests continuous rather than discrete depressive symptoms. Evaluation of the depressive symptoms trajectories found comparable rates of newly reported clinically significant depressive symptoms in our sample (13%) to those reported by Peyrot and Rubin [24]. Despite the persistence of depressive symptoms, we did not observe significant differences in the number of treatment strategies or number of antidepressants reported across groups (new, remitted, and recurrent). It is unknown whether patients received multiple simultaneous treatment strategies.

Examination of the predictors of the persistence of depressive symptoms differed from prior studies. In our rural Appalachian sample, we found that increased complexity of diabetes treatment (ranging from diet alone to combination therapy) and dissatisfaction with antidepressant medications at baseline significantly predicted depressive symptom persistence at the 18-month follow-up. These findings differ from those reported by Peyrot and Rubin [24] in which non-insulin treated patients with a greater number of diabetes complications were more likely to report persistent depressive symptoms. In our study, greater number of diabetes complications was not a significant predictor of depressive symptoms. This may be a function of overall low levels of diabetes complications (i.e., less than 1 complication on average) in this sample which had favorable levels of glycemic control (i.e., average A1c 7.1% at Time 2).

Limitations of the current study include the use of self-report depressive symptom questionnaires and the use of a clinic patient population. The use of self-report questionnaires has been documented to be associated with higher reported rates of depressive symptoms than psychiatric interviews [1]. Given this inherent bias, we noted comparable rates of persistent depressive symptoms in this sample compared to other national samples [24]. We also attempted to overcome this limitation by utilizing conservative thresholds (i.e., BDI scores in the moderate/severe range) for the categorization of depressive symptoms status. The use of self-report questionnaires as well as a sample of clinic-attendees may limit the generalizability of these findings to patients with T2DM in this region who do not attend physician appointments, since the majority of this sample had access to health insurance and a primary care provider. In addition, it is possible that the observed rates of depressive symptoms may be underestimated for individuals with lower economic and health resources. Finally, the study response rate limited the number of cases that could be categorized as persistent. The samples at Time 1 and Time 2 were comparable with respect to demographic and depressive symptom data suggesting no systematic bias in the characteristics of respondents at Time 2. Prior research on the recurrence of depressive symptoms or depression is similarly limited by the use of small, urban sample of T2DM patients [25]. Replication of the current study is warranted in a larger sample of rural Appalachian T2DM patients with recurrent depressive symptoms.

For the T2DM patients experiencing persistent depressive symptoms and who were receiving an antidepressant medication at Time 2, the BDI indicated that medication may not have been sufficient in resolving depressive symptoms below moderate levels, suggesting insufficient treatment outcomes. It may be that single modes of treatment were

insufficient at treating co-morbid depressive symptoms within these patients. Those with persistent depressive symptoms also did not report a greater number of treatment strategies in the previous year compared to new or remitted depressive symptom groups. Given that dissatisfaction with antidepressant treatment at baseline predicted persistent depressive symptoms, it is possible that patients with these depressive symptoms lost faith in antidepressant medications when treatment “failed” (i.e., symptoms remained) thereby limiting their desire to seek future medications or alternate treatment strategies. This problem is further exacerbated by the paucity of psychiatry professionals in rural areas [21].

Findings from this study document the persistent nature of depressive symptoms in rural Appalachian patients with T2DM at an 18-month follow-up evaluation. These findings also provide important evidence for the need for appropriate identification and management of depressive symptoms as a part of standard T2DM care within this rural region. In our sample, less than half of those with clinically significant depressive symptoms were receiving antidepressant medication at Time 2 as documented in the medical record. This is consistent with previous findings that depression is often undiagnosed and under-treated in the primary care setting [31]. This is important given that the majority of rural Appalachian residents seek mental health services from their primary care providers. The presence of T2DM and co-morbid, persistent depressive symptoms challenges rural primary care providers to rise to the occasion by actively managing both diabetes and depression treatments. Rural primary care providers are well-positioned to regularly monitor depressive symptoms through interview techniques or the use of brief depression questionnaires (e.g., Beck Depression Inventory, PHQ-9 or PHQ-2) and work effectively with their T2DM patients to rigorously treat this co-morbid condition and improve patient outcomes.

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REFERENCES

1. Anderson RJ, et al. The prevalence of comorbid depression in adults with diabetes: A meta-analysis. *Diabetes Care*. 2001; 24(6):1069–1078. [PubMed: 11375373]
2. Katon W, Von Korff M, Ciechanowski P, Russo J, Lin E, et al. Behavioral and clinical factors associated with depression among individuals with diabetes. *Diabetes Care*. 2004; 27(4):914–920. [PubMed: 15047648]
3. Lustman PJ, et al. Depression and poor glycemic control: A meta-analytic review of the literature. *Diabetes Care*. 2000; 23(7):934–942. [PubMed: 10895843]
4. de Groot M, Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. Association of depression and diabetes complications: A meta-analysis. *Psychosomatic Medicine*. 2001; 63:619–630. [PubMed: 11485116]
5. Clouse RE, Lustman PJ, Freedland KE, Griffith LS, McGill JB, et al. Depression and coronary heart disease in women with diabetes. *Psychosomatic Medicine*. 2002; 65(3):376–383. [PubMed: 12764210]
6. Egede LE. Diabetes, major depression and functional disability among U.S. adults. *Diabetes Care*. 2004; 27(2):421–428. [PubMed: 14747223]
7. Ciechanowski PS, Katon WJ, Russo JE. Depression and diabetes: Impact of depressive symptoms on adherence, function, and costs. *Archives of Internal Medicine*. 2000; 160:3278–3285. [PubMed: 11088090]

