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The ups and downs of Mexican economic growth: the biological standard of living and inequality, 1870–1950[☆]

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Abstract

The secular change in the biological standard of living of the Mexican population between 1870 and 1950 is examined based on evidence on the physical stature from military and passport records. While Mexico industrialized and experienced rapid economic growth during this period, there was only a modest overall improvement in the height, health and nutritional status of the Mexican population. The average Mexican born in the 1940s was not only slightly taller than its compatriot of the 1870s. There were, however, considerable social differences: the Mexican upper class was markedly taller than the working class and the gap increased prior to the revolution. Economic growth with systemic inequality largely accounts for such a pattern.

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1. Introduction

The importance of living standards for understanding Latin American history is only matched by our ignorance of what actually happened. The first estimates of income distribution available for a Latin American country are for 1957. Prior studies offer mere “snapshots” of living standards for a particular group, in a specific place and time, but there are few systematic analyses of trends in the 19th and 20th centuries.² The evidence on physical stature analyzed in this paper is an initial attempt to fill this void in the literature. The main finding is that the average Mexican born in the 1940s was only slightly taller than those born in the 1870s. There were, however, marked social differences: average heights of the Mexican upper class increased in the late 19th and early 20th centuries, while that of the rest of the population remained constant and even decreased during and immediately after the revolution. These results are rather reminiscent of the European and American experience in the mid-19th century where average heights also tended to decline or stagnate at the onset of modern economic growth (Komlos, 1998). However, the Mexican experience is remarkable for the turn of the 20th century, insofar as they differ from the anthropometric history of the contemporary world, including that of East Asia, Europe, and the United States. They are also surprising in light of the fact that infant mortality decreased, and life expectancy increased in Mexico during the same period.³ However, our finding is consistent with the notoriously unequal income distribution in Mexico. We conclude that there are two histories of living standards in Mexico: that of the lower strata of the population, and that of the middle and upper-classes.

The traditional historiography addresses the issue of Mexican living standards only tangentially. The decline of living standards is argued to be of one of the main reasons for the populace to join the armed rebellion of 1910. The classics on the history of the Mexican Revolution write about unhappy people with no fire in their homes, no shoes, and empty stomachs (Silva Herzog, 1948, p. 25). In referring to living standards in the countryside they describe “peasants living semi-enslaved in the haciendas and workers who, being victims of an uncertain life, preferred to be drunk half of their lives” (González, 1988).

Most of our knowledge of living standards in the post-revolutionary period is indirect. The historiography is explicit in describing the investments that were made to modernize the country. In addition, the government carried out social reforms that aimed at improve the working conditions and property rights of the working class. Scholars have assumed that these programs improved the living standards of the population.⁴ While the view of falling living standards until 1910, and improving living standards after 1920, is widely held, it is based on little systematic evidence. Most of the assertions from the traditional

² Salvatore's (1998) analyzes of the evolution of the biological living standards in Argentina in the late colonial and post-independence periods is an exception.

³ In the 1880s, life expectancy at birth in Mexico City was 24.5 years; in 1950, life expectancy at birth in the country was 50 years (Instituto Nacional de Estadística, Geografía e Informática (INEGI), 1994; Cossío Villegas, 1973).

⁴ According to James Wilkie, “[. . .] The Revolution's program of state directed integration of Mexican social and economic life has always been justified on the basis that it has given the poor classes a better standard of living” (1967, p. 20).

historiography are drawn from anecdotal evidence. To the degree that quantitative evidence is brought to bear, the analysis is not based on substantial systematic evidence.⁵

This paper analyses extant evidence on the height of the Mexican population. It is organized into four sections. The first section describes the sources of data and presents some descriptive statistics. The second section corrects the biases inherent in many anthropometric samples. The third section presents the analysis of the trends in heights, and the fourth section concludes.

2. Height as a measure of living standards and the Mexican height sample

There are many ways to conceptualize and measure living standards.⁶ The most common methods use material indicators such as GDP per capita, real wages, life expectancy and literacy. Using such indicators for Mexico presents several difficulties because, prior to 1940, the information available on GDP per capita, mortality, demographic data, real wages and prices is scattered and is unreliable. This study concentrates on physical stature as a measure of an aspect of the quality of life, the biological standard of living.⁷

2.1. The sources

The primary sources⁸ are the recruitment files of inducted soldiers from the military archives of the Ministry of Defense (Secretaría de la Defensa Nacional, SDN) and the passport records from the Ministry of Foreign Affairs (Secretaría de Relaciones Exteriores, SRE).⁹ Both samples contain information on males and females, and such variables as heights, occupation, literacy, place of birth, age, place of recruitment (for soldiers), date, and, also for soldiers, information on health status.¹⁰

2.1.1. Military data

The data from the military are drawn from the *Archivo de Concentración*. This contains the soldiers who are still alive (*Sección de Personal Activo*), as well as the *Sección de Cancelados*, which includes the files of deserters and dismissed personnel, and the *Sección*

⁵ Wilkie's (1967, pp. 204–207) calculation of a poverty index in Mexico for 1910–1960 is an example of an ad hoc interpretation. The index uses such characteristics of poverty drawn from the population census as, illiteracy, speak only and Indian language, live in a community with less than 2500 persons, go barefoot, wear sandals, regularly eat tortillas instead of wheat bread, and absence of sewage disposal. They were given equal weight. Direct evidence on nutrition and health are absent from the index.

