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Depressive Symptoms and Diabetes Self-Management among Rural Older Adults

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Abstract

Objectives—To assess the association of depressive symptoms with diabetes self-management regimens among older adults with type 2 diabetes in a rural, ethnically diverse community.

Methods—Data from 696 rural older African Americans, American Indians and whites were used to assess depressive symptoms (modified CES-D) and diabetes self-management (physical activity, blood glucose self-monitoring, self foot checks, following a healthful eating plan, and medication adherence).

Results—In bivariate analyses, high CES-D scores were associated with decreased adherence to a healthful eating plan and physical activity, and increased foot checks; the latter 2 remained significant in multivariate analyses.

Conclusions—Older adults with diabetes and depression are less likely to adhere to self-management, increasing their risk of complications.

Keywords

depressive symptoms; type 2 diabetes; African Americans; American Indians; diabetes self-management

INTRODUCTION

Diabetes is a growing problem in the Unites States, placing a tremendous burden on primary care providers who play a major role in the management of these patients. Recent estimates indicate that approximately 24 million Americans have diabetes, and about $116 billion direct medical care costs are attributed to the disease.[1] Depression is a common complication associated with diabetes, especially among older adults. A recent meta-analysis of 42 studies concluded that diabetes doubles the risk of depression regardless of sex or diabetes type.[2] The co-existence of diabetes and depression has serious implications. Depression increases the risk of mortality, diabetes-related complications, and contributes to decreased quality of life.[3–5] Persons with depression are at higher risk for poor glycemic control, which is a risk factor for diabetes morbidity and mortality.[6,7]

Although the mechanism for this association is unclear, one proposed mechanism is that depression substantially inhibits motivation to perform diabetes self-management. A number of recent studies have shown that persons with depression are less likely to adhere to diabetes self-management regimens compared to those without depression.[8–13] However, these studies have not considered the influence of ethnic minority status and rurality as factors in this association. These populations are at increased risk for diabetes and its complications due to limited access to health care, particularly specialty health care,[14] mental health services[15,16] diabetes self-management programs, and resources such as blood sugar monitors and exercise equipment critical for appropriate chronic disease management.[17] It is especially important to understand these factors in this population, given the high rates of diabetes and its complications seen among these groups.

The purpose of this study was to evaluate the association between depression and diabetes self-management in an ethnically diverse sample of rural older adults. Implications of the study's findings for primary care providers' facilitating diabetes self-management in this vulnerable population are also considered.

METHODS

Study Description

The ELDER (Evaluating Long-term Diabetes Self-management among Elder Rural Adults) Study was a population-based cross-sectional survey that comprehensively assessed the self-management strategies of rural adults aged ≥65 years with diagnosed diabetes.[14,17–20] Participants were selected from 2 largely rural counties in central North Carolina with a high proportion of ethnic minorities and persons living below the poverty level. The study was approved by the Institutional Review Board of Wake Forest University School of Medicine.

Participant Recruitment and Selection

The ELDER Study recruited a random sample of community-dwelling older adults with diabetes, stratified by sex and ethnicity (African Americans, American Indians and Whites). The sampling frame was Medicare claims records for residents in the 2 study counties with at least 2 outpatient claims for diabetes (ICD-9 250.x) in 1998–2000. The study began in 2001, with recruitment of participants conducted from May – October, 2002. An interviewer

contacted each participant to confirm diabetes status and ethnicity, and assess further eligibility (English speaking, physically and mentally able to participate in survey), and willingness to participate in the study.

Sampling and recruitment have been described previously.[14] The final sample included 701 individuals. The overall response rate for eligible participants was 89% (701/787). A total of 696 participants were used for this analysis. Three participants who did not fit the 3 ethnic categories targeted for the study were excluded, and the remainder 2 participants were excluded due to missing data on the CES-D scale.

Study Measures

Face-to-face interviews were conducted by local, trained interviewers. Participation in the study involved a 1.5 hour interview. Interview data were recorded on paper forms and were entered into EpiInfo (Centers for Disease Control and Prevention).

