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Depression Among Type 2 Diabetes Rural Appalachian Clinic Attendees

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The prevalence and impact of type 2 diabetes in Appalachia is understudied despite the presence of high-risk socioeconomic conditions (e.g., low levels of education and income). Appalachian counties experience greater burdens of poverty, income inequality, unemployment (1), and diabetes compared with non-Appalachian counties (2–5). Rates of comorbid depression have not been documented in this region.

Patients with type 2 diabetes are two times more likely to experience depressive symptoms than their peers without diabetes (6). Depression prevalence in studies using self-report depression inventories was found to be 32.9%, with lower rates (28.5%) observed in studies using diagnostic interview schedules (6,7). Depressive symptoms are associated with worsened blood glucose levels (8), diabetes complications (9), increased functional disability (10), worsened adherence to diabetes regimen (11), higher ambulatory care costs (12), and increased mortality (13).

The current study was conducted to identify rates of self-reported depression and to identify the socioeconomic and medical correlates of depression among type 2 diabetic patients attending family medicine and endocrinology appointments from rural Appalachian counties of southeastern Ohio and West Virginia. It was hypothesized that poverty would increase the risk of comorbid depression in this region.

RESEARCH DESIGN AND METHODS

Participants, recruited from family medicine and endocrinology practices, were diagnosed with type 2 diabetes for ≥1 year and aged ≥18 years, with the ability to provide informed consent. Patients (n = 628) were identified from billing and registry databases. Of these, 288 patients responded to letters of invitation for study participation from their medical provider. Thirty-two participants did not meet inclusion criteria, and 55 declined participation (9.8% refusal rate). A total of 201 (36% response and 78.5% cooperation rates) completed questionnaires and consented to release medical record data.

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Participants completed the Beck Depression Inventory (BDI)-II (14), which assesses depressive symptom severity for 2 weeks prior to administration. Demographic questionnaire variables included age, ethnicity, Appalachian heritage, marital status, income, and educational status. Economic resource variables included employment status, total annual income, home ownership, appraisal of financial status and optimism, and presence of health insurance (15).

Medical records were reviewed for the year before study participation. Variables included physician diagnosis of type 2 diabetes, A1C (normal reference range 4.3–5.7% [DCA2000+ Analyzer; Bayer Diagnostics]), total cholesterol, BMI, diabetes complications and risk factors, and prescribed medications.

Analyses were conducted using SAS version 8.0e (16). Logistic regression analyses were conducted to assess predictors of depression status, coded dichotomously as “depressed” (BDI-II score ≥20) or “nondepressed” (≤19). Overall model fit was evaluated using Hosmer-Lemeshow goodness-of-fit statistic (17). Test of discrimination of depression status was evaluated by examining the area under the receiver-operating characteristic curve (ROC) (17). Multiple regression analysis was used to assess correlates of depression severity, using BDI-II score as a continuous outcome measure.

RESULTS

The sample was predominantly female (60%, *n* = 121), white (94%, *n* = 188), married (71%, *n* = 141), completed high school or less (53%, *n* = 106), and had a mean age of 57 ± 12 years. Forty-five percent (*n* = 87) reported a total annual income of $20,000 or less, with 43% (*n* = 87) working outside the home. Eighty percent (*n* = 161) reported owning their own home.

The mean duration of type 2 diabetes was 9.7 ± 8.2 years, with the majority of patients receiving oral agents (49%, *n* = 98) or combination treatment (27%, *n* = 54). Mean A1C value was 7.5 = 1.6%. Mean number of diabetes complications was 1.1 ± 1.2, with cardiovascular disease (22.1%, *n* = 44), neuropathy (16.6%, *n* = 33), and coronary heart disease (13.6%, *n* = 27) noted most frequently. The mean number of prescribed medications was 7.7 ± 3.9.

The mean BDI-II score was 14.5 ± 12.0. Of participants, ~58% (*n* = 116) reported few depressive symptoms (score 0–13), 12% (*n* = 23) with mild symptoms (14 –20), 16% (*n* = 31) with moderate symptoms (21–28), and 16% (*n* = 30) with severe symptoms (≥29). When the moderate and severe categories were combined, 31% (*n* = 61) of participants reported clinically significant levels of depressive symptoms.

Results of the logistic and multiple regression analyses are shown in Table 1. Younger age, unemployment, lack of home ownership, greater number of medications, and higher BMI significantly predicted depression status. Depression severity was associated with younger age, unemployment, and greater number of prescribed medications.

CONCLUSIONS

In this study, 31% of Appalachian participants reported comorbid diabetes and depression, a rate comparable with average prevalence estimates in studies using self-report questionnaire assessment methods (5,7).

Models predicting depression status and severity found younger, unemployed participants and those who did not own their own homes at increased risk of depression. These findings

are consistent with those observed in urban ethnic minority samples (18,19), suggesting that poverty may represent a common risk factor across ethnic groups for comorbid depression in diabetic individuals. The cross-sectional study design does not permit determination of the casual direction of this relationship.

Contrary to previously published studies (8), we did not observe significant differences in average A1C by depression status. This may be due to the limited variability in A1C observed in the sample as a whole.

Limitations to the current study include the cross-sectional nature of the study design, the use of a clinic patient population, limited recruitment response rate, and the use of self-report questionnaires. Response rates were comparable with those observed in studies of other low-income populations (20 –22) and may reflect barriers endemic to the rural research (23). Although rates of depression are higher in self-report questionnaires than psychiatric interviews (6), observed rates were not inflated compared with other national samples.

Findings from this study document a substantial burden of clinically significant depressive symptoms (one in three participants) in this Appalachian region. Poverty increases the risk of depression in diabetes. Further investigation into treatment availability and effectiveness is needed in light of the economic vulnerability of this region.

Abbreviations

BDI Beck Depression Inventory

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Table 1

Regression models to assess socioeconomic and medical correlates of depression

Logistic regression model predicting depression status				
Predictors	**B**	**SE**	**Wald**	**OR (95% CI)**
Younger age	−0.04	0.02	5.39*	0.96 (0.93–0.99)
Unemployment	1.07	0.45	5.75*	2.92 (1.22–6.99)
Lack of home ownership	1.34	0.49	7.31*	3.81 (1.45–10.03)
No. of medications	0.12	0.06	4.56*	1.13 (1.01–1.26)
Duration of diabetes	−0.03	0.02	1.15	0.98 (0.93–1.02)
BMI	0.05	0.03	4.43*	1.10 (1.00–1.11)
Hosmer-Lemeshow goodness-of-fit test	$\chi^2(8, n = 152) = 4.22$; $P = 0.84$		ROC = 0.80	$R^2 = 0.23$
Multiple regression model to assess correlates of depression severity				
Predictors	B	β	SE	—
Younger age	−0.27	−0.27†	0.09	—
Unemployment	4.30	0.18*	2.01	—
Income	−0.64	−0.09	0.67	—
Lack of home ownership	2.07	0.07	2.34	—
Ability to make ends meet	−1.79	−0.18	0.99	—
Exercise	−0.83	−0.13	0.49	—
BMI	0.11	0.08	0.11	—
No. of complications	−1.07	−0.13	0.73	—
Duration of diabetes	−0.05	−0.03	0.13	—
No. of medications	0.45	0.16*	0.23	—
Overall model test	$F = 8.33$†	$R^2 = 0.43$	Adjusted $R^2 = 0.43$	—

*$P < 0.05$,

†$P < 0.0001$.