⁶ “The history of welfare, of change over time in human physical and spiritual well-being, encompasses most of the research and teaching that historians do” (Coatsworth, 1996).

⁷ The concept of biological standard of living was first proposed in Komlos (1985).

⁸ *Primary sources*: (1) Secretaría de la Defensa Nacional, Dirección General de Archivo e Historia, SDN, Boulevard M. Ávila Camacho y Avenida Industria Militar #1, Código Postal 11640, México, D.F.; (2) Sección de Cancelados, Sección de Personal Extinto de Caballería, Infantería y Artillería, Sección de Relaciones Exteriores, SRE, Archivo de Pasaportes años 1918–1935, Dirección de Delegaciones, Paseo de la Reforma 255 Piso 12, Edificio Centro Bursátil, Colonia Cuauhtémoc, 06500 México, D.F.

⁹ Data will be deposited in the ICPSR data archive.

¹⁰ A detailed analysis of health status can be found in López-Alonso (2000, Chapter 5).

Personal Extinto, which has the files of the deceased.¹¹ However, the files of those who are still alive are not open to researchers. The sample on women was drawn from the *Sección de Personal de Sanidad*, which included nurses, doctors and janitorial personnel. Approximately 95% of the male soldiers were draftees. There is no evidence on officers.

Men could enter the military who were: (a) between the ages of 18 and 45; (b) a Mexican citizen; (c) at least 1.60 m tall;¹² (d) not have any chronic or contagious diseases, handicapped, deaf, or idiot; (e) not have any physical defect “or monstrous or ridiculous appearance”; (f) understand the Castilian language. However, these criteria were not strictly enforced. Height and health were the least enforced requirement, followed to a lesser extent by age and understanding of Castilian.¹³ Age and place of birth was self-reported, because birth certificates were not widely issued in Mexico until the 1930s, and parishes did not issue copies of baptismal records. Heights were measured in metric units, rounded to the nearest centimeter,¹⁴ at the time of recruitment. The place of recruitment allows us to consider migration patterns and to compare the quality of life of rural and urban dwellers. The urban variable among soldiers is probably biased, because persons who were from a very small town, community or rancho near a large city, he probably stated that he was actually from the nearby city.¹⁵ Occupation before joining the army is used to infer the social class of the soldiers.¹⁶ Soldiers who were younger than age 18 or older than age 50 are excluded from the analysis.

There are two limitations to the *Cancelados* section sample (deserters and dismissed personnel): the size of the sample ($N = 1739$) is very small relative to the total number of files available in this category (110,000),¹⁷ and it does not provide any information on health or the length of life of the recruits. The average length of stay of the deserters was just a few months, and most of the time they were not captured, but if they were, they were

¹¹ *Personal Extinto* included all soldiers who had served in the military and died while in service or retired and then died. This information was not included in the regression analysis because the cause of death was not systematically specified for those who died while in service.

¹² The minimum height requirement was not established until the 20th century and it is unclear when exactly the practice began.

¹³ Unhealthy individuals could be recruited and later dismissed. The lack of enforcement shows up clearly in the sample drawn from the *Cancelados* section. It was often the case that after one or 2 months in service, soldiers might be dismissed due to health problems that could not be detected with a medical examination.

¹⁴ Maximilian of Habsburg first introduced the metric system into Mexico in the 1860s during the French invasion (1864–1867), and the system was officially adopted in the 1880s.

¹⁵ Soldiers who could sign their name are considered literate. The military had programs to teach illiterate soldiers to read and write; hence, in theory all non-deserters eventually became literate. Because not all the files contained this information, literacy is might have been attained while in the military, this variable is not reliable enough to include in the analysis.

¹⁶ Until the 1930s, the height of the boys entering the school of officers (*Colegio Militar*) was not recorded. Once they graduated, their recruitment files did not record their height either; there is information only on their age, civil status, military rank and place of birth. Unlike draftees, the authorities did not fear the desertion of officers.

¹⁷ There were 2600 records collected of deserters, but some of these had inaccurate information. The sample collected is small relative to the total size of the available evidence, insofar as not all files contain information on height. To obtain a sample with 2600 observations the first author examined 3000 files. Since the files in this section did not have information on health status and, given that there was only a limited amount of time and resources to do field research, the author spent more time on files that did have information on health status. The author plans to collect more data from the *Cancelados* section.

imprisoned for a while and then were re-integrated into the service. The other category in this group was the dismissed personnel. Permission for dismissal was most commonly granted to arrange family affairs. Although such personnel served for an average of three years, once they left the army there was no follow up, because they were not entitled to a retirement pension or for medical services.

