The weight of nineteenth century Mexicans in the Western United States

Scott Alan Carson

aDepartment of Economics, University of Texas; bResearch Fellow, University of Munich and CESifo

Abstract

When traditional methods for measuring economic welfare are scarce or unreliable, heights and BMIs are now well-accepted measurements that represent biological conditions during economic development. Weight, after controlling for height, is an additional measure for current net nutrition. Little is known about how weights varied among Mexicans living in the nineteenth century American West. Between 1870 and 1920, average Mexican weight was low and remained constant. Mexican farmers had the heaviest weights, and unskilled worker weights were low. Weight of Mexican-born individuals were higher than Mexicans born in the United States at low weights but lower at high weights. For combined characteristics, weight varied the most with age, an uncontrollable characteristic, indicating that nineteenth century Mexican current net nutrition varied the most with factors over which they had no control.

Keywords

anthropometrics; nineteenth century US weights; net nutrition; health

JEL Classification

I10; J11; J15; N00; N31

Introduction

When traditional measures for material welfare are scarce or unreliable, stature and body mass index (BMI) values are now well-accepted values that reflect net nutrition during economic development. Average stature represents the cumulative net difference between calories consumed, less calories required for work and to fend off disease. BMIs are weight in kilograms divided by height in meters squared and may represent the current net difference between calories consumed and calories required for work and disease (Fogel 1994; Strauss and Thomas 1998, p. 773). However, interpreting BMI values is more complicated than interpreting stature because BMI is the ratio of current to cumulative net nutrition, and BMI variation depends on when privation occurs. For example, if a person receives insufficient nutrition in their youth, their statures may be short, their frames small, and their basal metabolic needs will be lower in later life (Mifflin et al. 1990; Schneider 2017, pp. 4–7). If their nutrition improves as they get older, their BMIs are more likely to be high because smaller frames have less area to distribute weight (Herbert et al. 1993, p. 1438; Carson 2009; Carson 2012). Alternatively, if an individual receives sufficient net nutrition during their youth, they are more likely to grow to taller statures, have higher metabolisms, and their BMIs are lower because their frames have more area to distribute weight (Sorkin, Muller, Andres 1999; Sorkin, Muller, Andres 1999). This inability to isolate the difference between current and cumulative net nutrition using BMI indicates an additional measure is needed, and weight conditioned on height is a viable measure to study changes in current net nutrition. On its surface, holding current net nutrition constant, there should be a positive relationship between stature and weight, indicating that weight alone is not the only measure that isolates changes in current net nutrition because it is dependent on cumulative net nutrition. Nonetheless, weight is more plastic and responsive to the immediate effects of privation than height, therefore, isolates changes in the current nutritional environment that does not depend on the complicating ratio of weight divided by height. Other unobservable factors associated with Mexican weight include cultural practices, such as diets, cultural changes, and changes in life structure.

Modern Mexican populations have a rich history in the United States with origins in both European immigrants and Native Mexicans. An individual of mixed European and indigenous Mexican ancestry is classified as Mexican Mestizo and is the primary ethnic group of interest throughout this study. Other ethnic groups are individuals described by prison enumerators as “black” and “white,” who were individuals born in the United States of African and European ancestry. Like the US’s
political separation from Great Britain, much of Mexico’s early history was shaped by its transition to independence from Spain. After its political separation in 1821, diverse political interests fought for control over Mexico. Between 1864 and 1867, Austria’s Hapsburg family controlled Mexico’s early economic and political development. However, in 1867, civil conflict with indigenous groups led Benito Juárez to overthrow Hapsburg rule in Mexico, and Juárez went on to serve as president during the 1870s. In 1876, Porfírio Díaz led a revolt and was installed as Mexico’s president, and Díaz served for nearly three decades as the head of the Porfiriato, which is the political and economic regime that was characterized by stability, modernization, and economic development. In 1911, Madero, a Mexican Revolutionary, led a successful revolt against Díaz but was himself assassinated in 1913. Throughout the 1920s, this revolt against Madero led to considerable political instability, and Mexican statures and BMIs stagnated. However, these Mexican revolutions and counterrevolutions were unlikely to influence the biological measurements of migrants who moved north, and most of late nineteenth and early twentieth century Mexicans remained peasants.

