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The shape of things to come? Obesity prevalence among foreign-born vs. US-born Mexican youth in California

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Abstract

Obesity among the Mexican-origin adult population in the US has been associated with longer stays in the US and with being US- vs. Mexican-born, two proxies for acculturation. This pattern is less clear for Mexican-origin children and young adults: recent evidence suggests that it may be reversed, with foreign-born Mexican youth in the US at higher risk of obesity than their US-born Mexican-American counterparts. The objective of this study is to evaluate the hypothesis that the immigrant advantage in obesity prevalence for Mexican-origin populations in the US does not hold for children and young adults. We use data from the Los Angeles Family and Neighborhood Survey ($N = 1143$) and the California Health Interview Survey ($N = 25,487$) for respondents ages 4–24 to calculate the odds of overweight/obesity by ethnicity and nativity. We find support for the hypothesis that overweight/obesity prevalence is not significantly lower for first-generation compared to second- and third-generation Mexican-origin youth. Significantly higher obesity prevalence among the first generation was observed for young adult males (ages 18–24) and adolescent females (ages 12–17). The previously-observed protective effect against obesity risk among recent adult immigrants does not hold for Mexican-origin youth.

Keywords

U.S.A.; Adolescent; Children; Obesity; Hispanic and Latino; Immigrant populations

Introduction

Hispanic youth in the US are a large and rapidly-growing group: the 5–17 year-old Hispanic population will increase from 11 million in 2006 to 28 million in 2050, at which point there will be more Hispanic than non-Hispanic white school children in the US (Fry & Gonzales, 2008). This group is growing in other ways as well: Overweight and obesity among Hispanic children and adolescents have increased substantially in the past 20 years, particularly for Mexican-origin adolescents (Flegal, Ogden, & Carroll, 2004). The National Health and Nutrition Examination Survey (1999–2002) recorded an overweight prevalence

of 40% for Mexican-origin children ages 6–18 (vs. 28% for non-Hispanic whites), and an obesity prevalence of 22% (vs. 14% for non-Hispanic whites) (Hedley et al., 2004). A pattern of higher obesity prevalence for Hispanic children relative to non-Hispanic white children emerges as early as preschool (Anderson & Whitaker, 2009).

High obesity prevalence in the young Hispanic population raises concerns about social disparities in current and future chronic disease burden. Hispanic-origin school children have already been shown to have higher prevalence of high blood pressure, hyper-lipidemia, and diabetes compared to non-Hispanic whites (Trevino et al., 1999; Winkleby, Robinson, Sundquist, & Kraemer, 1999), all of which are associated with overweight in children. Dietary and physical activity patterns established during adolescence often persist into adulthood, making obesity difficult to reverse. Therefore, the weight status of the young Hispanic population may point to the shape of things to come.

Understanding the mechanisms that produce race–ethnic disparities in obesity prevalence is important for designing effective obesity prevention and treatment programs. In addition to comparisons across race–ethnic groups, analyses of within-ethnicity differences have been a particular focus of studies of Hispanic adult obesity. Generally, adult obesity prevalence has been shown to be higher for US-born (second- and higher-generation) Hispanic adults compared to the foreign-born (first-generation) (Akresh, 2008; Bates, Acevedo-Garcia, Alegria, & Krieger, 2008). Within the first generation, a longer stay in the US has also been associated with higher risk of obesity and obesity-related health behaviors (Barcenas et al., 2007; Kaplan, Huguette, Newsom, & McFarland, 2004; Oza-Frank & Cunningham, 2010). Much less attention has been paid to describing and understanding these within-ethnic group differences in *younger* Hispanics, particularly foreign-born children. This evidence gap is unfortunate for at least two reasons. First, as stated above, this large and growing population in the US is at particularly high risk of obesity. Second, the mechanisms that pattern obesity risk by length of stay in the US or nativity may differ for Hispanic youth compared to adults. In this study we address this gap by describing patterns of overweight/obesity risk in the Mexican-origin population, the largest Hispanic subgroup in the US, in four recent samples of children and young adults in California. We motivate the study with a review of prior evidence linking length of stay in the US and generational status to obesity risk for Mexican-origin youth in the US, and a discussion of factors that may contribute to a different relationship between nativity and obesity risk in these younger cohorts compared to older adults.