The *Personal Extinto* section contains the files of soldiers who served and retired, were killed in action, or died of disease. These files are more complete, because they provide information on health status as well as on the time of death of the soldiers.¹⁸ There are 4497 such data in the sample.¹⁹ These represent all the records in this category which had information on both the height and health of the soldiers.²⁰

2.1.2. *Women in the military*

With the opening of the school of nurses in the second decade of the twentieth century, women were officially included in the army, but systematic recording of stature began only at the end of the 1930s. At that time women were recruited also to work as clerks and in the cleaning and cooking services of the military. This sample covers a wide spectrum of social status, from those who came from the countryside without any education, to urban women with some skills. There was no minimum height requirement for women. It is not possible to learn about the health history of women, because there is no information on their cause of death: none of them were in the army long enough to serve, retire, and die. If they were ill they usually left the military. All women in this sample were literate.

The racial composition of the sample is not possible to determine, because racial classification was officially abolished after Mexico gained independence from Spain in 1821. However, most of the Mexican soldiers were mestizo,²¹ with probably a significant number of indigenous recruits.

2.1.3. *The passport records*

The passport records are available on microfilm in the Archivo de Pasaportes. Those who requested passports had the means to travel abroad for business, study, or leisure, hence—in contrast to the military data that have negligible records on the upper social strata—these records pertain, in the main, to the middle and upper classes. The sample of all passports of

¹⁸ There is no information on the weight of soldiers. Moreover, information on the diseases from which the soldiers suffered while they were in service or when they retired is incomplete. In some cases, the death certificate lists all diseases from which the individual suffered at the time of death, even if they were not all the causes of death.

¹⁹ The first author went through 90% of the files in the *Personal Extinto* section and collected all records for which height information was given. About 40% of the records contained height information.

²⁰ Although it might seem incredible that Mexico has so few extant records on the regular military, one should note that this is not the actual number of soldiers in this period. There are other sections that do not have complete information on soldiers, such as the *Cancelados* section, and the veterans of the revolution (*Veteranos de la Revolución*), who are filed separately and whose records do not include height information. In addition, military service was not compulsory, and that the record keeping for those soldiers that did not qualify for benefits was inaccurate.

²¹ Mestizos are people of mixed European and American Indian ancestry.

Table 1
Size of the samples

| | Year of birth | | | | | | | | Total |
|---|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------|
| | 1870–1879 | 1880–1889 | 1890–1999 | 1900–1909 | 1910–1919 | 1920–1929 | 1930–1939 | 1940–1949 | |
| Males | | | | | | | | | |
| Military total ^a | 146 | 525 | 1687 | 2350 | 574 | 468 | 287 | 199 | 6236 |
| Non-deserters ^a | 97 | 332 | 1106 | 1710 | 436 | 385 | 258 | 173 | 4497 |
| Deserters ^a | 49 | 193 | 581 | 640 | 138 | 83 | 29 | 26 | 1739 |
| Military (>159 cm) ^a | 131 | 445 | 1371 | 1957 | 510 | 364 | 223 | 175 | 5176 |
| Military (>160 cm) ^a | 131 | 430 | 1311 | 1902 | 492 | 334 | 213 | 163 | 4976 |
| Military (23 years or older) | 118 | 436 | 1271 | 1330 | 287 | 290 | 79 | 54 | 3865 |
| Passport (23 years or older) ^a | 131 | 288 | 620 | 988 | 260 | – | – | – | 2287 |
| Females | | | | | | | | | |
| Passport ^a | 128 | 209 | 366 | 687 | 293 | 0 | – | – | 1683 |
| Military ^a | 0 | 0 | 10 | 29 | 61 | 205 | – | – | 305 |

^a Includes ages 18 years and above; among females 1920s birth cohort includes those born thereafter.

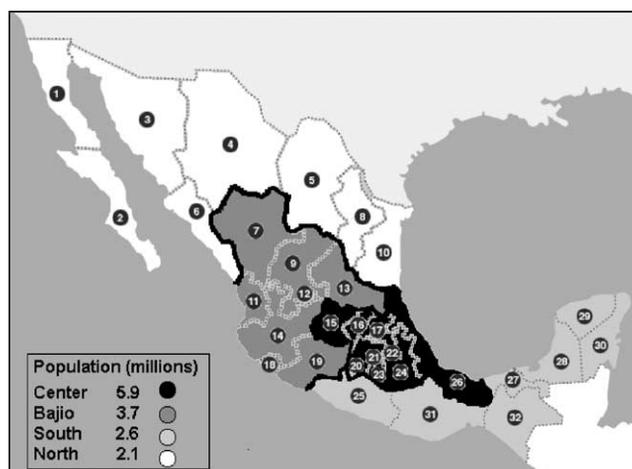


Fig. 1. Population density (1921 census) in the four regions of Mexico.

adults whose height was recorded between 1910 and 1935—has 3970 observations: 2287 males and 1862 females.²²

The occupation of adult men is used to infer social status. Although, most Mexican women at the time did not have a profession, we can infer their social status by considering the profession of their father listed in their birth certificate. The same can be done for children, teenagers, and young adults in the sample who are listed as students.