There is a well-established literature that addresses late nineteenth and early twentieth century Mexican biological conditions that shows early twentieth century Mexican statures followed a north-south stature gradient (Faulhaber 1970, pp. 94–96). Goldstein (1943, pp. 16–17) finds that early twentieth century Mexican children born in the United States were taller than their parents who did not migrate, demonstrating that Mexican net nutrition improved with migration to the American West. López-Alonso (2007) and López-Alonso (2012) use stature to show that Mexican living standards did not improve during Díaz’s effort to industrialize but may have responded favorably during the mid-twentieth century Cárdenas’ administration. Using Mexican-born prisoners in the United States, Carson (2005, pp. 414–415) demonstrates that adult Mexican statures decreased in the late nineteenth century. As Porfirián Díaz’s economic policies to favor greater factor mobility, railroads, and economic growth advanced, Mexican male statures decreased by nearly 1 cm. Inequality also increased during the Porfiriato (Haber 1989, pp. 16–18; Bortz and Haber 2002, p. 16; Carson 2005), and Díaz’s economic policies to rapidly develop were associated with increased inequality. Mexican weights in the Western United States may have also been related to inequality, which may have foreclosed Mexicans from material and net nutritional opportunity.2

Beans and rice were two staples in the nineteenth century Mexican diet; however, this diet lacked animal proteins and fats and was associated with lower body mass index values (Gamio 1969, pp. 140–147; Carson 2007; Dirks 2016, pp. 6–7). Lower BMIs are associated with lower levels of chronic health conditions, such as diabetes and heart disease (Waaler 1984; McLannahan and Clifton 2008, pp. 18–19). Moreover, the incidence of disease may vary over the BMI distribution and be related to both weight and health (Floud et al. 2011, pp. 41–43). Diets of nineteenth century Mexicans in Mexico were largely vegetarian and contained few calories from animal proteins. Dairy was also not an important part of the diet in Mexico. However, the diets of Mexicans in the United States were augmented with pork and dairy products (Gamio 1969, pp. 140–147; Dirks 2016, pp. 6–7). This is in marked contrast to modern obesity trends, where twentieth century US citizens of Mexican descent have among the highest rates of obesity and diabetes (Ogden et al. 2012; Ogden et al. 2014, p. 810). The difference is explained, in part, by cultural preferences and life practices that influence weight but are not included in the models presented here (Popkin 1993; Flegal et al. 2012, pp. 493–494; Ogden et al. p. 846; Grogger 2015).

Despite its importance relative to other physical measurements, weight has received little attention in historical health studies, which is due to a lack of nineteenth century weight data. To consider how weights in the United States varied with economic development, Komlos (1987) uses West Point cadet weight and height data to show there was a general decrease in nineteenth century net nutrition that was geographically widespread and affected blue collar workers and farmers more than workers in other occupations. Students at The Citadel did not experience a decline in net nutritional status until after the Civil War (Coclanis and Komlos 1995). Carson (2015b) shows that late nineteenth and early twentieth century black and white weights were in normal weight categories, and for the same height, blacks had heavier weights than whites. Farmers and unskilled workers were heavier than workers in other occupations; weights were greater in the South and decreased throughout the late nineteenth and early twentieth centuries (Carson 2015b). However, nothing is known about how nineteenth century weight varied for Mexicans in the western United States.

It is against this backdrop that this study considers three paths of inquiry into late nineteenth and early twentieth century weight variation for Mexicans living in the American West. First, across the distribution, how did weights vary during the late nineteenth and early twentieth centuries? Between 1870 and 1920, Mexican weights stagnated, their calories consumed may have been little above those required to maintain weight, and did not improve with economic development. Second, across the distribution, what was the relationship
between weight and socioeconomic status? Mexican farmers’ proximity to nutrition and distance from urban disease environments were associated with greater weight and better net nutrition. Third, during this period of Mexican economic and political development, what were the demographic factors associated with weight variation, and did Mexicans acquire attributes associated with better current net nutrition, or did their weights vary with factors over which they had little control? Among nineteenth century factors associated with Mexican weight variation, weight varied the most with height and age, indicating that nineteenth century Mexican current net nutrition was largely beyond their control.