Background

One of the first studies of nativity patterns of obesity for Hispanic youth in the US found higher obesity risk for 2nd (children of immigrants) and 3rd (children of natives) generation relative to 1st generation adolescents, confirming the immigrant advantage already observed in the adult population (Popkin & Udry, 1998). Subsequent studies have identified higher obesity risk specifically among the 2nd generation children or adolescents relative to 3rd (Baker, Balistreri, & Van Hook, 2009; Balistreri & Van Hook, 2009; Hernández-Valero et al., 2011; Hernandez-Valero et al., 2007; Liu, Chu, Frongillo, & Probst, 2012). Two studies based on the 2003 National Survey of Children's Health suggest that obesity prevalence may be similar or even higher among the 1st and 2nd generation compared to 3rd generation Hispanic youth (Singh, Kogan, & Yu, 2009; Taverno, Rollins, & Francis, 2010). Prior evidence is therefore not consistent about whether the immigrant advantage in obesity observed among Hispanic adults holds for Hispanic youth, particularly for the first generation. In addition, there is scant evidence for recent cohorts; with one exception (Hernández-Valero et al., 2011), data in these studies were collected prior to 2007.

Two mechanisms have been proposed to explain nativity or generational differences in obesity risk in Hispanic populations. A large literature cites acculturation, the process by which immigrant groups adapt to a new destination, as a primary cause of obesogenic habits and behaviors (Abraido-Lanza, Chao, & Florez, 2005). Acculturation may increase the risk of obesity for Hispanics because it is associated both with stress (leading to maladaptive behaviors) and with the abandonment of healthier behaviors from the country or culture of origin in favor of less healthy behaviors in the US, such as fast food or soda consumption (Finch & Vega, 2003; Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005). Studies assessing the relationship between acculturation and obesity operationalize acculturation many ways, most commonly through measures of exposure to US culture as defined by nativity, parents' nativity, and time spent in the US. Other acculturation measures include language use and ability, and social interaction with ethnically and linguistically similar or dissimilar people. Most of the studies cited above that found higher risk of obesity among more acculturated children and adolescents employed measures of duration of time in the US as proxies for acculturation.

A second and less studied mechanism linking nativity of US immigrants to obesity risk is the interconnectedness of the food environment and migration dynamics in the sending country (Buttenheim, Goldman, Pebley, Wong, & Chung, 2010; McLaren, 2007; Van Hook, Baker, Altman, & Frisco, 2012). This is particularly relevant in the case of obesity risk for Mexican-origin children in the US, given the large, circular migration flows between the two countries and the well-documented nutrition transition underway in Mexico (Popkin & Gordon-Larsen, 2004; del Rio-Navarro et al., 2004; Rivera et al., 2002; Rivera, Barquera, Gonzalez-Cossio, Olaiz, & Sepulveda, 2004). This transition is characterized by a shift from unprocessed and low energy density diets to highly processed, energy dense foods. The transition is due in part to new food marketing strategies and a simultaneous decrease in physical activity that has accompanied urbanization and economic development in Mexico (Franco-Marina, 2007; Popkin, 2001, 2006). Mexico's nutrition transition has been notably rapid: Mexico now has the second highest rates of adult obesity among OECD countries (after the US) (Sassi, 2010).

In prior decades, recent migrants from Mexico to the US may have enjoyed an obesity advantage because they were coming from a less obesogenic environment, and may also have been selected for better health. As Mexico's obesity rates approach those in the US, and as the propensity to migrate becomes less associated with lower obesity risk for both migrants (Rubalcava, Teruel, Thomas, & Goldman, 2008) and their family members remaining at home who may later migrate (Creighton, Goldman, Teruel, & Rubalcava, 2011), we would expect the immigrant advantage in obesity to be attenuated. This should be particularly true for youth, given that obesity rates have increased particularly rapidly for this age group in Mexico, and that health selection is likely to operate less strongly for migrant children. At the same time, two recent studies comparing overweight/obesity of Mexican-American children (both native and Mexican-born) in the US to children in Mexico find substantially higher prevalence in the Mexican-American populations, which argues against an "importation" of high obesity prevalence across the border (Hernández-Valero et al., 2011; Rosas et al., 2011).

Research questions

Our primary goal in this study is to describe ethnicity–nativity differences in obesity risk in several recent cohorts of Mexican-origin youth in California. We seek to evaluate whether the immigrant advantage in obesity observed in the adult population also characterizes Mexican-origin children, adolescents and young adults. Due to the changing food environment in Mexico and changes in migration dynamics and selection, we hypothesize that exposure to the US is not a strong determinant of obesity risk for youth. We add to the

literature on acculturation, migration, and obesity in Mexican– American youth by providing age–sex specific estimates of the odds of overweight/obesity in two large, recent datasets from California. Our inclusion of young adults ages 18–24 with the child and adolescent samples is also an important contribution. Many studies of adult obesity generally, and immigrant obesity specifically, restrict the sample to adults ages 25–64, thus excluding the young adult years. In addition, we argue that the 18–24 year old group still has much in common with children and adolescents in terms of family roles, food environment, and eating behaviors. Indeed, as of 2007– 2009, 43% of both whites and Latinos in the US ages 20–24 resided with their parents (Qian, 2012). Our analysis is focused on California, where 37% of the US Mexican-origin population lives.

