Higher risk for obesity among Mexican-American and Mexican immigrant children and adolescents than among peers in Mexico

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Introduction

Obesity is a major public health problem, not only in the United States (US) [1] but also in less developed countries [2]. In the US, the prevalence of obesity among children is rising [1].

Findings from the National Health and Nutrition Examination Survey indicate that more than 34% of children are overweight [1]. Obesity now affects 1 in 5 children in the US [1].

The obesity rates among children of Mexican origin in the US, especially those living in Texas [3,4], are higher than the obesity rates of the general US child population [1] and of the child population in Mexico [5,6].

It has been known for years that childhood obesity is a well-established risk factor for the development of chronic diseases in adulthood [7-13], such as diabetes [9], cardiovascular and coronary heart disease [10,11], colon cancer [11], and endometrial cancer [12]. Additionally, childhood obesity is an established risk factor for adult obesity, and obese adults have a higher mortality from chronic diseases than their non-obese counterparts [7].

Few studies in the US have examined the influence of country of birth on the rate of overweight and obesity among children [3] or adults [14,15] of Mexican origin. Given that a large proportion of immigrants to the US are of Mexican descent [16], we sought to examine the influence of country of birth and country of residence on the overweight and obesity status of children and adolescents of Mexican descent. We hypothesized that children and adolescents born and raised in Mexico are less likely to be overweight or obese than Mexican-American

children and adolescents and Mexican immigrant children and adolescents, regardless of their country of origin, after controlling for gender and age. Thus, we compared the overweight and obesity status of children and adolescents born and raised in Mexico (Mexicans), born in Mexico and raised in the US (Mexican immigrants), and born and raised in the US (Mexican-Americans).

Methods

Study Population

The children and adolescents in our study were a subsample of children and adolescents of Mexican origin who were enrolled in 1 study conducted in Mexico and 2 studies conducted in Texas: (1) Cohort of Mexican School Age Children and Adolescents conducted in Toluca and Cuernavaca, Mexico, by the Universidad Autónoma del Estado de México, Instituto Mexicano del Seguro Social, and Instituto Nacional de Salud Pública; (2) Mano a Mano Cohort a Mexican-American population-based cohort study comprised of Mexican-American families residing in the Houston metropolitan area, Texas, conducted by the Department of Epidemiology at The University of Texas MD Anderson Cancer Center in Houston, Texas; and (3) From Mother to Child Project a cross-sectional study comprised of mothers and children of Mexican origin residing in Harris and Hidalgo Counties, Texas, conducted by the Center for Research on Minority Health, Department of Health Disparities Research, MD Anderson Cancer Center.

Detailed descriptions of the study populations and recruitment methodologies for the aforementioned studies have previously been published [3,14,17]. The study populations and recruitment, as well as the cohort for the study reported herein, are briefly described here:

Cohort of Mexican School Age Children and Adolescents

From March 2004 to April 2006 a total of 8,315 adults and their children (n=2,145) residing in Toluca and Cuernavaca, Mexico were enrolled in a cohort study of relatives of employees of the Instituto Mexicano del Seguro Social, the Universidad Autónoma del Estado de México, and the Instituto Nacional de Salud Pública.

The cohort study focused on lifestyle and health factors. The ethics committees from the participating Mexican institutions approved the research protocol before participants were enrolled, and signed informed consent forms were obtained from each cohort participant [17].

Mano a Mano Cohort

From July 2001 to January 2003, 562 households of Mexican-American families with children were enrolled in the Mano a Mano Cohort. The cohort included 886 Mexican-American children and adolescents between the ages of 5 and 18 years. The cohort was established to study social, behavioral, and genetic determinants of health among Mexican-origin children and adults. MD Anderson Cancer Center's institutional review board approved the study protocol; the mothers of the children and adolescents 5 to 15 years of age signed an informed assent form and the adolescents 16 years of age and older signed an informed consent form at the time of enrollment [3,15].

From Mother to Child Project

From August 2004 to August 2007, a total of 384 children and adolescents of Mexican origin ages 5 to 18 years residing in Baytown, Harris County, Texas, and in La Joya, Hidalgo County, Texas, were enrolled with their mothers in a community-based participatory research study

investigating the health risks associated with chronic pesticide exposure. MD Anderson Cancer Center's Institutional Review Board approved the study protocol; the mothers of the children and adolescents 5 to 15 years of age signed an informed assent form and the children and adolescents 16 years of age and older signed an informed consent at the time of enrollment [18].

