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Association of Depressive Symptoms and Lifestyle Behaviors Among Latinos at Risk of Type 2 Diabetes

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Abstract

Little is known about depression among Latinos at risk for type 2 diabetes. The purpose of this cross-sectional study was to determine the rate of depression in Latinos at risk for type 2 diabetes and to examine the associations between depressive symptoms, diet, physical activity, and body mass index (BMI). Latinos at risk for type 2 diabetes (N=210) were surveyed from July 2007-August 2008.

Depressive symptoms were assessed using the Center for Epidemiological Studies-Depression Scale

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(CES-D). Three 24-hour recalls were used to assess diet and physical activity. Linear regression analyses were used to examine the association between depression, BMI, and lifestyle factors. The sample (78% female) was largely of Caribbean origin (83%) and mean age was 52 years (standard deviation; SD=11). Mean BMI was 34.2 kg/m² (SD=5.9) and 77% were obese. Average CES-D score was 16.3 (SD= 11.3, range 0-45) and 50% had CES-D of 16 or greater, suggesting clinical depression. Higher CES-D scores were associated with lower diet quality ($p<.05$), but were not associated with BMI or physical activity. Depression and lower dietary quality may contribute to risk for type 2 diabetes among Latinos.

Keywords

diabetes; type 2; dietary quality; depression symptoms

INTRODUCTION

The prevalence of type 2 diabetes (T2D) in Latinos is 2-3 times that of Caucasians (1) and by 2031 more than 20% of the adult Latino population will be affected (2). Diabetes-related mortality is twice as high for Puerto Rican and Mexican Americans than Cuban Americans, making prevention efforts a priority in these groups.(3) Depression affects 14-16% of Latinos (4,5) with Caribbean Latinos at higher risk than other Latino groups (6). Depression is especially a concern among Latinos who are at risk for T2D because depressed adults have a 37% increased risk for developing T2D (4). The mechanisms underlying the association of depression and T2D are largely unknown, however, depression might be associated with higher body mass index (BMI), higher caloric intake, lower quality diet, and sedentary lifestyle, factors which all increase T2D risk. Understanding lifestyle factors that are associated with depression among Latinos at high risk for T2D might help to identify key behaviors to target for T2D prevention in this population. Obesity (7), poor diet (8), and sedentary lifestyle (9) are generally associated with increased risk for T2D among Caucasian samples, but it remains unclear if Latinos with depression have disproportionate difficulty in these areas. The present study examined rates of depression as well as the association of depression and lifestyle factors among Latinos who met criteria for pre-diabetes via the Stern formula (10). It was hypothesized that Latinos at risk for T2D would have higher rates of depression than the general population and depression would be associated with worse lifestyle factors.

METHODS

Participants

A total of 215 residents of Lawrence, Massachusetts were enrolled into the Lawrence Latino Diabetes Prevention Project (LLDPP) from November 2004 to March 2007. Complete data were available for the variables of interest in the present study for 210 participants. The LLDPP was a diabetes prevention program for Latinos at high risk of developing T2D. Participants qualified if they were ≥ 25 years of age, Latino, had a BMI ≥ 24 kg/m², had telephone access, and had $\geq 30\%$ risk of developing T2D as predicted by the Stern formula. The Stern formula is a model using age, sex, ethnicity, fasting glucose level, systolic blood pressure, high density lipoprotein cholesterol, waist circumference, and family history of diabetes, to predict 7.5-year incidence of diabetes (10). The Stern formula was chosen to identify eligible participants because it is based on known risk factors for diabetes in Latino populations that is comparable to the oral glucose tolerance test (10), and it is inexpensive. Participants with type 1 or 2 diabetes were excluded. The Institutional Review Boards of the University of Massachusetts Medical School and the Greater Lawrence Family Health Center approved the study protocol. Written informed consent was obtained from all participants by Spanish speaking interviewers.

