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Depression is Associated with Increased Risk for Metabolic Syndrome in Latinos with Type 2 Diabetes

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Abstract

Objective—Latino adults are 66% more likely to have diabetes relative to non-Latino white adults. Prior research identifies depression as a significant risk factor for MetS, but research examining this among Latinos is lacking. This study sought to examine the links between depression and MetS, as well as clinically significant elevations in cardiovascular disease (CVD) risk markers of MetS in a sample of community-dwelling older Latinos with type 2 diabetes.

Methods—332 community-dwelling older (>=60 years of age) Latinos with type 2 diabetes completed the 9-item Patient Health Questionnaire (PHQ-9) and received a health check-up assessing Body Mass Index (BMI), triglyceride and high-density lipoprotein (HDL) cholesterol levels, and blood pressure. Logistic regression analysis compared MetS rates of those meeting criteria for depression to those who did not. Secondary analyses examined the associations between depression and individual MetS components. All analyses controlled for demographic (e.g., income, age) and other potential MetS risk factors (e.g., smoking status, physical activity, alcohol level consumption).

Results—Depression was significantly associated with an increased risk of MetS (OR=5.79, 95% CI=1.32–25.42), as well as clinically significant elevations in triglycerides (OR = 2.71, 95% CI=1.15–6.42) and reduced (HDL) cholesterol (OR=2.46, 95% CI=1.11–5.45). A significant association was not observed between depression and either BMI or hypertension.

Conclusions—Depression is significantly linked to MetS, and most notably dyslipidemia, in older Latinos with diabetes. Causation, however, cannot be inferred from these analyses given the

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cross-sectional nature of the study. Future research should prospectively examine the directionality of this effect.

Keywords

Latino; depression; metabolic syndrome; diabetes; cardiovascular disease risk

INTRODUCTION

According to the Centers for Disease Control (CDC), cardiovascular disease (CVD) is among the leading causes of death among adults in the United States (1). The presence of diabetes is a known risk factor for CVD, particularly heart disease and stroke. Specifically, adults with diabetes have a double to quadruple risk of suffering these conditions relative to adults without diabetes (2, 3). The American Heart Association (AHA) reports that at least 65% of adults with type 2 diabetes die from some form of heart disease or stroke (4).

Although it is clear that diabetes confers a significant increased risk for CVD, additional physiologic or metabolic risk factors, in conjunction with diabetes, increase this risk. This clustering of risk factors has been termed metabolic syndrome (MetS). According to the World Health Organization (WHO)(5), criteria for MetS include insulin resistance and any two of the following: 1) raised arterial pressure, 2) raised plasma triglycerides, 3) low High Density Lipoprotein cholesterol (HDL-C), 4) central obesity or elevated body mass index (BMI), and 5) high urinary albumin excretion rate.

Marchesini and colleagues (6) examined the prevalence of MetS in individuals already diagnosed with Type 2 diabetes and found that 81% met the WHO criteria. According to Alexander et al. (7), the prevalence of coronary heart disease (CHD) in older Americans (>50 years) with diabetes but without MetS was 7.5%, compared to 19.2% of those with both diabetes and MetS. Thus, while the presence of diabetes alone increases risk for CHD, the addition of other risk factors (i.e., MetS components) culminate in a higher risk.

Latinos are among the greatest at-risk populations for developing diabetes. In a population study of adults aged 45–84 years, 11.3% of Latinos had a diagnosis of diabetes, compared to just 6.3% of non-Latino whites, 9.5% of Blacks, and 7.7% of Asians (8). Another study found that Latino adults are 66% more likely to have diabetes relative to non-Latino white adults (9). Schneiderman and colleagues found differences in the prevalence rate of diabetes among a sample of 16,385 Latinos from diverse backgrounds with Mexican (18.3%), Dominican and Puerto Rican (18.0%), Central American (17.0%) study participants having higher rates to Cuban (13.4%) and South American (10.2%) (10). It is noteworthy that Latinos are also at increased risk for MetS. For example, Thom and colleagues (4) reported that the age-adjusted prevalence of MetS is significantly higher in Mexican Americans (31.9%) compared to whites (23.8%), African Americans (21.6%), and other racial/ethic groups (20.3%). Thus, given that MetS substantially increases the risk for heart disease or stroke, Latinos appear to be a vulnerable population for the development of these impairing health conditions.

