Sex differences in overweight and obesity among Mexican Americans in the National Health and Nutrition Examination Survey: A comparison of measures

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A R T I C L E   I N F O

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A B S T R A C T

The increasing prevalence of overweight and obesity in the United States, and disparities by race, ethnicity, and gender, have caused concern among public health practitioners, health care providers, and others, in part because overweight and obesity may be linked to chronic health problems and weight stigma. Researchers have traditionally relied upon body mass index (BMI) as a measure of overweight and obesity, despite its limitations. In this study we apply an intersectional framework and use data from the 2011–2018 waves of the nationally representative National Health and Nutrition Examination Survey (NHANES) to study sex differences in the risk of overweight and obesity among Mexican Americans, triangulating three measures that proxy for overweight and obesity: BMI, high waist circumference, and high percent body fat. We assess heterogeneity across nativity, education, income by parenthood status, food security, time in the United States (for immigrants), and receipt of SNAP/WIC benefits (for the low-income sample). Results from logistic regression models indicate choice of cutoff values and measure are critical to determining whether sex disparities exist. We find no evidence of disparities in BMI but evidence of greater risk for females using traditional cutoff values for high waist circumference and high percent body fat. Adjusted cutoff values provide differing results. Minimal heterogeneity is seen. Results reinforce the importance of considering sex disparities and emphasize the importance of critically examining measures that proxy for overweight and obesity risk, given the high stakes surrounding weight stigma.

1. Introduction

Overweight and obesity are considered serious concerns in the United States, because of a growing prevalence and many links to poorer health outcomes and well-being. From a health perspective, obesity appears to contribute to, or exacerbate the risk of, diseases like diabetes, certain cancers, cardiovascular disease, and serious illness from COVID-19 (CDC, 2020), although causal evidence is limited (Bombak, 2014). Other common chronic health conditions, such as arthritis and back pain may be worsened by obesity or overweight (CDC, 2020), and are a cause of missed work days that jeopardize employment and income (Hammond & Levine, 2010). Thus, it is critical to understand disparities in rates of overweight and obesity because they may translate into disparities in rates of chronic disease. We know there is considerable variation in the prevalence of chronic disease across socioeconomic status, race/ethnicity, and gender (e.g., Carrero et al., 2018; Shaw et al., 2016; Vahidy et al., 2020). To the extent that obesity is related to risk of chronic disease, disparities in obesity rates may be potential drivers of inequalities in chronic illness.

From a social well-being perspective, individuals with obesity suffer discrimination and lower wages (Wilson, 2012). Individuals categorized as overweight or obese experience weight stigma in multiple settings, including the health care system, which can precipitate negative mental and physical health changes (Bombak, 2014; Hart et al., 2020). Furthermore, in the health care setting, weight stigma may interact with racial bias to create negative outcomes for persons of color (Ciciurkaitė & Perry, 2018; Lewis et al., 2016).

Yet, some studies show overweight and obesity to be protective against mortality, and some groups of individuals with overweight or obesity appear cardiometabolically healthier than other groups of individuals with “normal” weight, causing many to call for a shift away from a focus on body weight toward a health-promoting Health at Every Size (HAES) approach (Bombak, 2014). This would help to reduce weight stigma.

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Disparities in overweight or obesity, and in experience of weight stigma, may exacerbate existing racial/ethnic, socioeconomic, and gender disparities in health. The highest rates of obesity are found among poor and disadvantaged racial and ethnic minorities (Fletcher, 2014; Lindberg & Stevens, 2011). In the latest decennial census of the United States—the 2020 Census—individuals identifying as Hispanic or Latino comprised 18.7% of the population (62.1 million individuals), making them the second largest (after Whites) racial/ethnic group in the United States (US Census Bureau, n.d.) and one that is at high risk of overweight and obesity. According to the Office of Minority Health at the U.S. Department of Health and Human Services, 80% of adults identifying as Hispanic are considered to have overweight or obesity based on body mass index (BMI), compared with 70% identifying as Non-Hispanic White (HHS, n.d.). Individuals of Mexican origin—either immigrants or through ancestry—make up the majority of Hispanics in the United States at 62% (Nee-Bustamante et al., 2019).

Risks of obesity also appear to vary by gender. Wells et al. (2012) reviewed 68 countries and reported that, based on traditional BMI cut points, for every two men classified as having obesity, there were three women. Other studies reinforce this finding that women have higher rates of obesity and a higher BMI overall, especially if they have low income (Martin & Lippert, 2012) or lower socioeconomic status (SES) (Pudrovksa et al., 2014; Zhang & Wang, 2004). Thus, it appears that the prevalence of obesity is disproportionately higher in (low-SES) women (Barcenas et al., 2007; Ro & Fleischer, 2014; Ryabov, 2012), and this is especially true for those identifying as African American or Hispanic (HHS, n.d.). These results point to the importance of engaging with an intersectional framework to think about interlocking disadvantaged social statuses when studying overweight and obesity, as socioeconomic status, gender, and race/ethnicity combine to create unique social positions for individuals in the United States (Bowleg, 2012; Viruell-Fuentes et al., 2012).