**Methods and materials**

**Quantile regression**

Least squares regression coefficients describe a characteristic’s effect on the mean of a conditional distribution. It does not, however, describe how a dependent variable changes across a distribution. Across the late nineteenth and early twentieth century weight distribution, Mexicans may have had different relationships with height, demographics, and socioeconomic status. Quantile estimation is important in ethnic weight and BMI studies because late nineteenth and early twentieth century BMIs of individuals of European descent increased at the top of the distribution at the same time that average and median white BMIs decreased (Carson 2012b, p. 154). To better understand the interaction between Mexican net nutrition and economic variables, a quantile regression function is constructed (Conley and Galenson 1994).

Let \( w_i \) be the individual’s weight, and \( x_i \) be the matrix of covariates representing demographic characteristics, observation period, and socioeconomic status. The conditional quantile function is

\[
 w_i = Q_w(p | x) = \theta x + \eta S(p), \quad p \in (0, 1)
\]

which is the \( p \)-th weight quantile, given \( x_i \) (Koenker and Bassett 1978; Koenker and Bassett 1982; Koenker 1982; Koenker 2005). The interpretation of the coefficient \( \theta \) is the relationship of the covariate on the weight distribution at the \( p \)-th quantile. For example, the farmer dummy variable coefficient at the median (.5 quantile) is the average difference in weight that keeps a farmer’s weight at the median relative to workers in other occupations. The late nineteenth and early twentieth century weight quantile model is expressed as a function of demographic, socioeconomic, and residential characteristics.

\begin{align*}
\text{Weight}_p &= \theta_0 + \theta_1 \text{Inches}_i + \sum_{c=1}^{2} \theta_{c} \text{Complexion}_i \\
&+ \theta_m \text{Mexican Birth}_i + \sum_{a=1}^{3} \theta_{a} \text{Age}_i \\
&+ \sum_{t=1870}^{1920} \theta_{t} \text{Observation Period}_t + \sum_{l=1}^{4} \theta_{l} \text{Occupations}_l \\
&+ \sum_{r=1}^{3} \theta_{r} \text{Residence}_r + \epsilon_i
\end{align*}

Height in inches is included to account for the positive relationship between weight and height. Complexion dummy variables are included to account for the relationship between weight variation and complexion, and a Mexican nativity dummy variable is included to account for weight and nativity. Age is accounted for with a third order polynomial. To account for the relationship with weights over time, observation period dummy variables are included in 10-year intervals between 1870 and 1920. Occupation dummy variables are included for white-collar, skilled, farming, and unskilled occupations. Prison dummy variables are a proxy for state of residence at time of measurement and are included to account for the relationship between weight and residence.

**Estimating the significance of collective effects**

Quantile weight regression coefficients account for individual relationships between weight and observable characteristics across a dependent variable’s distribution. They do not, however, account for the combined relationships for how observable characteristic subsets were associated with weight. For example, by itself, the farmer occupation dummy variable offers insight into how weight varied across the distribution for agricultural occupations, but individual effects do not account for how weights varied collectively with occupations. Sensitivity analysis accounts for how a dependent variable differs with an unconstrained model when variable subsets are excluded (Leamer 1983; Leamer 2010; Angrist and Pishke 2010, pp. 3–6). Table 3 presents weight sensitivity models when height, complexion, age, nativity, decade received, occupation, and residence are excluded. Model 1 presents the unrestricted Mexican weight model with height, demographic, complexion, and socioeconomic variables. Models 2 through 6 present restricted models when subsequent classes are omitted, which are used to determine how weight varied with cohort subsets.

Weight variation is sensitive to two general characteristics: choice and nonchoice factors. For example, height
and age are two nonchoice characteristics that individuals have no control. However, occupations and residence are two characteristics that individuals exercise considerable discretion. F-statistics test the collective relationship between joint characteristics. They do not, however, provide a magnitude for weight variation that restricted variables had with nineteenth century Mexican weight variation. To account for restricted variables’ magnitude with weight variation, the percentage change in the restricted model sum of squared regressions (SSR_r) relative to the unrestricted model (SSR_u) are reported for each set of observable characteristics.