Methods

Data

The study exploits two data sets: the second wave of the Los Angeles Family and Neighborhood Survey (L.A.FANS-2) and the California Health Interview Survey (CHIS). L.A.FANS-2 offers 2 important strengths: (1) a large Mexican-origin sample, including first-, second-, and higher-generation immigrants and (2) measured height and weight, which avoids the biases inherent in self-reported height and weight in other surveys. CHIS, a bi-annual statewide telephone survey, has a large sample size and is broadly representative of the California population. The two datasets therefore have complementary strengths that permit a rigorous analysis of our core research question.

L.A.FANS is a longitudinal study of individuals, households and neighborhoods. The first wave was conducted in 2000–2001 in a stratified probability sample of 65 census tracts in Los Angeles County with oversamples in high-poverty census tracts (Sastry, Ghosh-Dastidar, Adams, & Pebley, 2006). L.A.FANS-2, used in this analysis, was collected in 2006–2008 and re-interviewed panel respondents from L.A.FANS-1 still living within Los Angeles County and a sample of new residents in the original 65 census tracts. Detailed residential histories and migration status were collected for all respondents, as well as parents' and children's place of birth. Height and weight were measured for adults and children. L.A.FANS was reviewed and approved by the Institutional Review Boards of the University of California, Los Angeles, RAND, and RTI International. Adolescent respondents provided informed consent.

We exclude 6 respondents with missing census-tract identifiers or survey weights; 78 respondents who were missing both measured and self-reported anthropometry; and 18 respondents with outlier BMI values, defined using the CDC/WHO definitions of biologically implausible values (CDC). For an additional 65 adolescent and young adult respondents missing measured height and/or weight but who have self-reported height and/or weight, we impute the measured value from their self-report. Regression analyses presented here do not control for whether height or weight was imputed; however, results from regression models that include a dummy variable for imputed height or weight are substantively identical to results shown here. The final analytic sample comprises 1143 respondents ages 4–24.

To create a sample that is temporally comparable to L.A.FANS, we use the 2005, 2007, and 2009 waves of CHIS. Each survey wave includes approximately 50,000 households. The sample is designed to be representative at the county level for the state's 41 largest counties. Respondents report a wide range of sociodemographic and economic indicators, health indicators (including reported height and weight), health behaviors, and health services use. All CHIS procedures were approved by the IRB at the University of California, Los

Angeles, the State of California, Westat (the data collection organization), and the federal Office of the Management of the Budget.

Low response rates are a limitation of CHIS, but recent data quality reports suggest that the data remain representative of California's population nevertheless (California Health Interview Survey, 2008). As of 2007, the CHIS sample includes both landline households and cell-phone only households sampled via random-digit dialing. Several of California's race-ethnic minority groups are over-sampled, resulting in a complex sampling scheme. After excluding 2966 respondents with missing height and/or weight and an additional 613 respondents with outlier BMI values (defined as for L.A.FANS), we have a final analytic sample of 25,487 respondents across the three survey waves.

Measures

The main outcome of interest is overweight/obese status based on BMI (kg/m^2). We use the WHO BMI classification of $\geq 25 \text{ kg/m}^2$ for adults (WHO, 2000), and the CDC pediatric cutoff of the 85th percentile of BMI-for-age for children (ages 4–11) and adolescents (ages 12–17) (Ogden et al., 2002). In L.A.FANS, BMI is calculated from measured height and weight. In CHIS, BMI is calculated from self-reported height and weight (for adults and adolescents ages 12–17) or from BMI-for-age calculated from parent-reported height and weight (for children ages 4–11). In other work using L.A.FANS, we have assessed age- and ethnicity-specific differences in non-response and errors in self-reported height and weight in survey settings, and determined that BMI based on self-reported height and weight significantly underestimates obesity prevalence for younger and for heavier adolescents (Buttenheim, Goldman, & Pebley, in press). However, there are not significant differences in the magnitude or direction of the bias by race-ethnic categories. We expect that overweight/obesity prevalence is similarly underestimated in the CHIS sample, but not differentially so for the Mexican-origin population.

