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Metabolic and nutritional profile differences among Mexican, Mexican-American and Non-Hispanic White children

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ABSTRACT

Objective. To compare somatometric variables, lipid profile, diet, and physical activity between Mexican children living in México (MEX), and Mexican-American (MXA) and Non-Hispanic White (NHW) children from the United States (US) to examine the possible influence of ethnicity and residency on these factors. **Material and methods.** Six to twelve years old children data from a study from central México and the US National Health and Nutrition Examination Survey was compared. Data were categorized to examine the effect of residency (MEX *vs.* MXA & NHW) and ethnicity (MEX *vs.* MXA & NHW) on the variables of interest. **Results.** Living in the US was associated with higher cholesterol levels in younger boys and older girls ($p < 0.05$), and high saturated fat intake in all groups ($p < 0.0001$). Living in México increased the likelihood of abnormal HDL ($p < 0.001$), systolic ($p < 0.001$), and diastolic blood pressure ($p < 0.0001$). Caucasian young girls were more likely to have high cholesterol intake ($p < 0.02$) than their Mexican counterparts. **Conclusions.** These findings suggest that residency is linked to impaired lipid profile and blood pressure in children, whereas ethnicity seems to have an impact on dietary choices.

Key words. Children. Hispanics. Obesity. Lipid profile. Dietary intake.

Diferencias en los perfiles metabólico y nutricio en niños mexicanos, mexicano-americanos y blancos no hispanos

RESUMEN

Objetivo. *Comparar variables somatométricas, perfil lipídico, dieta y actividad física de niños mexicanos que viven en México (MEX) y niños mexicano-americanos (MXA) y blancos no hispanos (NHW) de Estados Unidos, con el fin de examinar la posible influencia de la etnia y la residencia en estos factores.* ***Material y métodos.*** *Se compararon datos provenientes de un estudio del centro de México y de la Encuesta Nacional de Salud y Nutrición de los Estados Unidos (NHANES 2003-2004) de niños de seis a 12 años de edad. Los datos fueron categorizados para explorar el efecto de residencia (MEX* vs. *MXA y NHW) y la etnia (MEX* vs. *MXA y NHW) en las variables de interés.* ***Resultados.*** *Vivir en Estados Unidos se asoció con niveles elevados de colesterol en niños pequeños (6-9 años) y niñas mayores (10-12 años; $p < 0.05$) y alto consumo de grasas saturadas en todos los grupos ($p < 0.0001$). La probabilidad de presentar niveles anormales de HDL ($p < 0.001$), presión arterial sistólica ($p < 0.001$) y presión arterial diastólica ($p < 0.0001$) fue mayor en niños que viven en México. Las niñas caucásicas pequeñas resultaron ser más propensas a consumir cantidades altas de colesterol en comparación con sus homólogas mexicanas ($p < 0.02$).* ***Conclusiones.*** *Estos resultados sugieren que el lugar de residencia está relacionado con un perfil de lípidos y presión arterial desfavorables, mientras que la etnia parece tener impacto en las elecciones dietéticas.*

Palabras clave. *Niños. Hispanos. Obesidad. Perfil lipídico. Ingesta dietética.*

INTRODUCTION

The prevalence of childhood obesity dramatically grew in the past decades. Although slight decreases have been seen in the past few years in countries like the United States (US) and México, this remains a critical problem.[1-3] Conditions associated with obesity, such as type 2 diabetes, hyperlipidemia, hypertension, and cardiovascular disease, formerly affected only adults, are currently prevalent among children.[4,5] Moreover, obese children are at high risk of becoming obese adults.[6] Childhood obesity is, thus, likely to seriously affect quality of life and shorten life expectancy.[7]

Hispanics are among the ethnic groups more prone to develop abdominal obesity and type 2 diabetes.[8-10] In México, 14.6% of the 5-to-11 year old children fall into the obesity category.[2] Despite the obesity prevalence in this group has shown a slight decrease in the past 6 years, it is still growing among children under 5 years of age.[2] Hispanic children in the US are disproportionally affected-21% of Mexican-American children 2-to-19-year old are at or above the 95th percentile of BMI for age.[3]

Increased availability and salience of energy-dense food and beverages, larger portion sizes, greater meal frequency, inadequate intake of fruit and vegetables, and limited safe play areas, characteristic of contemporary environments, are considered important contributors to obesity rates.[11-14]

Comparisons between the same ethnicity but in different residencies have been made to discern behavioral or environmental from heredity influences. Higher prevalence of overweight and obesity was found among Chinese adolescents living in California than those living in Wuhan, China.[15] One of the most significant of these epidemiological studies assessed the risk of cardiovascular disease among Japanese living in Nippon, Japan, Honolulu, Hawaii, and San Francisco, California, reporting lowest cardiovascular mortality in Japan and the highest in San Francisco.[16] However, to our knowledge, metabolic and dietary differences between Mexican children living in México and Mexican children living in the US have not been ascertained to date.

The purpose of this study was to compare somatometric variables, lipid profile, diet, and physical activity between Mexican children living in México, and Mexican-American and Non-Hispanic White children from the US to examine the influence of ethnicity or residency on these factors. We hypothesize that differences in the aforementioned variables among Mexican (MEX), Mexican-American (MXA), and Non-Hispanic White (NHW) children are better explained by residency than ethnicity.

MATERIAL AND METHODS

Data used for this study came from 2 sources, a study from central México (MEXS) and the National Health and Nutrition Examination Survey (NHANES 2003-2004). The MEXS group was obtained from randomly selected grammar schools in the cities of San Luis Potosí and León, in central México, using the Ministry of Education registries. Within each school, subjects were selected by means of an age based stratified random selection. Data were obtained from the children and one parent by direct questioning or measurement in the children.[17] The study was approved by the Faculty of Medicine of Universidad de San Luis Potosí Ethical Board, and each child and parent gave informed consent.

The NHANES assesses the health and nutritional status of adults and children in the US using a multistage, stratified sample of respondents that is representative of the civilian non-institutionalized population, approved by the National Center for Health Statistics' Institutional Review Board.[18] NHANES 2003-2004 was selected because this period had Mexican-American dietary data relevant to this study and coincided with Mexican data collection. Data from Mexican-American and non-Hispanic White children aged 6-12 years old were used for the analysis. Cases without diet data were excluded. This study was reviewed and approved by the University of Illinois Institutional Review Board.

