Metabolic Risk and Depression among Elderly Mexican Americans: The Roles of Nativity Status

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Objective: To evaluate the relationship between metabolic risk (MR) and depression in a sample of older Mexican Americans and examine whether the association differs by age at migration.

Methods: Longitudinal study using data from the Hispanic Established Populations for the Epidemiologic Study of the Elderly (HEPESE) (N=807, mean age = 84.3). The analytical sample was compiled from wave 6 (2007) to wave 7 (2010-2011) of HEPESE. Random-effect logistic regression examined the association between MR and depression and tested the model stratified by nativity status and age at migration.

Results: MR was associated with higher odds of depression for US-born Mexican Americans after controlling for potential confounders. Similarly, among Mexican Americans who migrated before age 20, MR was associated with higher odds of depression.

Conclusion: The findings highlight the importance of age at migration when evaluating the health of foreign-born Mexican Americans from a life-course perspective. Particularly among Mexican Americans who migrated before age 20, those with MR were more vulnerable to depression than their counterparts without MR. *Ethn Dis.* 2021;31(2):243-252; doi:10.18865/ed.31.2.243

Keywords: Metabolic Risk; Depression; Nativity; Immigrant Health Advantage

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Introduction

According to the US Census Bureau, Hispanics will make up 31% of the total population in the country by 2060.[1] In 2017, about 44% of US immigrants were Hispanics,[2] and among these Hispanics, about 60% were Mexican Americans. As more than 90% of older Mexican Americans reside and receive medical care in the United States,[3] it is vital to understand both the patterns of and risk factors for physical and psychiatric morbidity among older Mexican Americans. An emerging phenomenon connecting both physical and mental health is the concept of metabolic depression,[4,5] which refers to the association between metabolic dysfunction and depression.

To date, research on the possible underlying factors associated with variations in depression between race and ethnic populations remains unclear, and some emerging factors need to be considered. One contributing factor may be the rising prevalence of metabolic syndrome. Metabolic syndrome is a cluster of interrelated risk factors, including dysglycemia, raised blood pressure, elevated triglyceride levels, low high-density lipoprotein cholesterol, and central obesity. Although the prevalence of metabolic syndrome has been rising worldwide in recent years, there is no consensus on the use of the term and its diagnostic criteria.[6] One of the most commonly used criteria was developed by the National Cholesterol Education Program (NCEP), Adult Treatment Panel III guidelines.[7,8] According to these guidelines, metabolic syndrome can be measured by having three or more of the following five criteria: 1) abdominal obesity (waist circumference ≥102 cm for men or waist circumference ≥88 cm for women); 2) hypertriglyceridemia (≥150 mg/dL, or medication for lowering triglycerides); 3) low high-density lipoprotein (HDL) (<40 mg/dL for men and 50 mg/dL for women, or HDL-raising medication); 4) hypertension (systolic/

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diastolic blood pressure ≥130/85 mm Hg, or on antihypertensive medication); and 5) impaired fasting glucose or diabetes (≥110 mg/dL, or taking insulin or hypoglycemic medicines).

Research shows that metabolic morbidities such as obesity and diabetes are more prevalent in Mexican Americans than in other racial/ethnic populations.[9-11] Depression, a mental illness associated with emotional and physical problems,[12] is also reported to be the most prevalent mental illness among the Hispanic

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Understanding metabolic depression in older Mexican Americans with diverse immigration patterns needs to move beyond the biomarkers and use a multifactorial approach as the one we propose in this study.

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population.[13] Existing studies found an association between metabolic syndrome and depression not only among the general population,[4] but also in subgroups of the population, ie, among young women,[14] middle-aged people, and older adults around 70 years old.[15] However, three areas remain to be explored: 1) whether the association could be found among older Mexican Americans; 2) if the country of birth influences

the association among foreign-born Mexican Americans; 3) and whether among the foreign-born Mexican Americans, the association differs according to the age at migration.