The key independent variable is ethnicity-nativity. We focus the analysis on four groups: Foreign-born Mexicans living in the US ("1st generation"); US-born Mexican-origin with Mexican-born mother ("2nd generation"); US-born Mexican-origin with US-born Mexican-origin mother ("3rd+ generation"); and US-born non-Hispanic whites ("whites"). We use mother's place of birth to identify 2nd and 3rd+ generation Mexicans because of fewer missing values than father's place of birth in L.A.FANS-2 (Models using both mother's and father's birthplace to determine generational status produced substantially similar results; tables available from authors). Other (non-Mexican) Hispanics, foreign-born whites, and other race-ethnic groups (including black, Asian, Pacific Islander, and Native American) are excluded.

In L.A.FANS, respondents were first asked to identify "what group or groups describe your race or ethnic origin." If the respondent identified as Latino, he or she was then asked about his/her national origin or ancestry groups including Mexican, Mexican-American, Central American, Puerto Rican, Cuban, or other. Respondents had the option to complete the interview in Spanish if desired. Due to the sensitive nature of many of the questions asked in the survey, including migration, citizenship, and legal residency status, L.A.FANS obtained a Confidentiality Certificate from the U.S. Department of Health and Human Services which interviewers presented to respondents. 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.

In CHIS, respondents were first asked if they are Latino or Hispanic. If so, they were asked about membership in Latino/Hispanic subgroups, similar to the L.A.FANS categories. A subsequent question asked about race (not including a Hispanic/Latino category). Ethnicity-

nativity is determined using the same definitions as in L.A.FANS. However, we also split the first generation Mexican-origin sample into those who have been in the US for fewer than 5 years, and those who have been in the US for 5 or more years; sample sizes do not permit a more recent cutoff. This coding allows us to evaluate whether the most recently arrived Mexican-origin immigrants have the same odds of overweight/obesity as the 3rd+ generation, rather than lower odds as the immigrant advantage hypothesis would predict.

Analysis

We first estimate the unadjusted prevalence of obesity/overweight using the weights for L.A.FANS and CHIS that account for the surveys' complex sampling schemes. We then use logistic regression to estimate the odds of being overweight or obese as a function of age, sex, and race-ethnic and nativity categories. We estimate models separately for the L.A.FANS and CHIS samples. We then estimate a second set of models with the CHIS data that splits the 1st generation (foreign-born) Mexican-origin population into those with <5 years vs. 5+ years in the US. For all three sets of models we examine the full sample of respondents ages 4–24 and then stratify by age–sex groups. Both the L.A.FANS and CHIS models are weighted to account for the complex sampling schemes. The weights in the CHIS models also adjust for combined age groups and multiple survey waves (Lee et al., 2007). Other approaches to estimating these models, including weighted and unweighted multilevel models (L.A.FANS) and unweighted logistic models (L.A.FANS and CHIS), produced similar results (tables available from authors).

All models control for age in years (due to the different age composition of the ethnicity–nativity groups). Models including the full samples also control for sex. CHIS models control for survey year. Our goal is to test a hypothesis about recent changes in obesity/overweight prevalence in Latino health by nativity status rather than to explain ethnic and nativity differences in obesity/overweight. Thus, explanatory factors, such as socioeconomic status, are not included in the model. We address the role of socioeconomic status in accounting for ethnic and nativity differences in other papers (Buttenheim, Goldman et al., 2010; Buttenheim, Wong, Goldman, & Pebley, 2010; Creighton, Goldman, Pebley, & Chung, 2012; Creighton et al., 2011; Goldman, Kimbro, Turra, & Pebley, 2006; Ullman, Buttenheim, Goldman, Pebley, & Wong, 2011).

Results

Descriptive statistics for the L.A.FANS and CHIS samples are presented in Table 1. In the full L.A.FANS sample, 47% of respondents are obese or overweight. In the CHIS sample, 39% are obese or overweight. This difference is due in part to the larger proportion of Mexican-origin respondents in the L.A.FANS sample, and to the fact that height and weight were self-reported (for young adults and adolescents) and parent-reported (for children) in CHIS, both of which have been shown to underestimate obesity prevalence (Akinbami & Ogden, 2009; Buttenheim et al., in press; Gorber, Tremblay, Moher, & Gorber, 2007).

The hypothesis of little or no immigrant advantage in obesity for Mexican-origin children and youth compared to the Mexican-origin native born is confirmed by the estimates of prevalence presented in Table 1. The values in Table 1 are not adjusted for any covariates, but are weighted for the CHIS and L.A.FANS sampling schemes. For the full L.A.FANS sample, overweight/obesity prevalence was *higher* for 1st generation Mexican-origin respondents than for 2nd and 3rd+ generation. For the full CHIS sample, overweight/obesity prevalence is highest among the 2nd generation Mexican-origin group. Within L.A.FANS age–sex groups, 1st generation Mexican-origin males of all ages appear to be at a distinct disadvantage, as do female adolescents. In the CHIS sample, a similar pattern holds for male children and young adult males. Consistent with the large literature on Hispanic obesity in

the US, overweight/obesity prevalence is higher for the Mexican-origin populations relative to whites in both samples.