A number of studies have examined psychiatric factors associated with increased risk for both diabetes and MetS. Of these, depression has emerged as a consistent predictor of both. In a meta-analysis encompassing 23 longitudinal studies, Rotella and Mannucci (11) found that the presence of depression was associated with a 38% increased risk of incident diabetes. Others have found that the presence of depression among those with diabetes significantly increases risk for all-cause mortality (12, 13) as well as cardiovascular mortality (13).

In addition to risk for diabetes, depression appears to be both an outcome of, and a risk factor for the onset of MetS. In their meta-analysis, Pan and colleagues (14) found a bidirectional relationship between depression and MetS, whereby depression significantly predicted future risk of MetS and vice versa. Interestingly, the majority of studies in this meta-analysis included European samples (7 studies included European samples, 1 from Australia, 1 from Japan, and 3 from the United States), which may explain reduced heterogeneity in their findings and why subgroup analysis of racial/ethnic groups was not undertaken. Given the literature demonstrating increased risk of MetS (15) and high prevalence of depression (16) in older Latinos, it is important to examine the relations between depression and MetS among older Latinos to determine if there is an increased risk in this population. Thus, one of the aims of this study is to determine the relationship between depression and MetS in a community-based population of older Latinos with an existing diagnosis of diabetes.

A second aim of this study is to explore the associations between depression and specific components of MetS. Very little research exists examining these associations among Latinos, although prior research with community-dwelling Latinos suggests that greater depressive symptoms are associated with higher adiposity (i.e., BMI) and triglyceride levels, but not total cholesterol or hypertension (17). Yet, these authors did not evaluate the extent to which depression is associated with clinically significant levels of these various CVD risk markers. Thus, we sought to extend this prior research through examining the extent to which depression is associated with increased risk for specific conditions comprising MetS using clinically significant cutoffs for both depression and the various MetS outcomes.

METHODS

Participants

Participants were 332 Latino, community dwelling older adults recruited from two primary care facilities in San Diego County, California. All 332 participants were enrolled in the Salud Program, an evaluation study examining the implementation of two evidenced-based psychosocial interventions in patients with diabetes and concurrent depression/high risk of depression. Assessments for both clinics were administered approximately two weeks prior to initiating the respective interventions. Potential participants were identified during clinic visits and approached by facility clinical staff based on a Type 2 Diabetes diagnosis and introduced to the study. If interested, potential participants were then referred to study staff for further eligibility screening. To be eligible for the study, participants were required to identify as Latino/Hispanic, be 60 years of age or older and have a physician-determined diagnosis of Type 2 Diabetes (verified by medical chart review) and mild to moderately

severe depression (PHQ-9 score of 5 to 19). Exclusion criteria were currently experiencing severe depression (PHQ-9 score of 20 or greater) or other pre-diagnosed severe mental illnesses (e.g., bipolar disorder, schizophrenia) and/or under public conservatorship. Participants provided informed written consent prior to participating in study activities. All participants were administered the UCSD-Brief Assessment of Capacity to Consent (UBACC; 18) in order to determine capacity to provide informed consent prior to enrollment. Approval for this study was provided by the University of California, San Diego Institutional Review Board.

Measures

Metabolic Syndrome (MetS)—After consent was provided, trained bilingual study personnel administered a multi-part assessment that included measuring the participants' weight and blood pressure. Qualified clinic personnel completed the blood draw utilized to determine MetS criteria. Criteria for MetS were based on guidelines provided by the WHO (5), which requires the presence of insulin resistance and the presence of at least two additional clinical criteria. As per inclusion requirements, all participants in the present study met criteria for insulin resistance (i.e., Type II diabetes). To satisfy criteria for MetS, two of the remaining criteria were required as follows: a) hypertension, as defined by a blood pressure of at least 140/90 mmHg, taking antihypertensive medication, or diagnosis from a physician, b) plasma triglycerides 1.7 mmol/L, c) HDL-C 0.9 mmol/L in females, 1.0 mmol/L in males, and d) obesity, as defined by Body Mass Index (BMI) of 30 kg/m^2. In all cases, a score of '1' was assigned to individuals who were "at risk" (e.g., BP > 140/90; HDL-C 0.9 mmol/L in females), and a score of '0' was assigned to individuals who were not "at risk". Data on urinary albumin was not collected and thus could not be included as one of the MetS criteria. Thus, participants meeting at least 2 of the 4 criteria listed above were considered to have MetS.

