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Durational and generational differences in Mexican immigrant obesity: Is acculturation the explanation?

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Abstract

Using the Los Angeles Family and Neighborhood Survey (L.A.FANS-2; $n = 1610$), we explore the link between Mexican immigrant acculturation, diet, exercise and obesity. We distinguish Mexican immigrants and 2nd generation Mexicans from 3rd+ generation whites, blacks and Mexicans. First, we examine variation in social and linguistic measures by race/ethnicity, duration of residence and immigrant generation. Second, we consider the association between acculturation, diet and exercise. Third, we evaluate the degree to which acculturation, diet, exercise, and socioeconomic status explain the association between race/ethnicity, immigrant exposure to the US (duration since immigration/generation), and adult obesity. Among immigrants, we find a clear relationship between acculturation measures, exposure to the US, and obesity-related behaviors (diet and exercise). However, the acculturation measures do not clearly account for the link between adult obesity, immigrant duration and generation, and race/ethnicity.

Keywords

Immigration; Health; Acculturation; Obesity; USA; Mexican; Diet; Exercise

Introduction

In the United States, Latino immigrants often have the same or better health behavior and outcomes as non-Hispanic whites¹ despite lower average socioeconomic status, but this advantage is weaker for many health outcomes and behaviors (e.g., nutrition, exercise, substance abuse, and smoking) the longer immigrants remain in the US. Similarly, 2nd and 3rd generation immigrants often fare more poorly than first generation Latino immigrants (Carter-Pokras et al., 2008; Cho, Frisbie, Hummer, & Rogers, 2004; Finch, Do, Frank, & Seeman, 2009; Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005; Lopez-Gonzalez, Aravena, & Hummer, 2005; Vega, Rodríguez, & Gruskin, 2009). On the other hand, some health outcomes and behaviors (e.g., the use of health care and self-perceptions of health) for Latinos appear to *improve* with duration in the US and across generations (Lara et al., 2005).

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Appendix A. Supplementary material

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¹In this paper, we use Latino and Hispanic interchangeably, white to refer to “non-Hispanic white” and black or African American to refer to “non-Hispanic black.”

Although immigrant self-selection and data limitations may account for part of the pattern described above (Finch et al., 2009; Palloni & Arias, 2004; Rubalcava, Teruel, Thomas, & Goldman, 2008), the most common explanation in the public health literature is “acculturation.” The acculturation literature suggests that: (a) the process of adapting to a new culture itself creates significant stress that leads to poorer health and health behaviors (Finch & Vega, 2003) and/or (b) adaptation to US culture, in particular, leads to poorer health behavior and outcomes because it involves abandonment of beneficial traditional behavior (e.g., fiber-rich diet, familism) and adoption of newer, more negative behavior (e.g., consuming high calorie processed foods, individualistic orientation) (Lara et al., 2005; Zambrana & Carter-Pokras, 2010).

The public health community’s broad acceptance of acculturation as the primary cause of Latino health patterns has had important effects on health policy and programs. Specifically, it has led to interventions encouraging Latino immigrants to retain positive “traditional” health behaviors and to develop a bicultural life style (Bacallao & Smokowski, 2005; Martínez & Eddy, 2005) and, more generally, to an emphasis on “cultural competency” in public health and medicine (Lara et al., 2005; Zambrana & Carter-Pokras, 2010).

Recently, however, the acculturation literature has been strongly criticized (Carter-Pokras et al., 2008; Hunt, Schneider, & Comer, 2004; Viruell-Fuentes, 2007; Zambrana & Carter-Pokras, 2010). Zambrana and Carter-Pokras (2010) and Hunt et al. (2004) criticize the acculturation literature for failing to take socioeconomic status seriously. Zambrana and Carter-Pokras (2010) argue that the misplaced focus on acculturation has meant that poverty’s crucial role in Latino health and health behavior is often ignored. Lara et al. (2005) criticize the failure to differentiate among Latino subgroups, inadequate measures of acculturation (e.g., language spoken at interview), and limited theoretical grounding in the immigrant integration literature. Abraido-Lanza, Armbrister, Florez, and Aguirre (2006) add that previous research generally compares Latinos with only the white population and fails to consider the racially and ethnically diverse reality of the United States. Many studies also fault the acculturation literature for dependence on out-moded unidimensional models of assimilation, which posit that immigrants abandon their culture of origin and adopt the unified American “core” or mainstream culture – something that many observers argue does not exist.

Obesity’s prevalence among second generation Latinos has made it a focus of much of the empirical work on acculturation (Barrington, Baquero, Borrell, & Crawford, 2009; Bates, Acevedo-Garcia, Alegría, & Krieger, 2008). In this paper, we take a fresh look at Latino obesity patterns by duration in the US and generation and ask whether acculturation accounts for these patterns. We use data from Los Angeles County, California on immigrants and US-born Mexicans in comparison with US-born whites and blacks. Our analysis addresses several of the criticisms of the acculturation literature described above. First, we examine measures of social and linguistic acculturation designed to capture integration into American society, rather than simple proxy measures such as language spoken at interview. Second, our analysis includes measures of income, assets, and educational attainment, which allow us to determine whether relationships typically attributed to acculturation are, instead, a function of social class and poverty. Third, we focus on a single Latino group, the Mexican-origin population, rather than combining Latinos groups with disparate histories and circumstances. We compare the experience of this group with non-immigrants from other groups, both whites and blacks.

Background

For first generation immigrants, duration of residence in the US is typically associated with obesity. A recent review of studies of Mexican-origin adults found that duration is almost always significantly and positively associated with obesity (Oza-Frank & Cunningham, 2010). Results for obesity patterns by immigrant generation are more mixed, perhaps due to variation in length of exposure to the US among the first generation (Oza-Frank & Cunningham, 2010). For example, a longitudinal study of first and second generation Mexican-origin women (15–44) found no significant difference between the two generations (Wingo et al., 2009). For adolescents and children, results vary among studies. Popkin and Udry (1998) found that native-born Hispanic adolescents (ages 13–18) are more than twice as likely to be obese as the first generation. In a cohort of kindergartners, Van Hook and Baker (2010) showed that children of foreign-born parents gained weight more quickly than others. However, Gordon-Larsen, Harris, Ward, and Popkin (2003) found that, for the adolescent Mexican-origin population, the second generation is no more likely to be obese than the first.

