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# Social support modifies the negative effects of acculturation on obesity and central obesity in Mexican men

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**ABSTRACT**

**Background:** This study examined the moderating role of social support in the acculturation-obesity/central obesity relationship in Mexican American (MA) men and women.
**Methods:** Data from NHANES 1999–2008 were used. Acculturation derived from language use, country of birth and length of residence in the U.S. Social support assessed emotional and financial support. BMI (≥30) and waist circumference (≥88 cm for women; ≥102 cm for men) measured obesity and central obesity, respectively. Weighted multivariate logistic regression models were used to describe associations.
**Results:** Compared to less acculturation, more acculturation was associated with higher odds of obesity (ORs 2.48; 95% CI 1.06–5.83) and central obesity (2.90; 1.39–6.08) among MA men with low/no social support, but not among MA men reporting high social support. The modifying effects was not observed among women.
**Conclusion:** Higher amounts of social support appeared to attenuate the risk of obesity/central obesity associated with acculturation. Interventions enhancing social support maybe effective among acculturated MAs, particularly among men.

## Introduction

Mexican Americans (MAs) living in the U.S. are disproportionately represented in the obesity epidemic (Flegal et al. 2009). The prevalence of overall obesity and central obesity in MA adults are higher than in non-Hispanic whites (Flegal et al. 2009). An extensive literature suggests that acculturation to the U.S. society may be associated with risks for obesity outcomes in MAs (Albrecht et al. 2013; Bowie et al. 2007; Wolin et al. 2009). Compared to foreign-born individuals, U.S.-born MAs had higher odds of overall obesity

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and central obesity, regardless of their socioeconomic status (Albrecht et al. 2013). Additionally, length of U.S. residency and English fluency were found to be positively associated with obesity outcomes (Albrecht et al. 2013; Wolin et al. 2009).

Along with acculturation, other sociocultural influences, such as social support may also play a role for obesity risk in MAs. Social support — the interaction with family members, friends, peers and professionals that communicate information, esteem, and practical or emotional help (Stewart 2000) — is associated with obesity-related health behaviors (Finch and Vega 2003; Schmied et al. 2014; Sorensen et al. 2007). Research has found that stronger social support networks contribute to healthy diets (Bertram et al. 2014; Sorensen et al. 2007), participation in physical activities, and avoidance of smoking (Bertram et al. 2014). In addition, social support may attenuate the duration and intensity of stress associated with immigration and acculturation (Bertram et al. 2014; Finch and Vega 2003). Compared to individuals with low or no support, those with higher and more stable social support are less likely to experience adjustment difficulties (Crockett et al. 2007), and more likely to cope with stressors therefore maintain mental and physical health (Crockett et al. 2007).

The influence of acculturation on weight outcomes appears to vary between genders (Cerrutti and Massey 2001; Kanter and Caballero 2012). One study found that the effect of acculturation on weight gain seem more evident among MA women than men (Khan, Sobal, and Martorell 1997). One review paper concluded that there is a positive relationship between length of residence and BMI in the U.S. among migrants, and that the relationship is greater among Hispanic women than men (Oza-Frank and Cunningham 2010). In terms of waist circumference, men experience more substantial increase under the influence of acculturation than their female counterparts (Albrecht et al. 2013; Cerrutti and Massey 2001; Wang et al. 2012). A recent study reported that MA men who live in the U.S. for less than 10 years, had 8.92 cm lower waist circumference when compared to U.S.-born individuals. However, in MA women, the difference is only 3.12 cm (Albrecht et al. 2013). Studies suggest that the lifestyles of MA men and women change differently in the course of acculturation (Cerrutti and Massey 2001; Wang et al. 2012). For example, men may be more likely to consume western fast food and alcohol than women (Jasti, Lee, and Doak 2011) (Pearson et al. 2009; Ravaja, Keltikangas-Jarvinen, and Viikari 1998), which may contribute to the obesity disparities between genders.