In this paper our goal is to determine whether there are sex differences (as a proxy for gender differences) in risk of overweight/obesity among those identifying as Mexican American in the most recent waves of the National Health and Nutrition Examination Survey (NHANES), using multiple measures of overweight/obesity, and assess how any sex differences that are uncovered vary across nativity, education, and other demographic and economic characteristics. Understanding potential sex differences in this sample may help illuminate our understanding of potential future disparities in chronic disease, experience of weight stigma, and so forth. Sex differences across measures of overweight/obesity may put one group at more risk of experiencing weight stigma. Additionally, it is important to understand whether certain measures of body composition may result in fewer sex-based inequities in health care systems that continue to use such measures with their patients. In part, we demonstrate the arbitrariness of different measures of obesity and the cutoff values used with them. We consciously consider the intersectional statuses of our respondents as females/males, Mexican Americans, immigrants, and so forth, though implementing a truly intersectional framework using survey data is challenging (Bowleg, 2012).

1.1. Gender differences

The literature is relatively consistent in demonstrating a gender disparity in obesity, but there is not a strong consensus as to the underlying mechanism. Women—notably women categorized as having obesity—have lower incomes as well as less stability and opportunities for employment (Wells et al., 2012) due to social factors like discrimination (Ro & Fleischer, 2014). A person living in a larger body may experience discrimination, or weight stigma (Hart et al., 2020), that negatively impacts their social status (Emsberger, 2009). The combination of a lower income and lower SES could significantly affect the ability of these women to purchase healthy food for themselves or their families, leading to food insecurity, as described further in section 1.3.

Motherhood and the demands of the motherhood role, especially for low-income women, have been proposed as another explanation for the gender disparity (Gough et al., 2019; Martin & Lippert, 2012). Although not all women are mothers, most women in the United States (>80%) are mothers at some point (Livingston, 2018) and, on average, mothers experience greater stress and strain than fathers (Musick et al., 2016). The intense responsibilities of mothers to perform caregiving and prioritize their children can lead to stress and fatigue (Musick et al., 2016). They can also limit women’s time to engage in positive health behaviors, such as healthy eating and physical activity (Welch et al., 2009).

Furthermore, this is a structural problem. For example, the United States remains one of only three countries in the entire world, and the only industrialized country, with no guaranteed paid maternity leave (Jou et al., 2018). Yet paid maternity leave has been shown to have positive effects on mothers with regard to exercise, stress management, and depression outcomes (Jou et al., 2018; Van Niel et al., 2020). Broad structural disadvantages in U.S. society amplify parenting stress for mothers in racial/ethnic minority groups (Nomaguchi & House, 2013). Thus, from an intersectional perspective, the Mexican-American (immigrant) mother in the United States may experience myriad social inequities that ultimately yield poorer health outcomes, including unhealthy weight.

There may also be gendered effects of other predictors on obesity risk. For example, in research using data from the Health and Retirement Study (HRS), women who were divorced or separated were more likely to be classified as having obesity than men with the same relationship status (Wilson, 2012). Women with fewer than 12 years of education have a higher likelihood of having obesity (Ljungvall & Zimmerman, 2012).

1.2. The role of immigration

Over the past two decades a growing body of research has asserted that Mexican-American immigrants to the United States experience declines in health over time, possibly due to the effects of acculturation (e.g., Antecol & Bedard, 2006; Gorman et al., 2010) but also as a result of structural inequality (Viruell-Fuentes et al., 2012). Stress theory suggests that the process of immigration and acculturation presents difficult and intense life changes to which the immigrant is unable to efficiently cope (Kaestner et al., 2009). The comfort of friends and family, or the immigrant’s social network, can be lost. Physical activity participation in the sending country may not continue as one struggles to integrate oneself in the dominant culture. The stress of these changes can result in negative health behaviors such as excessive drinking or taking up an unhealthy diet, which can contribute to obesity (Kaestner et al., 2009).

Other aspects of integration into U.S. society may also be important. For example, immigrants come to understand themselves as racialized “minorities”, which leads to experiences of stigma and exposes immigrants to experiences of residential segregation and discrimination (Viruell-Fuentes et al., 2012). Furthermore, contemporary immigration policy in the United States characterizes many immigrants as undesirable. These experiences can negatively impact immigrants’ psychological and physical health (Viruell-Fuentes et al., 2012).

Duration of residence in the United States can be a complicating factor. Murillo et al. (2015) found that foreign-born Mexican Americans had a lower BMI than U.S.-born Mexican Americans and that for foreign-born Mexican Americans there was a positive relationship between the amount of time spent in the United States and the likelihood of having obesity. Additionally, the most recent immigrants (less than 10 years) had the lowest levels of sedentary activity while U.S.-born Mexican Americans had the highest levels (Murillo et al., 2015).

1.3. Food security and obesity

Food insecurity may play a role in risk of obesity for those identifying
as Mexican American (Guendelman et al., 2013), and gender differences in obesity may be linked to diet (Wells et al., 2012). A qualitative study by Papan and Clow (2015) in Canada found women in the study mentioned a reoccurring theme of difficulty affording healthy food, which led to nutritional deprivation and weight gain leading to obesity: the “food insecurity-obesity paradox”. Participants in the study also passionately discussed their decision to forgo a meal or eat last for the sake of their children—what the authors call “maternal deprivation” (Papan & Clow, 2015)—a concept also discussed by Martin and Lippert (2012) when they demonstrated that food-insecure mothers were at a higher risk of having overweight or obesity compared to food secure fathers and childless men and women, indicating an interaction between food security, gender, parenthood, and risk of overweight/obesity.