Variables in both databases measured in a similar manner were selected, with a more detailed description available elsewhere.[17,18] Body mass index (BMI) was calculated from weight and height data obtained using a calibrated column-scale with stadiometer (Detecto-Medic) in the MEXS, and a calibrated electronic scale (Toledo) and stadiometer (Seca) in NHANES. The International Obesity Task Force standards were used to determine age- and gender-specific weight status based on BMI, categorizing as healthy weight, overweight or obese.[19] Waist circumference (WC) was measured in centimeters (cm), with children at or above the 90th percentile identified as having high WC.[20]

In the MEXS systolic and diastolic blood pressure (BP) were obtained using an appropriate cuff size for each child.[21] In the NHANES these parameters were taken only in children older than 8 years old. Population-based percentiles were used to categorize children as having normal or abnormal BP if they were below or above the 90th percentile, respectively.[21]

Fasting blood samples were collected after venous blood drawn to ascertain levels of triglycerides, cholesterol, low-density lipoprotein (LDL), and high-density lipoprotein (HDL). Enzymatic techniques (Hitachi instrument model 911, Tokyo, Japan) were used for the MEXS, while in NHANES a Tosoh method was used. The cut-off points recommended by National Cholesterol Education Program Pediatric Report were used for the lipid profile categorization.[22]

Data from 24-h dietary recalls available in both surveys were used to dietary analysis. The US Department of Agriculture automated multiple pass method was used to record the NHANES dietary data, and the Food and Nutrient Database for Dietary Studies (FNDDS 2.0) was used for dietary assessment. In the MEXS, 24-h recalls were recorded during an interview and the data obtained was entered and analyzed using NUTRI KAL software (Universidad Autónoma de Nuevo León, México). Energy and macronutrient intakes were compared to the Dietary Reference Intakes and the American Heart Association dietary recommendations to create categories reflecting dietary adequacy.[23,24] The Estimated Energy Requirement (EER) for age and sex was calculated; total energy intake was deemed adequate if equal or greater than the calculated EER. The Estimated Average Requirement (EAR) for protein was estimated considering age and body weight; adequate protein intake was determined if equal or greater than calculated EAR.[23] Carbohydrate intake was categorized adequate if equal or greater than 100 g.[23] Dietary fiber Adequate Intake (AI) for age and sex was obtained; adequate dietary fiber intake was determined if equal or greater than calculated AI.[23] When saturated fat intake was less than 7% of the total energy intake, it was categorized as acceptable. Dietary cholesterol intake was deemed acceptable if less than 200 mg.[24]

Exercise, quantified as the reported times per week playing or exercising enough to sweat and breathe hard, and the reported average of hours per day spent watching television or playing video games, were the only two items related to physical activity recorded in both surveys similarly.

Data were analyzed using SAS (version 9.2, SAS Institute, Inc., Cary, NC, 2007), and are presented as medians and inter-quartile range (IQR) or percentages when appropriate. Each study group was divided into 2 age groups (i.e., younger, 6-9 years old and older, 10-12 years old) for the analysis. Analysis of variance was used to compare variables among MEX, MXA, NHW, followed by Tukey's *post hoc* analysis. Categorical variable comparisons were made using Chi-square tests. Residency and Ethnicity variables were created; children living in the US (i.e., MXA & NHW) were grouped together to compute Residency; children of Mexican origin (i.e., MEX & MXA) were merged to compute Ethnicity. The impact of residency and ethnicity on metabolic and dietary variables was then explored with stepwise multiple logistic regression, using the LOGISTIC procedure in SAS. In a first round of analysis, the response of each categorized variable was evaluated having the rest of the variables in the model as explanatory variables. In a second round, explanatory variables that remained significant after the last selection step were included in the final model for its corresponding response variable. The final model estimators are reported.

In order to account for the unequal probabilities of selection, non-response adjustments, and adjustments to independent population controls derived from the complex sampling design of NHANES, a second round of analysis, in which only MXA and NHW groups were compared, was performed following NHANES analytical guidelines using stratum (SDMVSTRA), cluster (SDMVPSU), and weight (WTMEC2YR for BMI, WC, total cholesterol, HDL-cholesterol, systolic BP, and diastolic BP; WTSAF2YR for triglycerides and LDL-cholesterol; WTDRD1 for diet variables; and WTINT2YR for TV hours) variables provided in the NHANES databases.[18] Medians and quartiles for continuous variables were obtained using the SURVEYMEANS procedure in SAS; frequencies and percentages for categorical variables were obtained with SURVEYFREQ. Differences between study groups were explored using SURVEYREG for continuous variables and SURVEYLOGISTIC for categorical variables.

Analysis of variance was used to analyze the effect of gender on the variables of interest. Those variables, for which gender differences were significant, were adjusted by adding gender as a covariate in the model. Likewise, dietary variables were adjusted for energy intake by including this variable in the model. Significance level was set at alpha ≤ 0.05.

RESULTS

The MEXS sample included 582 children; the NHANES data comprised 703 cases, including 372 Mexican-American children, and 331 Non-Hispanic White children.

Table 1 shows the differences in somatometric variables, lipid profile, blood pressure, and exercise. Gender differences were found for weight at birth ($F = 7.53$, $p < 0.01$) and exercise ($F = 8.13$, $p < 0.01$) in the younger group; and triglyceride ($F = 13.79$, $p < 0.001$), systolic BP ($F = 4.27$, $p < 0.05$), and exercise ($F = 9.48$, $p < 0.01$) in the older group. Therefore, gender adjustments were done for those variables.

Younger MEX children were significantly lighter than MXA, and the smallest of the 3 groups (weight, $F = 4.64$, $p < 0.01$; height $F = 9.76$, $p < 0.0001$), whereas older MEX children were lightest and smallest (weight, $F = 24.33$, $p < 0.0001$; height, $F = 62.40$, $p < 0.0001$). Even though waist circumference was larger in MXA than in MEX in both age groups, the difference was notably larger among older children (younger, $F = 4.20$, $p < 0.014$; older, $F = 10.40$, $p < 0.0001$). Older NHW children had significantly greater weight at birth than older MEX children ($F = 7.41$, $p < 0.001$).

As depicted in table 2, in the younger group, overweight frequency was higher in MXA (24% *vs.* MEX 15.3% & NHW 18.2%; $\chi^2 = 9.80$, $p < 0.04$), whereas the proportion of obese children was similar between MEX (13.9%) and MXA (12.6%) with the smallest among NHW (9.4%, $\chi^2 = 9.80$, $p < 0.04$). Older MXA had the smallest number of children within the acceptable WC range (68.4% *vs.* MEX 80.4% and NHW 74.7%; $\chi^2 = 7.07$, $p < 0.03$).

Total cholesterol and HDL-cholesterol were lower in MEX in both younger ($F = 19.40$, $p < 0.0001$ and $F = 49.49$, $p < 0.0001$, respectively) and older children ($F = 18.10$, $p < 0.0001$, and $F = 36.64$, $p < 0.0001$, respectively). Diastolic BP was different among the 3 groups, with MEX children presenting the highest values ($F = 94.46$, $p < 0.0001$). No differences were found for LDL-cholesterol, triglycerides, and systolic BP.