Yet, there are some disadvantages to these records. It was not until circa 1923 that stature was recorded in large numbers.²³ Moreover, this information was self-reported. Although this sample includes all passports ever issued, it does not include all permits to travel. Some areas were too far away from Mexico City to make it practical to travel to the capital to have a passport issued. For these states, the local governments were authorized to issue travel permits, and we have no record of these permits, presumably located in state archives. Thus, our sample undercounts people from the frontier states.

2.2. Characteristics of the samples

Sample sizes are reported in [Table 1](#). The recruits came mostly from the Center and the Bajío (Center/North) regions ([Fig. 1](#)). Men were mainly recruited between the ages of 18 and 30. Most of the draftees were working-class males, mainly unskilled workers. The percentage of illiterate soldiers decreased over time. The passport sample is composed

²² The data series for the post 1935 passports records is currently being collected.

²³ Although the microfilms are available for the period starting in the 1910s, the heights were not recorded until the 1910s. In the early part of the 1910s, we only have such descriptions as tall, medium, short. When stature began to be recorded in numbers this was mainly in meters and centimeters, but in a few cases (11), were given in inches and feet. To avoid rounding differences, these observations were excluded.

partly of skilled manual workers, but mainly of white-collar workers and members of the elite. Literacy was universal in this sample for both men and women.

3. Truncation and sample bias selection

One of the most common problems in military samples is shortfall, an erosion of the height distribution caused by a minimum height requirement, which could vary over time. The sample histograms of heights of adult soldiers (23 years and older) reveal deviations from a normal distribution²⁴ (Fig. 2). A substantial shortfall is evident below the minimum height requirement of 160 cm, particularly for those recruited between 1920 and 1945. After 1945, the minimum height requirement seems to have been lowered. Obviously shorter men tended to be rejected systematically from military service. By contrast, a minimum height requirement was not enforced for women in the military, as the distribution does not seem to have a shortfall, though it does suffer from extreme rounding on multiples of 0.5 and of 5 cm. Neither the male or female passport sample have a shortfall.²⁵

4. Trends in heights and compositional effects

The Komlos–Kim method is appropriate to use on height samples with shortfall in order to ascertain the direction of the trend (Komlos and Kim, 1990; Komlos, 2002). The procedure truncates the sample by eliminating all observations to the left of the minimum height requirement of 160 cm. Thereafter, the mean height of the remaining sample is calculated. The trend in this part of the sample is an accurate estimate of the trend of the height of the underlying population from which the sample was drawn, even if the level of height itself is *upwardly* biased. We repeat the analysis with the height requirement set at 159 cm in order to consider the sensitivity of the results to possible rounding of heights to the minimum requirement of 160 cm. The passport sample does not need this adjustment, insofar as it was not subject to a height requirement and will be analyzed below.

According to both estimated trends, the height of the male soldiers stagnated during the period under consideration until the birth cohorts of the 1940s, when an increase in height is first evident (Fig. 3). The raw height of the soldiers is included for reference purposes only as it does not provide an accurate estimate of the trend.²⁶

However, the Komlos–Kim method of calculating the trend does not standardize the estimates for the correlates of height. In order to account for compositional effects truncated regression analysis using maximum likelihood methods to estimate the effect of independent variables on height is appropriate. Truncated regression provides consistent and unbiased estimates of the coefficients of the independent variables, as well as their standard errors, thereby allowing for further statistical inference, such as the calculation of the *t*-values of

²⁴ A similar result for youth is available from the author upon request.

²⁵ These histograms are also available from the author upon request.

²⁶ Although the raw data of the military sample in Fig. 3 indicate some fluctuations in height, these are induced—in the main—by variations in stringency with which the minimum height requirement was enforced.