Some research has addressed whether the relationship between metabolic syndrome and depression extends to other racial/ethnic groups, particularly to older Mexican Americans. Using a cross-sectional approach, researchers reported that older Hispanics born in Mexico had higher odds of depressive symptoms than the US-born counterparts,[16] but the factors contributing to the high risk for depressive symptoms in this population group have not been investigated. To extend the previous study, we use a dataset specific to Mexican Americans to explore the most prevalent measured components of metabolic syndrome in our sample of older Mexican Americans. The longitudinal features of this dataset may improve the precision of estimates and better model the within-subject changes over time in the relationship between metabolic risk (MR) and depression.[17]

Next, if metabolic depression is found among older Mexican Americans, the diverse immigration patterns may complicate the understanding of this relationship. There is a well-documented immigrant health paradox (also referred to as the Hispanic Paradox), which suggests that immigrants, particularly Hispanics, are healthier than their US-born peers despite immigrants often reporting more disadvantaged socioeconomic status (SES).[18,19] For example, first-generation Mexican American women had healthier diets, lower obesity rates,[20] and lower mortality[21] than both non-

Latino Whites and second-generation Mexican Americans. However, the immigrant health advantage is not always evident in mental health outcomes such as depression.[22,23]

Prior research found that immigrants are more prone to depression than US-born because of stressful life events, social isolation, and acculturative stress after immigration.[22,23] Metabolic depression is more complicated than the depression itself because it has both physical and mental health components. Therefore, whether metabolic depression holds among immigrants is unknown.

Finally, from a life-course perspective, the stressful events experienced in young adulthood may affect one's health in later life.[24] The immigration process and the subsequent adjustments are stressful life events, and the age of experiencing such events may have differential impacts on late-life health. For example, immigrants who arrived as children may be more likely to assimilate in the culture of destination countries, while those who migrated as adults may be under more substantial acculturative stress, herein more vulnerable to depression.[25] Therefore, age at migration may capture immigrants' health selectivity and help elucidate the health disparities between the US-born and immigrants at old ages.[26-28] From a life-course perspective, this study aims to assess whether nativity status and age at migration moderate the relationship between MR and the odds of depression.

In addition, existing literature suggests that depression is associated with known socioeconomic, health, and cultural factors. For example, the prevalence of depression in later life

is correlated with socioeconomic status,[29] gender,[30] and chronic diseases,[31] and adverse health behaviors, such as smoking.[32] The low prevalence of unhealthy behaviors such as smoking and drinking is hypothesized as one reason immigrants may exhibit better health than the native-born populations.[33-35] Psychosocial factors such as high acculturation[36] and self-esteem[37] are protective against depression. Understanding metabolic depression in older Mexican Americans with diverse immigration patterns needs to move beyond the biomarkers and use a multifactorial approach as the one we propose in this study.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

Figure 1 displays the conceptual framework of this study. As implied by the concept of metabolic depression, MR is conceptualized as a precursor of depression. We propose that metabolic depression exists among older Mexican Americans. Furthermore, because of the differences in the selection and acculturation processes that individuals experience with immigration at different ages, this association will vary according to the respondents' nativity status and age at migration. Based on the findings from the existing literature, we expect foreign-born respondents who migrate as adults to be under stronger acculturative stress, thus more likely to experience depression. However, they may also retain the benefits of the physical health component of the immigrant health paradox, which may decrease the prevalence of metabolic depression. Drawing from the literature and conceptual framework, this research aims to test the following hypothesis:

H1. MR is associated with higher odds of depression among older Mexican Americans.

H2. The association between MR and the odds of depression is modified by nativity status and age at migration.