Cohort for the Current Study

The total number of children, adolescents, and young adults who participated in the 3 studies was 3,415 but in the analyses presented in this paper, we included only individuals ages 5 to 19 years of age for whom the data needed for the analyses were available. Children 4 years of age or younger, individuals older than 19 years (n=994), individuals with missing data (n=277), females who were pregnant at the time of enrollment (n=24), and individuals who were adopted (n=26) were excluded from the analyses. After all of these exclusions, a total of 1,717 children and adolescents ages 5 to 19 years were included in the analyses presented in this paper.

Outcomes Measures

Body mass index (BMI) was calculated according to the US Centers for Disease Control and Prevention guidelines for children's BMI classification [19]. These guidelines take into consideration normal differences in body fat between boys and girls at various ages. In our paper, children and adolescents with BMI below the 5th percentile were classified as underweight, those with BMI from the 5th to the 84.9th percentile were classified as normal weight, those with BMI from the 85th to the 94.9th percentile were classified as overweight, and those with BMI at or above the 95th percentile were classified as obese.

Control Measures

Study participants were classified according to their country of birth and residential status as Mexicans (born and raised in Mexico). Mexican immigrants (born in Mexico but raised in the US) or Mexican-Americans (born and raised in the US).

The age of the study participants was calculated as the date of enrollment minus the date of birth, reported in years. For descriptive purposes, the participants' ages were categorized into 3 age groups: 5 to 9 years, 10 to 14 years, and 15 to 19 years.

Statistical Analyses

Statistical analyses were performed using the SPSS/PC statistical program (version 12.0 for Windows; SPSS, Inc., Chicago, IL). All statistical tests were 2-sided, with significance set at a p value of $< .05$.

Student's t tests were used to examine mean differences in the continuous variables, and Pearson's χ^2 tests were used to examine the associations between the categorical variables. Univariate multinomial logistic regression analyses and multivariate multinomial logistic regression analyses were used to determine which of the children and adolescents' demographic characteristics were associated with their overweight and obesity.

Multinomial logistic regression analysis is a robust technique that enables classification of participants on the basis of a set of predictor variables. The procedure breaks the regression into a series of binary regressions, in which is groups is compared to the reference group. In all of the regression analyses the children with normal weight served as the reference category.

Results of the Study

Selected demographic and anthropometric characteristics of the 1,717 children and adolescents included in this study by country of birth and residence status are summarized in Table 1.

Overall, there were more differences than similarities between the 3 groups of children and adolescents. The Mexican participants were older than the Mexican immigrants and Mexican-American participants ($p < .001$). Regardless of their country of birth, the participants who lived in the US had significantly higher mean BMIs than their Mexican counterparts ($p < .001$). Likewise, the participants who lived in the US were more likely to have BMIs at the 85th percentile or above (46% vs. 29.3%; $p < .001$). Mexican-Americans had the highest rates of overweight (20.6%) and obesity (28.1%).

The univariate multinomial logistic regression analyses (Table 2) showed that the odds of being overweight vs. normal weight were higher for the children and adolescents who lived in the US [Mexican-American: odds ratio (OR)=1.9 (95% confidence interval [CI], (1.4–2.6); Mexican immigrant: OR=1.4 (95% CI, 1.0–1.9)] than for their Mexican peers. A similar pattern was observed for the odds of being obese vs. normal weight [Mexican-American: OR=2.7 (95% CI, 2.0–3.7); Mexican immigrant: OR=2.3 (95% CI, 1.7–3.1)].

Although there were no gender differences in the odds of being overweight vs. normal weight, males were more likely than females to be obese vs. normal weight [OR=1.6 (95% CI, 1.2–2.0)]. Finally, the odds of being overweight vs. normal weight decreased with age; participants 15 to 19 years of age were leaner than their younger peers, specifically children 5 to 9 years of age [OR=0.4 (95% CI, 0.3–0.6)].

The multivariate multinomial logistic regression analyses (Table 3) showed that after controlling for country of birth, country of residence, gender and age, the odds of being overweight and obese remained higher for the children and adolescents who lived in the US than

for the Mexican children and adolescents. The same obesity patterns seen in the univariate analyses were observed in the multivariate analyses: males were more likely than females to be obese [OR=1.6 (95% CI, 1.2-2.1)], and older adolescents were leaner than children ages 5 to 9 years [OR=0.5 (95% CI, 0.4-0.7)].