Outcome variables—Five domains of diabetes self-management were considered as outcome measures. Each of these measures was drawn from the Summary of Diabetes Self-Care Activities (SDSCA) Scale.[21] This instrument is a brief instrument for assessment of diabetes self-care in research and clinical practice that show high validity and reliability with other self-care measures. Responses to the following questions were considered: (1) *physical activity* - "On how many of the last 7 days did you participate in at least 30 minutes of physical activity?" (persons who reported on a separate question having exercised less than once per week on average in the past year were classified as 0 days of exercise); (2) *blood glucose self-monitoring* - "On how many of the last 7 days did you test your blood sugar?"; (3) *foot care* - "On how many of the last 7 days did you check your feet?"; (4) *diet* - "On how many of the last 7 days did you follow a healthful eating plan?"; (5) *medication adherence* - "On how many of the last 7 days did you take your recommended insulin injections?" and "On how many of the last 7 days did you take your recommended number of diabetes pills?" For persons using both insulin and oral agents, we used the response to the insulin question, given that insulin is more difficult to administer and is generally indicative of more advanced disease. For those on neither medication, we indicated those persons as being in full compliance (ie, 7 days).

With the exception of medication adherence, these measures were categorized as 0, 1 – 4, and 5 – 7 days for descriptive purposes. For medication adherence, descriptive categories were established as 0 – 3, 4 – 6 and 7 days. For the multivariate analysis, all self-management behavior outcomes were dichotomized. The outcomes of physical activity, self-monitoring blood glucose, foot care, and diet adherence were dichotomized as 0 days vs. >0 days. Consistent with a previous analysis, medication adherence was dichotomized as <7 days vs. 7 days.[19]

Predictor variable—The predictor variable, depressive symptoms, was assessed by the CES-D, a 20-item self-report depression symptom scale developed by the Center for Epidemiologic Studies.[22] The response categories were modified from the original Likert scale to "yes" and "no" responses based on the validation of this modification for this population by Blazer and colleagues.[23] This modification to the response options was validated in the Duke Established Populations for Epidemiologic Studies of the Elderly (EPESE). This approach was used by our investigative team after careful consideration because the Duke EPESE cohort is very similar to the one in the current study, and because of the difficulty experienced by older adults, particularly those with low levels of formal education, in responding to Likert-type questions.[18] "Yes" responses were scored as 1 and "no" responses were scored as 0, with a range of total scores from 0 – 20. Because of this modification, the cutoff value used for classification of high CES-D score was ≥9, which is considered to be equivalent to the

traditional cutoff of ≥16 using the Likert scale.[23] Data using this approach from this study has been previously published.[20]

Model covariates—Demographic variables considered include: ethnicity (African American, American Indian, and White), sex, age (continuous), marital status (married, not married), level of formal education (< high school, high school degree, at least some college), number of persons in the home (1, 2, and 3+), poverty status (receiving Medicaid, not receiving Medicaid and annual income <$25,000, and not receiving Medicaid and annual income ≥ $25,000). Because of the collinearity between marital status and number of people in the household, we combined these variables to form a living arrangement variable for the multivariate analysis: living alone, living with others and unmarried, and living with others and married. Health-related variables considered included: diabetes medication (none, oral agents only, insulin with or without oral agents), diabetes duration (continuous), HbA1c (continuous), body mass index (continuous), and self-rated health (excellent, very good, good versus fair or poor). Quality of life was assessed using the physical (PCS) score subscale of the SF-12.[24–25] Higher scores for this measure indicate higher physical functioning. Number of prescription medications was tallied and categorized as ≤ 5 and > 5. Number of long-term health conditions was the total number of conditions reported in response to questions about eleven specific conditions, and to an open-ended question asking if they had any other long-term health condition. Diabetes was not counted as a condition. This variable was categorized as ≤5 and >5.