If food insecurity is an important risk factor, participation in the Supplemental Nutrition Assistance Program (SNAP) and/or Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) program could reduce the risk of overweight and obesity by reducing food insecurity. Studies suggest that SNAP either has no impact on obesity (Gunderson, 2013) or that greater SNAP benefits (in households with school-aged children) are associated with decreases in BMI and the likelihood of obesity (Almada & Tchernich, 2016). Most studies of WIC and obesity have focused on childhood obesity, but WIC comes with nutrition education that may help mothers with healthy eating (Koleilat et al., 2017). Notably, WIC is also available to income-eligible immigrants regardless of time in the U.S. or documented status (Bitler et al., 2021).

1.4. Contributions

Expanding from prior literature, we have three novel contributions in this study: 1. We characterize sex differences in risk of overweight/obesity among those identifying as Mexican American using recent waves of the NHANES; 2. We triangulate three measures of overweight/obesity to understand risks—BMI (the traditional measure in the literature); waist circumference; and percent body fat—which has rarely been done in the literature—and we test traditional and adjusted cutoff values (with adjusted values derived from a Mexican sample); 3. We assess the possibility of heterogeneity in sex differences by a set of known risk factors, including nativity, education, income by parenthood status, food security, years in the U.S. (for immigrants) and program participation (for low-income individuals).

The population identifying as Mexican-American in the United States has changed over time in ways that may be related to risk of overweight/obesity or sex differences in this outcome. Thus, we provide estimates using the most recent waves of data to characterize current patterns. We focus on those identifying as Mexican American because they are the only Latina/o group with sufficient numbers represented in the NHANES data. Furthermore, they have high rates of certain chronic diseases that are thought to be linked to obesity, including Type II diabetes, dyslipidemia, and non-alcoholic fatty liver disease (Fernandez, 2021). To the extent that weight stigma and racial bias are present in the health care system (Hall et al., 2015; Hart et al., 2020), these factors may also affect those identifying as Mexican-American women differently than those identifying as Mexican-American men due to stereotyping about these groups (e.g., Morales-Alemán et al., 2020).

Most prior research (and official statistics on overweight and obesity) has relied on BMI and its categorization into four or more categories, for example, underweight (BMI<18.5), normal weight (BMI 18.5–24.9), overweight (BMI 25–29.9), and obese (BMI 30+) (CDC, 2021a). This is a potentially major flaw for a few reasons. First, BMI is a poor indicator of “fatness” for individuals with a large muscle mass, and at the same BMI some groups have more fat on average than others (e.g., women vs. men, Whites vs. Blacks) (CDC, 2021a). Second, high BMI is a less-than-perfect predictor of mortality, Type II diabetes, heart disease, and other diseases (Heymsfield et al., 2016; Misra, 2015). Third, there has been a growing critique of the racist and sexist origins of the BMI measure among scholars and journalists (Hughes, 2013; Jackson-Gibson, 2021; McPhillips, 2020; Nuttall, 2015; Saguy, 2013; Stern, 2021; Strings, 2019). Therefore, in an effort to both build upon prior research and expand the literature in the face of these critiques, we leverage two additional measures: waist circumference (which has long been available in NHANES) and percent body fat. To the extent that obesity is tied to chronic health outcomes, it appears to be the case that central fat or excess adipose tissue is to blame, which are better proxied with waist circumference and percent body fat than BMI (Tutunchi et al., 2020). These measures are available in more recent years through the examination component of NHANES. Furthermore, we consider traditional cutoff values for these measures along with cutoff values proposed by Macias et al. (2014) in their study of obesity and metabolic disease in the Mexican population. The cutoff values in the latter paper were empirically derived based on risk of metabolic disease.

Finally, as described above, factors such as nativity, SES, and time in the United States may mediate or moderate the relationship between sex and risk of overweight/obesity, and they are reflective of interlocking identities in the United States. We operationalize aspects of these intersectional identities using interaction terms in our models. For those identifying as Mexican American in particular, challenges in explaining sex disparities may arise in part from analysts combining those identifying as Mexican-American immigrants with those identifying as U.S.-born Mexican Americans. Researchers have shown differences in rates of overweight and obesity by nativity, with rates usually higher among those identifying as native-born Mexican Americans compared to those identifying as foreign-born Mexican Americans (Barcenas et al., 2007; Guendelman et al., 2011), using NHANES data from the early 2000s, found gender differences between immigrants and their U.S.-born counterparts; immigrant women had higher reported BMI compared to their U.S.-born counterparts while immigrant men had lower reported BMI compared to their U.S.-born counterparts. Thus, we test for potential heterogeneity across nativity and the other factors discussed above, including education, income by parenthood status, food security, years in the U.S., and program participation. Because those identifying as female experience greater weight stigma, structural disadvantages, and often, negative interactions with the health care system when they are categorized as overweight or obese, if all measures of body composition that we test demonstrate sex differences to the disadvantage of females, one possible implication is that all common body composition measures exacerbate sex differences in weight stigma.

2. Materials and methods

We use data from the 2011–2018 NHANES (Centers for Disease Control and Prevention (CDC). National Center for Health Statistics (NCHS), 2011) waves for two reasons: 1. These are the most recent waves, and 2. These waves include all of the outcome measures. NHANES is an annual survey of the non-institutionalized civilian resident population of the United States. An average of 5000 individuals are surveyed every year with oversampling of those identifying as Mexican American. A multistage probability sampling design was used by NHANES staff to select a nationally representative sample of the civilian population of the United States. Data were collected through both an in-person interview and physical examination. Our sample is restricted to those identifying as Mexican American, ages 18 and up. The final sample size consists of 1603 individuals identifying as Mexican Americans, 890 of whom identify as immigrants.