Why would duration of time in the US and immigrant generation affect obesity? Two obvious explanations are differences in diet and physical activity patterns. The acculturation literature has emphasized the importance of dietary changes by duration in the US and across generation: increased acculturation is hypothesized to lead to decreased consumption of healthy foods and increased consumption of processed and high fat/sugar foods. Gordon-Larsen et al. (2003) reported that first generation Mexican immigrant adolescents eat more rice, beans, fruit, and vegetables and less cheese and fast food than 2+ generation Mexican-origin immigrants. Island-born Puerto Ricans and Cubans also consume more fruit and vegetables than their mainland/US-born counterparts. Ayala, Banquero, and Klinger (2008) found no association between Latino fat intake and measures of acculturation (including duration and generation), but found that less acculturated Latinos consume smaller amounts of fast food, snacks, sugar and sugar-sweetened beverages, and more fruit, beans, and rice.

In addition to changes in diet, physical activity levels may decline with longer duration in the US and may be lower for 2nd+ generation Latino immigrants than for first. However, Crespo, Smit, Carter-Pokras, and Andersen (2001) showed that second and higher generation Mexican-origin immigrants are actually *more* likely to participate in regular physical activity, which is consistent with other research (Esparza et al., 2000; Gordon-Larsen et al., 2003). As Crespo et al. (2001) suggested, their findings and those of other studies may be limited because they include only leisure-time activities, whereas Latino immigrants may be quite physically active in the workplace, transportation, and home-making.

A third potential explanation is acculturative stress. Finch, Hummer, Kolody, and Vega (2001) proposed that Latinos, and particularly Mexican-origin immigrants, are often faced with discrimination based on race/ethnicity and immigrant status. This discrimination, in turn, leads to chronic stress and psychophysiological stress responses, which are known to affect health over the long run (McEwen, 1998). Thus, the process of integration into a society that views Mexican-origin immigrants as being of lower status than other social and racial/ethnic groups may itself result in chronic health problems, even if health behaviors remain constant over time and across immigrant generations. Although we examine the association between duration/generation and obesity, we do not explicitly explore the potential role of acculturative stress.

Research questions

In this paper, our overarching goal is to investigate the role of acculturation as an explanation for observed differences in obesity for the Mexican-origin population by duration in the United States and by generation and to compare this population to other race/ethnic and socioeconomic status groups in the US. First, we examine whether measures of social and linguistic acculturation vary by duration in the US, across immigrant generations, and between the Mexican-origin populations and other race/ethnic groups as the acculturation literature suggests. Second, we investigate whether current diet and exercise patterns are associated both with duration and generational status and with level of acculturation. Third, we assess whether obesity increases across immigrant generations and duration of residence, as previous research would suggest. Finally, we determine whether differences in acculturation level and in current diet and exercise account for these observed differences in obesity status across immigrant generation, duration of residence in the US, and race/ethnic groups.

Measuring acculturation

Although many acculturation measures have been developed (Alegria, 2009; Carter-Pokras et al., 2008; Thomson & Hoffman-Goetz, 2009; Zane & Mak, 2003), most studies of acculturation and health do not measure acculturation directly, but instead use duration since immigration or generation. These latter measures capture variation in *exposure* to the US and are often assumed to be adequate proxies for acculturation (Carter-Pokras & Bethune, 2009). However, they do not measure the degree to which a person has integrated into or adapted to American society. In addition, there may also be factors other than acculturation that vary by duration and across generations and affect obesity and health (e.g., aspirations, economic success).

Language use and ability more directly measure acculturation because of the importance of language for social mobility and in daily life outside of ethnic communities. However, simple measures used in many studies (e.g., ability to speak English/Spanish, language spoken at home or during the interview) provide very limited information on linguistic adaptation. Bilingual individuals are often thoroughly integrated into US society and have advantages in job markets such as Los Angeles. Monolingual Spanish-speakers, on the other hand, have less contact outside their ethnic/linguistic community. Monolingual English-speakers are more likely to have contact outside their ethnic/linguistic community, but may, nonetheless, primarily associate with their own community.

In this paper, we employ two measures, derived from the work of Marín and Gamba (1996), that capture the degree of interaction between an individual and (a) linguistically or (b) ethnically similar and/or dissimilar people in daily life. These measures are included for all respondents, regardless of race/ethnicity or immigrant status, to allow us to consider variation in levels of ethnic and linguistic interaction among both immigrants and the US-born.

Data

The Los Angeles Family and Neighborhood Survey (L.A.FANS) is a longitudinal study of individuals, households, and neighborhoods. L.A.FANS-1 included approximately 3000 households in a stratified probability sample of 65 tracts (using 1990 census tract boundaries) in Los Angeles County in 2000 and 2001. Poor neighborhoods and households with children were oversampled (Sastry, Ghosh-Dastidar, Adams, & Pebley, 2006). L.A.FANS-1 interviewed one (randomly selected) adult in each household and the primary caregiver of a (randomly selected) child in households with children (age 17 and younger).

By chance, the randomly selected adult (RSA) and primary caregiver (PCG) could be the same individual. The response rate was 85% for RSAs and 89% for PCGs. L.A.FANS-2 (2006–2008) interviewed panel respondents, including those who had moved to new census tracts, and a sample of new entrants who moved into the 65 sampled tracts between Waves 1 and 2. L.A.FANS was reviewed and approved by the Institutional Review Boards of the University of California Los Angeles, RAND, and RTI International. All respondents provided informed consent.

The analysis is based on L.A.FANS-2 adults (18 years and older) who were interviewed in Los Angeles County.² Our analytic sample includes Mexican-origin respondents (1st, 2nd, and 3rd+ generation) and 3rd+ generation US-born whites and blacks. Previous studies typically compare immigrant groups to whites (Abraido-Lanza, Chao, & Florez, 2005; Hazuda, Braxton, Haffner, & Stern, 1991), implying that whites represent the group to which Latinos will acculturate. In contrast, we compare the health outcomes and behaviors of Mexican-origin immigrants to third and higher generation whites, African Americans, and Mexican Americans.

L.A.FANS-2 interviewed a total of 2291 adult respondents. We excluded 1st and 2nd generation non-Mexican-origin Latino immigrants ($n = 522$) because the sample size was too small to subdivide them both by national origin and immigrant generation. First and 2nd generation white and black immigrants and all respondents who were Asian and of other ethnicities were also excluded because they were too few in number to analyze separately. We also excluded respondents missing information on both measured and self-reported height and weight ($n = 24$) and those missing information on other variables ($n = 128$). Seven additional respondents were excluded who could not be matched to their tract of residence in L.A.FANS-1.

The resulting sample includes 1610 adults ages 18 years or older within 1152 households; there are between one and three adults per household in the sample, with an average of 1.3. As described in the Methods section below, the analysis includes tract level random effects to account for the clustered sample design. These random effects are based on the original 65 tracts from which these respondents were selected. For these tracts, the sample includes between 9 and 29 households per tract with an average of 18. Descriptive statistics, based on weighted data, are shown in Table 1.