Social support from family and friends may also exert differential effects on weight status between genders (Christakis and Fowler 2007; Gallo et al. 2007; Ravaja, Keltikangas-Jarvinen, and Viikari 1998). Some studies suggest that the beneficial effects of social support on health are more pronounced in women (Gallo et al. 2007). However, a longitudinal study showed that social support is a better predictor of abdominal adiposity among men as compared to their female counterparts (Ravaja, Keltikangas-Jarvinen, and Viikari 1998). Another study also found that males have a 100% increase in the chance of becoming obese if their male friends became obese, whereas this same effect of friendship on obesity is not significant among females (Christakis and Fowler 2007).

Although both acculturation and social support are critical to the negotiation of adapting to a new culture and to the well-being in MAs (Albrecht et al. 2013; Bowie et al. 2007; Crockett et al. 2007; Oppedal, Røysamb, and Sam 2004), the interrelationship between these two factors has not been well examined, especially with respect to obesity outcomes

for men and women separately. In the field of mental health, researchers suggest that social support modifies the positive association between acculturation and mental health problems such as anxiety symptoms and depression (Crockett et al. 2007; Oppedal, Røysamb, and Sam 2004). If increased acculturation and contact with the U.S. society contributes to high risks for obesity among MAs, it is possible that social support may mitigate the negative effects of acculturation based on the afore-mentioned protective aspects of social support. Previous research has demonstrated the association between acculturation and obesity as well as a link between social support with obesity-related outcomes including hypertension, elevated plasma glucose, and waist circumference among Latinos (Bell, Thorpe, and LaVeist 2010). However, these analyses did not explore the potential interaction of acculturation and social support (Bell, Thorpe, and LaVeist 2010).

Using a nationally representative sample, the current study aimed to examine whether acculturation and social support influence the weight outcomes between MA men and women differently. The study also aimed to assess the potential moderating role of social support in the acculturation-obesity/central obesity relationship and whether the possible modifying effects of social support vary between genders among MAs who are undergoing acculturation.

## Methods

### Data

Data from Continuous NHANES cycle 1999–2000 to cycle 2007–2008 were used for the current study. NHANES 2011–2012 and 2013–2014 were excluded because they did not include information of social support. NHANES procedures are described in detail elsewhere (US Centers for Disease Control and Prevention National Center for Health Statistics 2017). Social support questions were only asked of participants age 40 years and older in NHANES cycles 1999–2000 to 2003–2004 and age 60 years and older in cycles 2005–2006 to 2007–2008. The final study sample included 2946 MA adults with valid acculturation, social support and body measures. The National Center for Health Statistics Research Ethic Review Board approved NHANES, and informed consent was obtained from all participants (US Centers for Disease Control and Prevention National Center for Health Statistics 2017).

### Measures

Obesity and Central Obesity were categorized based on physical exam information from NHANES. Respondents with a body mass index (BMI) of ≥30 were defined as obese. Central obesity was defined as a waist circumference of ≥88 cm for women and ≥102 cm for men (World Health Organization).

Acculturation was constructed as an acculturation score, which is based on three proxy measures: country of birth, language spoken at home, and length of time in the U.S. Combining country of birth and length of time in the US, a 0–3 score was assigned based on four categories (3 = U.S. born, 2 = foreign born and lived in the U.S. ≥20 years, 1 = foreign born and lived in the US 10–19 years, 0 = foreign born and lived in the U.S.<10 years). A score of 0–2 was assigned to language spoken at home (2 = English only or

pro-English, 1 = both equally, 0 = Spanish or pro-Spanish). These scores were then summed to yield a total acculturation score, ranging from 0 (least acculturated) to 5 (most acculturated). This is a validated scale that has been tested in Hispanic populations in the U.S. (Kandula et al. 2008). Instead of using the three components as separate variables, the authors argued that an acculturation score gives a more accurate representation of acculturation status than each independent indicator, in that these characteristics are usually clustered within an individual and they are inseparable (Kandula et al. 2008). For the purpose of better interpretation, acculturation was dichotomized based on the median value of the index (more acculturated vs. less acculturated).