Depression—The 9-item Patient Health Questionnaire (PHQ-9)(19) was used to assess the presence and potential severity of depression. A trained rater supervised by a licensed clinical psychologist administered and scored the questionnaire. Items from this scale are based on DSM-IV-TR symptom criteria for Major Depressive Disorder, and participants rate each of the 9 symptoms based on how often they experienced each symptom over the past two weeks. Responses occur on the following 4-point scale: '0' = Not at all, '1' = Several days, '2' = More than half the days, and '3' = Nearly every day. The PHQ-9 does not have a cutoff score at which participants meet criteria for depression. Rather, to meet criteria for a major depression, participants must provide a score of '2' or higher on item 1 (i.e., "little interest or pleasure in doing things") or item 2 (i.e., "feeling down, depressed, or hopeless"), indicating one of these symptoms had occurred on at least half of the days during the past two weeks. Further, participants must report a score of '2' or higher on at least 4 of the remaining 8 items, indicating the symptoms had occurred on "more than half the days" during the previous 2-week period (19).

Health Behaviors—Smoking behavior was assessed by self-report, with participants initially reporting whether or not they had ever smoked in their lifetime, with 'Yes'

responses followed by requesting the number of years participants had smoked. A value of '0' years was assigned to participants who reported never smoking.

History of alcohol use was assessed using the CAGE screening questionnaire (20). This brief scale asks participants if they had ever: a) felt they should cut down on their drinking, b) been annoyed by people criticizing their drinking, c) felt bad or guilty about their drinking, and d) had a drink first thing in the morning to steady their nerves or get rid of a hangover. Each item was scored '1' for "yes responses and '0' for "no" responses. Scores for the 4 items were summed, with scores of 2 or greater indicative of lifetime presence of an alcohol use disorder. Reliability and validity of the CAGE has been shown to be good in a variety of populations (21).

Exercise was assessed by a single item from the Summary of Diabetes Self Care Activities measure (SDSCA)(22) asking participants to indicate the number of days during the previous 7 days they had engaged in 30 minutes or more of continuous activity. This single item is highly correlated with longer, more sophisticated instruments to measure physical activity (22). Based on responses to this question, we coded participants who engaged in 5 or more days of activity as adherent to CDC guidelines for physical activity (23), with those who engaged in fewer than 5 days coded as non-adherent.

Religious Activity—Participants responded to a single item assessing their engagement in religious worship. This item asked participants "How often do you attend religious services, meetings, and/or activities?" with response options of 1 = 'never', 2 = 'once a year', 3= 'a few times per year', 4 = 'at least once per month', 5 = 'at least once per week' and 6 = 'nearly every day'. Participants were then grouped into 1 of 3 categories of attendance: 1) rare attendees (i.e., 'never' or 'once a year'), 2) Moderate attendees (i.e., 'a few times per year' or 'at least once per month'), and 3) regular attendees (i.e., 'at least once per week' or 'nearly every day').

Data Analysis

Data were analyzed using PASW statistics version 18 (24). Logistic regression analysis was used to test our primary hypothesis that major depression (yes vs. no) was significantly associated with the presence of MetS. Also included in the model were demographic and health covariates including: a) age (in years), b) sex, c) years residing in the United States, d) monthly household income, e) years smoked, f) History of a drinking problem (yes vs. no), and g) regular physical activity (yes vs. no). Various studies have linked religiosity to lower blood pressure or lower rates of hypertension (25–28) and to better lipid profiles (29). Thus, we included two dummy codes for religious activity, whereby participants who were rare attendees served as a reference group compared to those who were either moderate or regular attendees as per our definition above. All predictors of MetS were entered simultaneously with alpha set at .05. Odds ratios with 95% confidence intervals are presented as measures of effect size.