Statistical Analysis

Data were analyzed using SAS Statistical Software (SAS Institute, Inc., Cary, NC, version 8.02). Demographic and health characteristics, as well as categorical self-management outcomes, were summarized by CES-D category using counts and percentages, or means and standard deviations. Bivariate associations between demographic and health characteristics and Depression and CES-D were evaluated for statistical significance using chi-square or independent sample t-tests. Medians and inter-quartile ranges were also used to summarize the uncategorized self-management outcomes by CES-D group; Wilcoxon rank-sum tests were performed to evaluate the bivariate associations. Exact P-values were estimated for the Wilcoxon tests using Monte Carlo simulation based on conditional inference for contingency tables.[24]

Multiple logistic regression models were used to evaluate the independent associations between CES-D and each dichotomous self-management outcome adjusting for sex, ethnicity, education, marital status, poverty status, self-rated health, SF-12 physical component score, number of chronic conditions, and number of prescription medications. These variables were independently associated with CES-D scores or were of relevance to the study goals (eg, ethnicity). For each outcome, a sex x ethnicity interaction term was evaluated in the model with all other covariates. If this term was statistically significant (P<.05), then it was retained in the model. If the interaction was not significant, then it was dropped from the model. Logistic regression results for CES-D (after adjusting for all model covariates) were presented as estimated odds ratios and corresponding 95% confidence intervals for each outcome.

RESULTS

As previously reported,[20] approximately 16% of the sample had CES-D scores ≥9. Table 1 shows the demographic and health characteristics of the sample according to categories of depressive symptoms. Among the demographic characteristics, depressive symptoms were associated with female sex, not being married, lower levels of formal education, and higher levels of poverty. For the health characteristics, depressive symptoms were associated with

fair or poor self-rated health, lower physical functioning, and increased number of prescription medications and chronic health conditions.

Table 2 shows bivariate associations between depressive symptomatology and diabetes self-management. High level of depressive symptoms was inversely associated with being physically active and following a healthful eating plan. Nearly 19% of those with CES-D scores <9 reported exercising 5 – 7 days, compared to only 5.5% of those with CES-D scores of 9 or more. The upper quartile value was 3 days for those with a CES-D score <9, compared to 0 for those with a CES-D score of 9 or more (P<0.001). Similarly, 24.2% of persons with CES-D scores <9 reported following a healthful eating plan 5 – 7 days, compared to 16.5% of those with CES-D scores ≥9. The upper quartile values for those with CES-D scores <9 or ≥9 were 4 and 0 days, respectively (P=0.02). Conversely, depressive symptomatology was positively associated with self-foot inspection. About 76% of those classified as having depressive symptoms reported checking their feet 5 – 7 days, compared to 64.5% of those classified as not having depressive symptoms. The lower quartile value for those with CES-D scores <9 or ≥9 were 1 and 5, respectively. No association was observed between depressive symptomatology and medication adherence and self-monitoring of blood glucose.

Table 3 shows adjusted odds ratios for the association between depressive symptoms and diabetes self-management. The associations of depressive symptoms with physical activity and foot inspection remained significant: persons with high CES-D scores were half as likely to report being physically active on at least one day compared to those without depressive symptoms (odds ratio = 0.5, 95% confidence interval, 0.2 – 0.9), and persons with high CES-D scores were twice as likely to perform self foot inspection at least once compared to those with low CES-D scores (odds ratio = 2.1, 95% confidence interval, 1.1 – 3.9). No independent effects were observed for living arrangements or ethnicity, with the exception that African Americans were significantly more likely to report dietary adherence compared to American Indians and Whites (odds ratio = 1.8, 95% confidence interval, 1.2 – 2.8 for comparison between African Americans and Whites; odds ratio = 1.7, 95% confidence interval, 1.1, 2.7) for comparison between African Americans and American Indians).