METHODS

Data and Sample

This study uses data from the Hispanic Established Population for Epidemiological Studies of the Elderly (HEPESE)— a large, multistage probability sample of Mexican Americans aged ≥65 years who reside in the southwestern states of Texas, California, New Mexico, Arizona, and Colorado. These five states represented 85% of the Mexican American population aged ≥65 years living in the United States when the study started. The first wave of the
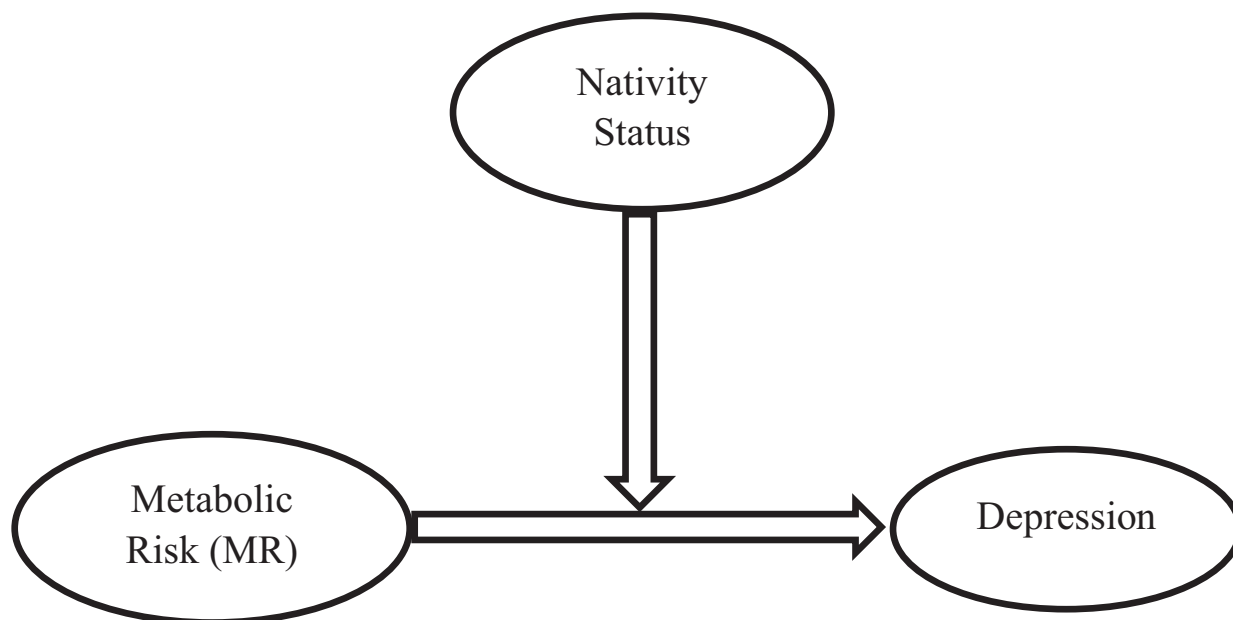

Figure 1. Conceptual framework

study (1993) surveyed 3,050 individuals. The HEPESE dataset and the MR measure developed from it provide an opportunity to understand the connection between metabolic morbidities and depression among older Mexican Americans.

For this study, the analytical sample was compiled from wave 6 (2007) to wave 7 (2010-2011) of HEPESE. This is because MR measures were collected from wave 6 and health behaviors were only available from waves 6 and 7. At wave 6, surveyed in 2012, there were 921 respondents who belonged to the original cohort that was surveyed in and followed from 1993. We excluded the observations with incomplete information, which resulted in a final analytic sample of 807 respondents with 1,276 person-wave observations.

Measures

Depression

Depression was measured by the self-reported score using the Center for Epidemiological Studies Depression Scale (CES-D). The 20 items in the CES-D scale assess nine groups of depression symptoms: sadness (dysphoria), loss of interest (anhedonia), appetite, sleep, thinking/concentration, guilt (worthlessness), tired (fatigue), movement (agitation), and suicidal ideation. The total score ranges from 0 to 60. Respondents who reported a CES-D score of at least 16 were classified as having depression (1=yes, 0=no).[38]

Metabolic Risk

Among the five metabolic syndrome indicators provided by NCEP,[7,8] HEPESE collected data on only three: waist circumferences (waist circumference ≥102 cm for men or waist circumference ≥88 cm for women), taking antihypertension medication, and taking insulin. The MR was coded 1 for participants who met all three criteria and 0 otherwise. Participants who failed to report any one of the three items were removed from the sample. Due to the data limitation, the composite indicator of MR based on three variables may underestimate the prevalence of metabolic syndrome. Therefore, this study's MR variable should be deemed a more conservative measure than the metabolic syndrome.

