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Links between Childhood and Adult Social Circumstances and Obesity and Hypertension in the Mexican Population

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Abstract

Objectives—This study examines links between early life circumstances and adult socioeconomic status and obesity and hypertension in the adult Mexican population.

Methods—We use data from the Mexican Family Life Survey (MxFLS) collected in 2002 for people aged 20 or older (N=14, 280).

Results—We found that men with low education and women with more education have significantly lower obesity. Women with higher education also have significantly less hypertension. Obesity triples the likelihood of hypertension among both men and women. Better childhood experiences are associated with less hypertension among women, but more hypertension among men in rural areas.

Discussion—Recent changes in income, nutrition, and infection in Mexico may be responsible for the observed high prevalence of overweight and obesity and the extremely high odds of hypertension among obese young adults.

Keywords

obesity; hypertension; childhood conditions; education; Mexico

Introduction

Mexico has undergone a rapid epidemiological transition in the last half century. Life expectancy has risen from 58 years in 1960 to about 75 years in 2010 (Camposortega Cruz, 1992; CONAPO, 2010). This transition has been accompanied by increasing rates of obesity. In the 1980s and 1990s, Mexico had among the world's fastest annual increases in the prevalence of overweight and obesity (Popkin, 2006). It is likely that obesity-related conditions, such as hypertension, are also increasing in the Mexican population as a result of increasing weight (Rivera, et al., 2002).

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Because Mexico is undergoing rapid change, we expect that health characteristics such as obesity and hypertension are likely to vary across the population because both childhood and later life circumstances and behaviors will differ across population segments that have experienced economic and demographic transitions at different times. We do not necessarily expect socioeconomic differences to be the same in Mexico as in countries where demographic changes took place earlier (Strauss & Thomas, 2008). For this reason, we expect that the pattern of socioeconomic differences in obesity and hypertension within Mexico might differ by location within the country, as indicated by rural and urban residence, and also across cohorts who experienced different circumstances.

In this paper we examine the associations between childhood and adult social circumstances, on one hand, and two related biological risk factors – obesity and hypertension, on the other hand. We focus on the adult Mexican population using the first wave of the Mexican Family Life Survey (MxFLS), a nationally representative sample of the country. We also examine how the links between early life and adult life characteristics and obesity and hypertension differ by place of residence and age.

Because we define hypertension based on measured blood pressure we are able to identify cases that would not have been identified had we relied on self reports. This is important because there are very high rates of undiagnosed hypertension in the population and this approach yields improved insights into the level of hypertension and factors associated with high blood pressure. We link the two biological risk factors by showing that in Mexico obesity is an important risk factor associated with hypertension. This is particularly important among young adults given their high prevalence of obesity and undiagnosed hypertension. Such high levels of obesity and hypertension in Mexico, especially at such young ages, will potentially have important health and economic consequences in the years ahead.

Background

Contrary to the observed inverse association between socioeconomic status (SES) and health outcomes in developed countries, the relationship between health and SES varies for developing nations (Strauss & Thomas, 2008). For example, evidence from Latin American countries shows that women with higher education are significantly more likely to be obese in poor countries (e.g., Haiti and Guatemala), but the association is negative among better off nations in the region (e.g., Mexico and Brazil) (Martorell, Khan, Hughes, & Grummer-Strawn, 1998). This pattern of different relationships of obesity and social factors for developing countries arises from the speed of their nutrition transitions in recent years with a shift toward high-density diets and a growing concentration of jobs requiring low energy expenditure (Popkin, 2002, 2006). Understanding the association between socioeconomic status and obesity and hypertension is then an important issue for developing countries as they continue to experience the nutrition transition as part of their overall development process.

Previous research in Mexico shows a large increase in overweight and obesity in recent decades with important differences by region, rural/urban location, and socioeconomic status. From 1988 to 1999, the prevalence of overweight and obesity among women aged 18–49 in the country increased by 47 and 160 percent, respectively (Rivera, et al., 2002). In the year 2000, the prevalence of overweight in the adult population aged 20–69 was about 61 percent for men, and 66 percent for women, with the highest prevalence among men in the southern region but among women the highest prevalence is in the north of the country (Sánchez-Castillo, et al., 2003). In rural poor communities, the prevalence of overweight was estimated to be about 60% in women and 50% in men in 2003 (Fernald, et al., 2004).

Analysis from a national health survey in Mexico for the year 2000 showed that higher economic assets are associated with a significantly greater likelihood of obesity among men in both urban and rural places, but the association was negative among women in urban areas (Buttenheim, Wong, Goldman, & Pebley, 2009). Among poor rural communities higher SES (educational attainment, housing conditions, and assets) is also significantly associated with higher prevalence of overweight and obesity in both men and women (Fernald, 2007). Even at very young ages there is evidence that the prevalence of overweight and obesity is higher among urban adolescents (aged 12–16) compared to their rural counterparts (Yamamoto-Kimura, et al., 2006). Among older Mexicans, however, there is evidence of an inverse association between SES (education) and obesity in urban areas but a direct association in less urban places (Smith & Goldman, 2007). However, older Mexicans with higher income and more assets are more likely to be obese (Wong, Ofstedal, Yount, & Agree, 2008).