Social Support was measured by emotional support and financial support. We focused on these two aspects of social support because prior empirical research has demonstrated that they are key components of social support (Cohen 2004). They been repeatedly used in health studies and are shown to be associated with clinical outcomes including hypertension, Hemoglobin A1C, lipid profiles and depression (Andrea, Siegel, and Teo 2016; Bell, Thorpe, and LaVeist 2010; Rees, Karter, and Young 2010; Sabbah et al. 2011). Two binary variables assessed whether a respondent was having emotional support (someone to talk over problems or help make a difficult decision) and financial support (anyone to help pay bills, housing costs, hospital visits, or provide food or clothes). If the respondent answered 'yes' to these questions, they were assigned a '1'. These two questions were fully validated in the MacArthur studies on aging (Berkman et al. 1993) and employed in previous studies using NHANES data (Bell, Thorpe, and LaVeist 2010; Rees, Karter, and Young 2010). Because individuals who received only emotional or financial support, or neither of these supports were much fewer than those who received both supports, social support was kept as binary variable in the study— 'more social support', which included individuals receiving both emotional and financial support, and 'less or no social support', which included those receiving only emotional or financial support, or neither of these supports. Sensitivity analyses were performed to validate the newly created binary social support variable. Its effects were compared to effects of emotional support or financial support separately.

Covariates: Sociodemographic variables included age (40–50, 51–59, or ≥60), education (<high school, = high school or equivalent, or >high school), marital status (yes or no), poverty-income ratio (PIR<1, 1≤PIR<3, or PIR≥3) (US Census Bureau Population Division Fertility & Family Statistics Branch 2004), smoking status (never, former, or current) and alcohol drinking status (never, former, or current). Insurance coverage were categorized into 1) public insurance including Medicare and Medicaid and other forms of government insurance, 2) private insurance and 3) no health insurance. Physical activity (PA) was assessed by using the physical activity questionnaire (PAQ) items employed in NHANES. Participants were asked their engagement in moderate-to-vigorous physical activity (MVPA) during the past 30 days related to transportation, household/domestic tasks, and leisure-time activities. Their responses were translated to minutes/week of MVPA. Each participant's combined weekly duration of MVPA were grouped into one of two categories (<150 or ≥150 min/week) based upon their achievement of the current activity guidelines (US Department of Health and Human Services 2008). Diet quality was assessed by using the Healthy Eating Index 2010 (HEI-2010) based on combining data from NHANES in-person 24-hour recall interview with the

USDA Food Pattern Equivalent Databases (FPED). HEI-2010 was summed up to a score of 100, with higher scores indicating higher diet quality.

## Analysis

Descriptive analyses first examined differences between acculturation groups for sociodemographic, behavioral factors, level of social support, and obesity outcomes. Student's t-tests were used for continuous variables and chi-square tests for categorical variables. Adjusted logistic regression models examined the influence of acculturation and social support on obesity/central obesity, and the acculturation × social support interaction term tested the potential modifying effect of social support. All analyses adjusted for sociodemographics, insurance status, physical activity, and diet quality. Because interactions are tested with lower power, a more liberal α-level ($p < 0.2$) was used to detect the presence of moderation (Fairchild and MacKinnon 2009). If interaction was detected, acculturation differences in odds of obesity and central obesity were determined within each social support level.

All analyses used procedures (e.g. SAS PROC SURVEYMEANS) that accounted for the complex survey design effect and were conducted using SAS version 9.4 (SAS Institute Cary, NC). In particular, Primary Sampling Unit (PSU) and stratum for each observation as well as appropriate weights corresponding to the six NHANES survey cycles were specified in the analysis. Also, analyses included Data Release Number (SDDSRVRY) as a covariate to account for potential different distributions of sampled populations in different survey cycles.

## Results

Table 1 presents descriptive data by acculturation status. Among all MAs, those who were more acculturated were older, more likely to have high educational attainment, less likely to live under the poverty line, less likely to be married, and more likely to have private or public insurance. With respect to health behaviors, more acculturated individuals were more likely to be current drinkers, current smokers, to meet physical activity guidelines, and to have poorer diet quality, compared to their less acculturated counterparts. Individuals with more acculturation also reported higher levels of social support, as well as higher prevalence of obesity and central obesity in comparison to their less acculturated counterparts.