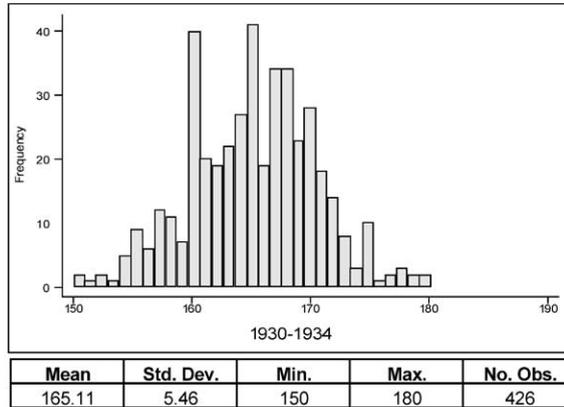
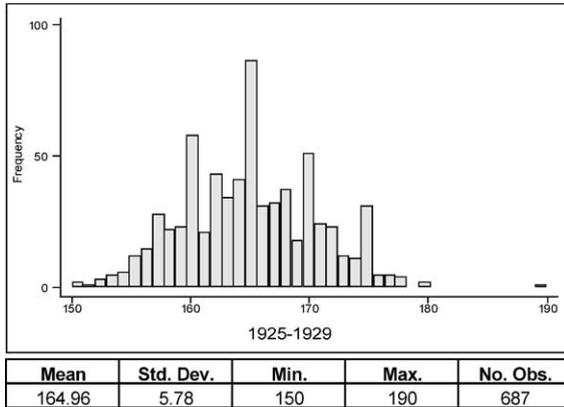
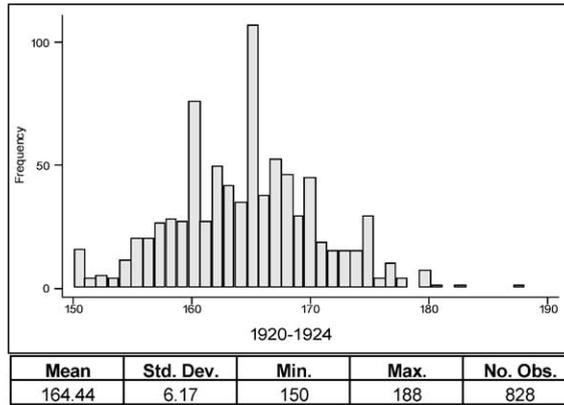
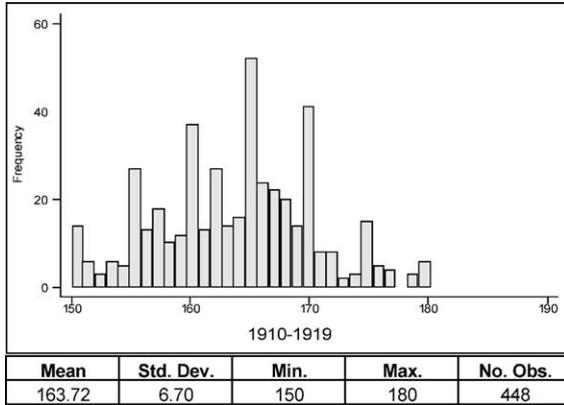


Fig. 2. Height distributions by recruitment year, adult male soldiers.

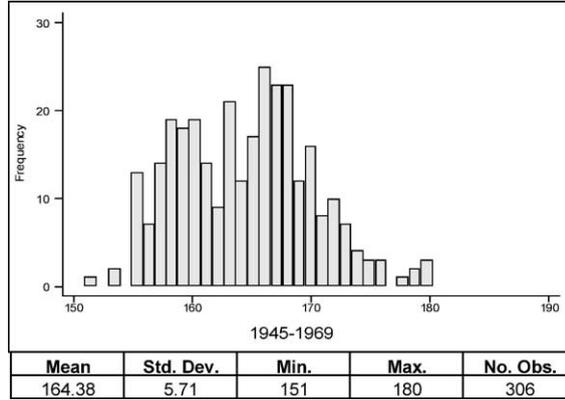
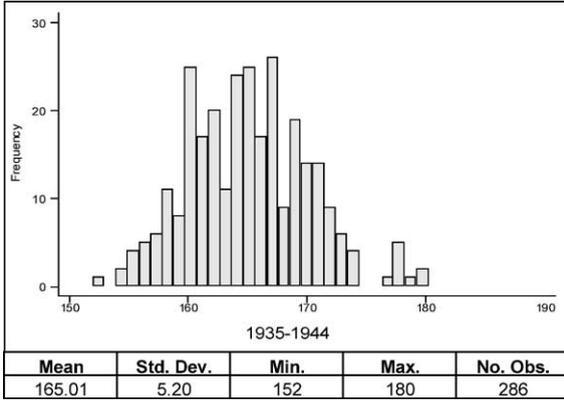


Fig. 2. (Continued).

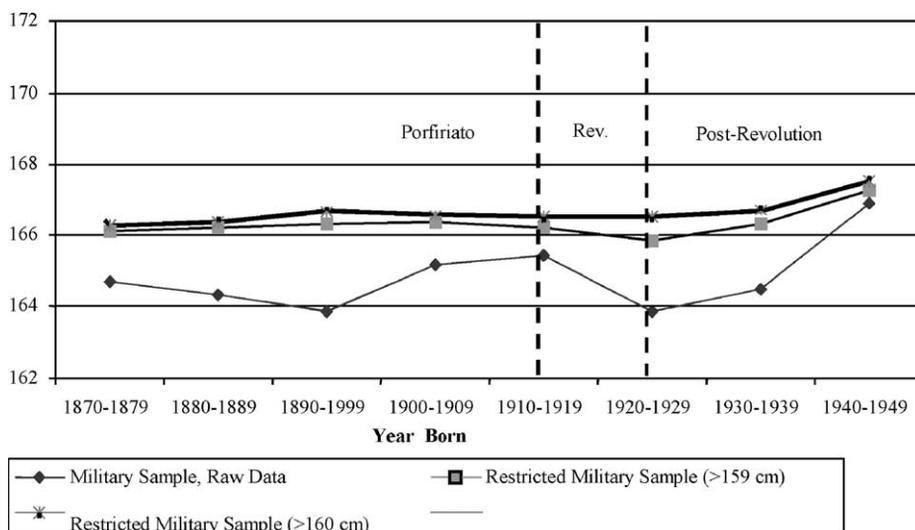


Fig. 3. Estimated trends of the height of Mexican adult male soldiers (cm).
Note: Komlos–Kim method is used for the restricted military samples.