Nativity Status and Age at Migration

Previous literature acknowledges the importance of age at migration in studying the health status of older immigrants.[26,39] We created a variable combining nativity status and age at migration and categorized as follows: US-born, foreign-born migrated before age 20 (henceforth, early arrivers), and the foreign-born migrated at age 20 or older (henceforth, late arrivers), similar to the practice in previous research.[26,40]

Covariates

Control variables included known sociodemographic characteristics and health conditions identified in the literature review: age (in years), education at baseline (in years), marital status (currently married=1, otherwise 0), and sex (female=1, male=0). Financial difficulty is a 4-scale ordinary variable, with 1 indicating no difficulty and 4 indicating a great deal of difficulty. For health behaviors, we controlled for current smoking (1=yes, 0=no) and whether the respondent ever drank alcohol in the last month (1=yes, 0=no).

The acculturation score shows the degree that the respondent interacted with members of mainstream society. The respondents were asked three questions: 1) "Throughout your adult life, have your neighbors been mostly Mexican Americans, mostly Anglo, or about equal numbers of each?" 2) "(Are/Were) the people with whom you work closely on [the job/your last job] mostly Mexican Americans, mostly Anglo, or about equal numbers of each?" 3) "Throughout your adult life, have your close personal friends been mostly Mexican Americans, mostly Anglo, or about equal numbers of each?" For each question, 0 points were assigned if the answer was Mexican, 1 if mostly Mexican American, 2 if mostly Non-Hispanic White, and 3 if the answer is about equal numbers of each. The final acculturation scores were summed using the scores from the three questions and categorized into a 4-degree ordinary variable: 3 points or less, 4-5 points, 6-7 points, 8 points or more. A higher score indicates more complete acculturation.

A self-esteem score was constructed from five questions about the respondent's attitude toward him/herself: 1) "I take a positive attitude toward myself"; 2) "I feel that I'm a person of worth, at least on an equal plane with others"; 3) "I feel that I have a number of good qualities"; 4) "I am able to do things as well as most other people"; 5) "On the whole, I am satisfied with myself". For each question, agree was assigned 1, and disagree was assigned 0. These five questions' summed score was a continuous vari-

Table 1. Descriptive statistics stratified by nativity status and age at migration, the Hispanic Established Populations for the Epidemiologic Study of the Elderly 2007-2011

	US-Born, n=466	Early arrivers, n=66	Late arrivers, n=275	Total, N=807	Pa
	Mean(SD) or Proportion	Mean(SD) or Proportion	Mean(SD) or Proportion	Mean(SD) or Proportion	
Depression (% yes)	21.25	27.62	30.38	25.00	.002
Metabolic risk (% yes)	5.28	4.76	5.99	5.49	.825
Age (years)	84.11(4.03)	86.30(5.65)	84.19(3.94)	84.33(4.19)	
Female (%)	67.92	63.81	62.08	65.52	.115
Married (%)	36.94	26.67	34.37	35.19	.108
Education (years)	6.10(4.14)	4.45(3.76)	3.85(3.00)	5.16(3.89)	<.001
Financial difficulty (%)					<.001
no difficulty	29.44	19.05	17.52	24.37	
a little	24.17	20	23.95	23.75	
somewhat	28.61	36.19	38.36	32.68	
a great deal	17.78	24.76	20.18	19.2	
Currently smoking (%)	5.28	1.90	5.76	5.17	.269
Ever drank (%)	11.81	14.29	9.98	11.36	.389
Self-esteem	4.77(.70)	4.70(.64)	4.79(.62)	4.77(.67)	.016
Acculturation	1.67(.89)	1.30(.57)	1.22(.52)	1.48(.78)	.000

a. Ps were generated from one-way ANOVA for continuous variables and Chi-square tests for categorical variables.

able ranging from 0 to 5 (a higher score indicates higher self-esteem).