2.1. Dependent variables

For each set of outcome measures we estimate a group of models using traditional cutoff values and a group using adjusted values derived from a recent sample of Mexicans (Macias et al., 2014). The first measure to proxy for overweight/obesity is a categorical measure of BMI. We initially use the standard cutoffs for BMI: less than 25 for normal weight,
25–29.9 for overweight, and 30 or higher for obese (CDC, 2021b), combining overweight and obese (=1) versus normal weight (=0). Research in the Mexican sample suggested that certain metabolic health concerns increase in prevalence at a BMI of 26.7 (Macias et al., 2014), so we also test an adjusted cutoff of 26.7 as an indicator of overweight/obese (=1) compared to normal weight (=0).

The second measure to proxy for overweight/obesity is waist circumference. The cutoffs for high waist circumference are less fully established in the literature, but commonly a value of 35 inches or more (88.9 cm) for women and 40 inches (101.6 cm) or more for men is considered a health risk, as it is one factor in the determination of metabolic syndrome (Grundy et al., 2005). In their sample of Mexicans, Macias et al. (2014) found increasing risk of metabolic disease at 90 cm for women (roughly the same as the traditional cutoff) and at 93 cm for men (considerably less than the traditional cutoff). High waist circumference, as an indicator of overweight/obesity, is defined as a binary variable, comparing high waist circumference (=1) to non-high waist circumference (=0), with high waist circumference derived from the relevant gender-specific cutoff values.

The third measure to proxy for overweight/obesity is percent body fat from the DXA scans conducted as part of the examination study. Traditional cutoffs are more poorly established in the literature, with cutoffs of 32% for women and 25% for men in some studies (Obesity Medicine Association, 2016). Macias et al. (2014) demonstrated increased risk of metabolic conditions at 30% body fat for men and 44% body fat for women—percentages considerably higher than more traditional cutoffs. Thus, we test both sets of gender-specific cutoffs as indicators of overweight/obese (=1) vs. normal weight (=0). Table 1 shows the considerable variation in categorization that occurs across different measures, reinforcing the importance of estimating risk of overweight/obesity using multiple strategies.

### 2.2. Independent and control variables

Gender is measured using the NHANES “RIAGENDR”, which dichotomizes participants as male or female. Of note, NHANES uses the term “gender” to describe what is actually the binary sex of the participant and does not identify those with no gender, transgender, and nonbinary identities. In our study we use this sex variable as a proxy for gender and coded it as female = 1 and male = 0. Years of age is measured continuously. Partnership status is a binary variable, following Wilson’s (2012) finding that the gendered risk of obesity varied by marital status: = 1 if the respondent is living with a spouse or partner and = 0 for other marital statuses. Food insecurity, identified as important by Guendelman et al. (2011) and Martin and Lippert (2012) is included as a categorical variable. Respondents are coded as 1–4 using the standard categories: = 1 for fully food secure, = 2 for marginally food secure, = 3 for low food security, and = 4 for very low food security. Given the potential importance of nativity for body composition (Murillo et al., 2015), we include it as a discrete variable with = 1 indicating foreign born and = 0 indicating U.S. born. Although previous research indicated 12 years of schooling was most important for the gendered risk of obesity (Ljungvall & Zimmerman, 2012), here we study education as a discrete variable with five categories to better capture the potential spectrum of educational differences: less than high school (less than 9th grade), some high school, high school graduate/GED, some college, and college or more. Income by parenthood status represents income level and parenthood status in a single categorical variable, drawing on recent research examining risk of obesity for mothers (Gough et al., 2019). Those with a moderate/upper income have an income to poverty ratio greater than or equal to 1.8 whereas those with low income have an income to poverty ratio less than 1.8. The variable has four categories: = 0 for moderate/upper income with no children; = 1 for moderate/upper income with children; = 2 for low income without children; and = 3 for low income with children. Years spent in the United States is a binary variable with immigrants separated into groups that spent less than 10 years and more than 10 years in the United States, consistent with Murillo et al. (2015). Because participation in SNAP/WIC may provide access to healthy food, nutritional education, and have subsequent effects on risk of obesity (Almada & Tchernis, 2016; Koleilat et al., 2017), we include an indicator of participation = 1 if the household received SNAP or WIC benefits and = 0 if the household did not receive these benefits. A control for the presence of children was initially considered but was not correlated with the outcomes.

### 2.3. Analytic strategy

With the dependent variables all coded as 0/1 we estimated binary logistic regression models. All models include the following independent variables: sex, age, and partnership status. Model 1 includes these three variables. Model 2 assesses the intersectional identities of gender and nativity, including an interaction between sex and nativity. Model 3 tests for heterogeneity by education with an interaction between sex and education. Model 4 examines the intersectional identity of low-income parenting, including an interaction between sex and income by parenthood status. Model 5 assesses the intersectional identity of being a food insecure female, including an interaction between sex and food security. Model 6 is limited to the immigrant subsample and assesses heterogeneity based on length of time in the U.S. using an interaction between sex and time in the U.S. Finally, Model 7 is limited to the low-income sample and estimates whether there is an interactive relationship between sex and participation in SNAP/WIC.

All models are implemented in Stata 16 using the procedures for complex survey sample data that incorporate the NHANES weights, PSU, and strata measures.