the estimates (Komlos, 2002).²⁷ The independent (dummy) variables include occupation, decade of birth, age (18–22 years), region of birth, and deserter (Tables 2 and 3). In order to assess possible biases due to rounding practices in the military sample, regressions were run using 159 and 160 cm as truncation points. Moreover, regressions were run on the adult part of the sample and on the whole sample, including youth.

Regression results for the military sample indicate also that heights stagnated—in the main—until the revolution, and declined, even if insignificantly, during the revolution and its aftermath²⁸ (Table 2 and Fig. 4). When the increase in height first became evident is not quite clear. According to regressions 1a and 1b, which include the youth (Table 2) the increase began among the birth cohorts of the 1930s, whereas regressions 2a and 2b, which are restricted to only the adult segment of the sample, suggest that the increase began a decade later—among the 1940s birth cohorts. Just as importantly, the height of the men in the passport sample was increasing before the revolution. Consequently, the height advantage of the middle and upper classes vis-à-vis the lower classes was increasing over time. The difference between (unskilled) passport applicants and (unskilled) soldiers born in the North was about 2 cm at the beginning of the observation period, but was more than 3 cm by the time of the revolution. The difference between the two samples becomes even larger if one considers that the tallest soldiers—those with a skilled white-collar occupation were about 1 cm taller than the unskilled, whereas in the passport sample the tallest category—

²⁷ In addition, it estimates σ of the height distribution (provided that the truncation point is to the left of the mean).

²⁸ The level of heights in Fig. 4 reflects the height in the north region of the country, although the trend is the average trend across all regions.

Table 2
Regression model—military sample: dependent variable (height (cm))

| Independent variables | Truncation points | | | |
|------------------------------|-------------------|-------------|-------------|-------------|
| | 159 cm (1a) | 160 cm (1b) | 159 cm (2a) | 160 cm (2b) |
| Constant | 167.6* | 167.1* | 168.0* | 167.6* |
| Occupation | | | | |
| Unskilled | | | | |
| Skilled manual workers | 0.7** | 0.7** | 0.4 | 0.5 |
| Skilled white-collar workers | 1.1 | 0.9 | 1.1 | 0.8 |
| Provenance | | | | |
| North | | | | |
| Bajío | -1.2* | -1.2* | -1.4* | -1.4* |
| Center | -3.3* | -3.4* | -3.3* | -3.5* |
| South | -4.1* | -4.1* | -3.8* | -3.6 |
| Age (years) | | | | |
| 18 | -2.2* | -2.3* | | |
| 19 | -2.1* | -2.4* | | |
| 20 | -1.7* | -2.1* | | |
| 21 | -0.9* | -0.8* | | |
| 22 | -0.7** | -0.6 | | |
| 23 or more | | | | |
| Birth decade | | | | |
| 1870s | | | | |
| 1880s | -0.1 | 0.2 | -0.2 | 0.0 |
| 1890s | -0.2 | 0.2 | -0.4 | 0.0 |
| 1900s | 0.0 | 0.2 | 0.0 | 0.2 |
| 1910s | -0.3 | 0.0 | -1.0 | -0.7 |
| 1920s | -0.9 | -0.2 | -1.0 | -0.3 |
| 1930s | 1.2 | 1.8** | -0.7 | -0.3 |
| 1940s | 1.2 | 2.1** | 1.6 | 1.8 |
| Deserters | -0.4** | -0.4 | -0.6** | -0.5 |
| χ^2 | 303.0 | 265.3 | 171.9 | 142.5 |
| N | 5176 | 4976 | 3309 | 3194 |

The regressions were estimated with STATA's truncated regression routine. Constants refer to adult illiterate, unskilled, non-deserter workers from Central Mexico born between 1900 and 1909. Regressions 1a and 1b pertains to the whole sample while regressions 2a and 2b pertains to adults only.

* Significant at 1% level.

** Significant at 5% level.

those of the elite social status, were 4.4 cm taller than the unskilled in the passport sample. This implies that the Mexican elite men were some 6–7 cm taller than the unskilled soldiers. Regional differences were also greater among the soldiers. Those born in the South were about 4 cm shorter than those born among the North, whereas among the passport applicants the difference was 3.3 cm (Table 3). This finding is consistent with the narrative of traditional historiography, except that the evidence on physical stature accentuates not the absolute decline in welfare prior to the revolution, but the very large—and increasing—social differences among men, i.e. relative deprivation as the more important factors.