Variables

Exposure and acculturation

Immigrant generation is defined as follows: foreign-born immigrants are first generation, US-born individuals with at least one foreign-born parent are second generation, and US-born individuals with no foreign-born parents are third plus (3+) generation. For first generation immigrants, we distinguish between ≤ 15 years and >15 years duration in the US. We combine this information to generate four Mexican-origin immigrant status categories: 1) 1st generation Mexican-origin with ≤ 15 years of residence, 2) 1st generation Mexican-origin with >15 years of residence, 3) 2nd generation Mexican-origin, and 4) 3rd+ generation Mexican-origin. We compare Mexican-origin groups with 3rd+ generation blacks and 3rd+ generation whites. As shown in Table 1, the largest group in the sample is first generation Mexican immigrants ($n = 750$). Despite the long history of Mexican settlement in Southern California, the Mexican-origin sample that is 3rd+ generation is relatively small ($n = 104$), reflecting the large size of recent immigration flows.

²L.A.FANS-2 also interviewed panel respondents who moved out of Los Angeles by telephone, but they are not included in this analysis because only limited data were collected.

Our linguistic and social measures of acculturation are based on Marín et al.'s bi-dimensional acculturation scale (Marín & Gamba, 1996; Marín, Sabogal, Marín, Otero-Sabogal, & Pérez-Stable, 1987). The survey questions can be found in Appendices 1 and 2. Linguistic acculturation includes four questions asked of respondents reporting speaking two (or more) languages: which language the respondent speaks best, which language he/she reads best, which language he/she speaks and reads most often, and which language he/she speaks most often with friends. For bi-lingual English-Spanish speakers, the response categories are: 1) Spanish, 2) Spanish (more frequently or better), 3) Spanish and English equally, 4) English (more frequently or better), and 5) English. Monolingual Spanish-speakers were coded 1 while monolingual English-speakers were coded 5. Those speaking more than two languages were asked about the two they used most often. Using principal components analysis, we combined responses to these four questions into a single linguistic acculturation score (Filmer & Pritchett, 2001). The first factor from the unrotated matrix of the unweighted data captured over 90% of the variance and was standardized to have a mean of 0 and a standard deviation of 1. The resulting range is from -1.11 to 2.98.

The social acculturation question asks respondents whether their close friends are from the same ethnic group as themselves or from other ethnic groups (see Appendix 2). For example, for Latinos, the response categories are 1) all Latinos, 2) more Latinos than non-Latinos, 3) about half Latinos and half non-Latinos, 4) more non-Latinos than Latinos, and 5) all non-Latinos. Our measure is a dichotomous variable combining categories 1 and 2 in one group and 3, 4, and 5 in the other. In other words, we contrast respondents whose close friends are all or mostly of their own ethnic group with those whose friends are not. To the extent that race/ethnic identity represents cultural differences, individuals whose social contacts are mostly within their own race/ethnic group are more likely to be isolated from the behavior and habits of other groups than those with ethnically diverse friends.

As shown in Table 1, first generation immigrants have the lowest average scores on the linguistic acculturation scale while 3rd+ generation whites and blacks have the highest. 3rd+ generation Mexican-origin respondents are much closer to whites and blacks than to other Mexican groups, but are more likely than blacks and whites to use two languages regularly. Blacks and whites are least likely to have friends mostly of their own race/ethnic group and first generation Mexicans are most likely.

Diet and exercise

Our diet and exercise measures focus on the period immediately prior to the interview and do not take account of the longer-term habits that lead to obesity. However, they allow us to test the differences in current behavior for more and less acculturated groups. The survey questions for exercise and diet can be found in Appendices 3 and 4.

L.A.FANS-2 includes the National Health Interview Survey (NHIS) questions on physical activity, which focus on episodes of vigorous physical activity of more than 20 min in the previous week. We sum the number of episodes in each of three categories: housework, work, and leisure. For exercise at work, unemployed individuals are assigned a value of zero. We consider each category separately and also combine the total number of episodes into a single measure. As shown in Table 1, 1st generation immigrants do significantly less leisure-time exercise than 3rd+ generation Mexicans, but the difference in total amount of exercise is not significant.

Our measures of diet count the number of servings of fruit, vegetables, sweetened beverages, and fast food consumed in the previous day. As shown in Table 1, average daily consumption of sweetened drinks and fast food is higher among 3rd+ generation Mexicans relative to the 1st generation (although not all differences are significant) and suggests that

the consumption of sugar and fat by US-born Mexicans generally increases with generation. Consumption of sweetened drinks is also lower among whites relative to 3rd+ generation Mexicans.

Obesity

We measure obesity using a body mass index (BMI) of 30 or greater (WHO, 1995, 2000). For the 179 adults in the sample that were not measured, height and weight were imputed separately. The imputed values were obtained from regression models, estimated on the sample that provided both self-reported and measured height/weight, with self-reported height/weight, age at interview and sex as predictors. An indicator for imputed height or weight is included in all models of obesity. As shown in Table 1, although almost 30% of recent Mexican immigrants are obese, this prevalence is below that of all other groups, especially longer duration Mexican immigrants (42.7%) and blacks (47.7%).

Socioeconomic and demographic variables

We include controls for the sex, age (linear and quadratic terms), education, income, and employment status of the respondent. The mean age of respondents is 39.9 years, which masks large age differences between recent immigrants and subsequent generations. For example, 2nd generation Mexicans average 27.8 years, significantly lower than the 34.2 years for 3rd+ generation Mexican respondents. More than one-quarter of the total sample has not completed high school (26.4%), but that percentage is 60.3% among longer duration Mexican immigrants compared to only 14.3% for 3rd+ generation Mexicans, 6.9% for whites, and 3.8% for blacks.

The income variable is the logarithm of total family income in the previous year. For those that did not respond with an exact value (2% of the analytic sample), unfolding brackets were used to elicit a range of potential values. Respondents were first asked if their family income in the previous year was more, less or approximately \$17,000. For those that affirmed this to be their approximate income, that amount is used. For those that did not, a follow-up question was asked to further bracket the response within one of five possible ranges – (\$0–\$17,000), (\$17,000–\$37,000), (\$37,000–\$72,000), (\$72,000–\$181,000) and (\$181,000+). The mean income from respondents in the sample who reported an exact family income within a range is assigned to those bracketed individuals who selected a particular range. Employment status is a dichotomous measure of whether or not a respondent was employed at the time of the survey.