Discussion and Conclusion

Most previous studies that evaluated the overweight and obesity status of children and adolescents of Mexican origin in the US did not include the country of birth of the population being studied [4,20-26]. For this reason, in this study we wanted to investigate and compare the overweight and obesity status of children born and raised in Mexico (Mexicans) to the overweight and obesity status of children and adolescents born and raised in the US (Mexican-Americans) and born in Mexico but raised in the US (Mexican immigrants).

The results of our study showed a positive relationship between migration of Mexican children to the US and an increased risk of overweight and obesity. Regardless of their country of birth (Mexico or US), the children and adolescents in our study who lived in the US had higher mean BMI than their Mexican-counterparts. Almost 50% of the Mexican-Americans and 43.2% of the Mexican immigrants ranked at the 85th BMI percentile or above, compared to only 29.3% of their Mexican peers (Table 1).

Consistent with previous findings [4,20-22] the prevalence of overweight and obesity among children and adolescents who lived in the US was far higher (48.8% for Mexican-Americans and 43.2% for Mexican immigrants) than the national US average of 34% [1]. The prevalence of overweight and obesity observed among the Mexican-American children in our study also exceeded the prevalence of overweight and obesity observed in studies conducted among

children and adolescents in Mexico [5,17]. In support of our hypothesis we found that children born and raised in Mexico were less likely to be overweight or obese than children of Mexican origin residing in the US, regardless of their country of birth (US or Mexico), even after controlling for gender and age (Table 3).

The fact that a large proportion of the Mexican-American and Mexican immigrant children and adolescents were overweight or obese may be associated with their socioeconomic status since for the most part individuals of Mexican origin in Texas tend to be of low socioeconomic status (23-24).

Our finding that older adolescents (15-19 years) were less likely to be overweight or obese than their younger peers (5 to 14 years) [Table 3] corroborates the findings from previous studies conducted in the US which, showed that the highest risk for being overweight or obese starts at younger ages among children of Mexican origin [3,23-26]. In addition, the high prevalence of obesity among young Mexican-American children is consistent with findings from other studies indicating that the prevalence of obesity among this minority population continues to increase [3,4]. The findings from the current study and from these other studies emphasizes the need to target preventive interventions at younger ages for children of Mexican origin [3], especially newly arrived immigrant children.

Our finding that boys were more likely to be obese than girls, even after controlling for age, country of birth, and country of residence (Table 3), corroborates the findings of previous studies among children in Mexico [5,6,17] and in the US [3,4,20-26], which showed a higher prevalence of obesity among boys than girls, especially among Mexican-American children residing in Texas [3,23,24].

The main limitation of our study was that we could not control for several factors that have

previously been associated with being overweight as data on these factors were not collected in all 3 studies. These factors include birth weight [6] dietary intake [26], socioeconomic status [26], family income [26], physical activity [26], parental education [26-27], number of hours spent watching television [28], and pubertal maturation status [29-30]. In addition, because of missing values, we did not assess the length of residence in the US of the children and adolescents who migrated to the US, since longer length of US residence has previously been associated with an increased risk for obesity among Mexican immigrants [3,15]. Finally, since the data included in the analyses were collected at 1 point in time, we cannot rule out that the lower prevalence of overweight and obesity observed among the older adolescents may be due to a trend toward a decrease in the prevalence of obesity in Mexican-American or Mexican children and adolescents, a cohort effect, or a point-estimate effect associated with pubertal stage such as increased weight related to growth. However, since 2 of the 3 studies from which participants were drawn for this study are members of ongoing cohorts, anthropometric measurements could be taken during the pubertal process, which would allow us to answer some of these questions in the future.

The high prevalence of overweight and obesity among Mexican-American and Mexican immigrant children and adolescents residing in Texas emphasizes the need to develop and implement preventive interventions for this at-risk minority population targeting the younger age groups, especially the newly arrived immigrant children. Additionally, future obesity research should include the country of origin of study participants to develop more culturally specific obesity interventions.