Let the relative importance of a subset of variables associated with weight be:

$$\%\Delta SSR = \frac{SSR_u - SSR_r}{SSR_u} = \frac{SSE_u - SSE_r}{SST - SSE_u} = \frac{R^2_u - R^2_r}{R^2_u} = \%\Delta R^2$$

where SSE_u and SSE_r are the sum of squared errors of the unrestricted and restricted models. SST is the total variation in the model (Table 3).

Late nineteenth and early twentieth century Mexicans in US prisons

Data to analyze the weight of nineteenth century Mexicans living in the Western United States is from four Western state prisons that recorded both Mexican weight and height between 1871 and 1925: Arizona, Colorado, New Mexico, and Texas. At the time of incarceration, US prison enumerators recorded occupation, crime, place of birth, age, height, and weight. Since age, occupations, and physical measurements were recorded at the time of incarceration, they reflect preincarceration conditions and not conditions within Western prisons. Because most nineteenth century Western state prisons did not document an inmate’s Mexican city of birth, only their state or country of birth, it is not clear whether Mexicans living in the West were born in Mexico and immigrated north or if they were born in the West. However, the New Mexico prison recorded the hometown of each Mexican inmate, and Mexicans claiming birth in Mexico were born within Mexican territories after the 1848 border settlement with the United States. No Mexican-born inmate claimed birth in a Mexican city that later became part of the United States.3 If inmates in other prisons were like those in the New Mexico prison, it is sensible to conclude that Mexican inmates were born within Mexico after the 1848 border settlement with the United States. The comparison is, therefore, between Mexicans claiming birth in Mexico and Mexicans claiming birth in the United States.

Because institutions that randomly collected data were yet to develop, all historical data have various biases that reflect the purposes for which they were collected. There are two common sources of historical weight and height data: military and prison records. Historical military records represent recruiter’s selection on taller statures or conditions in higher socioeconomic groups (Sokoloff and Villaflor 1982, pp. 256–258; Ellis 2004, p. 27), whereas prison records represent conditions among the working class. While both military and prison samples are valuable, there are concerns when using military data because of minimum stature requirements for service, and disproportionally taller men with lower BMIs remain in service records. Prison records avoid this constraint and the resulting truncation bias because there were no height requirements for prison incarceration. However, prison data are not above reproach. For example, it is not clear which segment of society prison records represent, and if prisoners turned to theft for survival, prison records may represent conditions among the materially poorest individuals. Alternatively, law enforcement officers may have incarcerated more physically fit individuals who had an advantage in physical assault crimes over shorter physical assault arrestees. Because the majority of Mexican prisoners were incarcerated for theft and physical assault crimes, prison records likely represent conditions among the working class. There has been a recent challenge to the accepted view that statures declined during the nineteenth century’s second and third quarters that suggests the stature decrease is due to sample-selection bias rather than a genuine deterioration in net nutrition (Bodenhorn, Guinnane, and Mrocz 2015). However, Komlos and A’Hearn (2016) propose that failing to account for patriotism with military recruits is itself a source of bias, and Zimran (2015) indicates the antebellum paradox is not an artifact of sample-selection, but that sample-selection remains an important issue in anthropometric studies. It is also possible that law enforcement may have disproportionately targeted Mexicans in the West through social and ethnic discrimination; however, it is unclear how this influenced reported weight and height and if this was systematically different from other individuals incarcerated with different ethnic classifications.

Before the use of photographic technology was widespread, prison enumerators recorded complex characteristics in detail, and written descriptions were an important means of identifying inmates if they escaped and were recaptured. Written descriptions were also an important means of identifying individuals within a prison. The Arizona prison is the only institution that, for at least a time, recorded both written classifications with photographs, and it is clear from the Arizona
records that individuals recorded as “Mexican” had complexions consistent with the Mestizo ethnic group. Enumerators recorded a wide range of occupations and defined them narrowly, which are classified here into four categories. Laborers and miners are classified as unskilled workers. Unfortunately, enumerators did not always distinguish between farm and common laborers. Since farm laborers typically came to maturity under biologically favorable conditions compared to common laborers, this probably overestimates the biological benefits of being a common laborer and underestimates the benefits of being a farm laborer (Carson 2013a, p. 59; Carson 2015a). Workers in the agricultural sector are classified as farmers. Light manufacturers, craft workers, and carpenters are classified as skilled workers. Merchants and high skilled workers are classified as white-collar workers (Lauderie 1979; Margo and Steckel 1992; p. 520).