Methods

Adults who share a home and/or a neighborhood may be more similar to each other than individuals who do not. Coresidence and propinquity may facilitate or constrain certain types of social interactions, thereby violating underlying assumptions of independence of individual observations in the statistical models. To account for this potential correlation at the household and tract level, we employ multi-level random-intercept logistic models (Rabe-Hesketh & Skrondal, 2008). The tract level effect represents the original tract from which the respondent was selected – out of the 65 L.A.FANS tracts (using 1990 boundaries) – since the probability of selection for each individual is based on their association with one of these 65 tracts. Panel respondents from Wave 1 are assigned the tract they lived in at Wave 1, regardless of residence at Wave 2, and “new entrant” respondents sampled at Wave 2 in the 65 L.A.FANS tracts were assigned their Wave 2 tract (see Peterson et al., 2011).

Statisticians disagree about whether sample weights should be used in multivariate models which control for the variables on which the weights are based. We follow Winship and

Radbill's (1994) approach by estimating the multivariate models without weights. Our analysis follows three steps. The first two steps, which separately assess the link between acculturation and 1) immigrant generation, duration of residence, and race/ethnicity and 2) more proximate determinants of weight status (diet and exercise), are described by equation (1):

$$y_{iht} | x_{iht}, z_{ht}, z_t = \beta_0 + \beta_1 x_{iht} + \sigma_{ht} z_{ht} + \sigma_t z_t + \varepsilon_{iht}, \quad (1)$$

where y_{iht} is a continuous measure of acculturation (social or linguistic acculturation score), diet (servings) or exercise (episodes) for respondent i of household h within tract t . The third step, which assesses the link between acculturation and obesity, is described by equation (2),

$$\text{logit}(\Pr\{y_{iht}=1 | x_{iht}, z_{ht}, z_t\}) = \beta_0 + \beta_1 x_{iht} + \sigma_{ht} z_{ht} + \sigma_t z_t, \quad (2)$$

where y_{iht} is a dichotomous measure of obesity for respondent i of household h within tract t . In both equations (1) and (2), x_{iht} is a set of individual characteristics and σ_{ht} and σ_t are random error terms at the household and tract level. The random intercepts vary over households ($z_{ht} \sim N(0,1)$) and tracts ($z_t \sim N(0,1)$) and z_{ht} and z_t are assumed to be independent from each other and across households or tracts. Equations (1) and (2) were estimated using the *xtreg* and *xtmelogit* commands respectively in Stata 11 (StataCorp, 2009).

To assess the need for a multi-level approach, we compared the random-intercept models to the corresponding standard OLS or logit model using a likelihood-ratio χ^2 test. For equation (1), the null hypothesis that both the household and tract random-effect parameters are equal to zero was rejected ($p < 0.10$) for all outcomes except the consumption of fruit, suggesting that a random-intercept model is preferable. For equation (2), the null hypothesis could not be rejected ($p > 0.10$). Although this test is conservative, it suggests that a multi-level approach may not be required for the obesity models. However, we retained the random-intercept approach across all models for consistency.

Results

Acculturation and exposure

Table 2 reports the estimated coefficients and test statistics for the multi-level models assessing the relationship between measures of social and linguistic acculturation and the immigrant generation/duration/race/ethnicity variable. Compared to the newest arrivals, linguistic acculturation for Mexicans increases monotonically across duration of residence and generations. Although Table 1 suggests that 3rd+ generation Mexicans are less likely than whites and blacks to use English exclusively, Table 2 shows that 3rd+ generation Mexicans and whites are not significantly different once socioeconomic status variables are held constant (tests not shown). There is no significant difference in social acculturation by duration of residence for 1st generation immigrants. However, 2nd and especially 3rd+ generation Mexicans are significantly more likely to have ethnically diverse friends relative to recent immigrants. Third and higher generation Mexicans and blacks have virtually identical social acculturation scores, but 3rd+ generation whites are significantly less likely than these two groups (tests not shown) to have ethnically diverse friends, suggesting that whites are more socially isolated within their own race/ethnic group than 3rd+ generation Mexicans and blacks.

Although the difference in social acculturation between recent and earlier 1st generation immigrants is not significant, there is a substantial increase in the coefficients across immigrant generations for Mexicans. For linguistic acculturation, there is a statistically significant increase in coefficients across both immigrant duration and generations. These findings support the assumptions that social and linguistic integration increase with greater exposure to the US context.

Acculturation and exercise

Table 3 reports the estimated coefficients and test statistics for the models assessing the relationship between acculturation and the number of vigorous episodes of exercise in the previous week. Column 1, which includes immigrant generation/duration of residence/race/ethnicity along with controls for age and sex, shows that length of residence of 1st generation immigrants is not significantly associated with leisure-time exercise, but 2nd and 3rd+ generation Mexicans and 3rd+ generation whites are more likely to engage in vigorous leisure-time exercise than recent Mexican immigrants. However, when we add social and linguistic acculturation in column 2, these coefficients are smaller and no longer significant (except for 2nd generation Mexicans at $p < 0.10$); when SES variables are added in column 3, only the estimate for 3rd+ generation Mexicans is significant (at $p < 0.10$). In contrast to leisure-time exercise, longer-term Mexican immigrants report significantly more physical activity at work than more recent immigrants (columns 4 and 5), but this difference is attenuated and is only borderline significant ($p < 0.10$) in the presence of controls for SES (column 6). The effects of SES may reflect the fact that lower-skilled, manual work, which is more common among the less educated and among males, is an important determinant of exercise.

Relative to recent immigrants, 2nd and 3rd+ generation Mexicans whites and blacks report significantly fewer episodes of vigorous housework (column 7). Once linguistic and social acculturation are taken into account (column 8), these differences are no longer significant, suggesting that additional housework among immigrants is associated with their lower levels of facility in and use of English.

The estimates in Table 3 for total physical activity (columns 10–11) reveal that, relative to recent Mexican immigrants, all other Mexican groups are equally likely to participate in some form of exercise and blacks and whites are significantly less likely to do so (column 10). In the presence of controls for acculturation (column 11), differences among the race/ethnic groups lose significance. With the addition of SES variables to the model (column 12) the difference between longer and shorter duration 1st generation Mexican immigrants becomes significant. The coefficients for social acculturation are significant only for leisure-time exercise and indicate that having more ethnically diverse friends is associated with a greater frequency of exercise. The effect of linguistic acculturation is significant only for housework and for all exercise combined (when SES is held constant). We speculate that some respondents understood the housework question to include cleaning other people's houses or buildings for pay. Less facility with English decreases opportunities in the job market and may increase the chances that domestic work is the best employment option.