Despite a high prevalence of hypertension in Mexico, there is very little evidence of a link between hypertension and SES and behavioral factors in the Mexican population. One exception is the study of Fernald and Adler (2008) who analyzed a sample of women 18 years and older in poor rural populations of seven Mexican states. They found significantly lower blood pressure among those with higher educational attainment (Fernald & Adler, 2008). The prevalence of hypertension in the adult Mexican population aged 20–69 is estimated at about 30 percent in the year 2000; men had a prevalence of about 34 percent and women 26 percent with the northern region of the country having the highest prevalence (Sánchez-Castillo, et al., 2003; Velázquez-Monroy, Rosas, Lara-Esqueda, & Pastelín, 2002). High prevalence of hypertension has also been observed in adolescents in Mexico. In a small sample (1,846) of junior high school students in Mexico City (aged 12–16 years), the prevalence of hypertension was shown to reach about 11% in the late 1990s (Juarez-Rojas, et al., 2008).

Research on early life experiences for the Mexican population shows that better childhood conditions are associated with better health outcomes. For example, evidence from the Mexican Health and Aging Study (MHAS) shows that individuals who lived in a house with a toilet at age 12, an indicator of both economic and sanitary status, are less likely to be diabetic after age 50 (Kohler & Soldo, 2005). Using total height as a proxy indicator of early childhood circumstances, Crimmins et al. (2005) showed that taller individuals in a sample of older Mexican adults are more likely to report better self-assessed health and to have fewer functional difficulties. Childhood living conditions may reflect the resources available to families for nutrition as well as the exposure to infection of children. These in turn are likely to influence height in pretransitional societies.

Health behaviors are also likely to affect current levels of obesity and hypertension. SES has been associated with health behaviors in the Mexican population in complex ways. Evidence from a national health survey in Mexico showed that higher education and assets were linked to a significantly increased likelihood of being a smoker among urban women; but for urban men higher education is inversely associated with the likelihood of smoking (Buttenheim, et al., 2009). People with higher household income are more likely to smoke and consume excessive alcohol (Smith & Goldman, 2007; Vázquez-Segovia, Sesma-Vázquez, & Hernández-Avila, 2002). There are also behavioral differences by age and gender in Mexico. Older Mexican men are more likely than women to smoke and to engage in heavy drinking (Wong, et al., 2008). In addition, older people living in urban areas are less likely to exercise relative to those in rural places but there is a high likelihood of exercising among middle-aged adults (aged 55–64) relative to their older counterparts (Wong, et al., 2008). However, there were no significant differences in exercise status by education or income among older adults in Mexico (Wong, et al., 2008).

Our study adds to the previous research in three main dimensions. First, we test whether early life circumstances, proxied by place of birth (city vs. all other places), having a toilet inside the house at age 12, and stunting are associated with obesity and hypertension in adulthood. As there are no studies analyzing the association between hypertension, early life experiences, SES and behavioral factors for the adult population in Mexico, we extend previous research by analyzing this link in a nationally representative sample of the adult Mexican population. We also clarify for both obesity and hypertension how early life situations might be mediated by SES in adulthood. We also examine how obesity is linked to hypertension in this population. Because the association between early and later life circumstances and obesity is likely to vary both by place of residence and between younger and older adults, we examine these associations after stratifying our sample into three residence areas (rural areas, towns and cities) and broad age groups (aged 20–39, 40–59, and 60 or older).

Data

Prevalence of obesity and hypertension are estimated from the first wave of the Mexican Family Life Survey (MxFLS) which was collected in 2002. This survey includes both interview data and measured biological risk factors for a sample that is representative at the national, urban-rural, and regional level. The survey follows a probabilistic, stratified, multi-staged, cluster sampling design with an oversample of rural areas. It collects information on socioeconomic, demographic, and health indicators of the population including detailed information on households (about 8,440), individuals (about 35,000), and communities (about 150) in the country. For the present study we used biomarker data from the anthropometric and biomarker section and from the section on characteristics of adult household members. We selected adults age 20 and older at the time of the survey.

