Explaining the Hispanic Paradox in the United States Using Biomarkers for Mexicans in the United States and Mexico

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Abstract

Biomarkers can be used to disentangle the processes leading to the Hispanic Paradox in the United States. The Hispanic population in the U.S., a highly immigrant population, has better than expected health given its relatively low socioeconomic status. This paradox raises general questions about the effects of migration on the health of populations in both sending and receiving areas. Using biomarker information from national samples of both Mexicans (The Mexican Health and Aging Survey) and Americans 50 years of age and over (the National Health and Nutrition Examination Survey) , we examine health differences for native-born and foreign-born Mexicans in the United States and for Mexicans who do not migrate and Mexicans who return to Mexico from the United States. Health differences include anthropometric measures reflecting childhood circumstances, blood pressure, current height and weight, lung function, and grip strength.

Introduction

There are a growing number of Latino immigrants in the United States. According to the 2002 Census reported by Ramirez and de la Cruz (2003), there were about 37.4 million noninstitutionalized Hispanics, consisting of 13.3% of the total U.S. population. Over half of the Hispanic populations were recent immigrants, entering the United States in the past 12 years, indicating the trend of increasing Hispanic migration as well as a large number of recent migrant population.

While numerous studies have shown the positive relationship between lower socioeconomic status (SES) and health status (Adler, Boyce, Chesney et al., 1994), Hispanics have better health and mortality outcomes than expected given their low social and economic status. This has been termed the "Hispanic paradox". One explanation for the Hispanic paradox is the "healthy migrant hypothesis" hypothesizing that healthier Hispanics immigrate to the United States (Sorlie et al., 1993; Schaie & Rosenwaike, 1987,Abraido-lanza et al., 1999). Thus, selection of healthy persons from the sending population raises the level of health in the receiving population. Another hypothesis is the "returning salmon hypothesis" which posits that some sick migrants return home, also improving the health of the population they leave.

Mexican Americans are particularly of interest because they consist of about 70% of the Hispanic population in the United States and they have lower SES than both other Latino populations in the U.S. as well as non-Hispanic whites (Ramirez and de la Cruz, 2003). To test these hypotheses about the effect of migration on the health of the Mexican population in the U.S. relative to the rest of the U.S. populations, we compare US-born and foreign-born Mexican-Americans with Mexicans in Mexico.

Background

Given the better health outcomes among foreign-born Mexicans in the United States, health indicators that reflect earlier childhood experiences are useful in examining whether foreign-born Mexicans are a "selective" group. That is, in examining the effect of selectivity among migrant Mexicans, health measures that proxy earlier life events and the childhood environment such as family socioeconomic status, nutritional status, exposure to infectious diseases and education are useful. When extensive data on one's health, diet/nutrition, health behaviors and living conditions in younger ages are not available, indirect or proxy measures of childhood exposures may be used (Gunnell, 2002). Studies suggest that anthropometric health measures such as height, leg length, and weight are related to specific health outcomes in later life. Measurement of bone length, muscle size, and adipose (fat) tissue may provide important objective evidence of life circumstances. Height and leg height are indicators of nutritional and health status in earlier life, while measures of adiposity such as waist and hip circumference and BMI are more associated with later life experience. In the following sections we outline a number of indicators of biological or physiological status and clarify their relation to social and economic conditions as well as health problems common at the older ages/

<u>Height</u>

Adult height is determined by health, nutrition/diet and psychological stress through the developmental years as well as by genetic endowment. Research has shown adult height to be associated with a range of factors including parental height, birth weight, childhood social class, birth order, number of younger siblings, parental education, household crowding, childhood diet, and serious illness in childhood.

Height has also been related to the risk of diseases and death. There is an inverse association between height and overall mortality (Davey Smith et al., Hart, Upton, Hole, Gillis, Watt and Hawthorne, 2000; Song, Davey Smith and Sung, 2003), with stroke (McCarron, Greenwood, Ebrahim, Elwood and Davey Smith, 2000; McCarron, Hart, Hole and Davey Smith, 2001; Song, Davey Smith and Sung, 2003) and with cardiovascular disease (Davey Smith, Hart, Upton, Hole, Gillis, Watt and Hawthorne, 2000; Gunnell, Whitley, Upton, McConnachie, Davey Smith and Watt, 2003; Williams, Jones, Bell, Davies and Bourne, 1997). On the other hand the association with cancer is positive (Davey Smith, Hart, Upton, Hole, Gillis, Watt and Hawthorne, 2000; Gunnell, Okasha, Davey Smith, Oliver, Sandhu and Holly, 2001; Lawlor, Okasha, Gunnell and Davey Smith, 2003). Because height rarely changes during adulthood, the association of greater stature with an increased risk of cancer and a decreased risk of cardiovascular disease is thought to reflect the long-term consequences of pre-adult conditions.