Acculturation and diet

In Table 4, we examine the association between measures of acculturation and the number of servings consumed in the previous day of fruit, vegetables, sweetened drinks and fast food. More servings of fruit and vegetables generally indicate a healthy diet, and, therefore, a reduced risk of obesity, whereas more servings of the last two items pose a greater risk of obesity.

The findings suggest that the lower consumption of fruits for 2nd and 3rd+ generation Mexicans and for blacks, compared with recent immigrants (column 1), is partly accounted for by measures of social and linguistic acculturation (column 2). In contrast, there is little difference among Mexican-origin respondents by duration of residence or generation for consumption of vegetables (columns 4 and 5). Whites are significantly more likely to eat vegetables while blacks are not significantly different from recent Mexican immigrants. The estimates for socioeconomic variables for both fruits and vegetables imply that greater socioeconomic status generally translates into significantly greater consumption of healthy foods. Once socioeconomic status variables are included (columns 3 and 6), the coefficients on linguistic acculturation increase in absolute magnitude, indicating that, net of income and education, greater linguistic acculturation is associated with fewer servings in the previous day of fruit and vegetables.

Less healthy dietary behaviors (consuming sweetened drinks and fast food) are more common among native-born Mexicans than among 1st generation immigrants, with no differences by recency of immigration (columns 7 and 10). Blacks, but not whites, are also significantly more likely to consume sweetened drinks and fast food than 1st generation Mexican immigrants. However, for both sweetened drinks and fast food, the addition of the acculturation variables (columns 8 and 11) reduces the significance of the race/ethnicity coefficients. Addition of SES variables (column 9) increases the size and significance of the coefficients for 3rd+ generation Mexicans and blacks. In general, higher socioeconomic status is associated with lower levels of consumption of high-sugar beverages, but has little relationship with fast food consumption.

The role of acculturation in obesity

Table 5 reports the estimates from the multi-level logistic regression models assessing the degree to which social and linguistic dimensions of acculturation and SES mediate the association between obesity and duration in the US, generation, and race/ethnicity. The reported values are odds ratios, which can be interpreted as the odds of being obese for a given group relative to 1st generation Mexican immigrants who have lived in the US for 15 years or less.

Overall, the estimates for ethnicity confirm the general findings in the literature: compared with more recent Mexican immigrants, the odds of being obese are significantly higher for immigrants with longer stays in the US, for US-born Mexicans, and for blacks (column 1). The highest prevalence of obesity is found among 2nd generation Mexicans and African Americans, with odds ratios between 2.1 and 2.3. Inclusion of measures of social and linguistic acculturation (column 2), which are statistically significant (at $p < 0.05$ and $p < 0.10$ respectively), *increases* – rather than decreases – the disparities between recent Mexican immigrants and all other groups, with odds ratios as high as 2.5 for 2nd generation Mexicans and 3.1 for blacks. These results indicate that the acculturation measures do not account for the differences by race/ethnicity and immigration duration and generation as the acculturation literature suggests. The estimates change little with the inclusion of SES measures (column 3). Measures of diet and exercise (column 4) are not significantly related to obesity and their inclusion in the models has little effect on the resulting odds ratios by ethnicity and generation.

In order to determine whether the effects of socioeconomic status (income and education) on obesity varied by immigrant status, race/ethnicity or degree of acculturation, we estimated six additional models of obesity (results not shown). Each model included one set of interaction terms in addition to all of the variables shown in column 4 of Table 5: education and income were separately interacted with (1) immigrant status/race/ethnicity; (2) social acculturation; and (3) linguistic acculturation. Chi-square Wald tests for the joint

significance of the interaction terms indicated that the interaction terms were not significant in any of the six models.

Discussion

In this paper, we examine whether acculturation accounts for variations in obesity patterns among the Mexican-origin population by duration in the US and immigrant generation – as the Latino acculturation literature suggests. We also compare Mexican duration and generational groups with 3rd+ generation whites and blacks. A key question was whether we could reproduce the associations reported in the literature between obesity and immigrant duration and generation using L.A.FANS-2 data. Relative to recent 1st generation Mexican immigrants, other Mexican-origin groups are more likely to be obese. The highest likelihood of obesity among Mexican-origin respondents is for the 2nd generation. Blacks are the most likely group in the sample as a whole to be obese, while whites are not significantly different from recent migrants. These findings are consistent with those from previous studies. These results are also robust to controls for socioeconomic status, suggesting that race/ethnicity, duration, and generational differences in obesity are not accounted for by group differences in socioeconomic status as Zambrana and Carter-Pokras (2010) and Hunt et al. (2004) suggest.

The results also show that our acculturation measures vary by duration, generation, and race/ethnicity as the acculturation literature would predict: linguistic acculturation is lowest among 1st generation Mexican immigrants and highest among 3rd+ generation blacks, closely followed by 3rd+ generation Mexicans and whites. The pattern is similar for social acculturation (with the exception of relatively low levels for whites). Furthermore, our findings on dietary variations for the Mexican-origin population by duration and generation are consistent with the acculturation literature: although there are no differences by duration in the US, 2nd and 3rd+ generation Mexicans consume less fruit, more sweetened drinks, and more fast food than the first generation. African Americans are also significantly less likely to consume fruit and more likely to consume sweetened drinks and fast food than the first generation immigrants, whereas whites are significantly more likely to consume vegetables. Measures of social and linguistic acculturation appear to account in part for the differences in fruit, sweetened drinks and fast food consumption.

Given that relatively few previous studies of Latino immigrant acculturation focus on the role of physical activity, our analysis in this area is novel. We find that the associations of duration, generation, and race/ethnicity with physical activity vary by domain. For example, 2nd and 3rd+ generation Mexicans are significantly more likely than recent immigrants to engage in leisure-time activity, but less likely to engage in housework – thus, canceling each other out in terms of total activity. In both cases, the generational effect loses significance when acculturation measures are introduced. Whites are significantly more physically active during leisure-time, but overall both blacks and whites are significantly less likely to be physically active than recent Mexican immigrants. These effects are substantially attenuated when acculturation measures are introduced. Thus, physical activity patterns are associated with duration, generation, and race/ethnicity, but are more complex than diet. The population groups with the least healthy overall exercise patterns are 3rd+ generation whites and blacks. If Mexican immigrant groups are acculturating to the poor health habits of whites and blacks, we would expect levels of physical activity for Mexicans to decline across duration and generation, but this pattern is not apparent from the data.

Does acculturation account for the duration, generation, and race/ethnic differences we observed in obesity in Los Angeles County? Unlike many previous studies, we use indices designed specifically to measure acculturation, rather than proxy measures (e.g., duration

and generation) alone. Although acculturation measures vary among these groups as expected, our results show that inclusion of the acculturation variables in analyses predicting obesity generally does not diminish the size, direction, or significance of duration, generation, and race/ethnic effects on obesity. In fact, including acculturation variables increases the size and significance of some estimates. Thus, the acculturation hypothesis as an explanation for duration and generational differences in obesity among Mexican-origin populations is not supported by our results.