Our analytical sample comprises those respondents whose health status was assessed by a trained health worker and who also completed a face-to-face interview conducted by a trained survey enumerator. Health status was assessed in the home by an anthropometrist and nurse who visited the respondents and conducted the health assessment independent of the team of enumerators. Of these 20,115 respondents age 20 and older, 21.2% did not have height measured, a further 0.8% did not have weight measured and an additional 3% did not have blood pressure assessed yielding a sample of 15,084 respondents for whom valid biological risk factors necessary for this study were collected. About 80% of the respondents whose health was not assessed were not found by the anthropometrist and nurse after their households had participated in the interview component of the survey. The separation of the interview and health assessment was driven by local conditions and is a design feature that was changed in subsequent survey rounds. Of the 15,084 respondents for whom biological risk factors are measured, 4% have not completed a face-to-face interview in MxFLS and so we have no record of early life conditions. These exclusions reduce the final, analytical sample to 14,280 respondents which is 71% of the eligible sample. The completion rate is higher for females (77%) than males (67%). Among males and females, the better educated are less likely to be included in the analytical sample along with younger males and older females. Our analysis of the selectivity of the analytic sample relative to the original sample allows us to conclude that estimates of regression slopes in our models are not affected by sample selectivity.1

Measures

Health outcomes—We considered as hypertensive any individual whose measured blood pressure is above the clinically recognized threshold (systolic ≥140 mmHg or diastolic ≥90 mmHg) or who self-reported taking medication for high blood pressure. The latter account

for about 20% of those identified as hypertensive. Blood pressure was measured by the interviewer using an electronic monitor. Body mass index (BMI) is the ratio of weight (measured in kilograms) over the square of height (measured in meters), and then categorized into overweight (BMI ≥25), and obese (BMI≥30). Blood pressure, weight and height were measured by the trained anthropometrist or nurse. The age and sex-specific distributions of BMI and hypertension from this survey are very similar to those estimated the National Health and Nutrition Survey of Mexico 2006 (ENSANUT06) (Olaiz-Fernández, et al., 2006, pp. 78, 80).

Early life experience indicators—We selected three indicators of early life exposure to risks that could adversely affect later life health: place of birth outside a city, stunted height, and having a toilet inside the house at age 12. Place of birth is dichotomized as having been born in a city (vs. non-city) which we assessed from the question “when you were born, the place was (small village, village, city, parcel, hacienda, town, other).” Stunted is a dummy variable defined as having a total height less than or equal to 1.55 meters (about 5 ft) for men, and 1.40 meters for women (about 4 ft and 7 in) (Centers for Disease Control and Prevention, 1998). Having a toilet in the house at age 12, is indicated by answering “toilet” to the question “in the place where you lived when you were 12 years old, did the house have a (toilet, latrine, black hole/blind well, no sanitary services, other).” This is an indicator of both early life socioeconomic status and exposure to disease in childhood.

Socio-economic status in adulthood and place of residence—We measured adult SES with completed years of schooling which is categorized into five groups: no education (0 years of schooling), elementary education (1–6 years), secondary (7–9 years), high school (10–12 years), and more than high school (13+ years). In addition, we stratify samples using an indicator of the size of the current place of residence taken from administrative records. Community size comprises three categories, rural (less than 2,500 people), less urban (between 2,500 and 100,000 people, which we will call “towns”), and more urban (100,000 people or more, which we will call “cities”).

Health behaviors—In supplementary analyses, that are not reported in detail, we included two indicators of current health behavior that are associated with obesity and hypertension: smoking and exercising. Exercising is defined as routinely practicing any kind of physical exercise from Monday through Friday. Smoking was categorized into three groups: never smokers (those who responded “no” to the question “do you/did you ever have the habit of smoking cigarettes?”), former smokers (those who ever had the habit of smoking but are not currently smoking), and current smokers (ever had the habit and currently smoke).

[1]To provide a summary of the results, we estimated a logistic regression in which the dependent variable is 1 if the respondent is included in the final analytical sample and 0 otherwise. The independent variables are age and years of education. For males the odds ratios are 1.004 and 0.98 for age and education, respectively; for females, the odds ratios are 0.98 and 0.95. The key issue for this paper revolves around whether adding the respondents who are not included in the analyses are likely to change our substantive conclusions. Do the associations between biological risk factors, early life experience and SES reported below differ between those included and those not included in the analyses? As a partial answer to this question, we have estimated regressions for males and females separately that relate obesity to age and education for the entire sample with valid measures of obesity and included a control for whether the case is included in the regressions below along with an interaction between this control and each covariate. None of the estimated age and education effects differs substantively or significantly between the analytical sample used below and this larger sample. The F statistic for joint significance of the control for inclusion in the analytical sample and the interaction of that control with all the covariates summarizes the overall differences. The F statistic is 1.26 (p-value=0.26) for males and 0.63 (p-value=0.78) for females. We conclude that, at least based on these analyses, estimates of regression slopes in this model are not affected by the selectivity of the sample. We draw the same conclusions from parallel analyses of hypertension. The comparable F statistics are 1.04 (p-value=0.41) for males and 1.19 (p-value=0.30) for females.

Methods

We used logistic regression to estimate the association between obesity and hypertension with early life experiences and adult SES. We fit three models for each outcome. The first two models estimate the association of early life experiences and SES independently by including them in separate models (labeled 'Early Life' and 'SES' in the tables). A third model is then estimated where early life experiences and SES are included simultaneously while controlling flexibly for age2 (labeled 'All'). For hypertension, overweight and obesity are included in the third model with all controls. Wald statistics provide tests for the joint significance of the education covariates. Sample data were weighted in all analyses taking into account the complex sampling design to reflect the total Mexican population in 2002. All variance-covariance estimates take into account the complex survey design and arbitrary heteroskedasticity following Huber (1967).