As a result, regardless of the age group, MEX had the greatest proportion of children with acceptable values of cholesterol (younger, 74.5% *vs.* MXA 64.5% and NHW 54.2%, $\chi^2 = 21.0$, $p < 0.001$; older, 78.0% *vs.* MXA 66.5% and NHW 56.9%, $\chi^2 = 17.5$, $p < 0.01$) (Table 2), but also less children with normal values of HDL (younger, MEX 72.1% *vs.* MXA 90.1% and NHW 90.1%, $\chi^2 = 34.0$, $p < 0.0001$; older, MEX 64.6% *vs.* MXA 84.8% and NHW 87.7%, $\chi^2 = 32.06$, $p < 0.0001$). Similarly, the proportion of MEX children with normal values of systolic and diastolic BP was smaller than the other two groups (systolic BP, MEX 83.2% *vs.* MXA 95.3% and NHW 94.8%, $\chi^2 = 20.50$, $p < 0.0001$; diastolic BP, MEX 76.6% *vs.* MXA 98.2% and NHW 98.7%, $\chi^2 = 66.95$, $p < 0.0001$).

Significantly lower physical activity was found in the MEX group for both age groups (younger, $F = 3.33$, $p < 0.04$; older, $F = 6.46$, $p < 0.01$) (Table 1). On the other hand, no differences were seen in the proportion of children spending 2 or more hours a day watching TV or videos (Table 2).

Similar results were obtained after analyzing NHANES data (MXA and NHW) according to NHANES guidelines, using sample weights, cluster and strata variables (Table 3). No significant differences between MXA and NHW children were found, except for diastolic BP which remained significant as in the original analysis ($F = 5.14$, $p < 0.04$).

Since gender effect was significant for energy intake in both age groups, all diet comparisons were made controlling for gender (Table 4). Younger MEX children reported higher energy ($F = 11.36$, $p < 0.0001$), protein ($F = 8.23$, $p < 0.001$), carbohydrate ($F = 18.70$, $p < 0.0001$), fiber ($F = 8.59$, $p < 0.001$), and dietary cholesterol intakes ($F = 8.01$, $p < 0.001$), with boys having consistently higher intakes than girls. Similarly, older MEX had the highest intake of energy ($F = 4.08$, $p < 0.017$), carbohydrate ($F = 13.39$, $p < 0.0001$), fiber ($F = 8.18$, $p < 0.001$), and dietary cholesterol ($F = 6.16$, $p < 0.01$). Dietary fat was also the highest within MEX in both age groups, but was statistically significant only after controlling for energy (younger, $F = 12.97$, $p < 0.0001$; older, $F = 18.70$, $p < 0.0001$).

In line with those results, the proportion of MEX at or above the Estimated Energy Requirement (EER) was significantly higher compared to MXA and NHW in both age groups (younger, MEX 75.1% *vs.* MXA 62.6% and NHW 53.9%, $\chi^2 = 24.67$, $p < 0.0001$; older, MEX 56.9% *vs.* MXA 45.9% and NHW 45.3% ($\chi^2 = 6.39$, $p < 0.04$) (Table 5). Conversely, the MXA and NHW reported greater intakes of saturated fat, and thus the proportion of children in these groups meeting the AHA Guidelines for saturated fat was smaller than among MEX (younger, MXA 6.4% and NHW 6.5% *vs.* MEX 31.4%, $\chi^2 = 70.5$, $p < 0.0001$; older, MXA 6.3% and NHW 6.7% *vs.* MEX 43.5, $\chi^2 = 101.7$, $p < 0.0001$). Likewise, fewer NHW met the dietary fiber recommendations (younger, NHW 1.9% *vs.* MEX 9.9% and MXA 8.0%, $\chi^2 = 9.78$, $p = 0.007$; older, NHW 4.0% *vs.* MEX 12.9% and MXA 8.8%, $\chi^2 = 8.44$, $p < 0.015$). However, the number of young NHW within acceptable dietary cholesterol levels was greater than in MEX and MXA (NHW 64.9% *vs.* MEX 47.2% and MXA 49.7%; $\chi^2 = 14.14$, $p < 0.0009$).

Table 1. Differences in somatometric variables, lipid profile, blood pressure, and exercise between Mexican, Mexican-American, and Non-Hispanic White children.