Diet and physical activity also have little effect on the associations between obesity and duration, generation, and race/ethnicity. Moreover, the diet and physical activity variables are not significantly associated with obesity. These results are due in part to our dietary and physical activity measures which focus on a very recent time frame. However, even with substantially better measures, previous studies have found it difficult to quantify the link between diet, physical activity, and body mass index (BMI) (Jonnalagadda et al., 2000; Shephard, 2003; Steptoe & Wikman, 2011; Togo, Osler, Sørensen, & Heitmann, 2001).

Conclusions

The result that our acculturation variables do not account for variations in obesity by race/ethnicity and immigrant duration and generation yields two possible conclusions. The first is that an acculturation process does explain these variations in obesity, but our acculturation measures and methods do not adequately capture the process. Although we substantially improve on most previous research by examining specific elements of acculturation thought to be associated with health behavior change, the acculturation measures we use are far from complete or exhaustive. They reflect the use of English in different contexts and the extent to which individuals' close friends are from other race/ethnic groups. It may be that different aspects of cultural integration – e.g., media exposure, the attitudes and behavior of coworkers and others aside from close friends – are more important. The acculturation process may also be better captured by observing changes in individual immigrants and non-immigrants and their children and grandchildren over time, rather than by comparing groups cross-sectionally.

The second possible conclusion is that acculturation away from traditional healthy habits toward unhealthy US habits is not the reason for the observed changes in obesity by duration and generation for the Mexican-origin population, despite widespread acceptance of this idea in the public health and medical communities. If true, this conclusion would be important, but it clearly requires additional scrutiny with inclusion of more contexts and the exploration of other measures of acculturation. Nonetheless, the results provide an important caution about acculturation hypotheses, underscoring the need for future work to explore other explanations for the patterns observed.

To conclude, we offer an alternative explanation which is consistent with other research on obesity determinants. The duration and generational pattern of obesity observed for Mexican-origin immigrants in the US may result largely from economic factors rather than cultural ones. Specifically, consumption of “American” foods may be driven by their relatively low cost, availability, and other pragmatic concerns, showing little relationship to language fluency and social contacts of the Mexican-origin population; similar arguments may underlie changes in energy expenditure among Mexican-origin immigrants. Ironically, evidence in favor of this hypothesis is the rapidly growing obesity epidemic in Mexico and in other countries (Popkin, 2010; Uauy, Abala, & Kain, 2001). Recent work has shown that overweight/obesity prevalence is no longer lower for foreign-born compared to US-born Mexican-origin youth and, among boys (ages 4–10) and adult males (ages 18–24), it is actually higher (Buttenheim, Pebley, Hsieh, & Goldman, 2011). Obviously, the obesity

epidemic in Mexico cannot be explained by Mexicans in Mexico adopting negative American cultural habits wholesale, although there is evidence of a link between having social ties in the US and obesity in Mexico (Creighton, Goldman, Teruel, & Rubalcava, 2011). Rather, it is likely to be a consequence of the same macro-level forces which have produced the obesity epidemic in the United States and other countries: development and aggressive marketing of convenient, low cost, and often highly caloric foods, agricultural subsidies favoring inexpensive, high calorie foods, and large-scale secular changes in work, lifestyles, and transportation (Harris, Pomeranz, Lobstein, & Brownell, 2009; Nestle, 2007; Wallinga, 2010).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Descriptive statistics (weighted data).

	<u>1st generation Mexican (≤ 15 years)</u>	<u>1st generation Mexican (>15 years)</u>	<u>2nd generation Mexican</u>	<u>3rd+ generation Mexican</u>
	Mean (std. dev.) or %			
Linguistic acculturation (standardized) ^a	−0.89 (0.64) ***	−0.89 (0.59) ***	0.23 (0.52) ***	0.89 (0.39)
Spoken with friends (standardized) ^a	−0.84 (0.67) ***	−0.89 (0.61) ***	0.21 (0.61) ***	0.85 (0.45)
Spoken/read more often (standardized) ^a	−0.86 (0.70) ***	−0.86 (0.66) ***	0.22 (0.55) ***	0.85 (0.41)
Read better (standardized) ^a	−0.90 (0.66) ***	−0.86 (0.66) ***	0.27 (0.54) ***	0.88 (0.33)
Spoken better (standardized) ^a	−0.89 (0.64) ***	−0.89 (0.57) ***	0.21 (0.58) ***	0.89 (0.42)
Social acculturation (%)				
All/most same ethnicity	74.6	80.3	64.2	38.3
Equal/most/all other ethnicity	25.4 ***	19.7 ***	35.8 **	61.8
Education (%)				
Less than high school	45.6 ***	60.3 ***	17.1	14.5
High school/GED	20.5	19.3	22.1	19.2
Some post-secondary	33.9 ***	20.4 ***	60.8	66.3
Log family income (quartiles, %)				
1st	28.8	19.2	36.7	25.8
2nd	33.5 *	30.8 *	24.8	15.9
3rd	22.9	37.5 +	26.4	23.0
4th	14.9 *	12.5 **	12.1 **	35.3
Employment status (%)				
Employed	56.9	62.4	67.4	73.3
Unemployed	43.1 *	37.6	32.6	26.7
Sex (%)				
Female	58.4	51.3	51.0	49.9
Male	41.6	48.7	49.0	50.2
Age	32.06 (1.13)	45.60 (1.11) ***	27.84 (1.02) **	34.16 (1.97)
Obese (%)				

	1st generation Mexican (< 15 years)	1st generation Mexican (>15 years)	2nd generation Mexican	3rd+ generation Mexican
	Mean (std. dev.) or %			
No	70.6	57.3	66.0	66.7
Yes	29.4	42.7	34.0	33.3
Servings of vegetables in previous day	1.34 (0.13)	1.35 (0.08)	1.13 (0.09) *	1.54 (0.14)
Servings of fruit in previous day	1.86 (0.17) +	1.87 (0.10) *	1.36 (0.11)	1.47 (0.15)
Servings of sweetened drinks in previous day	0.75 (0.10) +	1.00 (0.11)	1.35 (0.15)	1.21 (0.23)
Servings of fast food in previous day	0.37 (0.06) +	0.26 (0.04) ***	0.55 (0.07)	0.58 (0.09)
Exercise in previous week (total episodes)	4.05 (0.37)	4.80 (0.38)	5.05 (0.50)	4.42 (0.50)
Episodes at home	1.54 (0.24)	1.61 (0.17)	1.35 (0.22)	1.19 (0.35)
Episodes at work	1.18 (0.23)	1.54 (0.18) *	1.48 (0.28)	0.92 (0.24)
Episodes during leisure-time	1.33 (0.19) **	1.65 (0.19) +	2.22 (0.25)	2.31 (0.33)
n (unweighted)	279	471	258	104