The literature reviewed above and preliminary analyses indicate significant gender differences in the links between the independent variables and obesity and hypertension. Thus, we estimated separate models for males and females. We also stratify our analysis by community size to test whether there are significant differences in the links between covariates and the likelihood of being obese and hypertensive between people living in urban and rural areas of Mexico. In addition, we test whether the associations vary with age or cohort by estimating separate models for people age 20–39, 40–59, and 60 or older at the time of the survey.

Results

Prevalence of Obesity, Overweight and Hypertension

The prevalence of obesity, overweight, and hypertension in the population, as well as descriptive information on the SES and behavioral characteristics are shown in Table 1. There is a high prevalence of obesity and overweight in the Mexican population 20 years old and over; two-thirds of Mexicans are overweight (67.2 %) and more than a quarter is obese (26.9%). The prevalence of both is higher for women than men and lowest among rural residents. The fraction overweight is highest in towns (72% of men and 73% of women) but obesity rates are very similar in towns and cities (23% for men and 32% for women). More than a third (37.5%) of the adult population in Mexico is hypertensive. It is more prevalent among men relative to women and varies little across rural, town and city dwellers.

The prevalence of obesity in the population by age, sex and community size is shown in Figure 1. We observe the lowest prevalence of obesity in rural areas for both men and women, but different patterns between towns and cities. For men, there is a higher prevalence of obesity in cities among young and older individuals, but for middle aged men, the highest prevalence is among those living in towns. For women, among young adults about the same proportion of women in rural and cities are obese, but a much larger proportion are obese in towns. Among older women the highest prevalence of obesity is observed in cities.

Figure 2 shows the prevalence of hypertension using three different criteria: self reported hypertension, high measured blood pressure (systolic or diastolic), and high measured blood pressure plus use of medication. The last indicator, measured plus medication, is our indicator of the level of hypertension in the population. In most cases we observe the lowest

[2]Indicator variables for age 20–24, 25–34, 35–44, 45–64 and ≥65 are included in the 'All' regression and appropriate subsets for the age-specific regressions. We prefer this specification because it is flexible. The results are not substantively changed if age is controlled with a linear term or with a linear and quadratic term.

prevalence in hypertension in rural areas and the highest in cities. The relationship of hypertension to age shows a slight curvilinear pattern for both men and women.

There are two important conclusions drawn from the other two lines in these graphs. First, there is very little use of medication in the Mexican population, particularly among men; however, the highest usage is in cities. Second, if one uses self reports of hypertension only a small fraction of those with hypertension would be identified. The gap diminishes with age, but even at the older ages there is more than a 20% difference between the prevalence of hypertension based on self-reports and measured blood pressure. This difference in the prevalence represents undiagnosed cases. Particularly important is the high prevalence of undiagnosed hypertension among young adults, mainly men.

Associations of Obesity and Hypertension with Childhood and Adult Characteristics

Estimated odds ratios for the association of obesity and hypertension with early life experiences and adult SES are shown in Tables 2 and 3, and Tables 4 and 5, respectively. The top panel of each table shows odds ratios for men and the bottom section corresponds to women. Each table shows the results for the whole population controlling early life experiences in the first column, adult SES in the second column and all covariates in the third column. The first and third regressions are repeated separately for people currently living in rural areas, towns, and cities.[3]

Obesity—There is some association between early life indicators and obesity (Table 2). For women, those who had a toilet in the house by age 12 or were born in a city had higher odds of being obese after controlling age and education (Table 2, Column 3). When we divide the population by size of place of residence, we see that the links between childhood variables and obesity are not the same across places. Having a toilet in the house at age 12 is only related to significantly higher obesity among women who live in rural areas. Women born and still living in a city are more likely to be obese. In these groups, stunting also has a different effect. Those who are stunted are less likely to be obese in rural areas but in cities stunting is related to more obesity, albeit not a significantly higher level. The latter association remains fairly similar before and after the inclusion of education suggesting that stunting operates on obesity independently of adult socioeconomic status.

Education is related to obesity for both women and men but somewhat differently. Men with low education have significantly less obesity while women with low education have significantly more obesity. The association for men is strongest among people living in rural areas where men with fewer years of schooling are less likely to be obese relative to those with secondary education. For women the association is mainly found in cities where it looks like the pattern arising is one of lower BMI with each increase in educational category.

When these relationships are examined by age, there appear to be stronger associations among women and there are no significant relationships for men less than 40 (Table 3). The magnitude of these associations shows a clear upward trend with age among women. For example, middle-aged and older adults are about twice and three times more likely to be obese, respectively, if they have elementary school education relative to those with more education. However, among younger cohorts the pattern is reversed and those with high school or more are less likely to be obese than their counterparts with lower education.