Statistical Analysis

The analysis was conducted in two steps. First, descriptive statistics are presented for the dependent variable, independent variable, and covariates stratified by nativity status and age at migration to examine the group differences. One-way ANOVA (for continuous variables) and Chi-square tests (for categorical variables) were used to assess the group differences. Second, random-effects (RE) logistic regression models were conducted to account for the within-individual correlation.

The formula for a RE model is as follows:

$$\text{logit}(E[Y_{ij}|b_i]) = \beta_1 + \beta_2 MR_{ij2} + \beta_p X_{ijp} + b_i$$

where Y_{ij} is the binary outcome of depression status, β_p is a coefficient vec-tor for p covariates for each person i at time j. In addition, b_i is an individual-specific random effect, which is assumed to vary from one individual to another. MR refers to the binary metabolic risk, and X_{ijp} refers to other covariates included in the model. To examine whether the risk for metabolic depression differs by nativity status, we first applied an interaction term of MR with a variable created using nativity status and age at migration.

RESULTS

Descriptive Statistics

Table 1 provides descriptive statistics for all variables stratified by nativity status and age at migration. The average age of the total sample was 84.3 years old (SD= 4.2), and the mean education completed was 5.2 years (SD=3.9). About two-thirds of the whole sample were females, and

35.2% of the respondents were married. In this sample, foreign-born Mexican Americans who migrated after age 20 years (henceforth, late arrivers) had a higher percentage of depression (30.4%) than the US-born Mexican Americans (21.3%) and those who migrated before age 20 years (early arrivers) (27.6%). The prevalence of MR did not differ significantly by different age at migration, although the percentages varied from 4.8% (early arrivers) to 6% (late arrivers).

Table 2 presents the results of the RE logistic regression models for MR and depression for the total sample and then stratified by the nativity status. For the total sample, MR was associated with a higher odds of depression in Models 1 and 2. However, this association was no longer significant in the fully adjusted model (Model 4). Therefore, our H1 was not fully supported for older Mexican Americans.

An interaction term of MR with

Table 2. Odds ratios of depression for metabolic risk and stratified by nativity status and age of arrival, the Hispanic Established Populations for the Epidemiologic Study of the Elderly 2007-2011

Depression	Model 1	Model 2	Model 3	Model 4
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Metabolic risk (Ref=no risk)				
Total Sample				
Metabolic risk (Ref.=no risk)	2.70(1.24,5.88)	2.06(1.00,4.26)	2.03(.98,4.20)	2.02(.98,4.14)
Number of individuals	807	807	807	807
Number of person-periods	1276	1276	1276	1276
Nativity status and age at migration				
US-born				
Metabolic risk (Ref.=no risk)				3.17(1.19,8.43)
Number of individuals				466
Number of person-periods				720
Early arrivers				
Metabolic risk (Ref.=no risk)				20.18(1.26,322.40)
Number of individuals				66
Number of person-periods				105
Late arrivers				
Metabolic risk (Ref.=no risk)				.51(.15,1.78)
Number of individuals				275
Number of person-periods				451

OR, adjusted odds ratios; CI, confidence interval; MR, metabolic risk.