	3rd+ generation White	3rd+ generation Black	Total sample
Linguistic acculturation (standardized) ^a	1.01 (0.25) *	1.09 (0.08) ***	0.00 (1.00)
Spoken with friends (standardized) ^a	1.01 (0.20) **	1.07 (0.12) ***	0.00 (1.00)
Spoken/read more often (standardized) ^a	0.98 (0.28) *	1.07 (0.06) ***	0.00 (1.00)
Read better (standardized) ^a	0.97 (0.30)	1.05 (0.07) **	0.00 (1.00)
Spoken better (standardized) ^a	1.02 (0.22) *	1.09 (0.07) ***	0.00 (1.00)
Social acculturation (%)			
All/most same ethnicity	55.5	23.8	60.7
Equal/most/all other ethnicity	44.5 *	76.2 +	39.4
Education (%)			
Less than high school	6.9	3.8 +	26.4
High school/GED	11.3	16.4	17.0
Some post-secondary	81.9 *	79.8 +	56.6
Log family income (quartiles, %))			
1st	17.5	22.8	23.4
2nd	12.1	31.7 +	23.8

3rd	20.2	17.1	25.0
4th	50.1 ⁺	28.5	27.8
Employment status (%)			
Employed	67.0	67.1	64.7
Unemployed	33.0	32.9	35.3
Sex (%)			
Female	46.9	51.2	51.0
Male	53.1	48.8	49.0
Age	46.71 (1.50)***	38.76 (2.68)	39.89 (0.76)
Obese (%)			
No	65.4	52.3	63.3
Yes	34.6	47.7	36.7
Servings of vegetables in previous day	1.80 (0.11)	1.51 (0.16)	1.49 (0.05)
Servings of fruit in previous day	1.81 (0.12) ⁺	1.17 (0.19)	1.68 (0.06)
Servings of sweetened drinks in previous day	0.67 (0.10) [*]	1.13 (0.24)	0.92 (0.06)
Servings of fast food in previous day	0.30 (0.06)**	0.49 (0.09)	0.37 (0.03)
Exercise in previous week (total episodes)	3.57 (0.27)	3.49 (0.52)	4.15 (0.16)
Episodes at home	0.81 (0.14)	1.16 (0.34)	1.24 (0.09)
Episodes at work	0.69 (0.13)	0.61 (0.17)	1.06 (0.08)
Episodes during leisure-time	2.07 (0.18)	1.73 (0.32)	1.85 (0.09)
<i>n</i> (unweighted)	332	166	1610

⁺ $p < 0.10$,

^{*} $p < 0.05$,

^{**} $p < 0.01$,

^{***} $p < 0.001$.

The tests of significance are on the weighted data with the 3rd+ generation Mexicans as the reference group.

^aThe numbers in these rows are unweighted. Source: L.A.FANS-2.

Table 2

Estimated coefficients of three-level random-intercept linear regression models of social and linguistic acculturation.

	(1) Social acculturation (dichotomous)	(2) Linguistic acculturation score
Generation (ref. = 1st generation: Mexican – duration > 15 years)		
1st generation: Mexican (duration > 15 years)	–0.297	0.135 ***
2nd generation: Mexican	0.584 *	0.902 ***
3rd+ generation: Mexican	1.632 ***	1.587 ***
3rd+ generation: White	0.809 **	1.663 ***
3rd+ generation: Black	1.699 ***	1.822 ***
Education (ref. = high school/GED)		
Less than high school	–0.900 ***	–0.218 ***
Some post-secondary	0.337 +	0.137 ***
Log family income (ref. = 1st quartile)		
2nd quartile	–0.293	–0.038
3rd quartile	–0.310	0.093 **
4th quartile	–0.607 *	0.232 ***
Sex (ref. = female)	0.347 *	0.048 *
Age	0.011	–0.034 ***
Age ²	–0.000	0.000 ***
Employment status (ref. = employed)	–0.037	–0.018
Individuals	1610	
Tracts	65	
Households	1152	

+ $p < 0.10$,

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.

Source: L.A.FANS-2.

Table 3

Estimated coefficients of three-level random-intercept linear regression models of exercise.

	(1)	(2)	(3)	(4)	(5)	(6)
Number of episodes of vigorous exercise in previous week						
During leisure-time						
Generation (ref. = 1st generation: Mexican – duration 15 years)						
1st generation: Mexican (duration >15 years)	0.026	0.045	0.262	0.441**	0.444**	0.268 ⁺
2nd generation: Mexican	0.585**	0.400 ⁺	0.336	0.189	0.228	0.107
3rd+ generation: Mexican	0.693**	0.369	0.555 ⁺	0.053	0.109	0.020
3rd+ generation: White	0.431*	0.142	0.411	–0.340*	–0.274	–0.143
3rd+ generation: Black	–0.033	–0.387	–0.077	–0.264	–0.199	0.017
Social acculturation (ref. = all/mostly same eth.)						
Linguistic acculturation			0.304*	0.274*	0.036	–0.035
Education (ref. = high school/GED)			0.121	–0.056	–0.039	–0.116
Less than high school			0.005			–0.004
Some post-secondary			0.174			–0.293*
Log family income (ref. = 1st quartile)						
2nd quartile			0.036			0.178
3rd quartile			–0.055			–0.063
4th quartile			0.244			–0.339*
Employment status (ref. = employed)			0.150			–1.750***
Sex (ref. = female)			0.439***			0.782***
Age			–0.051*			–0.008
Age ²			0.000			0.000
Individuals	1610					
Tracts	65					
Households	1152					
(7)	(8)	(9)	(10)	(11)	(12)	
Number of episodes of vigorous exercise in previous week						