Measures

Depressive symptoms were assessed by bilingual interviewers using the Spanish version of the Center for Epidemiological Studies-Depression Scale (CES-D; (11)). The CES-D is a well-validated measure for community samples (12,13) and validated for use in Spanish-speaking populations (14). It consists of 20 items to which respondents reply on a 4-point scale with regard to symptoms during the past week. Total CES-D scores of 16 or higher suggest clinical depression (11). Three interviewers were trained to administer the CES-D by a Spanish-speaking licensed clinical psychologist. Although inter-rater reliability was not obtained, we compared scores between interviewers and no differences emerged in the mean CES-D scores ($p > .05$). Interviews took 10 minutes to complete. Baseline dietary intake and physical activity was assessed by three 24-hour recall (24-HR) telephone calls (2 weekdays, 1 weekend day) over two-weeks after baseline. Three days of 24HRs are sufficient to estimate dietary macronutrients (15). The Nutrition Data System for Research (NDS-R, versions 2005-2007, Nutrition Coordinating Center, University of Minneapolis, Minneapolis, MN) software for dietary data collection was used to assist in recalls. Two trained bilingual dietitians, blinded to condition, performed interviews. The 24HR-derived data were used to determine diet quality via the Alternative Healthy Eating Index (AHEI) (16), an instrument used to examine criteria associated with reduced cardiovascular and diabetes disease risk (8), including: 1) fruit, 2) vegetables, 3) nuts and soy, 4) ratio of white to red meat, 5) cereal fiber, 6) trans-fat, 7) ratio of polyunsaturated fat to saturated fat, 8) alcohol, and 9) duration of multivitamin use. Eight of the nine AHEI components were used to calculate the AHEI score; multi-vitamin use was not included because greater than 5 years use was not assessed. Each component received a score from 0 (lowest) to 10 (highest). Detailed scoring algorithms are described elsewhere (16). Higher scores are associated with a greater intake of protective foods for diabetes (8).

Physical activity was assessed on the dietary call. Subjects were asked to recall the amount of time they spent in light, moderate, vigorous, and very vigorous leisure time activities. Estimates of physical activity energy expenditure (MET hours/day) were calculated from the reported activities and intensities via the compendium of physical activities (17). This 24-hour physical activity methodology has been validated against accelerometers (18).

Body weight and height were measured in stocking feet by research assistants (HealthOMeter, Bridgeview, IL). Two weights were measured and then averaged. The baseline questionnaire was used to assess age, marital status, family history of diabetes, education, employment, and smoking status.

Statistical analyses

Linear and logistic regression analyses were conducted to examine the association of depressive symptoms with diet quality, dietary intake, BMI, and physical activity while adjusting for covariates including age, gender, and smoking status. Diet quality, dietary intake, BMI, and physical activity were dependent variables and analyzed separately; independent variables included depression and covariates. Energy intake, percent of calories from fat or saturated fat, AHEI, and BMI were normally distributed, thus original values were used. Because distribution of leisure time physical activity was skewed, with many of the participants reporting zero (41%), it was dichotomized (yes/no). Because distribution of depression scores was highly skewed and not correctable via natural logarithms transformation, it was dichotomized (less than 16 and 16 or greater). Model assumptions and adequacy were also assessed and found to meet normality assumption for residuals. Analyses were performed using Stata 9.2 (College Station, Texas).

RESULTS AND DISCUSSION

Characteristics of participants are presented in Table 1. The majority of participants were female, obese, had less than a high school education, and unemployed. Most participants (83%) identified themselves as Caribbean, while 16% identified themselves as Mexican, and 1% other Latino. The mean age was 51.8 years. The mean risk of developing diabetes in 7.5 years per the Stern formula was 56%. The mean CES-D score was 16.3. Half (50%) of the present sample had CES-D scores of 16 or greater, indicating a depressive disorder, which is more than twice the rate that has been observed in the general population (22%) (11) and other Latino samples (23%) using the same measure (19). Latinos at elevated risk for T2D appear to have disproportionately high rates of depression. Given the association of depression with the development of T2D, Latinos with both pre-diabetes and depression represent a particularly high risk group that should be targeted by prevention efforts.

Several mechanisms have been proposed to explain the relationship between depression and T2D. Depression can be associated with increased activity of the hypothalamic-pituitary-adrenal axis, which is associated with elevations in cortisol, a stress hormone that stimulates glucose production and in some, promotes abdominal fat storage and insulin resistance (20, 21). Immune function has also been implicated in the link between depression and T2D (22). A recent meta-analysis revealed that depression is a risk factor for T2D of comparable magnitude to both smoking and physical activity (4). Once T2D develops, Latinos are more likely to have worse glycemic control when compared to Caucasians (23). To the extent that depression contributes to the manifestation of T2D, treating depression in people with pre-diabetes should be a priority.