A particular concern are those who have very short stature. Short stature, also referred to as stunting, is extremely short stature (defined by comparison to the age- and sex-specific length or height reference population developed by CDC's National Center for Health Statistics (NCHS) (Centers for Disease Control and Prevention, 1998) and adopted by the World Health Organization for international use). Stunting, a conditions developing in early childhood, directly results from poor diets and regular and/or severe infection, generally occurs between 3 and 12/18 months. Thus, stunting serves as an indicator of early childhood experience including inadequate nutrition, chronic or recurrent infections, low birth weight and sometimes extreme psychosocial stress without nutritional deficiencies (Lewit and Kerrebrock, 1997). Stunting is also associated with other biological risk dimensions in later life.

Leg length/knee height, and trunk height

In expanding the association of height and disease risk, researchers suggest separating the two components of height – leg length and trunk length – in order to better clarify the effect of the postnatal environment. Leg length – or lower limb development - is thought to be more affected by postnatal adversity (Leitch, 1951). Research has demonstrated that the association of overall height with cancer and cardiovascular disease is due to leg length (Gunnell, Okasha, Davey Smith, Oliver, Sandhu and Holly, 2001; Gunnell, Davey Smith, Frankel et al., 1998; Davey Smith, Greenwood, Gunnell, Sweetnam, Yarnell and Elwood, 2001).

Wadsworth, Hardy, Paul, Marshall and Cole (2002) argue that while both leg length and trunk length are related to birth weight and parental height, adult leg length is particularly sensitive to diet (breastfeeding and energy intake) in early childhood given the rapidity of leg growth in this period. On the other hand, they showed that trunk length may be associated with serious childhood illness and parental separation. This may be due to the sensitivity of children's growth to stressful circumstances and the biological effects of illness.

Studies have also demonstrated the positive association of leg height with cancer (Gunnell, Okasha, Davey Smith, Oliver, Sandhu and Holly, 2001; Lawlor, Okasha, Gunnell, Davey Smith and Ebrahim, 2003) and the inverse association with cardiovascular risk (Davey Smith, Greenwood, Gunnell, Sweetnam and Elwood, 2001;

Gunnell, Whitley, Upton, McConnachie, Davey Smith and Watt, 2003). While no study that we are aware of specifically has examined knee height or lower leg length, it is expected to have similar associations to health outcomes as overall leg length.

Calf Circumference

Calf circumference has been suggested as a measure that indicates muscle mass of older persons (Patrick, Bassey, Fentem, 1982). It indicates physical activity both earlier in life and later in life. Calf circumference is also related to muscle-related disability and physical function in later life (Baumgartner, Koehler, Gallagher et al., 1998; Rolland, Lauwers-Cances, Cournot, Nourhashemi, Reynish, Riviere, Vellas and Grandjean, 2003). Rolland et al. (2003) found that elderly women with a calf circumference of less than 31 cm were three times more likely to have difficulties moving, indicating leg weakness.

Weight, BMI, Waist and Hip Circumference

While overall height, leg height/knee height and trunk height are indicators of childhood experience, other anthropometric measures such as weight, Body Mass Index (BMI), waist and hip circumference may be mainly related to circumstances closer to the time of measurement. Adiposity measures such as weight, BMI, waist and hip circumference indicate the balance between energy intake and energy expenditure. Those with higher values in these measures tend to be at higher risks for hypertension, adult-onset diabetes mellitus, cardiovascular disease, gallstones, arthritis, various forms of cancer, and other diseases. For example, hip and waist circumferences and BMI provide information on fat mass and cardiovascular risks. Zhang et al. (2004) showed the positive relationship between BMI, waist and hip circumference and the risk of coronary heart disease in Chinese women.

Other Biological Risk Factors – To be added

Data

In this study, we examine whether Mexicans (US-born and foreign-born Mexican Americans and Mexicans in Mexico) are different in the measures affected by childhood circumstances, and whether selection of migrants is an explanation for the relative health status of Mexicans in the United States.

Data

This paper uses the two national surveys in the United States and Mexico: 2001 Mexican Health and Aging Survey (MHAS) and the third and fourth National Health and Nutrition Examination Surveys (NHANES) of the United States.