[3]The differences between models that control adult SES and those that include all covariates are modest and so we do not report the second model in the stratified regressions.

However, there is no evidence of a significant link between our measures of early life indicators and obesity for these different ages or cohorts.

Hypertension—The associations between early life experience indicators and hypertension are quite different for women and men (Tables 4 and 5). Females who had a toilet in the house at age 12 are significantly less likely to be hypertensive (Table 4, Column 3) and this is fairly consistent across areas. There is no link between this variable and having hypertension for men. Women born in a city are more likely to be hypertensive; a result that remains significant only in rural areas. Men who were born in a city showed a lower likelihood of being hypertensive in most of the models but the effect was only significant in the gross model for the entire population.

In the unadjusted models for both women and men hypertension is less likely among those with more education. There are significant associations of education and hypertension in the fully adjusted models: among all women (Table 4, Column 3), and in rural areas and towns for men (Table 4, Columns 5 and 7), and rural areas and cities for women (Table 4, Columns 5 and 9). Among both men and women, those with lower education are significantly more likely to be hypertensive relative to their counterparts with elementary school (Column 3), and a similar result holds for both men and women in rural places (Column 5) and towns (Column 7). Most of the significant results found in the early life models are explained away in the fully adjusted models suggesting that obesity may underlie the association with hypertension.

When these associations are examined by age, the differences in early life conditions indexed by having a toilet in the household at age 12 appear to be very different for men over 40 and for women under 40 (Table 5). For women age 60 years old and above, hypertension is more prevalent among those born in a city and still living in an urban area. For older women in cities, the odds of being hypertensive are 2.5 times higher if they were born in a city, but middle-aged women who are stunted are less likely to be hypertensive.

Obesity and overweight are significantly associated with hypertension for both men and women in all subpopulations relative to not being overweight (BMI<25) (Tables 4 and 5). The magnitude of the association with obesity is large and it is greatest in rural areas where obese males are 3.5 times more likely to be hypertensive than males who are not overweight. The odds are 3.0 times higher among urban males. Women show similar differences to those of men but with lower odds. In addition, there is a much greater relative effect of obesity on hypertension among young adults (Table 5), particularly for men. The magnitude of the associations declines with age among women, but follows a u-shape among men. For example, obese men aged 20–39 and those older than 60 have higher odds of being hypertensive relative to middle aged adults. Nonetheless, these magnitudes are quite large among men, and in rural areas and towns. The magnitude of the association of overweight and hypertension is fairly similar across places and across age for both men and women.

Additional analyses including an indicator of smoking status and exercise did not alter our main results with respect to early life experience and SES (data not shown).

Discussion

Our results show that there is an inverse association between education and obesity among women, particularly in cities and among younger females, but a positive association among men living in rural areas. Specifically, in cities, women with no education or with elementary school are significantly more likely to be obese than females with secondary school. Similar results for women in urban areas were found by Buttenheim et al. (2009).

There is no significant association between education and obesity among urban males. In contrast, in rural areas, obesity rates are highest among females with 1 to 6 years of education whereas men with 6 or less years of schooling have significantly lower odds of being obese. More urban areas of Mexico appear to be well into the nutrition transition whereas more rural areas appear to be at an earlier stage in this transition.

Several factors such as reduced infection, greater food availability, composition of diet and lifestyle choices are likely associated with the prevalence of overweight, obesity and hypertension in Mexico. For example, between 1988 and 1999, there was a national increase of about 29% in the consumption of fat as a percentage of total calories, an increase in the purchase of refined carbohydrates and soda by about 6.3% and 37.2%, respectively, and a decline of about 29% in the purchased of fruits and vegetables (Rivera, et al., 2002; Rivera, Barquera, González-Cossío, Olaiz, & Sepúlveda, 2004). During the 1990s, the northern regions of the country and Mexico City, which are the more urban areas, had a higher increase in fat consumption relative to the southern region, which is mainly rural (Rivera, et al., 2004). However, in recent years, there has been a pattern of more homogeneous fat consumption across regions, mainly driven by increasing consumption rates in the south (Barquera, et al., 2007; Barquera, et al., 2006). In addition, the traditional Mexican diet based on corn and beans that was typical of rural areas has been replaced by industrialized foods such as refined carbohydrates and sugar-sweetened drinks (e.g., soda, fruit juices, etc.) (Aguirre-Arenas, Escobar-Pérez, & Chávez-Villasana, 1998). Moreover, in our sample, a very low proportion of people routinely engage in any kind of physical exercise from Monday through Friday, particularly in rural areas (Table 1).