8. Egede LE, Zheng D, Simpson K. Comorbid depression is associated with increased health care use and expenditures in individuals with diabetes. *Diabetes Care*. 2002; 25(3):464–470. [PubMed: 11874931]
9. Zhang X, Norris SL, Gregg EW, Cheng YJ, Beckles G, et al. Depressive symptoms and mortality among persons with and without diabetes. *American Journal of Epidemiology*. 2005; 161(7):652–660. [PubMed: 15781954]
10. Katon W, Rutter C, Simon G, Lin EB, Ludman E, et al. The association of comorbid depression with mortality in patients with type 2 diabetes. *Diabetes Care*. 2005; 28:2668–2672. [PubMed: 16249537]
11. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders IV-TR*. Washington, DC: American Psychiatric Press; 2000. p. 372–373.
12. Schwartz F, Ruhil A, Denham S, Shubrook J, Simpson C, Boyd S. High self-reported prevalence of diabetes mellitus, heart disease and stroke in eleven counties in rural Appalachian Ohio. *Journal of Rural Health*. 2009 Spring;:225–229.
13. Black, DA.; Sanders, SG. Labor market performance, poverty, and income inequality in Appalachia. *Appalachian Regional Commission*; 2004.
14. Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the United States. *Journal of the American Medical Association*. 2001; 286(10):1195–1200. [PubMed: 11559264]
15. Centers for Disease Control. BFRSS 2005 Data, State of Ohio. 2005. Available at <http://apps.nccd.cdc.gov/brfss/display.asp?cat=DB&yr=2002&qkey=1364&state=US>
16. Voinovich Center for Leadership and Public Affairs. *Appalachian Rural Health Institute Health Needs Assessment Survey Report of Findings*. Athens, OH: Ohio University Voinovich Center for Leadership and Public Affairs; 2006.
17. Dabney, B.; Gosschalk, A. *Rural healthy people 2010*. College Station, TX: The Texas A&M University System Health Science Center, School of Public Health, Southwest Rural Health Research Center; 2003. Diabetes in rural America.
18. de Groot M, Doyle T, Hockman E, Wheeler C, Pinkerman B, et al. Depression among type 2 diabetes rural Appalachian clinic attendees. *Diabetes Care*. 2007; 30(6):1602–1604. [PubMed: 17353505]
19. Jackson-Triche ME, Sullivan J, Wells KB, Rogers W, Camp P, et al. Depression and health-related quality of life in ethnic minorities seeking care in general medical settings. *Journal of Affective Disorders*. 2000; 58:89–97. [PubMed: 10781698]
20. de Groot M, Auslander W, Williams JH, Sherraden M, Haire-Joshu D. Depression and poverty among African-American women at risk for type 2 diabetes. *Annals of Behavioral Medicine*. 2003; 25:172–181. [PubMed: 12763712]
21. Gamm L, Stone S, Pittman S. Mental health and mental disorders. A rural challenge: A literature review. *Rural Healthy People*. 2000:97–113.
22. Pfeiffer PN, Glass J, Austin K, Valenstein M, McCarthy JF, Zivin K. Impact of distance and facility of initial diagnosis on depression treatment. *Health Services Research*. 2011; 46(3):768–786. [PubMed: 21210800]
23. Fortney J, Rost K, Zhang M, Warren J. The impact of geographic accessibility on the intensity and quality of depression treatment. *Medical Care*. 1999; 37:884–893. [PubMed: 10493467]
24. Peyrot M, Rubin RR. Persistence of depressive symptoms in diabetic adults. *Diabetes Care*. 1999; 22(3):448–452. [PubMed: 10097927]
25. Lustman PJ, Griffith LS, Clouse RE. Depression in adults with diabetes. Results of 5-yr follow-up study. *Diabetes Care*. 1988; 11(8):605–612. [PubMed: 3219966]
26. Beck, AT.; Steer, RA.; Brown, GK. *BDI-II Beck Depression Inventory Manual*. 2nd ed.. San Antonio, TX: The Psychological Corporation, Harcourt, Brace & Company; 1996.
27. Lustman PJ, et al. Screening for depression in diabetes using the Beck Depression Inventory. *Psychosomatic Medicine*. 1997; 59(1):24–31. [PubMed: 9021863]
28. SAS Institute, I. version 8.03e. Cary, NC: 2001.
29. Tabachnick, PF.; Fidell, L. *Using multivariate statistics*. 4th ed.. New York, NY: Allyn & Bacon; 2001.