MHAS is a prospective panel study, representing 13 million Mexicans aged 50 and over at baseline in 2001 and their spouses. MHAS is the replication of the Health and Retirement Survey (HRS) in its design and content (a detailed data description is available in Kohler & Soldo, 2003). About 20% were sub-sampled to conduct anthropometric measures such as height, weight, knee height, hip and waist circumference, and timed one-leg stands.

Conducted by the National Center for Health Statistics (NCHS), Division of Health Examination Statistics (DHES), part of the Centers for Disease Control and Prevention (CDC), NHANES, since its beginning in the early 1960's, has examined the civilian, noninstitutionalized, US nationally representative sample of about 7,000 persons of all ages each year, and about 5,000 complete the health examination component of the survey. The NHANES interview includes demographic, socioeconomic, dietary and health-related questions. The third NHANES, conducted between 1988 to 1994, included

33,994 persons ages 2 months and older, and the fourth NHANES, 1999-2000, included about 10,000 persons.

Sample

The sample persons include Mexicans in Mexico and Mexican Americans at ages 50 and over whose place of birth is either Mexico or the United States. The sample size is 1,388 (865 US-born and 523 foreign-born Mexican Americans) for NHANES III, 533 (247 US-born and 286 foreign-born Mexican Americans) for NHANES IV, and 2,623 for MHAS. In NHANES 3, the nativity of the sample was divided into the following two categories: (1) Those who were born in the United States or were born in Mexico but came to the United States between ages 0 and 15, and (2) those who were born in Mexico and came to the United States after age 15, assuming that those who came to the United States at younger ages were not a selected group.

Measures

Anthropometric measures available in each data are presented in table 1. Body measurements examined include height, lower leg length (NHANES III and MHAS only), calf circumference (NHANES IV and MHAS only), weight, BMI, waist and hip circumference (NHANES III and MHAS only). All anthropometries were measured by the trained examiners. In NHANES III and/or IV, height, waist and calf circumference were measured for those ages 2 years and over, and lower leg length in NHANES III was examined only for 60 years and over.

Waist circumference was measured by crossing a horizontal line at the high point of the iliac crest. For hip circumference, the measuring tape was placed at the top of the protruding bone below waist to measure the maximum extension of the buttocks. For calf circumference, three measurements are taken in the most prominent part of the calf, and the highest one is recorded (MHAS). In NHANES, maximal calf circumference on the right calf was measured. Knee height is measured in a sitting position forming a 90 degrees angle for both knee and ankle.

We use the above anthropometric measures to examine whether there is any selection for migrants from Mexico. In particular, height and leg height are used as potential biomarkers of early childhood experience while calf circumference, weight, BMI, and hip and waist circumference are used as body measures that are more affected by current lifestyle.

Given the relationship between stunting and earlier nutrition and health status and the serious impact/concern of stunting on late life health, we divide standing height into two categories, stunted or not using the WHO definition of stature less than –2 standard deviations (Z-score) of a reference (Centers for Disease Control and Prevention, 1998). Since the NCHS/WHO international reference population was developed to categorize the health and nutritional status of children from birth to 18 years, there is no transnational reference population defining stunting for adults beyond those ages. We defined stunting based on our data as height equal to or below 155cm for males and 140cm for females (the lowest 5%). We used the cutoff points of 48cm and 44 cm for males and females, respectively, to define very short lower leg (knee) length.

We also included sociodemographic factors such as age, gender, education, place of residence, and current income as risk factors for health differentials among the three groups. Education is divided into (1) no (school) education, (2) 1-4 years of education, (3) 5-8 years of education, and (4) 9 and more years of education. Place of residence is divided into more urban (population 1 million or more) and less urban. Current annual family income (NHANES III) or annual individual income (MHAS) were also used. In MHAS, additional variables such as father's and mother's education, and some childhood health conditions such having tuberculosis, rheumatic fever, polio, typhoid fever and blow to head before age 10 were included to examine the effect of these circumstances on anthropometric measures.

Analysis

Bivariate analysis that compares anthropometric and other biological risk ractors measures and sociodemographic factors across different groups are presented. Multivariate analysis uses logistic regression.