We found mixed results regarding the association between our markers of early life experiences and health outcomes in the Mexican population. It is important to note that the association with childhood factors appears to be gender-specific with a stronger link among women. For example, women who had a toilet in the house at age 12 are more likely to be obese if they live in rural areas. The mechanism relating having had a toilet in the house with a higher likelihood of obesity in adulthood is not clear; but it may be that these individuals grew up in a household with more economic resources that allowed them to have access to higher caloric intake and fewer diseases that sapped nutrition. This may be particularly important among younger cohorts given the recent increases in energy-dense diets, energy-containing beverages, as well as reductions in physical activity (Barquera, et al., 2008; Rivera, et al., 2004). It is also possible that having a toilet may be related to living in more sanitary conditions and having fewer intestinal diseases throughout life. Consistent with this interpretation is our finding that among male rural dwellers, those of shorter stature (who are more likely to have had experienced disease insults in early life) are less likely to be obese.

An important contribution of this research is establishing a strong association between obesity, overweight and hypertension. Of particular relevance are the very high odds of being hypertensive among obese young adults, those cohorts that have been exposed throughout their lifetimes to the changes in nutrition in Mexico. These results, in conjunction with evidence of significant declines in physical activity among young people in Mexico (Hernández, et al., 1999; Olaiz-Fernández, et al., 2006) suggest an urgent need for major changes in behavior if Mexico is to avoid massive increases in health care costs in the coming decades.

We find a negative association between education and hypertension in rural areas. Men and women living in rural areas with lower education are significantly more likely to be hypertensive relative to their counterparts with secondary school. This suggests that

socioeconomic differences matter as those with more education are more likely to have more resources and better nutrition and, possibly, face less stress than the poorest rural dwellers.

There were opposite results between early life experience indicators and hypertension among women, but not significant results for men. For women, there is a positive association of hypertension with being born in a city among those living in a rural place, but a negative link if they had a toilet in the house at age 12 and live in an urban area. Having had a toilet in the house at age 12 could be a proxy for better hygienic household environment and to some extent lower disease burden in childhood, thus they could have experienced lower levels of inflammation that may be associated with lower risks for cardiovascular disease in adulthood (Dandona, Aljada, Chaudhuri, Mohanty, & Garg, 2005).

There are some limitations in our work. We are unable to specify more precise mechanisms for the associations of early life experiences and health outcomes given our limited information on early life characteristics and the use of a cross-sectional data. Mexico has experienced an epidemiologic and nutrition transition in recent decades, and exposure to these changes may not be fully captured in our cross-sectional data. However, our results may be capturing unobserved differences in childhood living characteristics. It is important to note that our measure of obesity is based on individual's body mass index (BMI), a surrogate for body fat which does not accurately assess body fat in all subpopulations (Prentice & Jebb, 2001). However, BMI has been shown to be a good indicator of changes in underlying health risks due to changes in weight at the population level (Caballero, 2007). Moreover, Flegal et al. (2005) estimate excess deaths associated with body mass index and other anthropometric variables and conclude that for studying mortality there is no meaningful difference in results between BMI and other measures.

Finally, our results support the hypothesis that increases in food intake may be partly responsible for both the observed prevalence of obesity and the exceedingly high likelihood of hypertension among obese and overweight young adults. Mexico has recently proposed a public health policy to reduce overweight and obesity which calls for reversing the increasing rates of overweight and obesity among children aged 2–5, to stop the trend in overweight and obesity among people aged 5 to 19, and to slow down the raising prevalence among adults (Barquera-Cervera, et al., 2010). If they reach these goals we may see important changes in obesity and hypertension in Mexico in the years to come which will have important consequences for the costs of health care.

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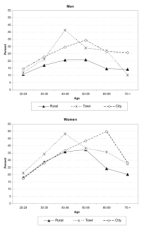

Figure 1.
Prevalence of Obesity by Sex and Place of Residence in Mexico.
Note: Rural corresponds to places with less than 2,500 people, Town relates to places with population between 2,500 and 100,000 people, and City represents places with more than 100,000 people.
Source: MxFLS-I (N=14, 280)

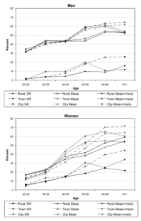

Figure 2.
Prevalence of Hypertension in Mexico Using Three Definitions: Self-reported, Measured, and Measured + Med
Note: Rural corresponds to places with less than 2,500 people, Town relates to places with population between 2,500 and 100,000 people, and City represents places with more than 100,000 people.
Source: MxFLS-I (N=14, 280).

Table 1

Socioeconomic and Biobehavioral variables for the Mexican Adult Population aged 20 or older: MxFLS-I