DISCUSSION

Depression is highly prevalent among persons with diabetes, and the co-existence of these conditions greatly increases risk of morbidity, mortality, and negative impacts on quality of life.[3–5] These poor health outcomes associated with depression among persons with diabetes may be related to difficulties in adhering to diabetes self-management, such as exercise, diet, medication adherence, and regular blood sugar foot checks. Previous research demonstrates that such an association may exist.[8–13] For example, Lin and colleagues[11] observed in a sample of type 2 diabetes patients in a large health maintenance organization in Washington state that major depression was associated with less physical activity, unhealthy dietary patterns, and low adherence to diabetes, hypertension and lipid-lowering medications. No associations were observed in this study between depression and other forms of self-management, including self-monitoring of blood glucose and foot checks. Similar observations were observed in a separate analysis by these investigators in type 1 and type 2 diabetes patients.[8] In this latter study,[9] depressive symptoms were associated with decreased physical functioning and increased health care cost. The population from which these data were drawn varies dramatically from the current study in that they were less ethnically diverse, high higher household incomes and were insured through a health maintenance organization. Thus, our ability to compare our results to these studies is somewhat limited.

The limited data on the relationship between depression and diabetes self-management has not considered rural populations. These data generally have small numbers of ethnic minorities,

which limit the ability to examine the influence of ethnic minority status on this relationship. These populations are important to consider because of their limited access to health care[14–16] and high levels of poverty, which limits access to supplies and medications, healthy foods and exercise equipment and facilities. Thus, access to diabetes self-management education and compliance with diabetes self-management regimens may be even further compromised in these populations.

In the present study, conducted with a sample of older African Americans, American Indians, and Whites in rural central North Carolina, increased depressive symptoms were associated with poor adherence with physical activity and healthful eating plans, a finding that is consistent with other studies.[8–13] This finding is consistent with the notion that depression has a significant impact on a patient's motivation to exercise and eat healthy. Even though a trend toward an inverse association between following a healthful eating plan remained in multivariate analysis (OR=0.6), this association was no longer significant after adjusting for demographic (ethnicity, sex, education, living arrangements, poverty status) and health (self-rated health, SF-12 physical component score, number of chronic conditions and number of prescription medications) characteristics. This indicates that one or more of the variables in our model explained away some of the relationship between following a healthful eating plan and depressive symptoms. We did observe that African Americans were more likely to report adhering to a healthful eating plan independent of depressive symptom status compared to Whites and American Indians, which is an encouraging finding given the poorer diabetes-related health outcomes in this population.

There was a positive association between self foot inspection and depressive symptoms. This finding is not consistent with the findings of Lin and colleagues, who found that persons with depression status were not more or less likely to report checking feet or checking the inside of shoes.[11] It is possible that our finding might represent the one self-management behavior that persons with depression are most capable of performing, given that performing self foot checks generally does not require equipment (except possibly a hand-held mirror) or any significant lifestyle change. We have previously shown that African Americans performed more self foot checks compared to American Indians and Whites.[25] However, this should not have played a role in our study, because the prevalence of depressive symptoms did not vary by ethnicity in our sample.[20] It is also possible that persons with depression may be more likely to visit their doctor for care, and are prompted to check their visit during these visits. We observed previously that increased diabetes duration and being shown how to check their feet by a health care provider was positively associated with higher levels of self-foot care.[25] However, we also showed no independent association between having been to the doctor for a diabetes-related visit or seeing a podiatrist in the past year and self-foot care. Further examination of this association should be undertaken to determine the underlying factors associated with this relationship, and to determine what can be learned and applied to positively impact other self-management behaviors.

Conversely, our data show that persons with depressive symptoms are less likely to be physically active and follow a healthful eating plan compared to persons with depressive symptoms. We have previously shown that physical activity is limited in this population, regardless of depression status.[26] However, the finding that persons with depressive symptoms are even less physically active is not surprising, given that these are fairly intensive and more costly behaviors. Persons with depression may be on medications for their condition that might affect their appetite and their motivation to exercise. They may also be less socially active, which might be a prime source of motivation exercise and eat healthy. While we are not able to assess the direction of these associations, it is important to understand their relationship, and further research should focus on interventions to help this vulnerable population.