Results

Table 1 shows the sample characteristics for three data sets. About three quarter of the NHANES III sample were either US born or foreign born young Mexican American migrants. While about 54% of the NHANES IV sample were US-born Mexican Americans, NHANES IV does not have information to identify whether a person is young or adult migrant. Mean age was similar as about 65 for NHANES III and IV, and the MHAS sample was a little younger. Mexican Americans had higher level of education than Mexicans in Mexico. The level of parents' education was low such that over 50% of Mexicans in Mexico had parents who did not have any elementary education. About 10% of Mexicans in Mexico had some health conditions before age 10. Mexican

Americans had about $19,000 of annual income while Mexicans in Mexico had about 3,131 Mexican dollar of annual individual income (US$512).

Figure 1 shows the mean height and lower leg length, indicators of earlier conditions, for three different groups. MHAS 2001 and NHANES III. With the exception of lower leg length for males between ages 50 and 64, US-born or foreign-born young migrants had the greatest height and longest lower leg length followed by foreign born adult migrants and Mexicans in Mexico.

The means of the adiposity measures such as weight, BMI, waist, hip and calf circumference, reflecting later-life conditions, for the same groups, are presented in Figure 2. While many measures showed the expected differences - US-born Mexican Americans, foreign-born Mexican Americans and Mexicans in Mexico as the order from the biggest (heaviest) to the smallest, different results were observed for some measures. Mexicans in Mexico had the biggest mean hip and calf circumference, followed by US-born/foreign born young migrants and foreign-born (adult) migrants; for males over 65, Mexicans had greater BMI than Mexican Americans; and for waist circumference, Mexican females in Mexico had greater waist circumference than foreign-born adult migrants in America.

Tables 3 and 4 show the percent of stunting and very short lower leg length by age group, education, the place of residence, income, parents' education and childhood health condition for males and females. About 21% of Mexican males in Mexico at ages 65 and over were stunted while 3.2% and 10% of foreign-born adult migrant Mexican American males were (Table 3). Among those males who had no formal education, 26% of Mexican American males were stunting while 1.4% and 4.3% of US-born/foreign-born young migrant Mexican males and foreign-born adult migrant Mexican males were stunting. Parents' education was related to stunting. For example, among female Mexicans in Mexico, 10% of those with no formal education were stunted while only 0.4% of those with more than elementary education were. In Table 4, the relationship of education to very short lower leg length was similar to that of stunting such that 39% of male Mexicans in Mexico with no formal education had very short lower leg length while 7% and 8% of US-born/foreign-born young migrant Mexican males and foreign-born adult migrant Mexican males did.

Table 5 presents the odds ratios of predicting stunting and very short lower leg length for Mexicans in Mexico, US-born/foreign-born young Mexican migrants, and foreign-born adult Mexican migrants by gender. Older ages and less education, and higher father's education were related to stunting among Mexican males in Mexico while education was not related to stunting among Mexican Americans regardless of their place of birth. Among females, older age, less education, living in an urban setting, lower father's education, higher mother's education, and no (selected) childhood health conditions were related to stunting while older age increased stunting for all three groups.

Discussion

This will be completed whenthe rest of the biological measures are added.

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Table 1. Anthropometric Body Measures in Datasets

	NHANES 3 (1988-1994)	NHANES 4 (1999-2000)	MHAS (2001)
Standing Height	X	X	X
Lower leg length (knee height)	X (only age 60+)		X
Calf Circumference		X	X
Weight	X	X	X
BMI	X	X	X
Waist Circumference	X	X	X
Hip Circumference	X		X

*Sitting height (trunk height is only available in NHANES III), so not included in analysis

Table 2. Sample Description among Those at Ages 50 and over in Three Datasets:

NHANES III, NHANES IV, and MHAS

	NHANES III (N=1,388)	NHANES IV (N=532)	MHAS (N=2,623)
%Nativity			
US born+ Foreign Born Young Migrants[5]	72.34	N/A	
Foreign Born Adult Migrants[6]	27.66	N/A	
Mean Age	65.01 (8.99)	65.02 (8.55)	62.38 (9.60)
%Female	49.28	52.91	53.45
%Yrs of Education			
0	18.91	80.83[1]	25.92
1-4	26.04		33.91
5-8	23.27		22.52
9 and Over (9-11 for NHANES IV)	31.78		17.65
12 and Over		19.17[2]	
%Urban Residence	47.48	N/A	64.85
Current Income[3]	19,499.58 (SD=17,767.40)	N/A	3,130.91 (SD=26,807.66) 512.43[4] (SD=3,139.32)
%Father's Education	N/A	N/A	
None elementary			51.76
Some elementary			32.61
Completed elementary			9.10
More than elementary			6.52
%Mother's Education	N/A	N/A	
None elementary			58.13
Some elementary			30.35
Completed elementary			8.03
More than elementary			3.49
Childhood Health	N/A	N/A	
Before 10, had tuberculosis			0.71
rheumatic fever			1.54
polio			0.33
typhoid fever			4.21
blow to head			4.43
had any one of the above 5			9.94