### 3. Results and discussion

Descriptive statistics are shown in Table 2. A little less than half of the sample identifies as female, and the majority of the sample falls into the high BMI, high waist circumference, and high percent body fat categories when using traditional cutoffs. With the adjusted cutoffs the percentages are a bit lower for high BMI and much lower for high percent body fat. The majority of this sample identifies as foreign born. Education and income are relatively low, and only about half of the sample is fully food secure. Of the immigrants in the sample 19% have been in the United States fewer than 10 years. Of those eligible for SNAP or WIC, about 85% participated in one of the programs in the prior year.

| Variables          | Females (%) | Males (%) |
|--------------------|-------------|-----------|
| BMI                | Traditional (=25) | 78.64% | 82.16% |
|                    | (921)       | (888)    |
|                    | Adjusted (=26.7) | 68.79% | 71.26% |
|                    | (805)       | (767)    |
| Waist Circumference | Traditional (=88.9 cm (F)) or 101.6 cm (M)) | 71.04% | 46.92% |
|                    | (805)       | (488)    |
|                    | Adjusted (=90 cm (F) or 93 cm (M)) | 68.77% | 71.35% |
|                    | (774)       | (752)    |
| Body Fat Percentage | Traditional (=32% (F) or 25% (M)) | 91.95% | 74.91% |
|                    | (831)       | (672)    |
|                    | Adjusted (=44% (F) or 30% (M)) | 26.66% | 38.38% |
|                    | (247)       | (341)    |
security, time in the United States, or SNAP/WIC receipt.

Results for models predicting high waist circumference are shown in Table 4. Here we see rather large differences between the models using the traditional and adjusted cutoff values. In models with adjusted cutoffs, there is no evidence of sex differences. Conversely, in all but one model using the traditional cutoff, those identifying as female have about 40% higher odds of high waist circumference compared to those identifying as male. For example, in Model 1, using the traditional cutoff, those identifying as female have 3.2 times the odds of high percent body fat compared to those identifying as male, but using the adjusted cutoff, they have about 40% higher odds.

Finally, results for models predicting high percent body fat are shown in Table 5. The odds ratios for those identifying as female are very different using the traditional cutoff versus the adjusted cutoff; using the traditional cutoff individuals identifying as female have much higher odds of high waist circumference compared to those identifying as male. For example, in Model 1, those identifying as female have 4 times the odds of high percent body fat compared to those identifying as male, but using the adjusted cutoff, they have about 40% higher odds.

### Table 2
Descriptive statistics for full analytic, immigrant, and SNAP/WIC-eligible samples.

|                          | Mean (SE) or Proportion | Full Sample (N = 1603) | Immigrant Sample (N = 890) | SNAP/WIC-Eligible Sample (N = 508) |
|--------------------------|-------------------------|------------------------|----------------------------|----------------------------------|
| **Female**               |                         |                        |                            |                                  |
| Age                      | 35.62 (0.33)            | 37.96 (0.32)           | 34.50 (0.45)               |
| Partnered                | 0.68                    | 0.76                   | 0.65                       |
| High BMI—Traditional     | 0.80                    | 0.83                   | 0.80                       |
| High BMI—Adjusted        | 0.69                    | 0.71                   | 0.69                       |
| High Waist               | 0.57                    | 0.57                   | 0.56                       |
| Circumference—Traditional| 0.69                    | 0.72                   | 0.68                       |
| **High Percent Body**    |                         |                        |                            |                                  |
| Fat—Traditional          | 0.33                    | 0.29                   | 0.33                       |
| **Immigrant**            | 0.55                    |                        |                            |                                  |
| **Education**            |                         |                        |                            |                                  |
| Less than High School    | 0.19                    | 0.31                   | 0.24                       |
| Some High School         | 0.21                    | 0.24                   | 0.24                       |
| High School              | 0.25                    | 0.25                   | 0.27                       |
| Some College             | 0.25                    | 0.14                   | 0.21                       |
| College or More          | 0.10                    | 0.06                   | 0.04                       |
| Income X Parenthood      |                         |                        |                            |                                  |
| Moderate/Upper Income, Non-Parent | 0.21 | 0.13 |                       |
| Moderate/Upper Income, Parent | 0.22 | 0.18 |                       |
| Low Income, Non-Parent   | 0.12                    | 0.10                   | 0.22                       |
| Low Income, Parent       | 0.45                    | 0.58                   | 0.78                       |
| Food Security            |                         |                        |                            |                                  |
| Fully Food Secure        | 0.51                    | 0.45                   | 0.35                       |
| Marginally Food Secure   | 0.18                    | 0.20                   | 0.20                       |
| Low Food Security        | 0.21                    | 0.26                   | 0.29                       |
| Very Low Food Security   | 0.10                    | 0.09                   | 0.16                       |
| Less than 10 Years in the United States |          |                        |                            |                                  |
| Participation in SNAP/WIC|                         |                        |                            | 0.85                             |