	Total Population	Rural		Town		City	
		Men	Women	Men	Women	Men	Women
Health outcomes							
Hypertension (%)	37.5	44.1	32.6	44.6	31.8	43.8	33.1
Obese (%)	26.9	16.4	27.4	23.8	33.4	23.3	30.7
Overweight (%)	67.2	55.8	63.1	71.7	73.0	68.0	67.7
Age							
20–39 (%)	53.1	42.3	49.8	53.0	57.6	56.5	53.5
40–59 (%)	32.2	35.2	31.8	33.3	31.4	29.9	33.0
60-+ (%)	14.7	22.4	18.4	13.6	10.9	13.6	13.5
Early life experience							
Toilet at age 12 (%)	47.3	14.3	14.6	37.8	39.4	70.4	67.7
Born in a city (%)	35.9	6.8	7.4	21.6	20.8	61.1	57.3
Stunted (%)	7.0	17.7	8.1	10.8	4.6	6.4	2.7
Socioeconomic status							
Years of schooling							
0 years (%)	12.6	20.9	25.1	9.3	13.9	5.5	9.0
1–6 (%)	42.2	55.8	54.8	42.0	48.1	29.4	36.9
7–9 (%)	24.1	15.1	15.6	28.8	22.7	28.1	27.4
10–12 (%)	10.3	5.1	2.9	9.4	8.3	16.0	13.3
13-+ (%)	10.5	3.0	1.5	10.3	7.0	19.7	13.0
Sample size	14,280	2,670	3,365	1,229	1,661	2,262	3,093

Note: All percentages are weighted taking into the complex sampling design to represent the Mexican population in 2002.

Source: MxFLS wave I.

Table 2

Odds Ratios for Logistic Models of the Association between Early Life Experiences, Socioeconomic Status, and Obesity by Size of Place and Sex: MxFLS-I

	All Mexico			Rural		Town		City	
	Early life (1)	**SES (2)**	**All[a] (3)**	**Early life (4)**	**All[a] (5)**	**Early life (6)**	**All[a] (7)**	**Early life (8)**	**All[a]**
					Men				
Early life experience									
Toilet at 12	1.04		1.16	1.26	1.25	0.97	1.05	0.88	1.12
Born in City	1.10		1.17	0.97	0.90	0.96	1.00	1.11	1.26
Stunted	0.86		0.89	0.59	0.61	0.84	0.97	1.28	1.22
Education									
0 yrs		0.68*	0.54***		0.32**		0.51*		0.98
1–6		0.94	0.75*		0.45**		0.90		0.86
7–9		1.00	1.00		1.00		1.00		1.00
10–12		0.94	0.97		0.57		1.04		1.04
13+		0.87	0.72		0.67		1.03		0.68
F (all educ covariates) [p value][b]		0.14	0.00		0.02		0.23		0.55
					Women				
Early life experience									
Toilet at 12	0.89		1.17*	1.35*	1.55**	0.72*	0.93	0.82	1.19
Born in City	1.00		1.19*	0.98	1.07	0.97	1.16	0.98	1.32*
Stunted	0.97		0.90	0.68	0.68	0.81	0.81	1.86	1.46
Education									
0 yrs		1.25	1.09		0.82		0.87		1.96**
1–6		1.47***	1.34**		1.31*		1.29		1.34*
7–9		1.00	1.00		1.00		1.00		1.00
10–12		0.59**	0.61**		1.04		0.50**		0.65
13+		0.54**	0.49***		0.81		0.49*		0.49**
F (all educ covariates) [p value][b]		0.00	0.00		0.01		0.00		0.00

*p<0.05,

[**] $p<0.01$,

[***] $p<0.001$

Source: Own calculation using the MxFLS-I (N=14, 280)

[a] Adjusted model includes age, early life experiences, and education.

[b] The F-statistic represents an adjusted Wald test of the joint significance of education categories.

Table 3

Odds Ratios for Logistic Models of the Association between Early Life Experiences, Socioeconomic Status, and Obesity by Age and Sex: MxFLS-I

	Age 20–39		Age 40–59		Age 60+	
	Early life (1)	**All[a] (2)**	**Early life (3)**	**All[a] (4)**	**Early life (5)**	**All[a] (6)**
	Men					
Early life experience						
Toilet at 12	1.33	1.33	0.96	0.88	1.80	1.84
Born in City	0.99	1.03	1.51*	1.42	1.01	0.86
Stunted	0.93	0.93	0.80	0.83	0.88	0.93
Education						
0 yrs		0.63		0.36***		0.42*
1–6		0.86		0.64*		0.47
7–9		1.00		1.00		1.00
10–12		1.04		0.87		1.12
13+		0.97		0.55*		0.14*
F (all educ covariates) [p value][b]		0.80		0.01		0.11
	Women					
Early life experience						
Toilet at 12	0.91	1.13	0.97	1.18	1.30	1.40
Born in City	0.93	1.06	1.11	1.29	1.47	1.53
Stunted	1.08	1.02	0.80	0.74	0.95	1.00
Education						
0 yrs		0.74		1.65*		2.42
1–6		1.08		1.79***		3.06*
7–9		1.00		1.00		1.00
10–12		0.55**		0.75		2.14
13+		0.45***		0.61		0.94
F (all educ covariates) [p value][b]		0.00		0.00		0.08

*p<0.05,

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** $p<0.01$,

*** $p<0.001$

Source: Own calculation using the MxFLS-I (N=14, 280)

[a] Adjusted model includes age, early life experiences, and education.

[b] The F-statistic represents an adjusted Wald test of the joint significance of education categories.