[1]never or not complete high school (<high school); [2]high school or greater than high school

[3]In MHAS, income is an individual income in the last 12 months; In NHANES III, income is a family income in the last 12 months

[4] converted to US dollar as of June, 1, 2001 – 1 peso=0.108932 USD)

(Following analyses were based on peso rather han the converted US dollar assuming that the value of US $ is different in two countries….)

[5] US-born and foreign born young migrants: US born and foreign born who came to US between ages 0 and 15

[6] Foreign-born adult migrants: Foreign born who came to US after age 15

Figure 1. Means of Height and Lower Leg Length for Mexicans in Mexico and Mexican Americans Ages 50 and Over by Place of Birth and Age Group for Males and Females: MHAS 2001 and NHANES III

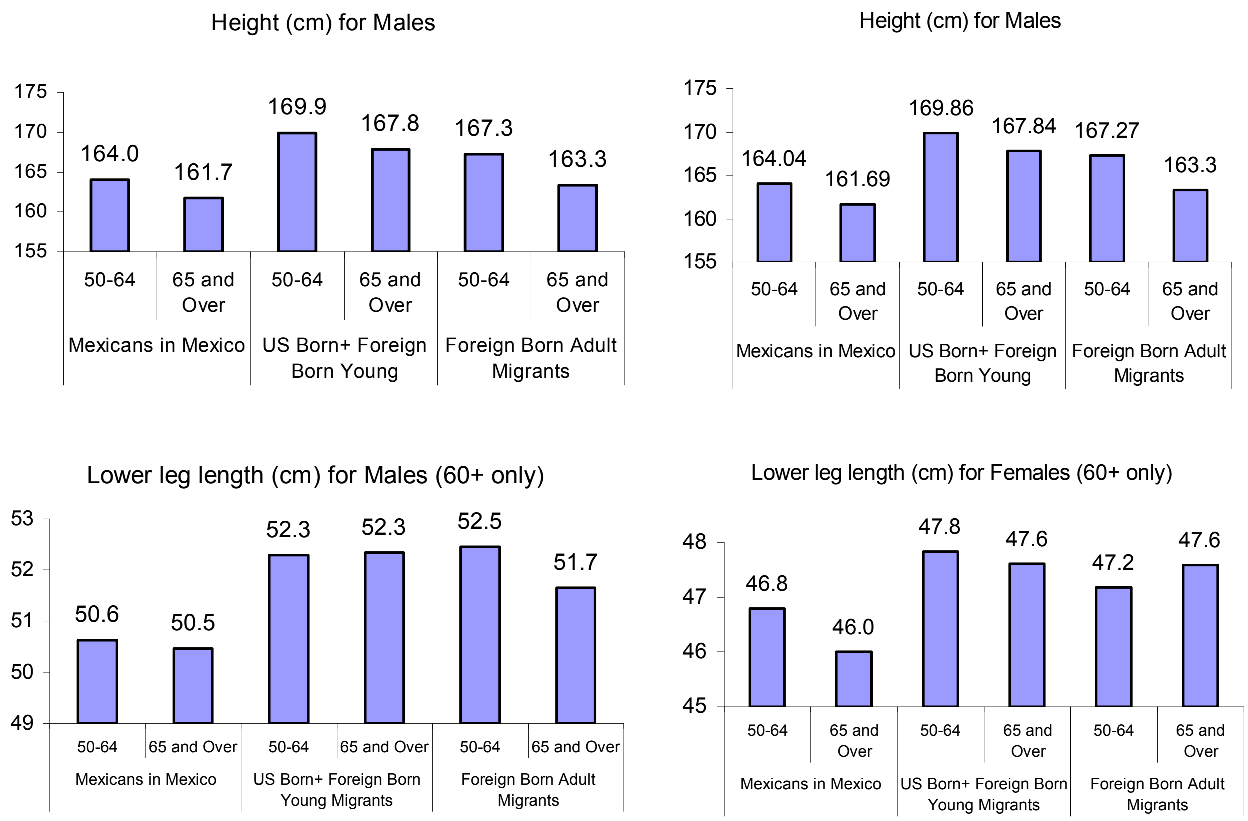
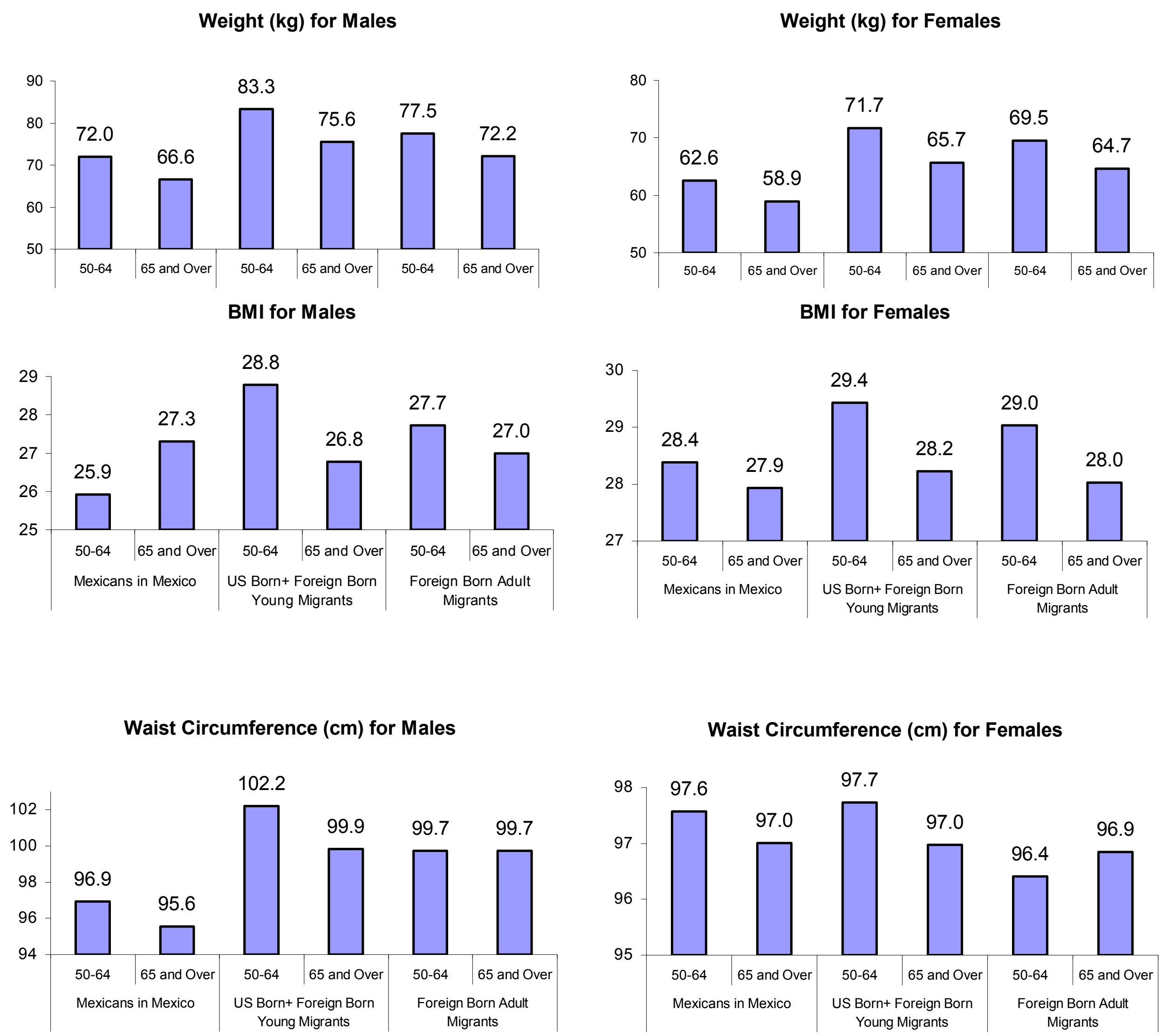
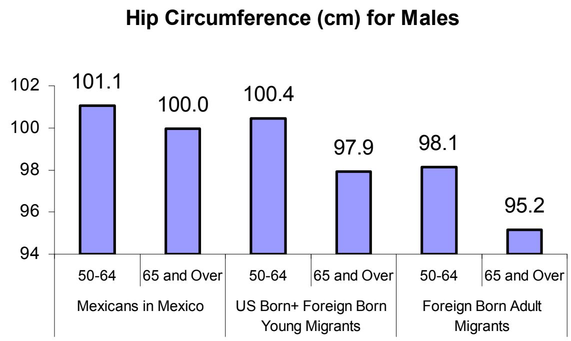
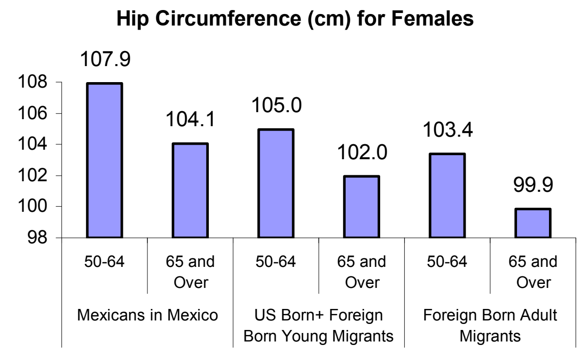
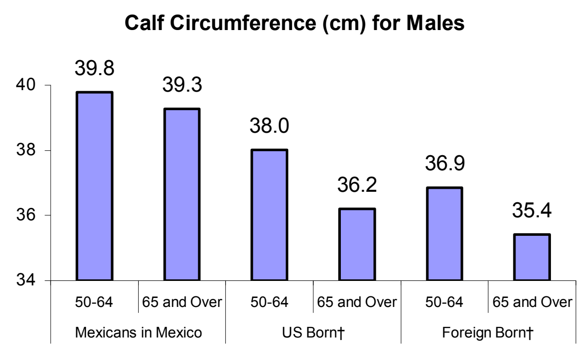