Results also revealed that higher depression scores were associated with lower AHEI scores ($p=.001$; See Table 2). Depression scores were not associated with BMI, caloric intake, percentage calories BMI, or physical activity ($p=.95$). The diet quality of at-risk Latinos with depression was lower per the AHEI, a measure of diet quality that has been associated with risk for both T2D (8) and cardiovascular disease (24). Average AHEI score was 33 out of 80. Several components of AHEI did not meet dietary recommendations, including intake of vegetables (1.3 servings/day), fruit (2.6 servings/day), nuts and soy protein (0.67 servings/day), cereal fiber (1.84 grams/day), and trans fat (1.2%). Deficient areas of diet included total fiber, vegetables (particularly non-starchy), fruit, nuts, and cereal fiber, which were considerably lower than the general US population (24), while trans fat intake was higher (25). These specific areas should be targeted clinically as well in public health campaigns for Latinos (8,24).

Our finding that depression was associated with worse dietary quality is consistent with findings from a cross-sectional study of women with breast cancer. Scores on the CES-D were inversely related to diet quality (26). The authors suggested that diet quality may be an important factor influencing the manifestation of depressive symptoms or conversely, poorer diet quality may be an outcome of depression. Among Latinos, a diagnosis of depression might be an indicator of the need not only for depression treatment but also for nutrition counseling to help reduce risk for T2D. The CES-D is an easy-to-use tool that can be used by health care professionals in primary care settings to assess depressive symptomatology in high risk patients.

Depression was not associated with BMI, caloric intake, or physical activity in Latinos. The lack of association between depression and obesity might be attributed to the homogeneity of the population (77% obese). Obesity is a concern in Latinos regardless of depression status. Mean caloric intake was modest at 1515 kcal per day and did not vary by depression status. However, in a previous investigation, energy intake underreporting by a mean of 254 kcal per day was observed in this sample (27).

Limitations of this study include its cross-sectional nature, which limits conclusions regarding the temporal relationship between depression and dietary quality. Second, dietary underreporting in this population (27) might impact diet quality estimates. Third, the CES-D is a self-report measure and although it is frequently used in research (19), a diagnostic interview is the most valid measure of depression. Finally, most participants were female, of Caribbean descent (83%), unemployed, and may not be representative of Latino men or non-Caribbean Latinos. Recruitment did not attempt to oversample by gender, however, women enrolled in higher numbers.

CONCLUSIONS

Latinos at risk for diabetes have a high rate of depression and depression was associated with lower diet quality. Future studies should examine the temporal relationship between depression and dietary quality. Although total consumption was within the USDA recommendations, several aspects of diet could be improved. Nutritional interventions should specifically target increasing fruit and vegetable consumption, increasing sources of fiber, restricting trans fats and increasing essential fatty acids within a culturally acceptable menu. Nutritional counseling appears to be especially indicated for Latinos with depression and other risk factors for T2D.