Following this primary analysis, 4 exploratory analyses were conducted whereby each of the individual MetS criteria served as dependent variables (e.g., low HDL-C, hypertension, high

triglycerides, and high BMI). All covariates from the primary analysis were used for these exploratory analyses.

RESULTS

Sample Characteristics

Characteristics of the sample can be found in Table 1. Of the 332 participants, 256 (77.1%) met criteria for MetS, which is similar to other studies reporting the prevalence of MetS in individuals with diabetes (6, 7). For each of the specific MetS criteria, 288 (86.7%) participants met criteria for hypertension, 168 (50.6%) met criteria for obesity, 199 (59.9%) met criteria for elevated triglycerides, and 90 (27.1%) for low HDL-C. Mean ± SD SBP for individuals meeting METs criteria was 140.26 ± 22.07 mmHg, compared to 119.16 ± 15.43 mmHg in those who did not meet METs criteria. Mean ± SD DBP for individuals meeting METs criteria was 81.37 ± 12.41 mmHg, compared to 70.50 ± 8.99 mmHg in those who did not meet METs criteria. Mean ± SD HDL-C was 0.84 ± 0.10 for individuals who met METs criteria for low HDL-C, and 1.31 ± 0.33 for individuals who did not meet criteria. Mean ± SD triglycerides was 2.87 ± 1.52 for individuals who met METs criteria for triglycerides, and 1.24 ± 0.31 for individuals who did not meet criteria. Finally, Mean ± SD BMI for individuals meeting METs criteria was 35.69 ± 5.87 mmHg, compared to 26.71 ± 2.34 mmHg in those who did not meet METs criteria. A total of 32 participants (9.6%) met criteria for major depression as per PHQ-9 responses, which is similar to the 11% estimated rate of depression in diabetics when determined by diagnostic criteria (30). As seen in Table 1, the sample was primarily older, of low income, and female.

Prediction of Metabolic Syndrome

Among the depressed participants (n = 32), 30 (93.8%) met criteria for METs, and 2 (6.3%) did not. Among the non-depressed participants (n = 300), 226 (75.3%) met criteria for METs, and 74 (24.7%) did not. Results of our primary analysis indicated that major depression was significantly related to having higher risk for MetS (B = 1.76, SE = 0.76, Wald = 5.42, df = 1, p = 0.020). In addition, regular attendance at religious services (B = −1.46, SE = 0.65, Wald = 5.05, df = 1, p = 0.025) was associated with lower risk for MetS. All other covariates in the model were not significantly related to the presence of metabolic syndrome (all p-values > 0.052). Odds ratios with 95% confidence intervals for the individual predictors are presented in Table 2.

Prediction of Individual Risk Markers

Results of our exploratory analyses indicated that depression was significantly related to the presence of low HDL-C (i.e., 0.9 mmol/L in females, 1.0 mmol/L in males) (B = 0.90, SE = 0.41, Wald = 4.87, df = 1, p = 0.027) and high triglycerides (B = 1.00, SE = 0.44, Wald = 5.18, df = 1, p = 0.023). However, depression was not significantly related to either hypertension (B = 0.69, SE = 0.65, Wald = 1.11, df = 1, p = 0.292) or elevated BMI (B = 0.41, SE = 0.40, Wald = 1.06, df = 1, p = 0.302). When examining the covariates in these secondary analyses, several emerged as significant. Specifically, individuals who regularly attended religious services had lower risk of high triglycerides than those who rarely or never attended (B = −1.47, SE = 0.49, Wald = 8.99, df = 1, p = 0.003). As expected, older

age was associated with increased risk for hypertension (B = 0.07, SE = 0.03, Wald = 4.48, df = 1, p = 0.034). Finally, females were at higher risk for obesity (B = 0.66, SE = 0.27, Wald = 6.06, df = 1, p = 0.014). Odds ratios and 95% confidence intervals for all covariates and all models are also presented in Table 2.