30. National Institutes of Health. The practical guide: Identification, evaluation and treatment of overweight and obesity in adults 1–77. Bethesda, MD: National Institutes of Health; 2000.
31. Olfson M, et al. Continuity of antidepressant treatment for adults with depression in the United States. *American Journal of Psychiatry*. 2006; 163:101–108. [PubMed: 16390896]

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Table 1

Demographic Characteristics for Time 1 and Time 2

	Time 1 (N = 201)		Time 2 ^a (N = 100)		p-Value
	N	%	N	%	
Age (Mean, SD)	56.7	12.4	60.4	11.1	.009*
Sex					
Male	80	39.8	38	38	.76
Female	121	60.2	62	62	
Ethnicity					
White	188	93.5	93	93	.13
African-American	6	3.0	1	1	
American Indian	1	0.5	1	1	
Asian or Pacific Islander	1	0.5	1	1	
Mixed ethnic heritage	5	2.5	4	4	
Marital status					
Married/Living with partner	141	70.9	71	71	.44
Single	15	7.5	2	2	
Divorced/Separated	21	10.6	15	15	
Widowed	22	11.1	12	12	
Education					
Less than high school	43	21.5	13	13.4	.76
High school diploma/GED	63	31.5	34	35.0	
Trade school	14	7.0	9	9.3	
Part college/4-year/post	80	40.0	41	42	
Income					
0–10,000	47	24.4	18	18.6	.72
11,000–20,000	40	20.7	16	16.5	
21,000–40,000	45	23.3	24	24.7	
More than 40,000	61	31.6	39	40.2	
Home ownership	161	80.1	86	86	.21

	Time 1 (N = 201)		Time 2 ^a (N = 100)		p-Value
	N	%	N	%	
Work outside home	87	43.3	32	32	.06
Mean # dependents (Mean, SD)	2.2	1.3	2.1	1.0	.46
Spousal support	94	47.0	36	41.4	.37
Difficulty making ends meet					
Hard	75	37.3	44	44	.66
50/50	77	38.3	30	30	
Easy	49	24.4	26	26	
Health insurance	190	96.0	95	96	.78
Current PCP	191	95.5	91	91	.12
Current endocrinologist	100	50.0	55	55.6	.37

^a Chi-square and student's *t*-test comparisons by time point.

* *p* < .05;

** *p* < .001.

Table 2

Depression Treatment and Satisfaction Characteristics for Participants Completing Time 1 and Time 2 Assessments ($N = 100$)

	Time 1		Time 2	
	<i>N</i>	%	<i>N</i>	%
BDI Score (Mean, SD)	14.5	12.0	14.0	11.7
Depressive symptom severity				
None	65	66.0	62	62.0
Mild	12	12.0	11	11.0
Moderate	10	10.0	11	11.0
Severe	12	12.0	16	16.0
Self-reported use of depression treatment	Lifetime		Past year	
Antidepressant	49	49.0	47	47.0
Mental health provider	33	33.0	16	16.2
Herbal remedies	11	11.0	4	4.0
Alternative healers	7	7.0	5	5.1
Treatment satisfaction				
Antidepressant medications				
Very/Satisfied	34	69.4	31	72.1
Neutral	8	16.3	6	14.0
Very/Dissatisfied	7	14.3	6	14.0
Mental health provider				
Very/Satisfied	24	72.7	12	75.0
Neutral	2	6.1	3	18.8
Very/Dissatisfied	7	21.2	1	6.3
Herbal remedies				
Very/Satisfied	5	45.5	2	50.0
Neutral	3	27.3	0	0.0
Very/Dissatisfied	3	27.3	2	50.0
Alternative healers				
Very/Satisfied	3	42.9	2	40.0
Neutral	2	28.6	3	60.0
Very/Dissatisfied	2	28.6	0	0.0

^a Chi-square and student's *t*-test comparisons by time point.

* $p < .05$;

** $p < .001$.

Table 3

Logistic Regression Model to Assess Socioeconomic and Medical Correlates of Persistent Depressive Symptoms

Logistic Regression Model Predicting Depressive Symptom Status					
Predictors	B	S.E.	Wald	OR	95% CI
Gender	.10	.79	.23	1.5	.31–6.9
Lack of home ownership	.43	.97	6.4	11.8*	1.7–80.3
Complexity of DM treatment at Time 1	.41	.39	3.9	2.2*	1.0–4.7
Depression treatment at Time 2	.02	.99	.01	1.1	.16–7.7
Number of antidepressant medications at Time 1	.20	.24	.83	1.2	.78–1.9
Satisfaction with antidepressant medications at Time 1	.50	.29	6.4	2.1*	1.2–3.6
Hosmer-Lemeshow	$\chi^2 (7, N = 96) = 11.8, p = .11$				
Good-of-Fit Test	ROC = 8.5 $R^2 = 0.26$				