REFERENCES

1. Health disparities experienced by Hispanics--United States. *MMWR Morb Mortal Wkly Rep* 2004;53:935–937. [PubMed: 15483525]
2. Mainous AG 3rd, Baker R, Koopman RJ, Saxena S, Diaz VA, Everett CJ, Majeed A. Impact of the population at risk of diabetes on projections of diabetes burden in the United States: An epidemic on the way. *Diabetologia* 2007;50:934–940. [PubMed: 17119914]
3. Smith CA, Barnett E. Diabetes-related mortality among Mexican Americans, Puerto Ricans, and Cuban Americans in the United States. *Rev Panam Salud Publica* 2005;18:381–387. [PubMed: 16536924]
4. Knol MJ, Twisk JW, Beekman AT, Heine RJ, Snoek FJ, Pouwer F. Depression as a risk factor for the onset of type 2 diabetes mellitus. A meta-analysis. *Diabetologia* 2006;49:837–845. [PubMed: 16520921]
5. Golden SH, Williams JE, Ford DE, Yeh HC, Paton Sanford C, Nieto FJ, Brancati FL. Depressive symptoms and the risk of type 2 diabetes: The Atherosclerosis Risk in Communities study. *Diabetes Care* 2004;27:429–435. [PubMed: 14747224]
6. Ortega AN, Feldman JM, Canino G, Steinman K, Alegria M. Co-occurrence of mental and physical illness in US Latinos. *Soc Psychiatry Psychiatr Epidemiol* 2006;41:927–934. [PubMed: 17013767]
7. Colditz GA, Willett WC, Stampfer MJ, Manson JE, Hennekens CH, Arky RA, Speizer FE. Weight as a risk factor for clinical diabetes in women. *Am J Epidemiol* 1990;132:501–513. [PubMed: 2389754]
8. Fung TT, McCullough M, van Dam RM, Hu FB. A prospective study of overall diet quality and risk of type 2 diabetes in women. *Diabetes Care* 2007;30:1753–1757. [PubMed: 17429059]
9. Folsom AR, Kushi LH, Hong CP. Physical activity and incident diabetes mellitus in postmenopausal women. *Am J Public Health* 2000;90:134–138. [PubMed: 10630154]
10. Stern MP, Fatehi P, Williams K, Haffner SM. Predicting future cardiovascular disease: Do we need the oral glucose tolerance test? *Diabetes Care* 2002;25:1851–1856. [PubMed: 12351490]
11. Sawyer-Radloff L. The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement* 1977;1:385–401.
12. Radloff, LS.; Locke, BZ. The community mental health assessment survey and the CES-D scale. In: Weissman, MM., editor. *Community Surveys*. Prodist Publishers; New York: 1986. p. 177-189.
13. Shaver, PR.; Brennan, KA. Measures of depression and loneliness. In: Shaver, P.; Wrightsman, L., editors. *Measures of Personality and Social Psychology*. Academic Press; San Diego, CA: 1991. p. 195-290.

14. Salgado de Snyder N, Maldonado M. Psychometric characteristics of the Center for Epidemiologic Studies Depression Scale in adult Mexican women from rural areas. *Salud Publica Mexico* 1993;36:200–209.
15. Tarasuk V, Beaton GH. The nature and individuality of within-subject variation in energy intake. *Am J Clin Nutr* 1991;54:464–470. [PubMed: 1877501]
16. McCullough ML, Willett WC. Evaluating adherence to recommended diets in adults: The alternate healthy eating index. *Public Health Nutr* 2006;9:152–157. [PubMed: 16512963]
17. Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, O'Brien WL, Bassett DR Jr, Schmitz KH, Emplainscourt PO, Jacobs DR Jr, Leon AS. Compendium of physical activities: An update of activity codes and MET intensities. *Med Sci Sports Exerc* 2000;32:S498–504. [PubMed: 10993420]
18. Matthews CE, Freedson P, Hebert J, Stanek E, Ockene I, Merriam P. Comparison of physical activity assessment methods in the Seasonal Variation of Blood Cholesterol Levels Study. *Med Sci Sports Exerc* 2000;32:976–984. [PubMed: 10795789]
19. Golden SH, Lazo M, Carnethon M, Bertoni AG, Schreiner PJ, Roux AV, Lee HB, Lyketsos C. Examining a bidirectional association between depressive symptoms and diabetes. *JAMA* 2008;299:2751–2759. [PubMed: 18560002]
20. Weber-Hamann B, Hentschel F, Kniest A, Deuschle M, Colla M, Lederbogen F, Heuser I. Hypercortisolemic depression is associated with increased intra-abdominal fat. *Psychosom Med* 2002;64:274–277. [PubMed: 11914443]
21. Kyrou I, Chrousos GP, Tsigos C. Stress, visceral obesity, and metabolic complications. *Ann N Y Acad Sci* 2006;1083:77–110. [PubMed: 17148735]
22. Kiecolt-Glaser JK, Glaser R. Depression and immune function: Central pathways to morbidity and mortality. *J Psychosom Res* 2002;53:873–876. [PubMed: 12377296]
23. Brown AF, Gerzoff RB, Karter AJ, Gregg E, Safford M, Waitzfelder B, Beckles GL, Brusuelas R, Mangione CM. Health behaviors and quality of care among Latinos with diabetes in managed care. *Am J Public Health* 2003;93:1694–1698. [PubMed: 14534224]
24. McCullough ML, Feskanich D, Stampfer MJ, Giovannucci EL, Rimm EB, Hu FB, Spiegelman D, Hunter DJ, Colditz GA, Willett WC. Diet quality and major chronic disease risk in men and women: Moving toward improved dietary guidance. *Am J Clin Nutr* 2002;76:1261–1271. [PubMed: 12450892]
25. Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, Franklin B, Kris-Etherton P, Harris WS, Howard B, Karanja N, Lefevre M, Rudel L, Sacks F, Van Horn L, Winston M, Wylie-Rosett J. Diet and lifestyle recommendations revision 2006: A scientific statement from the American Heart Association Nutrition Committee. *Circulation* 2006;114:82–96. [PubMed: 16785338]
26. Tangney CC, Young JA, Murtaugh MA, Cobleigh MA, Oleske DM. Self-reported dietary habits, overall dietary quality and symptomatology of breast cancer survivors: A cross-sectional examination. *Breast Cancer Res Treat* 2002;71:113–123. [PubMed: 11881909]
27. Olendzki B, Ma YH, J. Rosal MC, Pagoto SL, Merriam PA, Ockene IS. Underreporting of energy intake and associated factors in a Latino population at risk of developing type 2 diabetes. *J Am Diet Assoc* 2008;108:1003–1008. [PubMed: 18502234]