These relationships are explored in more detail with regression analysis. Odds ratios from weighted logistic regression models predicting overweight-obesity sex are presented in Table 2 (L.A.FANS) and Tables 3 and 4 (CHIS). All odds ratios are adjusted for age; odds ratios for the full sample are also adjusted for sex. In all models, the reference group is the 3rd+ generation Mexican-origin population, who would be expected to have the highest prevalence among the Mexican-origin groups if the observed adult pattern holds and if exposure to US culture is indeed obesogenic. For the full sample of L.A.FANS respondents, 1st generation Mexican-origin youth had the highest odds ratio of overweight/obesity, followed by the 2nd generation. While both groups have significantly higher odds of overweight/obesity relative to whites (results not shown), neither group is significantly different from the 3rd+ generation Mexican-origin respondents. Results for age–sex subgroups indicate that in no case were the odds of overweight/obesity significantly lower for the 1st or 2nd generation relative to the 3rd+ generation. First generation adolescent girls had significantly higher odds of overweight/obesity relative to 3rd+ generation.

In Table 3, similar results are presented for the much larger CHIS sample. If the immigrant advantage in overweight/obesity for the Mexican immigrant adult population holds for youth, we would expect significantly lower odds of overweight/obesity in the 1st and 2nd generation relative to the 3rd+ generation. However, Table 3 suggests again that the immigrant health advantage in obesity is not apparent in the younger sample: For the full sample and for age–sex subgroups, the 1st and 2nd generation did not have significantly lower odds than the 3rd+ generation of obesity/overweight. To the contrary, among the full sample, the 2nd generation had significantly higher odds (OR = 1.18), and among the young adult males, both the 1st and 2nd generation had significantly higher odds of overweight/obesity than the 3rd+ generation. Generally, odds ratios for obesity are quite similar for Mexican-origin females by generational status—odds ratios are near 1.00 for the 1st and 2nd generation—while the results for men suggest higher obesity prevalence for the more recent generations.

Results from CHIS models that split the foreign-born sample into shorter (<5 years) vs. longer (5+ years) stays in the US in Table 4 allow a more fine-grained assessment of within-generation differences in risk of obesity associated with time in the US. Generally, results are consistent with Table 3, with significantly higher odds of overweight/obesity for 2nd vs. 3rd+ generation for the overall sample, driven primarily by the results for the young adult males. Within the 1st generation young adult males, those who have been in the US for 5 or more years have significantly higher odds of overweight/obesity compared to the 3rd+ generation, while the most recently arrived young adult males are not significantly different from the reference group. This finding of significantly higher odds of obesity in a 1st generation Mexican sample compared to a 3rd+ generation sample adds to a small but growing body of recent evidence challenging the previously observed pattern of Hispanic immigrant health advantage (Creighton et al., 2012).

Discussion

The goal of this study was to evaluate whether the lower risk of overweight/obesity previously observed among foreign-born Mexican-origin adults compared to US-born generations also applies to youth. The recent rapid nutrition transition in Mexico and changing migration dynamics led us to hypothesize that we would not find a lower risk of overweight/obesity in four recent cohorts of Mexican-origin youth ages 4–24. Results from descriptive analyses (unadjusted for socioeconomic characteristics) confirm this hypothesis

generally: we did not identify any age–sex groups in which the 1st or 2nd generation Mexican-origin respondents had lower odds of overweight/obesity compared to the 3rd+ generation. In one of the two surveys analyzed, the California Health Interview Survey, we found significantly higher age-adjusted odds of obesity in the 2nd generation (compared to 3rd+) for the full sample; and for 1st and 2nd generation young adult males (ages 18–24). Our results for children and adolescents are consistent with results from the National Survey of Children’s Health showing comparable or higher odds of overweight/obesity for 1st and 2nd generation Hispanic youth relative to 3rd+ generation.