**Notes:** All descriptive statistics are survey weighted using NHANES weights, PSU, and strata.

### Table 3
Results from Logistic Regression Models Predicting High BMI using Traditional Cutoffs and Adjusted Cutoffs.

|                          | Traditional Cutoff | Adjusted Cutoff |
|--------------------------|-------------------|-----------------|
| **Model 1. (N=1603)**    |                   |                 |
| Female                   | 0.81 (0.58, 1.12) | 0.87 (0.65, 1.18) |
| Age                      | 1.04 (1.03, 1.06) | 1.03 (1.02, 1.04) |
| Partnered                | 1.50 (1.05, 2.13) | 1.39 (1.09, 1.79) |
| Intercept                | 0.87 (0.49, 1.55) | 0.81 (0.50, 1.33) |
| **Model 2. (N=1603)**    |                   |                 |
| Female                   | 0.82 (0.51, 1.32) | 0.85 (0.55, 1.46) |
| Immigrant                | 1.02 (0.66, 1.56) | 0.92 (0.58, 1.46) |
| Female X Immigrant       | 0.97 (0.52, 1.83) | 1.04 (0.58, 1.87) |
| Age                      | 1.04 (1.03, 1.06) | 1.03 (1.02, 1.04) |
| Partnered                | 1.49 (1.05, 2.14) | 1.41 (1.09, 1.83) |
| Intercept                | 0.87 (0.49, 1.53) | 0.82 (0.51, 1.36) |
| **Model 3. (N=1603)**    |                   |                 |
| Female                   | 1.41 (0.64, 3.08) | 1.04 (0.55, 1.97) |
| Some HS                  | 1.16 (0.59, 2.29) | 1.16 (0.75, 1.81) |
| High School              | 1.24 (0.66, 2.34) | 1.03 (0.56, 1.90) |
| Some College             | 1.19 (0.60, 2.35) | 1.39 (0.77, 2.27) |
| College+                 | 0.99 (0.43, 2.31) | 0.71 (0.36, 1.40) |
| Female X Some HS         | 0.67 (0.26, 1.68) | 0.77 (0.40, 1.47) |
| Female X High School     | 0.56 (0.20, 1.60) | 1.03 (0.42, 2.56) |
| Female X Some College    | 0.47 (0.16, 1.36) | 0.62 (0.27, 1.39) |
| Female X College+        | 0.46 (0.16, 1.32) | 1.05 (0.47, 2.36) |
| Age                      | 1.04 (1.03, 1.06) | 1.03 (1.02, 1.04) |
| Partnered                | 1.51 (1.06, 2.16) | 1.42 (1.10, 1.84) |
| Intercept                | 0.79 (0.36, 1.72) | 0.72 (0.37, 1.38) |
| **Model 4. (N=1,413)**   |                   |                 |
| Female                   | 0.64 (0.29, 1.43) | 0.69 (0.35, 1.34) |
| Mod/Upper Income Parent  | 1.19 (0.41, 3.47) | 0.98 (0.42, 2.30) |
| Low-Inc. Non-Parent      | 0.88 (0.45, 1.74) | 0.96 (0.47, 1.98) |
| Low-Inc. Parent          | 1.17 (0.68, 2.04) | 0.91 (0.53, 1.56) |
| Female X Mod/Upper Inc. Parent | 0.97 (0.29, 3.29) | 1.04 (0.40, 2.75) |
| Female X Low-Inc. Non-Parent | 1.29 (0.40, 2.96) | 1.14 (0.44, 2.96) |
| Female X Low-Inc Parent  | 1.55 (0.65, 3.71) | 1.63 (0.75, 3.55) |
| Age                      | 1.05 (1.03, 1.06) | 1.03 (1.02, 1.04) |
| Partnered                | 1.52 (0.96, 2.39) | 1.36 (0.99, 1.87) |
| Intercept                | 0.74 (0.34, 1.61) | 0.84 (0.43, 1.66) |
| **Model 5. (N=1,573)**   |                   |                 |
| Female                   | 0.84 (0.54, 1.31) | 0.77 (0.51, 1.16) |
| Marginally Food Secure   | 0.53 (0.53)       | 0.78 (0.53)       |

(continued on next page)
Table 3 (continued)

Table 4

| Model 1. (N=1,603) | Traditional Cutoff | Adjusted Cutoff |
|---------------------|--------------------|-----------------|
| OR (CI) | p-value | OR (CI) | p-value |
| Female | 3.20 (2.47, 4.15) | <0.001 | 0.88 (0.63, 1.24) | 0.46 |
| Age | 1.04 (1.02, 1.05) | <0.001 | 1.04 (1.03, 1.05) | <0.001 |
| Partnered | 1.27 (0.99, 1.62) | 0.06 | 1.58 (1.19, 2.12) | 0.002 |
| Intercept | 0.21 (0.12, 0.34) | <0.001 | 0.50 (0.30, 0.86) | 0.01 |

| Model 2. (N=1,603) | Traditional Cutoff | Adjusted Cutoff |
|---------------------|--------------------|-----------------|
| OR (CI) | p-value | OR (CI) | p-value |
| Female | 2.40 (1.62, 3.54) | <0.001 | 0.83 (0.53, 1.30) | 0.41 |
| Immigrant | 0.66 (0.46, 0.95) | 0.03 | 0.89 (0.60, 1.21) | 0.55 |
| Female X Immigrant | 1.66 (0.97, 2.81) | 0.06 | 1.11 (0.65, 1.91) | 0.69 |
| Age | 1.04 (1.02, 1.05) | <0.001 | 1.04 (1.03, 1.05) | <0.001 |
| Partnered | 1.34 (1.05, 1.72) | 0.02 | 1.61 (1.20, 2.17) | 0.002 |
| Intercept | 0.24 (0.14, 0.41) | <0.001 | 0.53 (0.30, 0.92) | 0.03 |