Among MA men, but not MA women, more acculturation was significantly associated with obesity (P-value in model 4 was 0.01) and central obesity (P-value in model 4 was <0.01), and these relationships were moderated by social support (P-values for interaction terms in model 4 were 0.19 and 0.18 for outcomes of obesity and central obesity, respectively) (Table 2). Table 3 presents adjusted ORs of obesity/central obesity among MA men stratified by level of social support. Among MA men reporting low/no social support, individuals with more acculturation had statistically significantly higher odds of obesity/central obesity [ORs were 2.49 (95% CI 1.03–5.97) and 2.91 (95% CI 1.37–6.20), for obesity and central obesity, respectively]. These associations were not observed in MA men who received more social support. Our sensitivity analyses showed that study main findings were consistent between analyses using the binary social support variable (i.e. low/no social support vs. high social support) and analyses using emotional support (yes vs. no) or financial support (yes vs. no) only.

**Table 1.** Characteristics of Mexican American Men and Women by Acculturation Status[a], NHANES 1999–2008[b] ($n = 2946$).

| Characteristics | All | | | Men | | | Women | | |
|---|---|---|---|---|---|---|---|---|---|
| | Less Acculturated | More Acculturated | p | Less Acculturated | More acculturated | p | Less Acculturated | More Acculturated | p |
| Age (mean, SE) | 51.30 (0.46) | 53.25 (0.36) | ** | 50.45 (0.79) | 52.87 (0.53) | ** | 52.25 (0.61) | 53.58 (0.42) | * |
| Education (n, %)[c] | | | ** | | | ** | | | ** |
| <High school | 1165 (79.25) | 634 (36.29) | | 601 (79.93) | 294 (35.79) | | 564 (78.47) | 340 (36.72) | |
| =High school or equiv. | 94 (8.90) | 277 (23.60) | | 45 (8.29) | 118 (22.82) | | 49 (9.60) | 159 (24.26) | |
| >High school | 120 (11.84) | 451 (40.11) | | 59 (11.77) | 209 (41.39) | | 61 (11.93) | 242 (39.02) | |
| Income (n, %)[c,d] | | | ** | | | ** | | | ** |
| PIR<1 | 486 (37.70) | 228 (15.88) | | 246 (36.93) | 98 (14.91) | | 240 (38.59) | 130 (16.66) | |
| 1 ≤ PIR < 3 | 630 (52.16) | 571 (41.10) | | 333 (52.95) | 261 (40.65) | | 297 (51.26) | 310 (41.50) | |
| PIR ≥3 | 112 (10.14) | 453 (43.06) | | 54 (10.11) | 215 (44.44) | | 58 (10.16) | 238 (41.85) | |
| Health insurance (n, %)[c,e] | | | ** | | | ** | | | ** |
| None | 619 (53.50) | 222 (19.30) | | 308 (52.75) | 106 (19.78) | | 311 (54.33) | 116 (18.88) | |
| Public | 380 (17.16) | 497 (25.27) | | 180 (13.86) | 217 (22.76) | | 200 (20.87) | 280 (27.46) | |
| Private | 361 (29.34) | 625 (55.43) | | 207 (33.39) | 289 (57.46) | | 154 (24.80) | 336 (53.66) | |
| Married | 949 (72.21) | 807 (60.47) | ** | 561 (79.79) | 419 (66.44) | ** | 388 (63.71) | 388 (55.29) | |
| Alcohol drinking (n, %)[c] | | | ** | | | * | | | ** |
| Non-drinker | 266 (18.08) | 176 (11.32) | | 27 (3.41) | 20 (4.40) | | 239 (34.76) | 156 (17.29) | |
| Former-drinker | 349 (24.54) | 305 (19.15) | | 197 (25.15) | 149 (18.88) | | 152 (23.86) | 156 (19.38) | |
| Current-drinker | 647 (57.38) | 779 (69.53) | | 441 (71.44) | 405 (76.71) | | 233 (41.38) | 374 (63.33) | |
| Smoking (n, %)[c] | | | * | | | | | | ** |
| Non-smoker | 769 (56.36) | 674 (50.56) | | 263 (40.12) | 216 (39.35) | | 506 (74.66) | 458 (60.23) | |
| Former-smoker | 394 (25.95) | 423 (27.80) | | 289 (36.31) | 257 (35.22) | | 105 (14.27) | 166 (21.39) | |
| Current-smoker | 214 (17.69) | 269 (21.64) | | 153 (23.57) | 149 (25.42) | | 61 (11.07) | 120 (18.38) | |
| Physical activity (n, %)[c,f] | 493 (38.22) | 628 (50.60) | ** | 267 (39.76) | 324 (57.85) | ** | 226 (36.48) | 304 (44.34) | * |
| HEI total score (mean, SE)[g] | 52.66 (0.56) | 49.88 (0.47) | ** | 51.00 (0.79) | 49.47 (0.52) | ** | 54.52 (0.61) | 50.23 (0.63) | ** |
| Social support (n, %)[c,h] | | | ** | | | ** | | | * |
| No support | 130 (30.15) | 62 (17.82) | * | 80 (32.91) | 30 (15.76) | ** | 50 (26.62) | 32 (19.60) | |
| Emotional support only | 842 (80.0) | 946 (91.39) | ** | 413 (78.02) | 439 (91.77) | ** | 429 (82.07) | 507 (91.06) | ** |
| Financial support only | 652 (58.97) | 767 (74.85) | ** | 302 (53.27) | 348 (75.59) | ** | 350 (65.01) | 419 (74.22) | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Both emotional and financial support | 598 (53.39) | 724 (70.00) | ** | 279 (47.78) | 329 (69.86) | ** | 319 (57.24) | 395 (70.12) | * |
| Obesity (n, %)[c,i] | 487 (36.94) | 523 (41.00) | * | 177 (27.43) | 215 (36.99) | ** | 310 (47.80) | 308 (44.43) | |
| Central obesity (n, %)[c,j] | 759 (52.66) | 834 (59.83) | ** | 255 (34.34) | 303 (47.67) | ** | 504 (73.23) | 531 (70.32) | |