	Mexican			Mexican-American			Non-Hispanic White			F*	p
	Median (25, 75 Percentile)		n	Median (25,75 Percentile)		n	Median (25, 75 Percentile)		n		
• Younger (6-9 years old)											
Weight, kg	26.6	(22.1, 31.4)^{a}	373	28.4	(24.5, 33.7)^{b}	198	27.7	(23.5, 32.6)^{a,b}	170	4.64	< 0.01
Height, cm	125	(120.0, 131.0)^{a}	373	127.9	(122.2, 135.3)^{b}	198	128.8	(122.7, 134.9)^{b}	170	9.76	< 0.0001
BMI, kg/m^2	16.6	(15.1, 19.2)	373	17.2	(15.8, 19.4)	198	16.3	(15.3, 18.5)	170	2.80	0.06
Waist circumference, cm	58.5	(54.0, 65.7)^{a}	373	60.9	(55.5, 68.7)^{b}	192	59	(55.2, 65.8)^{a,b}	170	4.2	0.01
Weight at birth, g	3200 -28,003,550		293	3345 -30,053,671		188	3402 -29,773,685		168	2.14	0.12‡
Boys	3250 -29,003,600		137	3317 -30,053,629		80	3430 -31,613,742		77		
Girls	3200 -28,003,500		156	3374 -30,053,685		83	3402 -29,773,912		81		
Total Cholesterol, mg/dL	149	(131.0, 170.0)^{a}	373	158	(146.2, 177.0)^{b}	172	164	(145.0, 181.0)^{b}	131	19.40	< 0.0001
HDL-Cholesterol, mg/dL	45.2	(39.0, 52.5)^{a}	373	53	(48.0, 62.0)^{b}	172	55	(46.0, 62.0)^{b}	131	49.49	< 0.0001
LDL-Cholesterol, mg/dL	88.9	(75.5, 103.6)	373	90	(78.0, 101.0)	83	90	(67.7, 108.2)	66	0.82	0.44
Triglyceride, mg/dL	84	(64.0, 114.0)	373	71	(53.0, 112.0)	83	83	(60.0, 119.0)	66	0.93	0.39
Exercise, hrs/week	2	(0, 7)^{a}	373	7	(5, 7)^{a,b}	198	7	(4, 7)^{b}	170	3.33	0.04‡
Boys	3	(1, 9)	192	7	(5, 7)	96	7	(5, 7)	84		
Girls	2	(0, 7)	181	5	(3, 7)	102	7	(3.75,7)	86		
• Older (10-12 years old)											
Weight, kg	39	(32.8, 46.5)^{a}	209	46.1	(37.5, 58.5)^{b}	174	46.2	(38.1, 54.7)^{b}	161	24.33	< 0.0001
Height, cm	142	(136.0, 148.0)^{a}	209	149.8	(144.0, 156.0)^{b}	174	151.8	(146.3, 157.3)^{b}	161	62.40	< 0.0001
BMI, kg/m^2	18.9	(17.2, 22.2)^{a}	209	20.6	(17.4, 24.3)^{b}	174	19.2	(17.2, 22.8)^{a,b}	161	6.63	< 0.01
Waist circumference, cm	68	(62.0, 77.0)^{a}	209	73.9	(64.7, 84.5)^{b}	168	71.5	(64.6, 80.4)^{a,b}	158	10.40	< 0.0001
Weight at birth, g	3200	(2800, 3600)^{a}	181	3345	(3005, 3657)^{a,b}	163	3402	(3090, 3827)^{b}	158	7.410	< 0.001
Total cholesterol, mg/dL	144	(127.5, 166.5)^{a}	209	158.5	(158.5, 177.2)^{b}	158	166	(149.0, 181.2)^{b}	130	18.10	< 0.0001
HDL-cholesterol, mg/dL	43.8	(36.8, 50.2)^{a}	209	52	(44.7, 60.5)^{b}	158	52.5	(46.0, 61.0)^{b}	130	36.64	< 0.0001
LDL-cholesterol, mg/dL	87	(72.0, 104.0)	209	92	(73.0, 101.5)	68	91	(76.0, 106.5)	57	0.77	0.46
Triglyceride, mg/dL	100	(73.5, 131.5)	209	93.5	(58.0,127.5)	68	99	(66.5, 127.0)	57	0.83	0.44†
Boys	95	(67.2, 125.2)	94	73.5	(52.5,109.0)	34	77.5	(53.0, 120.5)	24		
Girls	109	(80.0, 139.0)	115	104.5	(72.2, 139.5)	34	109	(75.5,139.5)	33		
SBP, mmHg	105.3	(99.3, 115.0)	209	104	(100.0, 110.0)	170	104	(98.7, 112.0)	154	1.22	0.30§
Boys	105.1	(99.3, 116.6)	94	106	(100.0, 112.0)	82	106	(100.0, 113.7)	76		
Girls	105.3	(99.3, 115.0)	115	103	(99.0, 109.0)	88	102.5	(96.7, 109.0)	78		
DBP, mmHg	70	(60.0, 76.6)^{a}	209	58	(50.0, 64.2)^{b}	170	56	(47.7, 62.0)^{c}	154	94.46	< 0.0001
Exercise, hrs/week	2	(0, 7)^{a}	209	7	(3, 7)^{a,b}	102	6	(3, 7)^{b}	89	6.46	< 0.01‡
Boys	4	(0.75, 8)	94	7	(4, 7)	43	7	(3.5, 7)	37		
Girls	1	(0, 3)	115	5	(3, 7)	59	5	(3, 7)	52		

Comparisons of study groups made with analysis of variance. Superscripts denote statistical differences between study groups as Tukey's *post hoc* analysis revealed-same superscripts and both superscripts indicate no statistical differences, whereas groups with different superscripts are statistically different at $p \leq 0.05$. * NHANES sampling design was not accounted for; results may not be reliable. Gender effect: † $p < 0.001$. ‡ $p < 0.01$. § $p < 0.05$. SBP: systolic blood pressure. DBP: diastolic blood pressure.

Table 2. Differences in the proportion of Mexican, Mexican-American, and Non-Hispanic White children within categories of somatometric variables, lipid profile, and blood pressure.

Variable[a]	Mexican n (%)	Mexican-American n (%)	Non-Hispanic White n (%)	χ^{2*}	p
Younger (6-9 years old)					
Overweight	57 (15.3)	49 (24.7)	31 (18.2)	9.8	0.04
Obesity	52 (13.9)	25 (12.6)	16 (9.4)		
Waist circumference, acceptable	313 (83.9)	146 (76)	138 (82.6)	5.39	0.07
Total cholesterol, acceptable	278 (74.5)	111 (64.5)	71 (54.2)	21	0.0003
HDL-cholesterol, normal	269 (72.1)	155 (90.1)	118 (90.1)	34	< 0.0001
LDL-cholesterol, acceptable	300 (80.4)	71 (85.5)	52 (78.8)	2.39	0.67
Triglyceride, normal	270 (72.4)	62 (74.7)	47 (71.2)	0.26	0.88
TV, ≤ 2 hours per day	223 (59.8)	125 (63.1)	110 (64.7)	1.4	0.50
Older (10-12 years old)					
Overweigh	52 (24.9)	49 (28.2)	45 (27.9)	9.30	0.05
Obesity	22 (10.5)	35 (20.1)	22 (13.7)		
Waist circumference, acceptable	168 (80.4)	115 (68.4)	118 (74.7)	7.07	0.03
Total cholesterol, acceptable	163 (78)	105 (66.5)	74 (56.9)	17.5	0.0015
HDL-cholesterol, normal	135 (64.6)	134 (84.8)	114 (87.7)	32.06	< 0.0001
LDL-cholesterol, acceptable	177 (84.7)	56 (82.3)	45 (78.9)	1.34	0.85
Triglyceride, normal	123 (58.8)	45 (66.2)	34 (59.6)	1.17	0.056
SBP, normal	174 (83.2)	162 (95.3)	146 (94.8)	20.50	< 0.0001
DBP, normal	160 (76.6)	167 (98.2)	152 (98.7)	66.95	< 0.0001
TV, ≤ 2 h per day	132 (63.2)	112 (64.4)	105 (65.2)	0.17	0.92

Categorical comparisons between study groups made with Chi-square tests. * NHANES sampling design was not accounted for; results may not be reliable. [a] Variable cutoff points: 1. Overweight and obesity age- and sex-specific categorization according to the International Obesity Task Force.[19] 2. Acceptable waist circumference if < 90th percentile adjusted for age, sex, and ethnicity.[20] 3. Acceptable total cholesterol if < 170 mg/dL.[22] 4. Normal HDL-cholesterol if < 40 mg/dL.[22] 5. Acceptable LDL-cholesterol if < 110 mg/dL.[22] 6. Normal triglycerides if < 110 mg/dL.[22] 7. Normal systolic and/or diastolic blood pressure if < 90th percentile adjusted for age, sex, and height.[21] SBP: systolic blood pressure. DBP: diastolic blood pressure.

Most diet results were similar after differences between MXA and NHW were analyzed considering the NHANES sampling design. The only exception was dietary fiber, which lost statistical significance in both age groups (younger, $F = 3.43$, $p = 0.08$; older, $F = 3.08$, $p = 0.10$).