	(1)	(2)	(3)	(4)	(5)	(6)
Number of episodes of vigorous exercise in previous week						
	During leisure-time			At work		
	Housework			Total		
<hr/>						
Generation (ref. = 1st generation: Mexican – duration 15 years)						
1st generation: Mexican (duration >15 years)	0.047	0.053	0.166	0.518	0.549 ⁺	0.706 [*]
2nd generation: Mexican	−0.442 [*]	−0.040	0.055	0.341	0.585	0.495
3rd+ generation: Mexican	−0.685 ^{**}	−0.066	0.033	0.117	0.455	0.655
3rd+ generation: White	−0.992 ^{***}	−0.323	−0.162	−0.893 [*]	−0.467	0.089
3rd+ generation: Black	−0.724 ^{***}	−0.014	−0.020	−0.996 [*]	−0.603	−0.068
Social acculturation		0.040	0.023		0.379	0.261
Linguistic acculturation		−0.363 ^{***}	−0.303 ^{**}		−0.268	−0.475 [*]
Education (ref. = high school/GED)						
Less than high school			−0.031			−0.049
Some post-secondary			0.176			0.069
Log family income (ref. = 1st quartile)						
2nd quartile			0.079			0.261
3rd quartile			−0.066			−0.199
4th quartile			−0.288			−0.387
Employment status (ref. = employed)			0.493 ^{***}			−1.091 ^{***}
Sex (ref. = female)			−0.431 ^{***}			0.787 ^{***}
Age			0.056 ^{**}			−0.001
Age ²			−0.001 ^{**}			−0.000
Individuals	1610					
Tracts	65					
Households	1152					

⁺ $p < 0.10$,

^{*} $p < 0.05$,

^{**} $p < 0.01$,

 $p < 0.001$.
Source: LAFANS-2.

Table 4

Estimated coefficients of three-level random-intercept linear regression models of diet.

	(1)	(2)	(3)	(4)	(5)	(6)
Number of servings in previous day						
Fruit						
Generation (ref. = 1st generation: Mexican – duration 15 years)						
1st generation: Mexican (duration >15 years)	0.088	0.082	0.116	–0.049	–0.055	0.039
2nd generation: Mexican	–0.257*	–0.093	–0.060	–0.203 ⁺	–0.112	–0.094
3rd+ generation: Mexican	–0.464**	–0.193	–0.196	–0.144	0.0101	0.067
3rd+ generation: White	–0.072	0.202	0.098	0.284**	0.434**	0.396*
3rd+ generation: Black	–0.611***	–0.314 ⁺	–0.346 ⁺	–0.0780	0.0913	0.121
Social acculturation (ref. = all/mostly same eth.)		–0.087	–0.054		–0.088	–0.079
Linguistic acculturation		–0.133*	–0.146*		–0.0685	–0.156*
Education (ref. = high school/GED)						
Less than high school			–0.040			–0.160 ⁺
Some post-secondary			0.098			0.229**
Log family income (ref. = 1st quartile)						
2nd quartile			0.200*			0.006
3rd quartile			0.132			0.0414
4th quartile			0.393***			0.244*
Employment status (ref. = employed)			0.266***			0.254***
Sex (ref. = female)			–0.219**			–0.253***
Age			–0.005			–0.005
Age ²			0.000			0.000
Individuals	1610					
Tracts	65					
Households	1152					
Number of servings in previous day						
	(7)	(8)	(9)	(10)	(11)	(12)

	(1)	(2)	(3)	(4)	(5)	(6)
Number of servings in previous day						
Fruit						
Vegetables						
Fast food						
Generation (ref. = 1st generation: Mexican – duration 15 years)						
1st generation: Mexican (duration >15 years)	0.043	0.040	0.097	–0.017	–0.017	–0.000
2nd generation: Mexican	0.373 ^{**}	0.283 ⁺	0.291 ⁺	0.222 ^{***}	0.108	0.079
3rd+ generation: Mexican	0.421 [*]	0.284	0.370 ⁺	0.245 ^{**}	0.065	0.095
3rd+ generation: White	–0.127	–0.273	0.028	0.032	–0.160 ⁺	–0.073
3rd+ generation: Black	0.388 ^{**}	0.231	0.425 [*]	0.294 ^{***}	0.093	0.174 ⁺
Social acculturation (ref. = all/mostly same eth.)		–0.012	–0.040		0.001	–0.000
Linguistic acculturation		0.081	0.089		0.101 ^{**}	0.079 [*]
Education (ref. = high school/GED)						
Less than high school			0.070			0.043
Some post-secondary			–0.275 ^{**}			–0.089 ⁺
Log family income (ref. = 1st quartile)						
2nd quartile			–0.070			–0.009
3rd quartile			–0.082			–0.005
4th quartile			–0.302 [*]			0.022
Employment status (ref. = employed)						
Sex (ref. = female)			–0.070			–0.149 ^{***}
Age			0.344 ^{***}			0.109 ^{**}
Age ²			0.003			–0.019 ^{**}
Individuals	1610		–0.000			0.000 [*]
Tracts	65					
Households	1152					

⁺ $p < 0.10$,

^{*} $p < 0.05$,

^{**} $p < 0.01$,

 $p < 0.001$.
Source: LAFANS-2.

Table 5

Estimated odds ratios of three-level random-intercept logistic regression models of obesity.

	(1)	(2)	(3)	(4)
Generation (ref. = 1st generation: Mexican – duration > 15 years)				
1st generation: Mexican (duration > 15 years)	1.75 **	1.81 ***	1.69 **	1.72 **
2nd generation: Mexican	2.07 ***	2.50 ***	2.56 ***	2.50 ***
3rd+ generation: Mexican	1.67 *	2.19 *	2.10 *	2.04 *
3rd+ generation: White	1.01	1.42	1.45	1.49
3rd+ generation: Black	2.29 ***	3.14 ***	2.94 **	2.81 **
Social acculturation (ref. = all/mostly same eth.)				
		1.34 *	1.36 *	1.36 *
Linguistic acculturation				
		0.81 +	0.91	0.88
Education (ref. = high school/GED)				
Less than high school			1.37 +	1.35 +
Some post-secondary			0.96	0.99
Log family income (ref. = 1st quartile)				
2nd quartile			0.99	1.01
3rd quartile			1.08	1.09
4th quartile			0.86	0.90
Employment status (ref. = employed)				
			1.09	1.13
Servings of vegetables in previous day				
				0.94
Servings of fruit in previous day				
				0.95
Servings of sweetened drinks in previous day				
				1.02
Servings of fast food in previous day				
				1.13
Episodes of exercise in previous week				
				0.99
Sex (ref. = female)				
	0.63 ***	0.62 ***	0.62 ***	0.59 ***
Age				
	1.10 ***	1.09 ***	1.11 ***	1.11 ***
Age ²				
	1.00 ***	1.00 ***	1.00 ***	1.00 ***
Individuals				
	1610			
Tracts				
	65			
Households				
	1152			

+ $p < 0.10$,* $p < 0.05$,** $p < 0.01$,*** $p < 0.001$.

Note: All models also include a dummy variable for respondents missing anthropometry measures. Source: L.A.FANS-2.