[a]Acculturation score (0–5) is from the proxy measures on country of birth, language spoken at home and length of time in the U.S. For this set of analyses, scores are used to categorize individuals into less (0–2) and more (3–5) acculturated groups for comparison.

[b]NHANES cycle 1999–2000 to 2003–2004 contain social support questions for adults 60 years and older; cycle 2005–2006 and 2007–2008 contain social support questions for adults 40 years and older.

[c]Percentages were weighted.

[d]PIR: Poverty Income Ratio.

[e]Insurance status: 1) public insurance including Medicare and Medicaid and other forms of government insurance 2) private insurance 3) no health insurance.

[f]PAGA: Physical Activity Guidelines for Americans. Met PAGA is defined as engaging in moderate-to-vigorous physical activity ≥150 min per week.

[g]The HEI-2010 is summed to a total score of 100. Higher score indicates better diet quality.

[h]For the analysis, social support is composed as an index derived from information of emotional support (yes or no) and financial support (yes or no). The index is dichotomized into low or no (neither or either of two kinds of support) and high (both) social support groups for comparison.

[i]Obesity is defined as BMI≥30.

[j]Central obesity is defined as WC ≥102 cm in men; ≥88 cm in women.

*$P < .05$.

**$P < .001$.

Missing: education 53; income 314; insurance 90; married 125; smoking 51; alcohol drinking 245; PA 48; social support 701; obesity 128; central obesity 48

**Table 2.** Assessment of Interaction between Acculturation and Social Support, and Effects of the Interaction on Obesity Outcomes among Mexican American Men and Women[a] (Coefficient, SE).