| Model 3. (N=1,603) | Traditional Cutoff | Adjusted Cutoff |
|---------------------|--------------------|-----------------|
| OR (CI) | p-value | OR (CI) | p-value |
| Female | 4.29 (2.53, 7.28) | <0.001 | 0.95 (0.51, 1.77) | 0.87 |
| Some HS | 1.04 (0.66, 1.64) | 0.86 | 1.10 (0.68, 1.87) | 0.70 |
| High School | 1.49 (0.91, 2.45) | 0.11 | 1.31 (0.72, 2.35) | 0.37 |
| Some College | 1.46 (0.92, 2.33) | 0.11 | 1.07 (0.68, 1.78) | 0.78 |
| College+ | 0.74 (0.40, 1.35) | 0.32 | 0.87 (0.45, 1.68) | 0.66 |
| Female X Some HS | 1.20 (0.58, 2.47) | 0.61 | 1.17 (0.55, 2.49) | 0.67 |
| Female X High School | 0.60 (0.31, 1.17) | 0.13 | 0.85 (0.40, 1.87) | 0.67 |
| Female X Some College | 0.53 (0.24, 1.17) | 0.11 | 0.88 (0.41, 1.88) | 0.73 |
| Female X College+ | 0.88 (0.36, 2.16) | 0.77 | 0.87 (0.35, 2.16) | 0.77 |
| Age | 1.04 (1.02, 1.05) | <0.001 | 1.04 (1.03, 1.05) | <0.001 |
| Partnered | 1.30 (1.01, 1.67) | 0.04 | 1.58 (1.19, 2.11) | 0.002 |
| Intercept | 0.16 (0.08, 0.32) | <0.001 | 0.45 (0.23, 0.82) | 0.03 |

| Model 4. (N=1,413) | Traditional Cutoff | Adjusted Cutoff |
|---------------------|--------------------|-----------------|
| OR (CI) | p-value | OR (CI) | p-value |
| Female | 2.96 (1.39, 6.31) | 0.006 | 0.80 (0.41, 1.56) | 0.50 |
| Mod/Upper Income Parent | 1.01 (0.51, 1.97) | 0.99 | 1.48 (0.72, 3.09) | 0.28 |
| Low-Inc. Non-Parent | 0.97 (0.52, 1.82) | 0.92 | 1.21 (0.63, 2.29) | 0.53 |
| Low-Inc. Parent | 1.01 (0.67, 1.53) | 0.95 | 1.03 (0.68, 1.57) | 0.87 |
| Female X Mod/Upper Inc. Parent | 1.07 (0.43, 2.66) | 0.88 | 0.79 (0.35, 1.75) | 0.53 |
| Female X Low-Inc. Non-Parent | 0.91 (0.33, 2.50) | 0.86 | 1.01 (0.40, 2.56) | 0.99 |
| Female X Low-Inc Parent | 1.17 (0.52, 2.63) | 0.71 | 1.32 (0.65, 2.69) | 0.44 |
| Age | 1.03 (1.02, 1.05) | <0.001 | 1.04 (1.03, 1.05) | <0.001 |
| Partnered | 1.20 (0.99, 1.50) | 0.22 | 1.49 (1.07, 2.07) | 0.04 |
| Intercept | 0.22 (0.11, 0.44) | <0.001 | 0.47 (0.23, 0.96) | 0.04 |
| Model 5. (N=1,573) | Traditional Cutoff | Adjusted Cutoff |
|---------------------|--------------------|-----------------|
| OR (CI) | p-value | OR (CI) | p-value |
| Female | 3.02 (1.95, 4.69) | <0.001 | 0.88 (0.55, 1.39) | 0.57 |
| Marginally Food Secure | 0.48 (0.26, 0.87) | 0.03 | 0.77 (0.39, 1.54) | 0.44 |

Notes: All models are survey weighted using NHANES weights, PSU, and strata. Bolded numbers are odds ratios with confidence intervals for which the p-value is less than 0.05.

lower odds. A similar pattern is seen in Models 2, 3, 5, and 6. As in the prior models, age is generally positively associated with odds of high percent body fat, and in a few models this is also true for being partnered. There is one significant interaction in Model 3 using the traditional cutoffs: compared to those identifying as female with less than a 9th grade education, individuals identifying as female with some college have much lower odds of high percent body fat.

Overall, the findings were mixed. In this sample of individuals identifying as Mexican American, we found no evidence of sex differences in risk of overweight/obesity using a BMI-based measure (either using traditional or adjusted cutoff values). For high waist circumference we did find large sex differences, using traditional cutoff values, with those identifying as female having much higher odds but no significant differences using the adjusted cutoffs. Since the traditional and adjusted cutoff values for women are nearly identical, this difference between models may be attributable to men. The traditional cutoff value for men for high waist circumference is larger than the adjusted cutoff value, such that a higher percentage of men have a high waist circumference using the adjusted measure (73% vs. 47%). Thus, using a more conservative cutoff for high waist circumference for men appears to lead to the sex difference in high waist circumference. For body fat we
also found large sex differences. In this case, with the traditional cutoffs we see those identifying as female having much higher odds of high percent body fat, whereas in the adjusted model we see much lower odds of high percent body fat. The adjusted percent body fat cutoff for women is considerably higher than the traditional cutoff value, such that a much lower percentage of those identifying as female have high percent body fat than when measured with the traditional cutoff (27% vs. 92%). The adjusted cutoff is also higher for those identifying as male, and a lower percentage of those identifying as male have high percent body fat than when measured with the traditional cutoff (9% vs. 17%).