We found no association between depressive symptomatology and blood glucose self-monitoring and diabetes medication adherence. While this is somewhat encouraging, it is also the case that this population, given their higher risk of poor diabetes outcomes, should be more diligent in these behaviors. These are moderately intensive self-management behaviors, but are nonetheless critical to successful diabetes outcomes. We have previously shown that health care provider recommendation is the most significant correlate of blood glucose self-monitoring in this population.[27] Thus, more aggressive assessment and encouragement by health care providers to self-monitor among those dealing with depression is warranted.

In summary, we observed in an ethnically diverse sample of older rural adults that depressive symptoms are associated with performance of some, but not all, diabetes self-management behaviors. Thus, depression may be one of the many barriers that prevent adherence to diabetes self-management behaviors. Given the tremendous impact of depression on diabetes outcomes and the significant burden that these conditions place on medical care, strategies need to be implemented by the primary care provider team to address these issues. This might include more intensive efforts to recognize and treat depression in diabetes patients in the primary care setting, or tailored self-management education and interventions that recognize the unique adherence barriers in this among rural older adults with diabetes and depression, and solutions to overcome these barriers. Efforts to improve physical activity and dietary adherence could be encouraged by the management team, such as participation in exercise sessions in group settings (eg, churches and senior centers) or education of caregivers and health care providers regarding the importance of dietary adherence and physical activity.

This study has a number of limitations which may limit the generalizability of these findings. First, this is a cross-sectional study, hampering our ability to assess a cause and effect relationship between depression and diabetes self-management. Second, we are not able to assess the influence of this relationship on long-term complications. We do show that depression is not related to HbA1c, which is not consistent with the findings of others.[6–9] In a meta-analysis of 24 studies, Lustman and colleagues[6] showed that depression is associated with poor glycemic control similarly in both type 1 and type 2 patients. Third, while we used validated measures to assess depressive symptoms and diabetes self-management, the findings of this study might vary from those of other studies due to variations in the instruments used across studies. Finally, we rely on self-report for the self-management behaviors as well as many of the covariates in our model, which may introduce some error into these findings. Nonetheless, this study has a number of strengths, including a large, ethnically diverse sample, a high response rate, and validated measures of self-reported diabetes self-management behaviors. Our findings add to the body of knowledge on the relationship between depression and diabetes self-management by extending the findings of previous investigations to an ethnically diverse sample of rural older adults, and bringing additional attention to the need to develop strategies to increase adherence to self-management in this vulnerable population. Future research should be conducted to determine the effectiveness of such strategies, particularly among older adults and ethnic minorities in rural communities.

Abbreviations

ELDER, Evaluating Long-Term Diabetes Self Management among Elder Rural Adults; CES-D, Center for Epidemiologic Studies Depression; CDC, Centers for Disease Control and Prevention; SF, Short Form; EPESE, Established Populations for Epidemiologic Studies of the Elderly; PCS, Physical score subscale; OR, Odds Ratio; SDSCA, Summary of Diabetes Self-Care Activities.

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Table 1

Demographic and Health Characteristics (Count (%) or Mean ± SD) by CES-D Score

	CES-D ≥9 (n=110) 15.8%	CES-D<9 (n=586) 84.2%	P-Value
Demographic			
Ethnicity			0.08
African American	32 (29.1)	188 (32.1)	
American Indian	38 (34.6)	143 (24.4)	
White	40 (36.4)	255 (43.5)	
Female	71 (64.6)	272 (46.4)	<0.001
Age (yrs)	74.1 ± 5.9	74.1 ± 5.3	0.96
Married	43 (39.1)	305 (52.1)	0.01
Formal education (n=695)			<0.001
Less than high school	95 (86.4)	356 (60.9)	
High school	13 (11.8)	132 (22.6)	
At least some college	2 (1.8)	97 (16.6)	
Number of persons in home			0.17
One	30 (27.3)	183 (31.2)	
2	50 (45.5)	289 (49.3)	
3 or more	30 (27.3)	114 (19.5)	
Poverty Status (n=666)			<0.01
On Medicaid	52 (49.1)	183 (32.7)	
No Medicaid & income <$25,000	43 (40.6)	260 (46.4)	
No Medicaid & income ≥$25,000	11 (10.4)	117 (20.9)	
Health			
Diabetes medication			0.54
No medication	17 (15.5)	69 (11.8)	
Oral agent only	65 (59.1)	353 (60.2)	
Insulin with or without oral agents	28 (25.5)	164 (28.0)	
Diabetes duration (yrs)	12.4 ± 11.0	12.5 ± 11.0	0.95
HbA1c (%) (n=691)	6.8 ± 1.4	6.8 ± 1.3	0.55
BMI (kg/m^2) (n=664)	29.5 ± 5.9	29.6 ± 5.88	0.85
Self-rated health: Excellent, very good, or good	24 (21.8)	291 (49.7)	<0.001
SF-12 physical component score	29.5 ± 8.2	36.2 ± 11.6	<0.001
Number of prescription medications >5 (n=691)	81 (74.3)	287 (49.3)	<0.001
Number of chronic health conditions >5	59 (53.6)	161 (27.5)	<0.001