Table 1 summarizes nineteenth century Mexican population characteristics in Western state prisons and indicates that nearly one-half of Mexican inmates were incarcerated in Texas. Like modern populations, younger inmates were more common than older inmates (Hirschi and Gottfredson 1983; Gottfredson and Hirschi 1990). US born Mexicans were more likely than Mexican-born Mexicans to be farmers. Mexican nativity was more common early in the 19th century, but US birth became more common over time. Arizona had a high percentage of Mexicans born in Mexico, while New Mexico had more Mexicans that were born in the West. While a few female weights and heights were recorded, their numbers are small, so only Mexican male inmates are considered here.5

Results

While it is not clear how historical BMIs and health align with modern standards because of the effects of disease, the majority of 19th century Mexicans in the American West were in the normal category (Figure 1; Fogel 1993, p. 7; Floud et al. 2011, pp. 57–61, 146–151; Stephenshen 1999); neither starvation nor obesity were common.6 Average Mexican-born BMI was 22.93, while average US-born Mexican BMI was 22.87. There were surprisingly few Mexicans in the underweight category, and few in overweight and obese categories. To the degree that BMIs represent access to current net nutrition, nineteenth century Mexican net nutrition was constant over time (Carson 2007). However, rather than a sign of adequate Mexican diets in the Western United States, low and constant Mexican BMIs probably represents conditions among Mexicans in the American West that are

<table>
<thead>
<tr>
<th>Occupations</th>
<th>N</th>
<th>US Born</th>
<th>Average Weight</th>
<th>Average Height</th>
<th>N</th>
<th>Mexican Born</th>
<th>Average Weight</th>
<th>Average Height</th>
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<td>White-collar</td>
<td>64</td>
<td>1.87</td>
<td>141.91</td>
<td>66.70</td>
<td>85</td>
<td>1.49</td>
<td>137.85</td>
<td>65.74</td>
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<tr>
<td>Skilled</td>
<td>296</td>
<td>8.66</td>
<td>142.30</td>
<td>66.12</td>
<td>690</td>
<td>12.08</td>
<td>137.87</td>
<td>65.43</td>
</tr>
<tr>
<td>Farmer</td>
<td>310</td>
<td>9.07</td>
<td>145.36</td>
<td>66.70</td>
<td>310</td>
<td>5.43</td>
<td>144.50</td>
<td>65.67</td>
</tr>
<tr>
<td>Unskilled</td>
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<td>77.91</td>
<td>142.94</td>
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<td>140.63</td>
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<tr>
<td>No occupation</td>
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<td>2.49</td>
<td>139.77</td>
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<td>114</td>
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<td>137.29</td>
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<td>143.67</td>
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<td>1,329</td>
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<td>141.61</td>
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<td>803</td>
<td>23.49</td>
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<td>1,615</td>
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<td>143.59</td>
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<td>1,847</td>
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<td>37.65</td>
<td>143.86</td>
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<td>3,339</td>
<td>58.46</td>
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<td>78</td>
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<td>1.68</td>
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<td>New Mexico</td>
<td>1,349</td>
<td>39.47</td>
<td>143.86</td>
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<td>556</td>
<td>9.73</td>
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<td>3,339</td>
<td>58.46</td>
<td>139.91</td>
<td>65.55</td>
</tr>
</tbody>
</table>

Source: Arizona State History and Archives Division, State Capital, Suite 342, 1700 West Washington, Phoenix, AZ 85007; Colorado State Archives, 1313 Sherman, Room 1820, Denver, CO 80203; New Mexico State Records Center and Archives, 1205 Camino Carlos Rey, Santa Fe, NM 87507; Texas State Library and Archives Commission, P.O. Box 12927, Austin, TX 78711.
indicative of low net nutritional status in this population who’s nutrition did not improve over time.

To illustrate how nineteenth century Mexican weights were distributed, weight kernel density estimates are presented in Figure 2 and illustrates that Mexican weights are distributed symmetrically. Average Mexican youth and adult weights were 136.93 and 142.61 pounds, respectively. In comparison, nineteenth century US black and white youth weights were 144.21 and 140.94 pounds. During the same period, black and white adult weights were 154.09 and 148.00 (Carson 2015b; Carson 2015d), and Mexican adult weights in the American West were lower than both their black and white counterparts. In sum, the majority of late nineteenth and early twentieth century Mexican BMIs were in normal categories, and Mexican weights were lower than their US-born black and white counterparts (Carson 2009; Carson 2012).