| | Obesity[b,d] | | Central Obesity[b,d] | |
|---|---|---|---|---|
| | Men | Women | Men | Women |
| Model 1[c] | | | | |
| Acculturation[e] | 0.53 (0.17) | −0.24 (0.12) | 0.68 (0.14) | −0.26 (0.15) |
| (ref. less acculturation) | $P = 0.002$ | $P = 0.05$ | $P < .001$ | $P = 0.08$ |
| Model 2[c] | | | | |
| Social support[f] | −0.00 (0.20) | −0.21 (0.22) | 0.03 (0.17) | −0.44 (0.22) |
| (ref. low/no social support) | $P = 0.99$ | $P = 0.35$ | $P = 0.86$ | $P = 0.05$ |
| Model 3[c] | | | | |
| Acculturation[e] | 0.51 (0.22) | −0.17 (0.15) | 0.68 (0.17) | −0.19 (0.18) |
| | $P = 0.02$ | $P = 0.24$ | $P < .001$ | $P = 0.31$ |
| Social support[f] | −0.11 (0.21) | −0.19 (0.23) | −0.11 (0.19) | −0.42 (0.21) |
| | $P = 0.60$ | $P = 0.39$ | $P = 0.55$ | $P = 0.05$ |
| Model 4[c] | | | | |
| Acculturation[e] | 0.96 (0.39) | −0.18 (0.26) | 1.01 (0.32) | −0.31 (0.33) |
| | $P = 0.01$ | $P = 0.51$ | $P < .01$ | $P = 0.42$ |
| Social support[f] | 0.23 (0.33) | −0.20 (0.28) | 0.12 (0.28) | −0.52 (0.33) |
| | $P = 0.51$ | $P = 0.49$ | $P = 0.68$ | $P = 0.13$ |
| Acculturation × Social support | −0.74 (0.46) | −0.01 (0.31) | −0.53 (0.40) | 0.18 (0.41) |
| | $P = 0.19$ | $P = 0.98$ | $P = 0.18$ | $P = 0.66$ |

[a]NHANES cycle 1999–2000 to 2003–2004 contain social support questions for adults 60 years and older; cycle 2005–2006 and 2007–2008 contain social support questions for adults 40 years and older.
[b]Coefficient estimates (SE) and significance of each parameter.
[c]Model 1 includes acculturation and all covariates; model 2 includes social support and all covariates; model 3 includes both acculturation and social support, as well as all covariates; model 4 includes acculturation, social support, interaction term, as well as all covariates. Covariates include age, education, income, marital status, alcohol drinking, smoking, physical activity, diet quality, and survey year.
[d]Obesity is defined as BMI ≥ 30; central obesity is defined as waist circumferences ≥ 102 cm in men; ≥88 cm in women.
[e]Acculturation score (0–5) is used to categorize individuals into less (0–2) and more (3–5) acculturated groups for comparison in this set of analyses.
[f]Social support is composed as an index derived from information of emotional support (yes or no) and financial support (yes or no). The index is dichotomized into less or none (neither or either of two kinds of support) and more (both) social support groups for comparison.

**Table 3.** Logistic Regression Models for the Association between Acculturation and Obesity or Central Obesity by Level of Social Support among Mexican American Men (Social Support-Stratified Analysis).

| | Obesity | | Central Obesity | |
|---|---|---|---|---|
| | Low or no social Support | High social support | Low or no social Support | High social support |
| Acculturation | OR | OR | OR | OR |
| | (95% C.I.) | (95% C.I.) | (95% C.I.) | (95% C.I.) |
| Less acculturation | 1.0 | 1.0 | 1.0 | 1.0 |
| More acculturation | **2.49** | 1.21 | **2.91** | 1.47 |
| | **(1.03–5.97)\*** | (0.73–2.01) | **(1.37–6.20)\*** | (0.94–2.29) |

Adjusted for age, income, education, marital status, alcohol drinking, smoking, physical activity, diet quality, and survey year.
Acculturation score (0–5) is used to categorize individuals into less (0–2) and more (3–5) acculturated groups for comparison in the analysis.
\*$P < .05$.

## Discussion

This study helps clarifying the interrelationship between acculturation and social support, and their effects on obesity/central obesity among MA. The study found social support is an important effect modifier in the association between acculturation and obesity/central obesity among MA men. This finding suggests that while acculturation is associated with

higher odds of obesity, social support may be able to attenuate the negative influences of acculturation on obesity outcomes. MA male immigrants with low or no social support, possibly those who are isolated from the community or migrate to the U.S. without family or friends, may be more susceptible to unhealthy western lifestyles, therefore are at higher risk of obesity/central obesity.