Table 2

Bivariate Associations between CES-D Score and Diabetes Self-Management Behaviors (count [%])

Diabetes Self-Management Behavior (number of days in prior week)	CES-D ≥9 n=110 (15.8%)		CES-D <9 n=586 (84.2%)		P-Value[a]
	Count (%)	Median (Inter-Quartile Range)	Count (%)	Median (Inter-Quartile Range)	
Days Physically Active (n=690)		0 (0, 0)		0 (0, 3)	<0.001
0 Days	95 (86.4)		387 (66.7)		
1 – 4 Days	9 (8.2)		84 (14.5)		
5 – 7 Days	6 (5.5)		109 (18.8)		
Days Self-Monitoring of Blood Glucose		6 (1, 7)		4 (1, 7)	0.25
0 Days	24 (21.8)		139 (23.7)		
1 – 4 Days	26 (23.6)		175 (29.9)		
5 – 7 Days	60 (54.6)		272 (46.4)		
Days Inspected Feet (n=685)		7 (5, 7)		7 (1, 7)	0.02
0 Days	15 (13.9)		143 (24.8)		
1 – 4 Days	11 (10.2)		62 (10.8)		
5 – 7 Days	82 (75.9)		372 (64.5)		
Days Following a Healthful Eating Plan (n=684)		0 (0, 0)		0 (0, 4)	0.02
0 Days	83 (76.2)		370 (64.4)		
1 – 4 Days	8 (7.3)		66 (11.5)		
5 – 7 Days	18 (16.5)		139 (24.2)		
Days in Compliance with Recommended Medication		7 (7, 7)		7 (7, 7)	0.85
0 – 3 Days	7 (6.4)		18 (3.1)		
4 – 6 Days	1 (0.9)		25 (4.3)		
7 Days	102 (92.7)		543 (92.7)		

[a] Exact P-values for comparing the 2 CES-D groups were estimated using Monte Carlo simulation based on the Wilcoxon test and conditional inference for contingency tables.

Table 3

Logistic Regression Results[a] for Associations Between Depressive Symptoms and Diabetes Self-Management Behaviors

Self-Management Behavior [b]	N	Odds Ratio	95% Confidence Interval
Physical Activity	630	0.5	(0.2, 0.9)
Self-Monitoring Blood Glucose	633	0.8	(0.5, 1.4)
Foot Inspection	624	2.1	(1.1, 3.9)
Healthful Eating Plan	622	0.6	(0.4, 1.1)
Compliance with Recommended Medication	633	1.1	(0.5, 2.7)

[a] Note. Adjusted for ethnicity, sex, education, living arrangements, poverty status, self-rated health, SF-12 physical component score, number of chronic conditions and number of prescription medications

[b] For the multivariate analysis, all self-management behavior outcomes were dichotomized. The outcomes of physical activity, self-monitoring blood glucose, foot inspection, and healthful eating plan were dichotomized as 0 days vs. >0 days. Compliance with recommended medication was dichotomized as <7 days vs. 7 days.