When data were categorized by residency (MEX *vs.* MXA & NHW) and ethnicity (MEX & MXA *vs.* NHW), younger boys in the US were 48% more likely to have borderline values of total cholesterol and 6 times more likely to have high total cholesterol levels than younger boys living in México ($\chi^2 = 9.15$, $p < 0.01$) (Table 6); however, because the 95% confidence intervals include 1, these differences might not be real. Living in the US also increased the chances of having inadequate energy intake (boys, OR = 1.83, $p = 0.01$; girls, OR = 2.69, $p < 0.0001$) and high saturated fat intake (boys, OR = 5.59, $p < 0.0001$; girls, OR = 7.88, $p < 0.0001$).

As for the older children, US girls showed an 87% increase in the chances of having high total cholesterol levels and more than double the risk of having borderline levels ($\chi^2 = 7.05$, $p < 0.03$ (Table 6); they were also 3 times more likely to have inadequate energy intake than older girls living in Mexico ($\chi^2 = 18.41$, $p < 0.0001$). Compared to children living in Mexico, boys in the US were almost 10 times more likely to have high saturated fat intake ($\chi^2 = 34.21$, $p < 0.0001$); whereas girls had 12 times the risk ($\chi^2 = 43.9$, $p < 0.0001$).

On the other hand, living in México increased the chances of having abnormal HDL levels by more than 3 times in boys (younger, $\chi^2 = 14.32$, $p < 0.0002$; older, $\chi^2 = 11.75$, $p < 0.0006$) and by more than 5 times and 4 times in younger and older girls, respectively (younger, $\chi^2 = 23.69$, $p < 0.0001$; older, $\chi^2 = 21.83$, $p < 0.0001$); Living in México also increased the risk of abnormal systolic (boys, OR = 5.01, $p < 0.001$; girls, OR = 5.91, $p < 0.001$), and diastolic BP (boys, OR = 60.56, $p < 0.0001$; girls, OR = 15.48, $p < 0.0001$).

Regarding ethnicity, young NHW girls were almost 3 times more likely to have borderline total cholesterol levels and had 26% greater chances of having high total cholesterol than MEX and MXA

Table 3. Somatometric and cardiovascular characteristics of Mexican-American, and Non-Hispanic White children.

	Mexican-American		Non-Hispanic White		F*	p
	Median (IQR)	n	Median (IQR)	n		
• Younger (6-9 years old)						
Weight, kg	28.5 (24.4, 33.7)	198	28 (23.5, 32.8)	170	0.88	0.36
Height, cm	128.1 (122.3, 135.2)	198	128.9 (122.9, 134.8)	170	0.06	0.81
BMI, kg/m^2	17.2 (15.8, 19.2)	198	16.4 (15.4, 18.5)	170	3.15	0.096
Waist circumference, cm	61 (55.7, 68.3)	192	59.3 (55.3, 66.0)	170	1.36	0.26
Weight at birth, g	3319.2 -29, 923,645	188	3382.4 (2972, 3668)	168	0.04	0.85
Total cholesterol, mg/dL	156.4 (146.4, 175.4)	172	163.2 (144.2, 179.3)	131	0.45	0.51
HDL-cholesterol, mg/dL	53 (47.0, 61.7)	172	53.3 (44.9, 60.9)	131	0.51	0.49
LDL-cholesterol, mg/dL	89.6 (77.9, 100.0)	83	87.5 (67.2, 107.7)	66	0.47	0.5
Triglyceride, mg/dL	69.6 (51.5, 108.1)	83	81.7 (58.4, 118.4)	66	0.88	0.36
Exercise, h/week	6.1 (4.1, 6.6)	198	6.2 (4.0, 6.7)	170	1.82	0.2
• Older (10-12 years old)						
Weight, kg	45.7 (36.9, 57.2)	174	45.2 (37.0, 54.0)	161	0.74	0.41
Height, cm	148.8 (143.1, 155.1)	174	151.2 (144.6, 156.9)	161	1.37	0.26
BMI, kg/m^2	20.7 (17.3, 24.0)	174	19.2 (17.1, 22.8)	161	1.77	0.2
Waist circumference, cm	73.9 (63.9, 81.5)	168	71.3 (64.4, 80.4)	158	0.72	0.41
Weight at birth, g	3300.8 (2977, 3630)	163	3397.0 (3057,3783)	158	2.04	0.17
Total cholesterol, mg/dL	160.6 (146.2, 177.2)	158	165.5 (148.5, 179.9)	130	0.56	0.47
HDL-cholesterol, mg/dL	51.4 (42.8, 60.2)	158	52.6 (45.8, 60.7)	130	0.36	0.56
LDL-cholesterol, mg/dL	92.3 (75.9, 101.4)	68	89.1 (75.2, 104.3)	57	0.03	0.86
Triglyceride, mg/dL	90.4 (57.8, 127.5)	68	97 (66.0, 126.1)	57	0.01	0.93†
Boys	73.9 (56.9, 109.2)	32	71.6 (52.2, 113.1)	24		
Girls	98.8 (68.8, 139)	33	108.2 (77.2, 137.3)	33		
SBP, mmHg	103.8 (99.0, 109.7)	170	103.6 (98.6, 111.1)	154	0.16	0.69
DBP, mmHg	57.4 (51.4, 65.3)	170	54.7 (46.9, 61.6)	154	5.14	0.04‡
Boys	57.8 (52.7, 65)	82	52.7 (43.7, 57.8)	76		
Girls	56 (49.8, 66.1)	88	56.6 (49.1, 63.8)	78		
Exercise, h/week	6.1 (3.1, 6.7)	102	5.7 (2.8, 6.8)	89	3.11	0.098

Comparisons of study groups as reflected in the analysis of variance from regression modeling. *Analysis made applying NHANES sample weights, strata, and cluster variables. Gender effect: †p < 0.001. ‡p < 0.05. IQR: inter-quartile range. BMI: body mass index. SBP: systolic blood pressure. DBP: diastolic blood pressure.

girls combined ($\chi^2 = 11.13$, $p < 0.004$) (Table 6). Likewise, older NHW boys were almost 3 times more likely to present borderline total cholesterol values and had 67% greater likelihood of having high levels of this parameter than older MEX and MXA boys ($\chi^2 = 8.62$, $p < 0.01$). Young MEX girls were 86% more likely to report high dietary cholesterol intake ($\chi^2 = 4.96$, $p < 0.02$). Inadequate protein intake was almost 5 times more likely to happen among older NHW boys ($\chi^2 = 7.60$, $p < 0.006$) and 3 times likely among older NHW girls than among MEX and MXA children ($\chi^2 = 4.42$, $p < 0.03$).

DISCUSSION

We compared somatometric variables, lipid profile, diet, and physical activity between MEX children, and MXA and NHW children from the US from a study conducted in central México and the NHANES 2003-2004 and examined the possible influence of the ethnicity and residency on these factors. To our knowledge, this is the first study comparing Mexican children from México with MXA and NHW children in the US. Although the data from the

Table 4. Dietary differences between Mexican, Mexican-American, and Non-Hispanic white whildren.