Model 1 is the unadjusted model, including only MR and age at migration. Model 2 adjusted for the demographic and socioeconomic variables (age, sex, marital status, educational attainment, and financial difficulty). Model 3 added health behaviors (smoking, and drinking), Model 4 fully adjusted all covariates, including psychosocial factors (self-esteem and acculturation). The interaction term shows a significant effect of MR and nativity status/age at migration (P=.01).

nativity status and age at migration was tested in the fully adjusted model and was statistically significant (P=.01). We found a significant association between MR and higher odds of depression for US-born Mexican Americans. For example, among US-born Mexican American, the odds of depression was three times greater among those with MR relative to their counterparts without MR. The odds of depression was more than 20 times in Mexican Americans who had MR, compared with those without MR for Mexican Americans who migrated before adulthood. However, for the late arrivers, MR was not associated with depression. These results provided support for H2.

Figure 2 shows the predicted probabilities of depression based on the fully adjusted model (Model 4). As shown in Figure 2, among all the respondents with MR, early arrivers had a substantially higher probability of depression, while late arrivers had a lower probability of depression.

Discussion

By 2050, Hispanic older adults are expected to make up about 20% of the US population aged ≥65 years.[41] Understanding the physical and mental health of older Mexican Americans, the largest ethnic group in the Hispanic population, and the potentially modifiable factors may provide insights into policy designs to address aging issues within the United States. This study used a longitudinal dataset to assess the relationship between MR and depression among a representative sample of older Mexican Americans residing in the five southwestern states of the United States.

Our main findings suggest that the presence of MR was associated with depression status only among US-born Mexican American respondents and those who migrated to the United States before age 20 years. Previous literature found metabolic depression in the general population[4] and certain subpopulations,[14,15] and our results add to the literature by showing that this emerging phenomenon also extends to particular subpopulations of Mexican American older adults. This study's longitu-
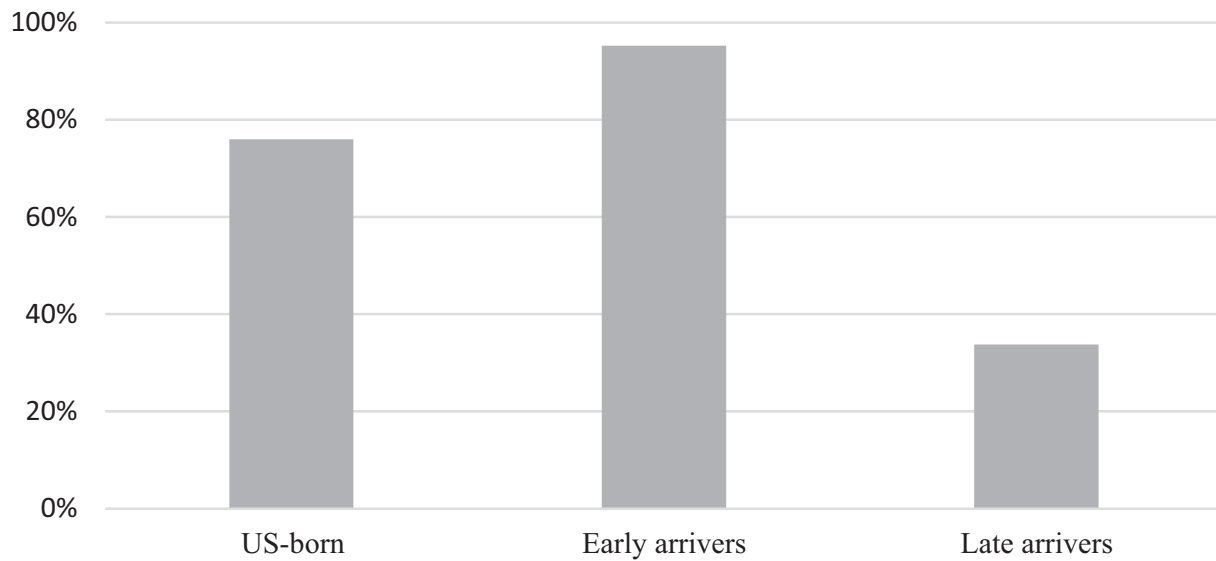
Figure 2. Predicted probabilities of depression among respondents with metabolic risk

dinal design strengthens the findings on the direction of the association going from MR to depression, rather than the reverse direction.