We now test how Mexican weights were conditionally related to demographic, socioeconomic characteristics, and residence across the weight distribution. Three paths of inquiry are considered when analyzing late nineteenth and early twentieth century Mexican weight variation. First, Table 2 demonstrates that Mexican weight decreased by less than one percent for any Mexican weight quantile observed between 1870 and 1920 (Figure 3).

Second, like stature, BMI, and nutrition, Mexican weight varied by occupations, and farmers’ proximity to nutrition and removal from urban disease environments were associated with greater weight and better net nutrition, especially at higher weights (Figure 4).

Other patterns are consistent with expectations. Mexicans residing in New Mexico had greater weights than other Mexicans living in the United States. Without greater detail, it cannot be inferred that Mexicans listed as dark Mexicans had greater degrees of indigenous ancestry, or Mexicans listed as light had greater degree of European extraction. However, neither light nor dark complexions were related to weight. Weight of Mexican-born individuals was higher than US natives at lower quantiles but lower in higher quantiles. As they were not subject to a paternalistic bound-labor system with managed diets, Mexican youth weight increases with age were modest (Figure 5). When height is excluded from Table 2’s weight Model 1, it upwardly biases the

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**Figure 1.** Late nineteenth and Early twentieth century Mexican BMIs by Observation Year. Source: See Table 1. Black and white nativities are for birth in the United States. “US Born” is Mexicans born in the United States, whereas “Mexico” is Mexicans born in Mexico. Notes: Imputed Mexican weight is for Mexicans observed in Texas during the 1900s decade without a listed occupation. US born represents Mexicans born in the United States. Mexicans born in Mexico are Mexicans born in Mexico but who migrated to the American West. BMI estimates over time are from Carson (2007).

**Figure 2.** Mexican youth and adult weight comparison. Source: See Table 1.
Table 2. Mexican weight quantile by height, demographics, socioeconomic status, and residence.