DISCUSSION

MetS is a known risk factor for developing CVD (7), particularly among Latinos (4). The current study sought to understand the relationship between depression and MetS in older Latinos with diabetes. We found that compared to non-depressed diabetics, the presence of major depression was related to significantly higher risk for MetS (OR = 5.79; 95% CI = 1.32–25.42) in an older Latino sample. These effects remained significant after controlling for age, sex, years residing in the United States, monthly household income, smoking status, drinking status, religiosity, and physical activity. Regular physical activity and regular attendance to religious activities were both affiliated with lower risk for MetS, indicating protective effects.

To our knowledge, the current study is the first to examine relationships between depression and metabolic syndrome in an older sample of Latinos with diabetes. We further investigated the relations between major depression and specific MetS criteria that increase risk for CVD, such as hypertension, dyslipidemia (as measured by HDL-C and plasma triglyceride levels), and obesity (as measured by BMI). We found that major depression was significantly associated with elevated plasma triglyceride levels and low HDL-C. Because the present study was cross-sectional, we urge caution in interpreting causality for these relationships.

In speculation, perhaps depression interacts with diabetes to produce excess buildup of triglycerides in the bloodstream. Depression and diabetes may further interact to prevent HDL-C from transporting lipids to the liver to be broken down. Alternatively, it is possible that diabetic individuals with low HDL-C and high triglycerides experience physical symptoms (e.g., malaise) that contribute to elevations in depression. Finally, depression may have an impact on health behaviors. For example, individuals who are depressed may be less likely to engage in adequate self-care, such as eating less healthy and engaging in less physical activity compared to non-depressed individuals. Regardless it appears that major depression is associated with the biomarkers that play an important role for older Latinos in their level of risk for developing MetS, which may further their risk for CVD.

A meta-analysis of a dozen studies reports that depressed individuals are at approximately 30% increased risk of having MetS. In contrast, our study finds that depression is associated with a 6-fold increase in risk for MetS. This risk differential demonstrates the potentially added importance of identifying and managing depression among Latinos with diabetes. Active screening for depression among patients with diabetes should be a first-line approach for primary care providers. If depression is evident, referral of these patients to receive one or more evidence-based treatments (EBTs) such as anti-depressive medications or psychosocial treatments (31) should be considered. These proven effective interventions may include problem-solving therapy, behavioral therapy, cognitive behavioral therapy, cognitive bibliotherapy, brief psychodynamic therapy, and reminiscence therapy (31).

It is important to note that, among older Latinos, social, cultural, and societal factors may hinder access to appropriate care. For example, there is evidence that Latinos under-utilize specialty mental health services (32, 33), which may be a barrier for adequate treatment of depression. Thus, with regard to EBTs for depression, a growing body of literature suggests that Latinos may be more likely to engage in mental health treatments for depression if offered within appropriate sociocultural contexts (e.g., delivering services in their primary language, address cultural health beliefs, and involve community health workers) (34–37).

It is important to note a few limitations to the present study. First, we did not collect data on all WHO MetS criteria, including urine microalbumin or use of statins or other medications as examining MetS was not a primary emphasis of the overall study. Additionally, given the specific population targeted for participation in the Salud Program (Latinos aged 60 and over with diabetes and depression/high risk of depression who are receiving health care services from a community health clinic), the results may not reflect the broader population of all older Latinos. Similarly, because the current study included mostly Latinos of Mexican ethnicity, these findings may not extend other ethnicities within the Latino group. In order to minimize burden on the target population, fasting was not required for the Salud Program participants prior to blood draws. For practical reasons fasting blood samples are difficult to obtain; thus, studies commonly comprise non-fasting or 'semi-fasting' blood samples (38–40). We conservatively applied previously proposed cut-offs for non-fasting TG levels to define hypertriglyceridemia as a MetS factor (40) since TG levels are more sensitive to recent food intake than are HDL-C levels. We recognize that this may artificially inflate certain triglyceride values; however there is no expectation of a systematic bias that would alter our primary findings. Next, our study did not examine functional outcomes that may extend from the impact of depression on METs outcomes. Specifically, we did not evaluate the role of depression and METs outcomes on functional indicators of job performance, or on broader measures of quality of life that are pertinent to the medical and lay communities. Future research should extend our findings to these important areas of research. Finally, we did not assess for use of pioglitazone, which is a commonly prescribed medication for individuals with diabetes. In addition to its antidiabetic effects, pioglitazone has been shown to have antidepressant effects (41) which may reduce the severity or presence of depression in diabetic samples. Future studies should evaluate whether the use of this medication modifies the relationship between depression and METs outcomes in diabetic samples.