Our results, and other recent studies of the association between nativity, exposure to US culture and obesity risk for Hispanic-American youth, suggest a complex and dynamic relationship. Our findings are consistent with an acculturation process that is less obesogenic for children and adolescents than it is for adults. Acculturation hypotheses posit that protective health behaviors (such as a healthy diet or regular physical activity) accompany migrants from their country of origin, but their protection erodes as immigrants spend more time in the US and adopt less healthy behaviors. For example, there is some evidence that the diets of non-acculturated or more recently-arrived Mexican women are better than diets of acculturated Mexican women (Guendelman & Abrams, 1995; Neuhauser, Thompson, Coronado, & Solomon, 2004). Similarly, first-generation Hispanic adolescents consume significantly more servings of fruits and vegetables and glasses of milk and significantly fewer cans of soda per day than second- or third-generation Hispanic adolescents (Allen et al., 2007). If these dietary habits are substantial enough to influence body weight, then they could result in increasing obesity prevalence for later generations.

However, acculturation arguments rest on the assumption that health behaviors in the sending country are better than adopted health behaviors in the US. Evidence from food and nutrition surveys in Mexico suggest that this may have been the case as recently as 10–15 years ago (when some of the studies cited above were conducted) but is no longer so. Specifically, increased consumption of fats (Rivera et al., 2002) and processed foods (Hawkes, 2006) have transformed the Mexican diet over a very short time period from high-fiber to high-calorie density, rapidly converging with the US obesogenic diet. In this context, higher levels of acculturation and longer stays in the US may not lead to substantially poorer diets compared to living in Mexico.

Consistent with other studies, we see different results for males vs. females in terms of both prevalence and the relationship of nativity to overweight/obesity risk across the age categories. With some exceptions, males have higher prevalence of overweight/obesity than females, particularly among the 1st generation. While the alarming obesity prevalence among Mexican-origin boys has been documented elsewhere (Hedley et al., 2004), our analysis highlights the important contribution of first-generation Mexican males to this problem and the need to examine the gendered aspects of culture and acculturation that may underlie these differences (Van Hook & Baker, 2010). In the CHIS young adult samples, 1st and 2nd generation males have higher obesity odds compared to 3rd+ generation, while females do not exhibit this pattern. There are several possible explanations for this observed pattern: A higher prevalence of obesity for males vs. females in Mexico combined with less selective migration for men, could produce this pattern in the first generation, although prior evidence does not support either of these (Buttenheim, Wong et al., 2010; Rubalcava et al., 2008), nor does our finding of higher obesity odds compared to the 3rd+ generation only among the longer-stay Mexican-born men. Among the second generation, acculturation and assimilation may be more obesogenic processes for males vs. females, differentially affecting diet and physical activity. Given that these results are based on self-reported height and weight, it is also possible that there are sex differences in the underreporting of weight by nativity status.

Limitations

Given that we have cross-sectional data that describe patterns on only the US side of the border, it is not possible to disentangle acculturation and selective migration factors; longitudinal studies that follow successive cohorts of children over time and across the US–Mexico border are needed. In the absence of suitable data, researchers have examined the impact of family migration on obesity risk for children *in Mexico*. Creighton et al. (2011) find that children in households with extended family members in the US are at higher risk for obesity/overweight than children in households without these networks. Children with migrant kin (who are at higher risk for obesity) are also more likely to migrate themselves. This is consistent with attenuation of an immigrant advantage in obesity for Mexican–American children. In contrast, results from Van Hook et al. (2012) suggest that children in Mexico with higher propensity for having migrant parents have lower BMI than children whose parents have a lower propensity to migrate.

Our study has several other limitations. The completion rates for CHIS are low (e.g., 18.7% for the 2007 adult landline sample and 15.9% for the 2007 adult cell phone sample). Parent-reported and self-reported height and weight in the CHIS survey may have led to underestimates of overweight/obesity, and the extent of underestimation may differ by ethnicity/nativity group and body size (although recent evidence (Buttenheim et al., in press)) suggests no systematic bias in underestimation by ethnicity/nativity. The CHIS sample also has higher rates of missing and outlier values for measured height and weight among the foreign-born Mexican population relative to other groups. For both L.A.FANS and CHIS, it is not clear what role immigration status may have played in overall response rates and, in the case of CHIS, in the accuracy of self-reported anthropometry.

An unanswered question is whether our results can be generalized to a nationally-representative sample of Mexican-origin children and youth. Although we explored this issue using the National Health Interview Survey (NHIS), the NHIS suffers from higher rates of non-response for (parent-reported) height and weight for foreign-born Mexican-origin adolescents compared to both US-born Mexican-origin respondents and whites. The NHIS also does not collect information on height and weight for children under age 12.