The results demonstrate that traditional cutoff values categorize a large proportion of those identifying as female in the sample as obese, a result that implies such measures may exacerbate existing sex differences in weight stigma.
Somewhat surprisingly, we see little evidence of heterogeneity. With regard to the lack of heterogeneity by immigration status, less than 20% of the sample has been in the United States for fewer than 10 years. Given prior research suggesting that acculturation and structural inequality experienced by immigrants increase over time, the majority of the immigrant sample may already be more similar to individuals identifying as U.S.-born Mexican Americans than recent immigrants (Murillo et al., 2015; Viruell-Fuentes et al., 2012). Thus, the salient social status may be as a Latina/o individual more than immigrant per se. In terms of socioeconomic status and program participation, we suspect the overall disadvantaged status of the sample plays a role by reducing variation; nearly 60% of the sample is low income, and nearly 50% is at least marginally food insecure. Additionally, of the low-income sample, participation in SNAP or WIC is very high, at 85%. Thus, program participation may buffer the effects of low income in the sample overall. We see only a small amount of heterogeneity by education, but prior research demonstrated a greater risk only for those with less than 12 years of education (Ljungvall & Zimmerman, 2012). In sum, although there are some important sex differences in outcomes, there is little evidence that these differences vary by nativity, income, or education. This study has a few limitations. First, the sample size is modest. Nonetheless, despite the modest sample size, there is sufficient variation to assess the research question. Second, we recognize that the use of NHANES’ gender variable conflates gender identity and sex, and excludes the identification of those who do not fall into the male/female categories. Third, only the traditional cutoff values for BMI (and to a lesser extent, waist circumference) are well-established in the literature. There is more variation in the literature for the other measures. However, comparing traditional cutoff values with the alternatives proposed in the Macias et al. (2014) study allows us to demonstrate the critical importance of testing different cutoff values before drawing conclusions. Finally, we attempted to operationalize our intersectional framework through the use of interaction terms, but this is an imperfect solution. In particular, non-significant interaction terms do not necessarily imply a lack of intersectionality, and this is especially true for logistic regression models, compared to linear regression (Bauer, 2014).

4. Conclusions

The aims of the study were three-fold: 1. To characterize sex differences in risk of overweight/obesity among those identifying as Mexican American using recent waves of the NHANES; 2. To triangulate three different measures of overweight/obesity to understand risks—BMI (the traditional measure in the literature); waist circumference; and percent body fat—and test traditional and adjusted cutoff values; and 3. To assess the possibility of heterogeneity in sex differences by nativity, education, income by parenthood status, food security, years in the U.S. (for immigrants) and program participation (for low-income individuals).

Although the literature suggests the potential for heterogeneity in gender differences across various characteristics, we find only a single instance of a significant interaction for education. Rather, sex differences appear to be quite stable across various demographic and economic characteristics in this sample. We found minimal evidence of intersectionality, as proxied by interaction terms, but the existing sex differences in the results suggest that individuals identifying as Mexican-American women and men may potentially experience different exposure to weight stigma (and possibly chronic disease) as a result of differences in waist circumference and percent body fat. However, as noted in the limitations, the absence of statistically significant interaction terms does not imply that intersectionality does not matter.

The choice of cutoff values and different methods of proxying for overweight/obesity (BMI vs. waist circumference vs. percent body fat) are crucial for determining whether sex differences are present in this sample. We do not see sex differences with BMI, but we do for waist circumference and percent body fat. Thus, the results demonstrate the limitations of relying on a single indicator of overweight or obesity (such as BMI, which is widely used in the literature), and the potential limitations of applying one-size-fits-all cutoff values to diverse groups.

In this study we focused on how social factors (e.g., education, nativity, and income) might interact with sex in ways that are related to risk of obesity, rather than focusing on obesity status and health outcomes. Our results concur with other recent studies demonstrating limitations to BMI as an indicator of overweight and obesity. Further, given the wide variation in sex differences across measures and cutoffs, existing measures and cutoff values to proxy for overweight and obesity appear to be quite arbitrary. Additional research is needed to determine whether any of these measures are useful predictors of chronic disease, after accounting for health behaviors such as engaging in physical activity, because many prior studies have seemingly made assumptions about health behaviors based on BMI (Hart et al., 2020, p. 4). We suspect, based on growing evidence, that these measures will have limited utility. Conversely, the experience of weight stigma is very real (Sobnack, 2014; Hart et al., 2020), and using arbitrary cutoff values may increase exposure to weight stigma, compounding racial and gender bias already experienced by many who identify as female in the health care system (Giciurkaitė & Perry, 2018; Lewis et al., 2016). We argue for a
move away from a focus on measuring overweight and obesity toward the HAES framework to emphasize health-promoting behaviors. Furthermore, we suggest that efforts be taken to reduce weight stigma across institutional settings because of its harmful effects on physical and mental well-being.

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Contributions

Margaret Gough Courtney: Conceptualization; Formal analysis; Methodology; Project administration; Supervision; Writing - original draft; Writing - review & editing. Alyssa Carroll: Conceptualization; Writing – original draft; Writing – review & editing.

Ethical statement

This deidentified, secondary data research was deemed Not Human Subjects Research by the University of La Verne Institutional Review Board (IRB). The original data collection followed applicable human subjects research protections laws and obtained IRB approval and informed consent (for more information on informed consent and IRB process see: NHANES 2011–2012 Brochures and Consent Documents (https://www.cdc.gov/nchs/nhanes/continuousnhanes/documents.aspx?Cycle=2011-2012). NHANES 2013–2014 Brochures and Consent Documents (https://www.cdc.gov/nchs/nhanes/continuousnhanes/documents.aspx?Cycle=2013-2014). NHANES 2015–2016 Brochures and Consent Documents (https://www.cdc.gov/nchs/nhanes/continuousnhanes/documents.aspx?Cycle=2015-2016). NHANES 2017–2018 Brochures and Consent Documents (https://www.cdc.gov/nchs/nhanes/continuousnhanes/documents.aspx?Cycle=2017-2018)).

Declaration of competing interest

None.

Data availability

Data will be made available on request.

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