<table>
<thead>
<tr>
<th></th>
<th>Model 1 OLS</th>
<th>Model 2 25th</th>
<th>Model 3 50th</th>
<th>Model 4 75th</th>
<th>Model 5 90th</th>
<th>Model 6 95th</th>
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<tbody>
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<td>-104.43***</td>
<td>-110.03***</td>
<td>-114.10***</td>
<td>-112.42***</td>
<td>-92.96***</td>
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<tr>
<td></td>
<td>(.381)</td>
<td>(.481)</td>
<td>(6.49)</td>
<td>(7.97)</td>
<td>(8.19)</td>
<td>(12.56)</td>
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<td>Height Inches</td>
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<td>3.15***</td>
<td>3.32***</td>
<td>3.52***</td>
<td>3.48***</td>
<td>3.30***</td>
</tr>
<tr>
<td></td>
<td>(.045)</td>
<td>(.071)</td>
<td>(.076)</td>
<td>(.077)</td>
<td>(.088)</td>
<td>(.116)</td>
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<td>Complexion Light</td>
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<td>-.473</td>
<td>-3.10*</td>
<td>-2.62*</td>
<td>-4.66</td>
<td>-20.11**</td>
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<td></td>
<td>(1.18)</td>
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<td>(1.53)</td>
<td>(9.28)</td>
<td>(7.92)</td>
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<td>-.268</td>
<td>-.518</td>
<td>-.219</td>
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<td>(.203)</td>
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<td>(.401)</td>
<td>(.493)</td>
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<td>(.987)</td>
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<td>Ages Age</td>
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<td>2.17***</td>
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<td>2.94***</td>
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<td>(.244)</td>
<td>(.341)</td>
<td>(.631)</td>
<td>(.464)</td>
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<td>-.055*</td>
<td>-.075*</td>
<td>-.063*</td>
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<td>(.007)</td>
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<td>(.019)</td>
<td>(.013)</td>
<td>(.027)</td>
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<td>Age³</td>
<td>3.610¹⁰⁻⁵</td>
<td>3.110¹⁰⁻⁴***</td>
<td>3.610¹⁰⁻⁴***</td>
<td>3.910¹⁰⁻⁴***</td>
<td>5.610¹⁰⁻⁴***</td>
<td>4.510¹⁰⁻⁴***</td>
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<tr>
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<td>(.740⁻⁵)</td>
<td>(.668⁻⁵)</td>
<td>(.765⁻⁵)</td>
<td>(.711⁻⁴)</td>
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<td>(.227⁻⁴)</td>
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<td>Reference</td>
</tr>
<tr>
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<td>-.409***</td>
<td>-.219</td>
<td>-.433⁷</td>
<td>-.196</td>
<td>.722</td>
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<td>(.146)</td>
<td>(.231)</td>
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<td>(.616)</td>
<td>(.610)</td>
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<td>-.138</td>
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<td>(3.39)</td>
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<td>.391</td>
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<td>(1.11)</td>
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<td>(1.86)</td>
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<td>(8.96)</td>
<td>(7.91)</td>
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<td>.618</td>
<td>4.40</td>
<td>1.02</td>
<td>6.12</td>
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<td></td>
<td>(1.42)</td>
<td>(.218)</td>
<td>(.330)</td>
<td>(2.89)</td>
<td>(4.81)</td>
<td>(8.26)</td>
</tr>
<tr>
<td>Residence New Mexico</td>
<td>1.64⁴</td>
<td>1.65⁴</td>
<td>1.02⁻¹</td>
<td>1.76⁻¹</td>
<td>2.63⁻¹</td>
<td>3.04⁻¹</td>
</tr>
<tr>
<td></td>
<td>(.290)</td>
<td>(.462)</td>
<td>(.508)</td>
<td>(.586)</td>
<td>(.741)</td>
<td>(.868)</td>
</tr>
<tr>
<td>Residence Texas</td>
<td>9130</td>
<td>9130</td>
<td>9130</td>
<td>9130</td>
<td>9130</td>
<td>9130</td>
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<tr>
<td>R²</td>
<td>.3045</td>
<td>.1706</td>
<td>.1698</td>
<td>.1798</td>
<td>.1834</td>
<td>.1805</td>
</tr>
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</table>

Source: See Table 1.

Notes: Imputed Mexican weight is for Mexicans observed in Texas during the 1900s decade without a listed occupation.
***Significant at .01. **Significant at .05; significant. *Significant at .10. Least squares standard errors are robust standard errors clustered on age. Quantile standard errors are bootstrapped standard errors.

The relationship between weights, occupations, and residence, while downwardly biasing the relationship between weight and age. In addition, an F-test between unrestricted and restricted height models illustrates that height had a measureable association with weight F(1, 9,102) = 5,269.06, p = .0000. A joint hypothesis test on Mexican ages demonstrates that weights were significantly related to age, F(3, 9,102) = 86.32, p = .000, and the %ΔR² when height is omitted is an 86% reduction, whereas the %ΔR² when age is omitted is only seven percent, indicating weight was related more with height than age. A joint hypothesis test on occupations indicates...
that weight was collectively related with occupations, $F (1, 9,102) = 6.30, p = 000$, but the collective effect of occupations with weight was small.

**Discussion**

When traditional measures for economic welfare are scarce or unreliable, stature and BMI are now well-accepted measures that reflect current net nutrition and are complements to traditional measures for economic welfare when they are. However, interpreting BMI variation is difficult because it represents the ratio of net current to net cumulative nutrition, which indicates that a complement to BMI is needed to isolate changes in current net nutrition. Weight—after controlling for height—is an important measure because it reflects changes in current net biological conditions, and this study analyzes late nineteenth and early twentieth century Mexican weights to assess how net nutrition varied over time, by demographic characteristics, and socioeconomic status.