Acknowledgement

We thank the participants from the 3 studies for their cooperation and participation in the research. We also thank the staff of the studies for their collaboration in the conduct of the research, and Ms. Stephanie Deming from the Department of Scientific Publications, MD Anderson Cancer Center for her editorial comments. This research was supported by grants from the National Institutes of Health ([NCMHD P60-MD000503 (MAHV) and CA126988 (AVW)]; the Fulbright Scholarship Program (MAHV); the Caroline W. Law Fund for Cancer Prevention (MLB); funds collected pursuant to the Comprehensive Tobacco Settlement of 1998 and appropriated by the 76th legislature to MD Anderson Cancer Center (MLB); the Comisión Nacional de Ciencia y Tecnología (EHC); the Comisión Mexiquense de Ciencia y Tecnología (EHC); the Universidad Autónoma del Estado de México (LPBM and EHC), and the Instituto Mexicano del Seguro Social (EHC).

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Table 1. Selected demographic and anthropometric characteristics of children and adolescents of Mexican origin by country of birth and country of residence (n=1,717)

Characteristic	Mexican (N=894) %	Mexican Immigrant (N=257) %	Mexican-American (N=566) %	<i>p</i> ^a
Gender				
Male	48.9	47.3	47.3	
Female	51.1	52.7	52.7	.80 ^b
Mean age $\pm$ SD ^b , years (range)	13.4 $\pm$ 3.3 (7-19)	12.0 $\pm$ 4.1 (5-18)	11.6 $\pm$ 3.4 (5-18)	<.001 ^c
Categorical age, years				
5-9	15.3	32.1	36.1	
10-14	43.5	35.4	36.8	
15-19	41.2	32.5	27.1	<.001 ^b
Mean BMI $\pm$ SD (range)	20.7 $\pm$ 4.5 (11.8-37.5)	22.1 $\pm$ 6.2 (14.3-37.0)	22.0 $\pm$ 6.3 (11.3-48.2)	<.001 ^c
BMI percentile				
<5th (underweight)	4.8	6.7	4.7	
5th–84th (normal weight)	65.9	50.1	46.5	
85th–94th (overweight)	15.0	16.6	20.6	
$\geq$ 95th (obese)	14.3	26.6	28.1	<.001 ^b
Obesity status				
BMI <85th percentile	70.7	56.8	51.2	
BMI $\geq$ 85th percentile	29.3	43.2	48.8	<.001 ^b

Note: BMI = body mass index; SD = standard deviation.

^a*P* values for ^b χ^2 test and ^c2-sided *t*-test (Mexican vs. other).

Table 2. Univariate multinomial logistic regression models of selected demographic predictors of overweight (BMI 85th-94th percentile) and obesity (BMI $\geq$ 95th percentile)

in children and adolescents of Mexican origin (n=1,717)

Predictor	OR (95% CI)	
	Overweight	Obese
	vs. Normal Weight ^a	vs. Normal Weight ^a
Country of birth and country of residence		
Mexican	1.0 (–)	1.0 (–)
Mexican immigrant	1.4 (1.0-1.9)	2.3 (1.7-3.1)
Mexican-American	1.9 (1.4-2.6)	2.7 (2.0-3.7)
Gender		
Female	1.0 (–)	1.0 (–)
Male	0.9 (0.7-1.2)	1.6 (1.2-2.0)
Age, years		
5-9	1.0 (–)	1.0 (–)
10-14	1.2 (0.9-1.7)	0.7 (0.5-1.0)
15-19	0.8 (0.6-1.2)	0.4 (0.3-0.6)

Note: BMI = body mass index; OR = odds ratio; CI = confidence interval.

^aNormal weight (BMI 5th-84th percentile), base category.

Table 3. Multivariate multinomial logistic regression models of selected demographic predictors of overweight (BMI 85th-94th percentile) and obesity (BMI ≥95th percentile) in children and adolescents of Mexican origin (n=1,717), adjusted for country of birth, country of residence, gender and age

Predictor	OR (95% CI)	
	Overweight	Obese
	vs. Normal weight ^a	vs. Normal weight ^a
Country of birth and country of residence		
Mexican	1.0 (–)	1.0 (–)
Mexican immigrant	1.4 (1.0-2.0)	2.2 (1.6-3.0)
Mexican-American	1.9 (1.4-2.7)	2.5 (1.8-3.4)

Gender		
Female	1.0 (–)	1.0 (–)
Male	0.9 (0.7-1.2)	1.6 (1.2-2.1)
Age, years		
5-9	1.0 (–)	1.0 (–)
10-14	1.4 (1.0-2.0)	0.9 (0.6-1.2)
15-19	1.0 (0.7-1.4)	0.5 (0.4-0.7)

Note: BMI = body mass index; OR = odds ratio; CI = confidence interval.

^aNormal weight (BMI 5th-84th percentile), base category.