In addition, in line with life course research that stressed the role of age at migration in studying health disparities,[25-28] we found that nativity status and age at migration modify the relationship between MR and depression. Specifically, foreign-born who migrated before age 20 years were more likely to have metabolic depression, while those who arrived in the United States as adults appeared to be protected, indicating positive health selection effects in migration.

The findings contribute to the literature on the Hispanic paradox by adding a more granular perspective to the age at migration and its role in both the physical and mental health of older Mexican Americans with diverse immigration patterns. By utilizing age

at migration, we captured some of the health selectivity of immigrants related to the length of exposure to the environment in the birthplace and the ability to maintain good health in the destination country.[26-28] Our nuanced approach also considers that child migrants are most likely to be brought in by parents and, therefore, less positively selected on physical health than those who migrated later. In addition, the age at migration captures the length of residence in origin countries and the degree of acculturation in the destination countries. For instance, immigrants who arrived as adults are positively selected in health and may be stronger in physical health. Meanwhile, they are less likely to be assimilated into destination countries' culture than the immigrants who arrive as children; therefore, they may be under more acculturative stress and more prone to depressive disorders.

Study Limitations

Several limitations of our study should be noted. First, this study uses only two waves of longitudinal data because the key variables were collected only in selected waves. For example, the MR measures were collected from wave 6 to 8 but smoking and drinking were only collected from wave 1 to 7. Also, due to data limitations, the MR measure used in this study is based on complete information of all three items instead of the commonly used five items. This may underestimate the prevalence of metabolic syndrome. Future studies on metabolic depression among older Mexican Americans should allow for longer follow-ups and use complete metabolic syndrome measures. Second, CES-D scores were coded missing if the respondents refused to answer, missed more than two of the individual items, or required proxy

interviews. This may potentially bias the representativeness of this sample. Relatedly, a healthy survivor bias may exist as the analysis based on complete information may be weighted in favor of respondents who were healthy and willing to participate in the surveys. Third, the odds ratios may overestimate the prevalence when working with frequent outcomes.[42] For this study, we did a series of sensitivity analyses to estimate the prevalence

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Our main findings suggest that the presence of MR was associated with depression status only among US-born Mexican American respondents and those who migrated to the United States before age 20 years.

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ratio using log-binomial regressions. These results showed that the prevalence ratios are lower than the odds ratios but the coefficients' direction and significance remain the same. We adopted the RE logistic regression models to address the convergence issues usually reported with binomial models when adding multiple covariates.

To mitigate the possibility of a healthy survivor bias/attrition bias, we conducted a supplementary analysis by including an attrition

variable (0=stayed, 1=dropped) into the fully adjusted model (Model 5). The analysis showed that attrition had no significant impact on the result (available upon request).

CONCLUSIONS

Despite limitations, this study contributes to the literature in several respects. First, it provides more evidence of the emerging phenomenon of metabolic depression and shows that it extends to the older Mexican American population with diverse immigration patterns. Second, this study advances our knowledge of the Hispanic paradox by mapping out the nuanced nature of health selection. That is, the older Mexican Americans did not have health advantages in mental health outcomes such as depression, but selectively displayed an advantage in metabolic depression for those who migrated after age 20 years. We believe that our findings merit consideration and may add urgency to the need for new policies to maximize cost-effective and culturally sensitive options in metabolic risk management to help mitigate depression risk among older Mexican American populations.

AUTHOR CONTRIBUTIONS
Research concept and design: Zhang, Vásquez, Botoseneanu, Yucel; Acquisition of data: Zhang, Vásquez; Data analysis and interpretation: Zhang, Vásquez, Botoseneanu, Yucel; Manuscript draft: Zhang, Vásquez, Botoseneanu, Yucel; Statistical expertise: Zhang, Botoseneanu, Yucel; Acquisition of funding: Vásquez; Administrative: Zhang, Yucel; Supervision: Vásquez, Yucel

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