Table 3
Regression model for passport sample—dependent variable: height (cm)

| Independent variables | Males (1) | Females (2) |
|------------------------|-----------|-------------|
| Constant | 169.4* | 160.2 |
| Occupation | | |
| Unskilled | | |
| Skilled manual workers | 1.1 | 0.3 |
| Skilled white-collar | 2.3* | −0.2 |
| Elite | 4.4* | 2.1* |
| Provenance | | |
| North | | |
| Bajío | −0.6 | −2.4* |
| Center | −1.9* | −2.6* |
| South | −3.3* | −4.4* |
| Age (years) | | |
| 18 | −1.5 | 0.5 |
| 19 | −1.6 | −0.7 |
| 20 | −0.8 | 1.1 |
| 21 | 0.4 | −0.3 |
| 22 | 0.2 | 0.3 |
| 23 or older | | |
| Birth decade | | |
| 1870s | | |
| 1880s | −0.1 | 1.7** |
| 1890s | 0.1 | 2.2* |
| 1900s | 0.3 | 2.2* |
| 1910s | 0.8 | 1.6** |
| R^2 | 0.041 | 0.027 |
| N | 2287 | 1683 |

Method used: OLS. Constants refer to adult unskilled workers from North Mexico born in 1870s.

* Significant at 1% level.

** Significant at 5% level.

The fact that unskilled workers were shorter than skilled men and those who had a white-collar occupation suggests that having a trade, a form of human capital correlates positively with nutrition. Parents who could afford to provide skill and education for their children apparently could also afford a higher nutritional status to their children. There were large difference in heights across social classes in the passport sample as well among both men and women: elite women were 2.1 cm taller than those with unskilled occupation. The regional variation in height is also consistent with known regional patterns in the quality of diet, with the density of population, and with the North–South disparity in economic performance. The diet in the Northern region had a higher protein content than that of the South.²⁹ In addition, the densities of population were lower, thus there was a lower exposure to diseases (Fig. 1). These factors made people from the North less prone to

²⁹ For a discussion of the regional differences in diet, see López-Alonso (2000, Chapter 6).

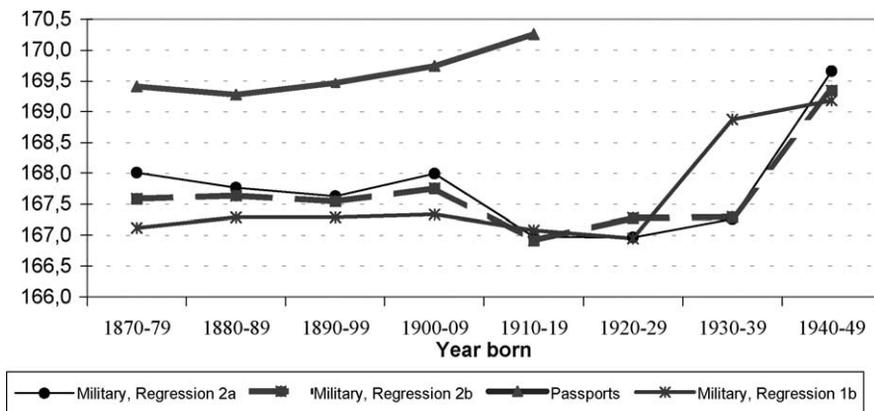
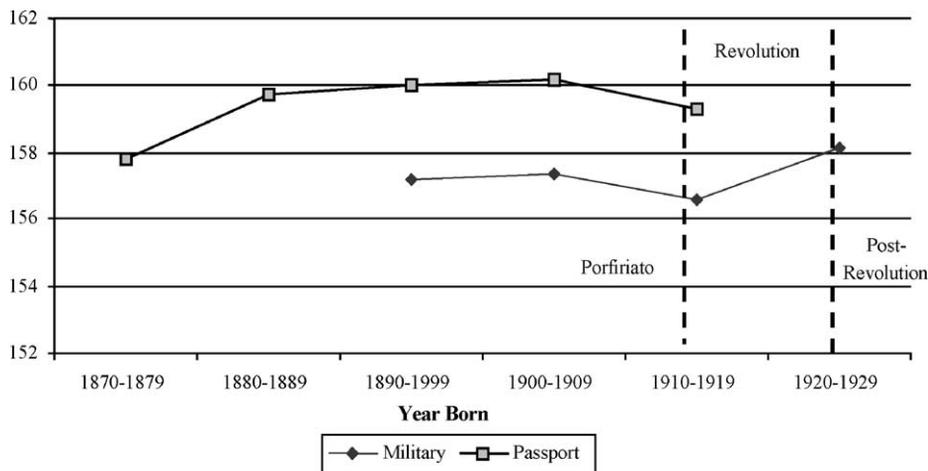


Fig. 4. Estimated height (cm) of adult Mexican men.



Note: Sample mean for military women. Regression estimates for passport sample.