Additionally, this study underscores gender differences of social support and its interaction with acculturation on obesity outcomes. The results showed that the moderating effect of social support was significant in MA men but not in MA women. Some suggest women are more likely to receive the direct beneficial effect of social support on weight through behavioral paths, including exercise or eating habits, as they tend to share information directly regarding health and lifestyles with each other, and are more influenced by their social networks (Cerrutti and Massey 2001; Gallo et al. 2007). Among men, social support may exert indirect beneficial effects by buffering against acculturation stress (Kim and Noh 2016). It was previously reported that social support appears to attenuate stress related to acculturation (Kim and Noh 2016). Even though the concept of acculturation stress is beyond the discussion here as the information was not available in the data, the general mechanism of an indirect buffer against acculturation stress may potentially explain the significant interaction between acculturation and social support among MA men. It is likely that men are less motivated to seek and share support within their network, as women do, but men benefit from social support when it mitigates the negative impacts of acculturation. The study finding suggests that men and women may differ in how they experience and utilize social support. Future research is for further comparison of gender groups when assessing acculturation and obesity outcomes, and to evaluate acculturation stress as well as other potential behavioral mediators.

## *Limitations*

There are several limitations to note. First of all, individuals 40 years old and older were administered questions on social support in survey cycles 1999–2000 to 2003–2004 and 60 years and older in cycles 2005–2006 to 2007–2008. The modifying effects of social support in the association between acculturation and obesity/central obesity may differ between middle age individuals (40 to 59 years) and those more senior (60 years and older). In our separate analysis (results not shown in Tables), however, we did not find meaningfully different results between these two age groups. Because our analysis only covered individuals in middle age and senior groups, cautions in interpreting results should be given. Studies have shown that social support also affects obesity outcomes among younger Mexican American adults (Thelus Jean et al. 2009). Future studies that include a younger age group will provide useful insight. Next, although both emotional and financial support were assessed, satisfaction with social support was not assessed. Satisfaction with social ties and social support has shown to be linked with health as well (Cohen and Wills 1985). Furthermore, the study cannot distinguish the source of social support (e.g. family vs. friends). Future analyses examining the quality and source of social support are necessary (Cohen and Wills 1985) and would be helpful for designing interventions (e.g. family-wise or peer-wise). Also, because acculturation stress was not measured in NHANES, testing the potential buffering effect of social support could not be done. Finally, the study was exclusively focused on MA adults, so results may not be

generalizable to other populations because of variations within the sociocultural context and obesity risks across races/ethnicities.

## Conclusion and implications

This study assists the understanding of the impact of sociocultural influences on obesity outcomes by highlighting the significant modifying effect of social support in the relationship between acculturation and obesity/central obesity among MAs men. Acculturated individuals who had low or no social support, may be more susceptible to unhealthy lifestyles that are associated with acculturation, thus experienced higher likelihood of being obese or centrally obese. Future immigrant or minority health research should take social support into account when assessing the relationship between acculturation and obesity outcomes. Public health efforts, whether to prevent overweight or obesity, or to manage obesity-related chronic conditions, needs to recognize the influence of social support in this ethnic group, especially in MA men (Albrecht et al. 2013). Strategies targeting families and communities may be effective given the fact that these two units strongly influence health behaviors including diet and physical activities (Albrecht et al. 2013). Creating a supportive environment for sharing, learning about and practicing healthy lifestyles, as well as promoting of the interpersonal communication between spouses and between other family members regarding healthy food choices and exercise, may be useful ways to decrease risk of obesity/central obesity among MAs who are undergoing lifestyles changes resulting from acculturation. Adequate social support may help an individual better cope with stress related to immigration and acculturation. Adopting healthy aspects of new culture and practices to achieve and/or maintain a healthy weight.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Key messages

- Higher amounts of social support attenuated the risk of obesity associated with acculturation among Mexican Americans.
- The moderating effect of social support on acculturation-obesity association was significant in MA men but not in MA women.

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