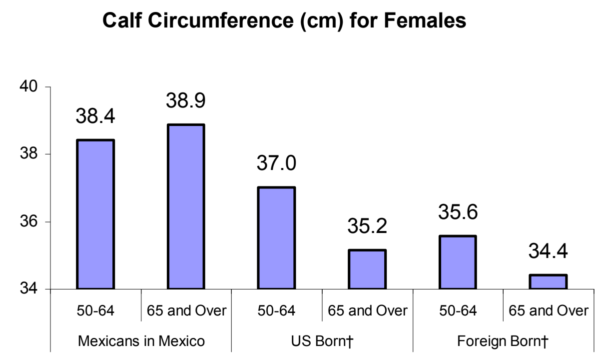
Figure 2. Means of Weight, BMI, Calf, Waist and Hip Circumference for Mexican Americans Ages 50 and Over by Place of Birth and Age Group for Males and Females: MHAS 2001 and NHANES III (NHANES IV for calf circumference)











† US-born and Foreign-born from NHANES IV

Table 3. Percent of Those at Ages 50 and Over who were Stunting[1] by Education and Urban/Rural Residence in MHAS 2001 and NHANES III

	Mexicans in Mexico	US Born + Foreign Born Young Migrant Mexican Americans	Foreign Born Adult Migrant Mexican Americans
MALES			
Mean Age	68.61 (SD=11.37)	66.36 (SD=9.95)	80.77 (SD=6.31)
Age			
50-64	10.12	1.30	0.23
65 and Over	21.30	3.24	10.18
Education (years)			
0	26.30	1.42	4.27
1-4	15.77	1.30	2.54
5-8	6.41	5.49	4.40
9 and Over	0.94	0.37	0.84
Urban/Rural Residence			
More Urban	11.87	1.20	4.70
Less Urban	16.33	2.57	0.35
Current Income	1428.28 (SD=5604.29)	1856.34 (SD=12499.28)	19466.69 (SD=9634.37)
Father's Education (years)		N/A	N/A
0	17.05		
1-6	12.57		
7 and Over	0.52		
Mother's Education (years)		N/A	N/A
0	18.19		
1-6	6.94		
7 and Over	1.51		
Childhood Conditions		N/A	N/A
Had	16.42		
Not Had	13.93		
FEMALES			
Mean Age	68.60 (SD=13.95)	77.00 (SD=5.70)	74.56 (SD=8.58)
Age			
50-64	6.05	0.16	1.15
65 and Over	13.08	2.28	5.75
Education (years)			
0	15.77	6.00	4.05
1-4	5.69	0.91	2.64
5-8	3.88	0.79	1.01
9 and Over	3.36	0.04	1.52
Urban/Rural Residence			
More Urban	7.94	0.79	2.69
Less Urban	8.87	0.94	2.75
Current Income	563.02 (SD=3551.53)	16184.65 (SD=15763.70)	13577.53 (SD=7556.61)
Father's Education		N/A	N/A
0	10.29		
1-6	6.07		
7 and Over	0.43		
Mother's Education		N/A	N/A
0	9.46		
1-6	7.20		
7 and Over	1.02		