Conclusions

Addressing the obesity epidemic among Mexican-origin children and youth is clearly a priority on both sides of the border. Among OECD countries, Mexico now has the second highest adult overweight prevalence (after the US), and among the highest child and youth prevalence (Sassi, 2010). A key research priority will be to calculate the expected relative contribution of increases in obesity prevalence among the Mexican-origin population and increases in the size of the Mexican-origin population in the US to overall obesity prevalence. At a programmatic level, prevention and surveillance programs in the US must account for the rising obesity prevalence in Mexico, particularly among children and youth. Opportunities may exist to exploit well-known geographic patterns of Mexico–US migration to target childhood obesity prevention programs in regions of Mexico that send substantial numbers of migrants to the US.

The obesity patterns observed among Mexican-origin youth in the United States today will follow these cohorts into middle and older ages, and will have important implications for the prevalence of obesity-related diseases including diabetes, cardiovascular disease, and cancer in this population. Obesity is poised to be a critical driver of social disparities in health between Hispanic and non-Hispanic white groups. Until recently, research in this area focused on the role of acculturation and length of stay in the US in driving higher rates of obesity. Our results suggest that migration dynamics and the obesity environment in Mexico

may also play a role. To reduce future disparities, attention must be focused on the causes and consequences of Mexico's obesity epidemic as well.

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Proportion overweight and obese by selected characteristics: California children, adolescents and young adults, Los Angeles Family and Neighborhood Survey (2006–2008, $N = 1143$) and California Health Interview Survey (2005, 2007, 2009, $N = 25,487$).

Table 1

Proportion overweight or obese (N)	Full sample	Ethnicity/nativity			Non-Hispanic white
		Mexican-origin, generation			
		1st	2nd	3rd+	
A. L.A.FANS					
Full sample	0.47 (1143)	0.67 (127)	0.50 (538)	0.49 (190)	0.35 (288)
Child (ages 4–11)					
Female	0.43 (185)	0.44 (11)	0.53 (102)	0.50 (31)	0.21 (41)
Male	0.41 (196)	0.71 (15)	0.48 (92)	0.39 (34)	0.23 (55)
Adolescent (ages 12–17)					
Female	0.39 (215)	0.86 (21)	0.36 (109)	0.26 (33)	0.33 (52)
Male	0.54 (222)	0.66 (21)	0.55 (118)	0.61 (33)	0.49 (50)
Adult (ages 18–24)					
Female	0.54 (171)	0.56 (34)	0.64 (60)	0.58 (34)	0.39 (43)
Male	0.53 (154)	0.72 (25)	0.49 (57)	0.63 (25)	0.43 (47)
B. CHIS					
Full sample	0.39 (25,487)	0.47 (1623)	0.50 (3570)	0.46 (2662)	0.33 (17,632)
Child (ages 4–11)					
Female	0.41 (5678)	0.52 (92)	0.52 (622)	0.52 (630)	0.35 (4334)
Male	0.44 (6065)	0.61 (105)	0.58 (623)	0.55 (653)	0.38 (4684)
Adolescent (ages 12–17)					
Female	0.28 (4055)	0.33 (285)	0.41 (651)	0.40 (392)	0.19 (2727)
Male	0.36 (4222)	0.41 (289)	0.46 (689)	0.39 (392)	0.31 (2852)
Adult (ages 18–24)					
Female	0.35 (2672)	0.39 (437)	0.40 (467)	0.37 (315)	0.31 (1453)
Male	0.45 (2795)	0.60 (415)	0.58 (518)	0.46 (280)	0.37 (1582)

CHIS = California Health Interview Survey, L.A.FANS = Los Angeles Family and Neighborhood Survey. Cell values are proportion of respondents who are classified as overweight or obese using the CDC Growth Chart 85th percentile cutoff (children and adolescents) or the WHO BMI overweight cutoff of BMI 25 (young adults), based on parent-reported height and weight (children) or self-reported height and weight (adolescents and young adults). Sample sizes are shown in parentheses. Percentages are weighted for the CHIS and L.A.FANS sampling schemes, Ns are unweighted.

Table 2

Adjusted odds ratios from weighted logistic models predicting overweight/obese as a function of ethnicity–nativity, Mexican-origin and white respondents ages 4–24, L.A.FANS-2 (2006–2008, $N = 1143$).