Nineteenth century Mexican weights were symmetrically distributed, and the weight of Mexicans in the American West was neither underweight nor obese (Figure 2). Mexican BMIs stagnated throughout the late nineteenth and early twentieth centuries. Between 1870 and 1920, Mexican weight decreased by less than 1% (Figure 3). The relationship between weight and socioeconomic status indicates that Mexican farmers consistently had greater weights than workers in other occupations. Rural Mexican farmers were in close proximity to more nutritious diets than workers in other occupations and were far removed from urban occupations where disease was easily spread. Nevertheless, interpreting this relationship between agricultural occupations and weight is made with caution because farmers may have been heavier to begin with, indicating reverse causation is possible (Margo and Steckel 1992, p. 518). Part of heavier farmer weights was also related to physical activity, and weight represents a person’s composition between muscle and fat. Farmers were more physically active and had greater muscle mass, demonstrating that farmers had sufficient calories to maintain weight (Carson 2015c). There were also various nineteenth century disease episodes; however, Mexican farmers were removed from densely populated areas where diseases were more easily propagated. Skilled workers had the lowest weights, but like other occupations, skilled worker weights increased across weight quantiles (Figure 4). There was a positive relationship between weight and height, and when height is excluded, the relationship between weight, age, observation period, nativity, socioeconomic variables, and residence varies considerably, indicating that weight had a significant, independent relationship with height (Keys et al. 1972, pp. 329–330; Carson 2013b).

Within the set of nonchoice characteristics associated with weight variation, height accounted for an 84.20%...
reduction in $R^2$; age accounted for a 7.10% decrease; complexion only accounted for a .07% $R^2$ decrease. Within the set of choice variables, occupations account for a .85% reduction in $R^2$; observation year accounts for .66% decrease in $R^2$. In sum, height accounts for the greatest weight variation, and nonchoice characteristics had the greatest explanatory power in nineteenth century weight variation. Occupations account for the largest magnitude associated among choice characteristics.

Among Spain’s New World settlements, New Mexico was among the first extensive settlements into the American West. With time and established settlements, individuals of Mexican ancestry in New Mexico may have found greater nutritional success. Moreover, because of this vintage effect, Mestizo Mexicans in New Mexico may have faced fewer barriers to economic mobility. Height increases as adolescent’s age, and individuals gain weight with age (Williams and Woods 2006; Sorkin, Muller, Andres 1999; Sorkin, Muller, Andres 1999). Steckel (1986) demonstrates that slave statures were short but experienced accelerated stature growth as slave children neared entry into the adult labor force. After accounting for height, there was little Mexican weight variation with age across quantiles (Figure 5). Lower Mexican weights at older ages were also similar to weight decreases with age experienced by African-Americans in the nineteenth century US (Carson 2015b). These collective effects and had the greatest magnitude associated among choice characteristics.
During the late nineteenth and early twentieth centuries, there were two important collective weight relationships that varied with characteristics among Mexicans living in the American West: height and age. Therefore, there are complex relationships between height, age, and weight, and Mexican weight differences were influenced by factors beyond their control.

Notes

1. \[ BMI = \frac{w(x)}{h^2} = \ln w - 2 \ln h \] subsequently, weight is positively related to height (Carson 2015b, p. 954).

2. Nineteenth century black statures were shorter than whites, and research indicates this may have been related to disparate access to net nutrition for darker complexioned African-Americans (Steckel 1979; Bodenhorn 1999).

3. Most inmates with identifiable hometowns were from, Matamoros, Chihuahua, Santa Rosalia, Ciudad Juarez, and other Northern provinces. A few inmates appear from Zacatecas and Mexico City, but none were from the Yucatan Peninsula or farther South. No Mexican inmate claimed a hometown in the Yucatan Peninsula or Southern Mexico.

4. Mexico’s Northern Provinces that border the United States are Tamaulipas, Nuevo Leon, Coahuila, Baja California Norte, Sonora, and Chihuahua. Other Northern Provinces include Sinaloa, Durango, Zacatecas, and San Luis Potosi.

5. There were 30 Mexican females in American prisons between the ages of 14 and 22 with average BMIs of 21.5. There were 63 females between the ages of 23 and 55, with an average BMI of 23.1.

6. To determine obesity’s prevalence, the World Health Organization (WHO) established obesity status in terms of BMI. Individuals with BMIs greater than 29.9 are obese; BMIs between 29.9 and 24.9 are overweight; individuals with BMIs less than or equal to 24.9 and greater than 18.5 are in the normal category; BMIs less than 18.5 are underweight. Nevertheless, as a measure for obesity, BMI is not above reproach, and African-Americans and individuals with greater muscle mass are more likely to be counted as obese when their weight is appropriate for their body type (Burkhauser and Cawley 2008).

References


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