Table 1
 Characteristics of Latinos at Risk for Type 2 Diabetes

		N (%) or Mean (standard deviation)
Demographic variables		
Gender		
Male		45 (21.63)
Female		163 (78.37)
Age (years)		51.77 (11.19)
Body Mass Index (kg/m ²)		34.22 (5.88)
Normal		8 (3.81)
Overweight		41 (19.52)
Obese		161 (76.67)
Education		
Never attended school		5 (2.41)
Some elementary school or high school		123 (59.13)
High school or GED completed		47 (22.60)
Vocational or tech school		10 (4.81)
University or College		23 (11.06)
Smoking in the past 3 months (yes)		25 (12.20)
Marital status		
Single		40 (19.23)
Married or Living with Partner		108 (51.92)
Separated, Divorced or Widowed		60 (28.85)
Employment status		
Full-time		65 (30.95)
Part-time		26 (12.38)
Unemployed		119 (56.67)
Psychosocial variables		
Center for Epidemiological Studies Depression Scale score		16.31 (11.34)
<16		105 (50.00)
>=16		105 (50.00)
Stern index^a		0.56 (0.21)
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Mean (standard deviation)		
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Dietary intake		Recommended Values
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Energy intake (kcal/day)	1515 (589.00)	-
Alternative Healthy Eating Index (AHEI) Score ^b	32.66 (8.08)	-
Components of AHEI		Daily intake criteria for maximum score of 10
Vegetables servings./day)	1.3 (1.0)	5
Fruit servings./day)	2.6 (2.6)	4
Nuts and soy protein	0.7 (0.7)	

Mean (standard deviation)		
Dietary intake		Recommended Values
(serving/day)		1
Ratio of white to red meat	2.5 (1.2)	4 (AHEI component score=10 if no red meat consumed)
Cereal fiber g/d	1.8 (2.8)	15
% calories from trans fat	1.2 (0.8)	<=0.5
Ratio of polyunsaturated to saturated	0.8 (0.4)	>=1
Alcohol (servings./day)	0.2 (0.9)	Men: 1.5-2.5 Women: 0.5-1.5
Leisure time physical activity (met-hr/day)	0.94 (1.39)	

^aStem formula a model using age, sex, ethnicity, fasting glucose level, systolic blood pressure, high density lipoprotein (HDL) cholesterol level, waist, and immediate family history of diabetes to predict 7.5-year incidence of diabetes (9).

^bAlternative Healthy Eating Index (AHEI) is an instrument used to examine criteria associated with reduced cardiovascular and diabetes disease risk

Table 2

Regression Analyses Predicting Lifestyle Factors, Body Mass Index (BMI), and Stern index by Depression Status among Latinos at Risk for Type 2 Diabetes ^a

Continuous outcome variable	Regression coefficient	Standard error	p-value
Energy intake (kcal/day)	-50.47	42.45	0.24
Alternative Healthy Eating Index score	-2.03	0.60	0.001
BMI	0.45	0.44	0.30

Categorical outcome variable	Odds ratios	Standard error	P-value
Leisure time physical activity (no activity as referent)	0.99	0.16	0.95

^aLinear and logistic regression models to examine the association of depressive symptoms with diet quality, dietary intake, BMI, and physical activity while adjusting for covariates including age, gender, and smoking status. The referent group was non-depression (i.e., Center for Epidemiological Studies Depression Scale score < 16)