Childhood Conditions		N/A	N/A
Had	4.95		
Not Had	8.08		

[1]Defined as 155cm or shorter for males; 140cm or shorter for females

Income: NHANESIII – USD, family income; MHAS- Peso, individual income

Table 4. Percent of Those at Ages 60 and Over Who had Very Short Lower Leg (Knee) Length[1] by Education and Urban/Rural Residence among Males and Females in MHAS 2001 and NHANES III

	Mexicans in Mexico	US Born + Foreign Born Young Migrant Mexican Americans	Foreign Born Adult Migrant Mexican Americans
MALES			
Mean Age	71.58 (SD=8.27)	70.39 (SD=5.94)	74.88 (SD=5.99)
Education (years)			
0	39.12	7.47	7.90
1-4	15.03	6.45	2.34
5-8	23.28	5.98	4.37
9 and Over	12.53	0.57	0.00
Urban/Rural Residence			
More Urban	21.83	4.13	7.08
Less Urban	26.85	4.69	1.25
Current Income	4348.22 (SD=38607.39)	12295.50 (SD=6207.86)	18837.20 (SD=8505.66)
Father's Education		N/A	N/A
0	30.20		
1-6	18.32		
7 and Over	8.76		
Mother's Education		N/A	N/A
0	31.11		
1-6	13.04		
7 and Over	16.72		
Childhood Conditions		N/A	N/A
Had	22.69		
Not Had	24.79		
FEMALES			
Mean Age	69.94 (SD=9.53)	66.47 (SD=6.89)	72.26 (SD=7.65)
Education (years)			
0	39.93	15.56	13.17
1-4	28.92	6.47	9.91
5-8	28.22	3.15	3.65
9 and Over	14.14	5.08	7.84
Urban/Rural Residence			
More Urban	26.85	8.07	8.03
Less Urban	35.87	4.26	10.65
Current Income	1998.82 (SD=6585.19)	23531.00 (SD=21632.22)	12206.21 (SD=6769.05)
Father's Education		N/A	N/A
0	41.03		
1-6	17.54		
7 and Over	9.14		
Mother's Education		N/A	N/A
0	35.46		
1-6	30.15		
7 and Over	7.81		
Childhood Conditions		N/A	N/A
Had	22.67		
Not Had	31.90		

[1]Defined as 48cm or shorter for males; 44cm or shorter for females
Income: NHANESIII – USD, family income; MHAS- Peso, individual income

Table 5. Odds Ratios of Predicting Stunting among Those at Ages 50 and Over and Very Short Lower Leg Length among Those at Ages 60 and Over on Age, Education, Urban/Rural Residence, Income, Parents' Education and Childhood Health Conditions: MHAS 2001 and NHANES III

	Males			Females		
	Mexicans in Mexico	US Born/Foreign-Born Young Mexican Americans	Foreign Born Mexican Mexicans	Mexicans in Mexico (MHAS)	US Born/Foreign-Born Young Mexican Americans	Foreign Born Mexican Mexicans
Stunting						
Age (as continuous)	1.047***	1.059	1.290**	1.042***	1.149*	1.141*
Education (as continuous)	0.822***	1.001	0.745	0.780***	0.706	1.002
More Urban	1.023	0.719	28.913	1.662*	0.794	1.843
Current Income	1.000	1.000	1.000	1.000	1.000	1.000
Father's Education (as continuous - 3)	1.618*			0.489*		
Mother's Education (as continuous – 3)	0.565			2.326*		
Childhood Health Conditions	1.147			0.529*		
Very Short Lower Leg Length						
Age (as continuous)	1.025	1.066	1.089	1.009	0.946	1.039
Education (as continuous)	0.975	0.906	0.656	0.894**	0.806**	0.985
More Urban	1.002	1.945	7.402	1.030	3.009	1.260
Current Income	1.000	1.000	1.000	1.000	1.000	1.000
Father's Education (as continuous - 3)	0.731			0.183***		
Mother's Education (as continuous - 3)	0.616			3.212***		
Childhood Health Conditions	0.977			0.551		

***p<.001; **p<.01; *p<.05

*Bivariate and multivariate analysis: the father's education was categorized into 3 (some elementary and completed elementary were put together)