As discussed above, our cross-sectional design identified a strong association between major depression and MetS but prevents concluding that depression causes MetS or CVD in older Latinos (or vice versa). Thus, the conclusions drawn from this study could be strengthened by a longitudinal design in which depression both pre-dates and predicts MetS after controlling for other factors that may predict risk for MetS. Future studies may also benefit from studying the longitudinal course of depression and its effects on other risk factors for CVD beyond MetS, and document to what extent Latinos who have depression go on to develop MetS, and consequently CVD.

Acknowledgments

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Table 1

Sample Characteristics

Variable		Sample Range
Age (years), M (SD)	66.64 (6.05)	59–88
Female, n (%)	217 (65.4)	
Years in U.S., M (SD)	28.96 (14.34)	0–72
Yearly Household Income, n (%)		
<$7,200	96 (28.9)	
$7,200–$10,799	119 (35.8)	
$10,800	117 (35.2)	
Years Smoked, M (SD)	7.35 (13.13)	0–56
History of Drinking Problem, n (%)	23 (6.9)	
Regular physical activity	126 (38.0)	
Religious Attendance, n (%)		
Never or Rare	32 (9.6)	
Moderate	107 (32.2)	
Regular	193 (58.1)	
Depression, n (%)	32 (9.6)	
Systolic Blood Pressure (mmHg), M (SD)	137.46 (22.46)	74–218
Diastolic Blood Pressure (mmHg), M (SD)	79.92 (12.56)	50–118
HDL-C (mmol/L), M (SD)	1.18 (0.35)	0.57–4.04
Triglycerides (mmol/L), M (SD)	2.22 (1.43)	0.43–13.02
BMI (kg/m2), M (SD)	31.26 (6.35)	19.59–65.48

Table 2

Odds ratios (95% CI) for Predictors of MetS and Individual MetS Criteria

Variable	Metabolic Syndrome	Hypertension	HDL-C	Triglycerides	BMI
Age (years)	1.00 (0.95–1.04)	1.07 (1.01–1.14) *	0.99 (0.95–1.04)	1.00 (0.96–1.04)	0.97 (0.94–1.01)
Female	1.48 (0.81–2.71)	0.50 (0.21–1.16)	0.74 (0.42–1.32)	1.30 (0.76–2.22)	1.94 (1.14–3.28) *
Years in U.S.	1.00 (0.98–1.02)	1.01 (0.98–1.03)	0.98 (0.96–1.00)	0.99 (0.98–1.01)	1.01 (0.99–1.02)
Income Tertile	1.26 (0.87–1.81)	0.78 (0.50–1.22)	1.20 (0.85–1.68)	1.22 (0.89–1.67)	1.15 (0.84–1.56)
Years Smoked	1.00 (0.98–1.02)	0.98 (0.95–1.00)	1.02 (1.00–1.04)	1.01 (0.99–1.03)	0.99 (0.97–1.01)
History of Drinking Problem	3.23 (0.68–15.20)	4.01 (0.48–33.53)	1.25 (0.47–3.32)	1.40 (0.51–3.82)	1.40 (0.55–3.57)
Regular physical activity	0.58 (0.34–1.01)	1.32 (0.65–2.67)	1.25 (0.75–2.10)	0.72 (0.45–1.16)	0.74 (0.46–1.17)
Regular Religious Attendance	0.23 (0.07–0.83) *	0.70 (0.22–2.28)	0.57 (0.24–1.32)	0.23 (0.09–0.60) *	0.79 (0.36–1.75)
Moderate Religious Attendance	0.32 (0.09–1.17)	2.59 (0.67–10.03)	0.65 (0.27–1.56)	0.38 (0.14–1.01)	0.87 (0.38–1.99)
Depression	5.79 (1.32–25.42) *	1.99 (0.56–7.10)	2.46 (1.11–5.45) *	2.71 (1.15–6.42) *	1.51 (0.69–3.28)
Nagelkerke R^2	.107	.123	.078	.080	.075

*
$p < .05$.