Table 4

Odds Ratios for Logistic Models of the Association between Early Life Experiences, Socioeconomic Status, and Hypertension by Size of Place and Sex: MxFLS-I

	All Mexico			Rural		Town		City	
	Early life (1)	SES (2)	All[a] (3)	Early life (4)	All[a] (5)	Early life (6)	All[a] (7)	Early life (8)	All[a] (9)
					Men				
Early life experience									
Toilet at 12	0.89		1.04	1.02	1.20	1.08	1.35	0.67*	0.81
Born in City	0.86*		0.93	0.82	0.90	0.88	0.98	0.85	0.95
Stunted	0.91		0.83	1.06	1.01	0.81	0.80	0.90	0.71
Education									
0 yrs		1.68***	1.00		1.46*		1.58		0.62
1–6		1.42***	1.13		1.51*		1.53**		0.81
7–9		1.00	1.00		1.00		1.00		1.00
10–12		0.95	0.98		1.23		1.16		0.88
13+		1.04	1.00		1.06		1.15		0.88
F (all educ covariates) [p value][b]		0.00	0.57		0.15		0.05		0.67
Not overweight		1.00	1.00		1.00		1.00		1.00
Overweight		1.91***	1.88***		1.85***		1.86***		1.93***
Obese		3.37***	3.18***		3.55***		3.68***		2.91***
					Women				
Early life experience									
Toilet at 12	0.54***		0.77**	0.70*	0.92	0.46***	0.80	0.46***	0.67**
Born in City	1.00		1.25*	1.13	1.55*	0.90	1.08	0.85	1.18
Stunted	1.25		0.84	1.55**	1.26	0.74	0.43*	1.73**	1.06
Education									
0 yrs		3.57***	1.27		1.32		1.52		1.42
1–6		2.27***	1.45**		1.62**		1.44		1.47*
7–9		1.00	1.00		1.00		1.00		1.00

	All Mexico			Rural		Town		City	
	Early life (1)	SES (2)	All[a] (3)	Early life (4)	All[a] (5)	Early life (6)	All[a] (7)	Early life (8)	All[a] (9)
10–12		0.87	0.93		0.90		1.02		0.90
13+		0.85	0.76		0.96		1.00		0.71
F (all educ covariates) [p value][b]		0.00	0.00		0.01		0.16		0.04
Not overweight		1.00	1.00		1.00		1.00		1.00
Overweight		1.89***	1.80***		1.81***		1.76***		1.83**
Obese		3.07***	2.85***		3.44***		3.32***		2.35***

*p<0.05,

**p<0.01,

***p<0.001

Source: Own calculation using the MxFLS-I (N=14, 280)

[a]Adjusted model includes age, early life experiences, education, not overweight, overweight, and obesity.

[b]The F-statistic represents an adjusted Wald test of the joint significance of education categories.

Table 5

Odds Ratios for Logistic Models of the Association between Early Life Experiences, Socioeconomic Status, and Hypertension by Age and Sex: MxFLS-I

	Age 20–39		Age 40–59		Age 60+	
	Early life (1)	**All[a] (2)**	**Early life (3)**	**All[a] (4)**	**Early life (5)**	**All[a] (6)**
	Men					
Early life experience						
Toilet at 12	0.90	0.88	1.28	1.39	1.18	0.97
Born in City	0.92	0.95	0.83	0.84	1.45	1.12
Stunted	0.93	0.90	0.71	0.72	0.84	0.90
Education						
0 yrs		1.01		0.99		0.94
1–6		1.15		1.20		0.90
7–9						
10–12		0.92		1.15		3.20
13+		1.12		0.70		3.67
F (all educ covariates) [p value][b]		0.69		0.09		0.05
Not overweight		1.00		1.00		1.00
Overweight		1.89***		1.84***		1.89***
Obese		3.82***		2.64***		3.17***
	Women					
Early life experience						
Toilet at 12	0.62***	0.76*	0.71**	0.79*	0.73	0.65
Born in City	1.15	1.37	0.86	0.91	3.08***	2.56**
Stunted	1.24	1.07	0.57*	0.53*	1.07	1.13
Education						
0 yrs		2.29*		1.09		0.74
1–6		1.51*		1.27		1.04
7–9						
10–12		0.89		1.07		3.54
13+		0.96		0.54		0.75

	Age 20–39		Age 40–59		Age 60+	
	Early life (1)	All[a] (2)	Early life (3)	All[a] (4)	Early life (5)	All[a] (6)
F (all educ covariates) [p value][b]		0.02		0.16		0.39
Not overweight		1.00		1.00		1.00
Overweight		1.82***		1.73***		1.78**
Obese		3.13***		2.76***		2.25***

*p<0.05,

**p<0.01,

***p<0.001

Source: Own calculation using the MxFLS-I (N=14, 280)

[a]Adjusted model includes age, early life experiences, education, not overweight, overweight, and obesity.

[b]The F-statistic represents an adjusted Wald test of the joint significance of education categories.