	Mexican			Mexican-American			Non-Hispanic white			F*	p
	Median	(25, 75 Percentile)	n	Median	(25, 75 Percentile)	n	Median	(25, 75 Percentile)	n		
• Younger (6-9 years old)											
Energy, kcal	2284	(1857, 2661)[a]	373	1975	(1574, 2373)[b]	187	1922	(1566, 2371)[b]	154	11.36	< 0.0001†
Boys	2312	(1931, 2788	192	2075	(1709, 2424)	92	1971	(1695, 2617)	76		
Girls	2164	(1771, 2581	181	1866	(1517, 2284)	95	1765	(1432, 2186)	78		
Protein, g	72.7	(55.8, 92.9)[a]	373	64.3	(50.1, 89.8)[a,b]	187	60.9	(50.7, 75.7)[b]	154	8.23	< 0.001§
Boys	76.6	(57.9, 94.7)	192	66	(51.5, 92.1)	92	66.7	(54.8, 84.9)	76		
Girls	67.6	(54.7, 91.6)	181	63.1	(49.9, 84.3)	95	56.7	(47.2, 68.3)	78		
Carbohydrate, g	327.9	(257.8, 404.2)[a]	373	271.7	(213.7, 331.3)[b]	187	266.2	(210.2, 334.1)[b]	154	18.70	< 0.0001†
Boys	331.9	(261.8, 416.0)	192	281.5	(231.1, 338.2)	92	288.6	(228.7, 349.2)	76		
Girls	322	(246.8, 401.0)	181	261.2	(202.9, 327.4)	95	234.4	(195.2, 318.1)	78		
Dietary fiber, g	13.9	(8.8, 19.1)[a]	373	12.9	(9.6, 18.4)[a]	187	11.0	(8.0, 14.7)[b]	154	8.59	< 0.001
Total fat, g	73.5	(56.9, 91.0)	373	68.7	(52.1, 93.8)	187	70.4	(53.5, 91.2)	154	0.1	0.91‡
Boys	76.3	(62.3, 93.7)	192	69.8	(52.1, 99.0)	92	75.1	(51.6, 95.3)	76		
Girls	72.2	(54.4, 89.1)	181	67.2	(52.1, 86.7)	95	65.9	(53.9, 87.8)	78		
Saturated fat, g	21.4	(15.3, 27.9)[a]	373	24.1	(18.4, 33.3)[b]	187	25.5	(18.8, 33.5)[b]	154	16.24	< 0.0001§
Boys	22.9	(16.0, 28.9)	192	24.9	(18.5, 32.1)	92	25.7	(19.4, 37.7)	76		
Girls	20	(14.6, 26.7)	181	23.2	(17.1, 34.9)	95	25	(18.0, 32.4)	78		
Dietary cholesterol, mg	215.8	(125.3, 374.6)[a]	373	200	(120.0, 365.0)[a]	187	161.5	(114.5, 238.7)[b]	154	8.01	< 0.001
• Older (10-12 years old)											
Energy, kcal	2319	(1931, 2913)[a]	209	2038	(1684, 2639)[a,b]	159	2048	(1617, 2578)[b]	150	4.08	0.017‡
Boys	2186	(1851, 2921)	94	2199	(1696, 2877)	78	2350	(1796, 2767)	71		
Girls	2444	(1954, 2891)	115	2000	(1684, 2448)	81	1909	(1507, 2374)	79		
Protein, g	76.8	(59.3, 91.9)	209	69.3	(53.9, 91.6)	159	69.2	(47.6, 89.1)	150	1.11	0.33†
Carbohydrate, g	339.9	(271.1, 436.1)[a]	209	278.3	(227.8, 367.4)[b]	159	285.7	(229.4, 373.4)[b]	150	13.39	< 0.0001
Dietary fiber, g	15.3	(10.2, 21.1)[a]	209	15	(11.1, 21.1)[a]	159	11.8	(8.4, 16.8)[b]	150	8.18	< 0.001
Total fat, g	70.6	(55.1, 93.0)	209	76.7	(55.6, 104.6)	159	73.1	(56.8, 94.6)	150	0.99	0.37‡
Boys	69.4	(54.8, 94.1)	94	78.1	(58.6, 112.2)	78	80	(60.7, 97.8)	71		
Girls	71.8	(55.4, 92.5)	115	74.8	(52.3, 90.2)	81	69.6	(52.4, 89.9)	79		
Saturated fat, g	19	(14.2, 25.9)[a]	209	25.1	(20.6, 35.1)[b]	159	25.3	(17.8, 34.9)[b]	150	20.12	< 0.0001‡
Boys	19.3	(14.2, 25.7)	94	25.7	(21.2, 41.2)	78	26.9	(18.7, 38.5)	71		
Girls	18.8	(13.6, 26.4)	115	24.1	(19.5, 32.8)	81	23.8	(17.3, 32.6)	79		
Dietary Cholesterol, mg	211.8	(116.2, 396.6)[a]	209	185	(126.0, 318.0)[a]	159	171	(117.2, 251.7)[b]	150	6.16	< 0.01§
Boys	268.2	(132.3, 450.2)	94	201.5	(135.2, 341.7)	78	171	(124.0, 267.0)	71		
Girls	185.1	(111.9, 376.8)	115	173	(118.5, 289.5)	81	173	(104.0, 231.0)	79		

Comparisons of study groups made with analysis of variance. Superscripts denote statistical differences between study groups as Tukey's *post hoc* analysis revealed-same superscripts and both superscripts indicate no statistical differences, whereas groups with different superscripts are statistically different at $p \leq 0.05$. * NHANES sampling design was not accounted for; results may not be reliable. Gender effect: † $p < 0.001$. § $p < 0.01$. ‡ $p < 0.05$.

Table 5. Differences in nutrient intake adequacy between Mexican, Mexican-American, and Non-Hispanic White children.