Outcome: overweight/obese	N	Ethnicity/nativity				US-born non-Hispanic white AOR (se)
		Mexican-origin, generation				
		1st AOR (se)	2nd AOR (se)	3rd+ (ref. group) AOR (se)		
Full sample	1143	1.88 (0.64)	1.06 (0.30)	1.00 (–)	0.52 (0.12) *	
Child (ages 4–11)						
Female	185	0.68 (0.59)	1.01 (0.50)	1.00 (–)	0.24 (0.14) *	
Male	196	2.44 (2.05)	1.42 (0.86)	1.00 (–)	0.35 (0.23)	
Adolescent (ages 12–17)						
Female	215	18.07 (16.00) **	1.81 (1.02)	1.00 (–)	1.41 (0.73)	
Male	222	1.19 (0.79)	0.76 (0.39)	1.00 (–)	0.61 (0.37)	
Adult (ages 18–24)						
Female	171	0.82 (0.43)	1.10 (0.58)	1.00 (–)	0.42 (0.25)	
Male	154	1.08 (0.88)	0.48 (0.32)	1.00 (–)	0.32 (0.23)	

Significantly different from 3rd+ generation Mexican-origin at

* $p < 0.05$,

** $p < 0.01$.

L.A.FANS-2: Los Angeles Family and Neighborhood Survey, Wave 2 (2006–2008). Each table row presents adjusted odds ratios from one weighted logistic model. All models control for age in years. Model on full sample also controls for sex. Reported standard errors (in parentheses) are the standard errors on the log odds multiplied by the odds ratio (exponentiated log odds).

Table 3

Adjusted odds ratios from logistic models predicting overweight/obese as a function of ethnicity–nativity, Mexican–origin and white respondents ages 4–24, CHIS (2005, 2007, 2009, $N = 25,487$).

Outcome: overweight/obese	N	Ethnicity/nativity			
		Mexican-origin, generation			US-born non-Hispanic white AOR (se)
		1st AOR (se)	2nd AOR (se)	3rd+ (ref. group) AOR (se)	
Full sample	25,487	1.10 (0.11)	1.18 (0.12) *	1.00 (–)	0.58 (0.04) **
Child (ages 4–11)					
Female	5678	1.03 (0.37)	1.01 (0.17)	1.00 (–)	0.50 (0.07) **
Male	6065	1.25 (0.35)	1.12 (0.23)	1.00 (–)	0.50 (0.07) **
Adolescent (ages 12–17)					
Female	4055	0.75 (0.20)	1.01 (0.21)	1.00 (–)	0.36 (0.06) **
Male	4222	1.15 (0.30)	1.38 (0.30)	1.00 (–)	0.72 (0.11) *
Adult (ages 18–24)					
Female	2672	1.01 (0.22)	1.14 (0.24)	1.00 (–)	0.71 (0.13)
Male	2795	1.58 (0.32) *	1.72 (0.38) *	1.00 (–)	0.67 (0.12) *

Significantly different from 3+ generation Mexican-origin at

* $p < 0.05$,

** $p < 0.01$.

CHIS: California Health Interview Survey. Each table row reports adjusted odds ratios from one logistic model. All models control for age in years. Model on full sample also controls for sex. Models are weighted for the CHIS sampling scheme. Reported standard errors (in parentheses) are the standard errors on the log odds multiplied by the odds ratio (exponentiated log odds). Standard errors are computed using jackknife resampling.

Table 4

Adjusted odds ratios from logistic models predicting overweight/obese as a function of ethnicity–nativity and duration of stay in the US, Mexican-origin and white respondents ages 4–24, CHIS (2005, 2007, 2009, $N = 25,487$).

Outcome: overweight/obese	N	Ethnicity/nativity				
		Mexican-origin, generation				
		1st in US <5 years	1st in US	5 years AOR (se)	2nd AOR (se)	3+ (ref. group) AOR (se)
Full sample	25,487	1.12 (0.17)	1.09 (0.12)		1.18 (0.12)*	1.00 (–)
Child (ages 4–11)						
Female	5678	0.77 (0.40)	1.18 (0.52)		1.01 (0.17)	1.00 (–)
Male	6065	1.61 (0.73)	1.09 (0.40)		1.12 (0.23)	1.00 (–)
Adolescent (ages 12–17)						
Female	4055	0.65 (0.27)	0.81 (0.24)		1.01 (0.21)	1.00 (–)
Male	4222	1.50 (0.56)	1.01 (0.31)		1.38 (0.30)	1.00 (–)
Adult (ages 18–24)						
Female	2672	1.49 (0.46)	0.90 (0.21)		1.14 (0.24)	1.00 (–)
Male	2795	1.26 (0.37)	1.75 (0.37)**		1.72 (0.38)*	1.00 (–)

Significantly different from 3+ generation Mexican-origin at

* $p < 0.05$,

** $p < 0.01$.

CHIS: California Health Interview Survey. Each table row reports adjusted odds ratios from one logistic model. All models control for age in years. Model on full sample also controls for sex. Models are weighted for the CHIS sampling scheme. Reported standard errors (in parentheses) are the standard errors on the log odds multiplied by the odds ratio (exponentiated log odds). Standard errors are computed using jackknife resampling.