Variable[a]	Mexican n (%)	Mexican-American n (%)	Non-Hispanic White n (%)	χ^{2*}	p
Younger (6-9 years old)					
Energy, adequate	280 (75.1)	117 (62.6)	83 (53.9)	24.67	< 0.0001
Protein, adequate	369 (98.9)	186 (99.5)	152 (98.7)	0.57	0.75
Carbohydrate, adequate	373 (100)	184 (98.4)	154 (100)	8.49	0.014
Dietary fiber, adequate	37 (9.9)	15 (8)	3 (1.9)	9.78	0.007
Saturated fat, acceptable	117 (31.4)	12 (6.4)	10 (6.5)	70.5	< 0.0001
Dietary cholesterol, acceptable	176 (47.2)	93 (49.7)	100 (64.9)	14.14	0.0009
Older (10-12 years old)					
Energy, adequate	119 (56.9)	73 (45.9)	68 (45.3)	6.39	0.04
Protein, adequate	204 (97.6)	147 (92.4)	128 (85.3)	18.9	< 0.0001
Carbohydrate, adequate	208 (99.5)	158 (99.4)	149 (99.3)	0.06	0.97
Dietary fiber, adequate	27 (12.9)	14 (8.8)	6 (4)	8.44	0.015
Saturated fat, acceptable	91 (43.5)	10 (6.3)	10 (6.7)	101.7	< 0.0001
Dietary cholesterol, acceptable	102 (48.8)	85 (53.5)	92 (61.3)	5.53	0.06

Categorical comparisons between study groups made with Chi-square tests. *NHANES sampling design was not accounted for; results may not be reliable. [a] Variable categorization: 1. Adequate energy intake if ≥ estimated energy requirement for age and sex.[23] 2. Adequate protein intake if ≥ estimated average requirement for age and body weight.[23] 3. Adequate carbohydrate intake if ≥ 100 g/d.[23] 4. Adequate dietary fiber intake if ≥ adequate intake for age and sex.[23] 5. Acceptable saturated fat intake if < 7% of calories/d.[24] 6. Acceptable dietary cholesterol intake if < 200 mg/d.[24]

MEXS is not representative of the whole Mexican population as the NHANES data is, the present study provides preliminary evidence on which to base a future analysis using national data from both countries.

We found MXA to have a greater overweight and obesity frequency compared to the other 2 groups and also larger WC than MEX children. High BMI and WC have been reported for both MXA and MEX children.[3,25-29] Surprisingly, the MXA children did not have the highest caloric intake nor the lowest physical activity levels. Unfortunately, previous reports of BMI in children have not explored these behavioral variables alongside. On the other hand, the BMI classification for overweight/obesity for US Mexican children has been questioned because the possibility of stunting increasing the likelihood of overweight classification and potentially masking chronic malnutrition.[30] A study conducted in México City, found that children 6-12 years old were shorter in regard to American standards.[31] In the present study, albeit Mexican children were significantly smaller than MXA and NHW, no differences were found between the latter (i.e., those living in the US), even after accounting for the sampling design in a separate analysis of NHANES data only. Hence, it would be tempting to argue that residency, more than ethnicity, and thus environmental rather than genetic factors, accounts for height differences. However, we failed to find residency to explain any of the somatometric variables in the logistic regression modeling. Although other studies have reported that foreign-born Hispanic adults have healthier BMI than Hispanics born in the US, and that the length of residency in the US is positively associated with body weight, this does not seem to be true for youth.[32,33] A recent study found first-generation Mexican adolescents to have an increased risk for obesity compared to later generational groups.[34]

High BMI and WC have been associated with chronic disease risks.[35,36] While no causal effects can be derived from this type of study, it was interesting to find that MEX children displayed more adverse cardiometabolic profiles (i.e., the lowest HDL-cholesterol and physical activity levels and the highest diastolic BP) than MXA children, even when the latest showed larger BMI and WC, especially in the older group. Similar to a study including recent NHANES data from 8 to 11 year-olds,[37] we did not find differences in HDL-cholesterol levels between MXA and NHW, in both age groups. However, we did detect significant lower HDL-cholesterol levels among MEX compared to MXA children. In fact, living in México was a predictor for abnormal HDL-cholesterol in all the models across age and gender groups. Low HDL-cholesterol levels have been documented previously in México, not only in children but also in adults.[38,39] The low exercise reported by MEX can explain their low HDL-cholesterol levels.[39]

Table 6. Multiple logistic regression analysis to explore effect of residency and ethnicity on somatometric variables, lipid profile, blood pressure, and dietary variables.*

	Boys					Girls			
	χ^2	p	OR	CI		χ^2	p	OR	CI
• Younger (6-9 years old)									
Total Cholesterol, borderline					Total Cholesterol, borderline				
Residency, US	9.15	0.01	1.48	0.91, 2.42	Ethnicity, NHW	11.13	0.004	2.70	1.50,4.34
					TV, > 2 h per day	7.56	0.02	0.72	0.42,1.21
Total Cholesterol, high					Total Cholesterol, high				
Residency, US	9.15	0.01	6.06	1.67, 22.06	Ethnicity, NHW	11.13	0.004	1.26	0.44,6.63
					TV, > 2 h per day	7.56	0.02	0.23	0.08,0.70
HDL-Cholesterol, abnormal					HDL-Cholesterol, abnormal				
Residency, México	14.32	0.0002	3.48	1.82, 6.63	Residency, México	23.69	< 0.0001	5.44	2.75,10.77
Waist, unacceptable	15.17	< 0.0001	3.53	1.87, 6.66	Waist, unacceptable	23.63	< 0.0001	5.53	2.78,11.03
TV, > 2 hours per day					TV, > 2 h per day				
Waist, unacceptable	6.38	0.01	1.98	1.16, 3.36	Residency, México	4.97	0.03	1.60	1.04,2.44
Energy, inadequate					Energy, inadequate				
Residency, US	6.62	0.01	1.83	1.15, 2.90	Residency, US	17.91	< 0.0001	2.69	1.70,4.25
Overweight	8	0.005	0.39	0.20, 0.75	Obesity	4.85	0.03	0.40	0.17,0.90
Saturated Fat, unacceptable					Saturated Fat, unacceptable				
Residency, US	25.87	< 0.0001	5.59	2.88, 10.85	Residency, US	32.47	< 0.0001	7.88	3.87,16.04
Dietary cholesterol, unacceptable					Dietary cholesterol, unacceptable				
Waist, unacceptable	5.42	0.02	1.97	1.11, 3.50	Ethnicity, Mexican	4.96	0.02	1.86	1.08,3.23
Energy, inadequate	32.74	< 0.0001	0.23	0.14, 0.38	Energy, inadequate	16.33	< 0.0001	0.38	0.24,0.61
• Older (10-12 years old)									
Total cholesterol, borderline					Total cholesterol, borderline				
Ethnicity, NHW	8.62	0.01	2.72	1.34, 5.31	Residency, US	7.05	0.03	2.12	1.16,3.85
Total cholesterol, high					Total cholesterol, high				
Ethnicity, NHW	8.62	0.01	1.67	0.48, 5.72	Residency, US	7.05	0.03	1.87	0.79,4.42
HDL-cholesterol, abnormal					HDL-cholesterol, abnormal				
Residency, México	11.75	0.0006	3.41	1.69, 6.86	Residency, México	21.83	< 0.0001	4.31	2.33,7.95
Waist, unacceptable	10.74	0.001	3.46	1.65, 7.27	Waist, unacceptable	6.02	0.01	2.25	1.18,4.30

SBP, abnormal					SBP, abnormal				
Residency, México	10.08	0.001	5.01	1.85, 13.53	Residency, México	10.72	0.001	5.91	2.04, 17.13
Overweight	6.68	0.01	3.06	1.31, 7.16					
Obesity	14.36	0.0002	4.95	2.16, 11.33					
DBP, abnormal					DBP, abnormal				
Residency, México	15.35	< 0.0001	60.56	7.78, 471.7	Residency, México	22.22	< 0.0001	15.48	4.95,48.37
Overweight	11.85	0.0006	7.04	2.32, 21.27	Obesity	9.21	0.002	4.91	1.76,13.71
Obesity	5.5	0.02	6.13	1.35, 27.92					
					Energy, inadequate				
					Residency, US	18.41	< 0.0001	3	1.82,4.96
Protein, inadequate					Protein, inadequate				
Ethnicity, NHW	7.6	0.006	4.98	1.59, 15.60	Ethnicity, NHW	4.42	0.03	2.96	1.08,8.15
Overweight	4.61	0.03	4.86	1.15, 20.62	Obesity	18.15	< 0.0001	10.8	3.61,32.29
Obesity	8.39	0.004	9.87	2.10, 46.43	Energy, inadequate	10.86	0.001	33.06	4.13,264.8
Energy, inadequate	6.88	0.009	16.19	2.02, 129.7					
Saturated Fat, unacceptable					Saturated Fat, unacceptable				
Residency, US	34.21	< 0.0001	9.71	4.53, 20.81	Residency, US	43.9	< 0.0001	12.13	5.78,25.39

* NHANES sampling design was not accounted for; results may not be reliable. OR: Odds Ratio. CI: 95% Confidence Interval. US: United States. SBP: systolic blood pressure. DBP: diastolic blood pressure.

Although differences in the instrumentation procedures between MEXS and NHANES could explain some of the variation between MEX and MXA data, the magnitude of these differences make us speculate they are real.

Low HDL-cholesterol is often but not always associated with high triglycerides. Among MEX, the percentages of abnormal HDL-cholesterol and abnormal triglycerides were similar, particularly in the younger group. Although high triglyceride prevalence have been documented among both Hispanic adults and children,[40] unlike HDL-cholesterol, we failed to detect differences in triglyceride levels between groups.

Children in the US not only had higher serum total cholesterol levels but also greater dietary saturated fat intake. In fact, living in the US was associated with intake of saturated fat above the recommendations (i.e., ≥ 7% of Calories/day) for all age and gender groups. Saturated fat and fiber are the two dietary factors commonly known to be related to cholesterol levels.[41] Despite having the lowest dietary cholesterol intake, few NHW children had enough dietary fiber. On the other hand, though MEX reported the highest dietary cholesterol intake, they had the lowest saturated fat intake and greatest dietary fiber intake. A study comparing children under 10 years in the US, Japan, and Spain, found total cholesterol levels to be higher in Spain and Japan, with the Spanish children having higher saturated fat and cholesterol intakes.[42] In the present study, dietary fiber was greater in both MEX and MXA compared to NHW. Dietary fiber intake has been documented to be higher among people from Mexican origin;[43,44] staple foods in Mexican diet are usually either good source or high in fiber (e.g., beans, corn products, salsas).[45] It has been recently reported that dietary recommendations for cardiovascular health are not met by the vast majority of the children in the US.[44] Nonetheless, dietary results should be interpreted with caution. Differences in data collection and processing between MEXS and NHANES cannot be discarded as sources error. Even though the same instrument was used (i.e., 24-h recall), the dietary data collection protocol and software differed in both surveys. Inaccuracies inherent to self-reported dietary data are also an expected source of bias. In addition to diet, total cholesterol concentrations are dependent on sexual maturation, and thus genetic differences in maturation rates, could explain the variations found in the present study.[46] Unfortunately, unlike MEXS, NHANES does not include Tanner data, thus puberal stage could not be accounted for in this analysis.

It is now recognized that elevated BP in children could lead to early development of cardiovascular disease and it is likely to persist to adulthood.[47,48] Diastolic BP was significantly different between our 3 study groups; being the highest in MEX and the lowest in NHW children. Similarly, a greater prevalence of high blood pressure has been reported in MXA compared to NHW children in the US.[44] In Mexico, a study found that 40.6% of all 8-10 year-olds had one type of hypertension; with the mixed form of systolic and diastolic hypertension being the most prevalent.[25] Although we were able to identify residency (i.e., living in México) as a risk factor for both abnormal diastolic BP and abnormal systolic BP, we failed to detect any ethnicity contribution in the regression models. Along with residency, we found obesity to significantly increase the risk of elevated BP, especially in boys. This finding agrees with the current state of evidence regarding obesity as a major risk factor for hypertension reported in both the US and Mexican populations.[25,49] Our results suggest a stronger influence of residency than ethnicity, especially in terms of lipid profile, blood pressure, and saturated fat intake. Because the cross-sectional nature of this study, the reasons that residency may have such an impact cannot be determined but deserve further investigation. For instance, residential isolation has been linked to obesity risk in US Hispanics in Utah.[32] In addition, parent-related factors, not explored in this study, should be considered-parents provide not only the genes, but also the context for health behaviors development and practice. In fact, it is now recognized that obesity has considerable roots in the family environment.[50,51] Besides parental factors, cultural norms, media exposure, and peer pressure are some additional variables that influence children's health behaviors.[50,52,53] Finally, socioeconomic status and education are important factors associated with health disparities, not accounted for in this study, that we recommend considering in akin future research.[54-56] Future comparison of nationally representative samples from both countries that include environmental and psychosocial variables may help to extend the results of this analysis.

The main limitation to this study is that we were unable to control for the complex sampling design of the NHANES in our main analysis. A secondary analysis, in which the complex sampling design of NHANES was accounted for, revealed differences between MXA and NHW to be very similar as in the original analysis of the 3 groups. Nonetheless, caution must be exercised when interpreting our results because median and dispersion estimators are likely to be biased and thus a potential lack of precision is expected in the derived estimators (e.g., F, OR, χ^2). Other limitations to this study have been already discussed; including:

- NHANES is a nationally representative survey whereas MEXS is not, thus results from this survey does not necessarily apply to the entire Mexican population.
- Causality cannot be intended due to the cross-sectional nature of the study.
- Even though only variables measured in the same fashion in both surveys were selected for the analysis, differences in their operationalization may contribute to explain some of the differences herein found; and
- Self-reported information, especially dietary data, is inherently subject to reporting-bias.

Despite its limitations, we believe this study is valuable at providing an initial panorama of the differential influence of residency (i.e., environment) and ethnicity (i.e., genetic factors) on metabolic factors and dietary patterns among children living in México and the US, and can afford the basis for future so-much-needed research in this area.

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