Fig. 5. Adult female heights (cm).

environmental stress that would have hindered physical growth. In addition, during the period under consideration, the North of Mexico industrialized and experienced rapid and sustained economic growth which must have provided added income for the population.³⁰

According to the passport sample women's height increased in the 1880s, then leveled off, only to decline during the revolution (Table 3 and Fig. 5).³¹ The trend of the height of the military women is parallel to that of the female passport applicants in the interval the

³⁰ For a presentation of industrialization and economic performance in northern Mexico, see Haber (1989).

³¹ It was not possible to make an assessment of the importance of education because all women in the sample were literate. The socio-occupation classification was very often made according to the father's status.

Table 4
International comparison of adult male height

| Year | Sweden ^a | United States ^b | France ^c | The Netherlands ^d | Italy ^d | Spain ^e |
|------|---------------------|----------------------------|---------------------|------------------------------|--------------------|--------------------|
| 1800 | 167.0 | 172.9 | | | | |
| 1830 | 167.9 | 173.5 | 164.1 | 166.5 | | |
| 1840 | 167.6 | 172.2 | 164.3 | 165.3 | | |
| 1850 | 168.2 | | 164.5 | 164.2 | | |
| 1860 | 169.5 | | 164.6 | 164.0 | | 162.1 |
| 1870 | 170.2 | | 165.1 | 164.8 | | 161.7 |
| 1880 | 170.9 | | 165.2 | 165.7 | 162.7 | 161.1 |
| 1890 | 172.3 | | 165.3 | 166.8 | 163.1 | 160.8 |
| 1900 | 172.5 | | 165.5 | 167.8 | 163.8 | 162.6 |
| 1910 | 172.9 | 172.1 | 166.0 | 168.7 | 164.1 | 163.5 |
| 1920 | 174.1 | 173.1 | 166.5 | 169.9 | 164.7 | 163.8 |
| 1930 | 175.2 | 173.4 | 166.0 | 171.9 | 166.0 | 164.7 |
| 1940 | 176.1 | 176.1 | 166.5 | 173.4 | 167.2 | 164.4 |
| 1950 | 177.9 | 177.1 | 168.8 | 174.1 | 167.4 | 164.4 |
| 1960 | 179.1 | 177.3 | 170.3 | 176.0 | 170.0 | 166.7 |

^a Sandberg and Steckel (1997, p. 129) (recruitment years).

^b Costa and Steckel (1997, p. 72) (birth cohorts).

^c Weir (1997, p. 191) (recruitment years).

^d Drukker and Tassenaar (1997, pp. 357–59) (birth cohorts).

^e Martínez-Carrión (2001) (recruitment years).

samples overlap.³² In the 1920s, height in the female military sample increased. Hence, in contrast to males, elite women did not increase in height at the turn of the century, but the trend was similar to that of the lower-class males: stagnation in the late 19th and early 20th centuries and a diminution in stature during the revolution. However, females' height seems to have recovered quicker after the revolution than those of men.

5. Conclusion

The height of the Mexican population in the first half of the 20th century is comparable to the 10th percentile of the National Center for Health Statistics standards for males and the 25th percentile for females (Steckel, 1996). Heights in these samples were affected by social status and region of birth. These dwarfed changes in height over time. The height of the male soldiers who were recruited mostly from the working classes stagnated for much of the period under consideration, and even declined slightly during the revolution and its immediate aftermath. The height of soldiers did not exceed the level of the 1870s until the birth cohorts of the 1930s or 1940s. The height of females also tended to stagnate. This is quite an unusual result for the first half of 20th century, inasmuch as heights increased considerably in almost all parts of the developed world at that time (Table 4). The Mexican pattern is rather reminiscent of the declining biological standard of living in Europe and

³² The number of observations among the female military was too small ($N = 278$) to warrant running a regression.

Table 5

Average height of urban mestizo 18-year-old male students in the 1980s, by income levels

| Income group | Average height (cm) |
|--------------|---------------------|
| High | 171.3 |
| Middle high | 168.1 |
| Middle low | 167.9 |
| Low | 164.2 |

Sandoval (1985).

North America at the onset of their modern economic growth in the first half of the 19th century (Komlos, 1998).

The elite and upper middle classes were substantially taller than the working class. The difference in women's height between the passport and military samples remained constant over time, while the difference between the height of men in the two samples increased by the time of the revolution. This could have provided a rationale for the outbreak of the revolution.³³

There was a lack of synchronicity between the evolution of GDP per capita and its effects on living standards. Moreover, the biological well being of Mexicans diminished relatively to that of the Spanish population (Table 4). This comparison is warranted, not only, because the Mexican population originates to some degree from Spain, but also because both countries experienced the early phases of modern economic growth during the period under consideration. All in all, the anthropometric history of Mexico in the first half of the 20th century suggests that the unequal income distribution had an adverse effect on the standard of living of most of the Mexican population.

There are other studies that confirm the stagnation in Mexican heights. The secular change in physical stature of the Zapotecs, an indigenous population in the state of Oaxaca in Southern Mexico, was negligible (Malina et al., 1983, p. 437).³⁴ Moreover, the Mayan Yucatecs experienced a gradual decrease in height over the past 20 centuries.³⁵ Anthropometric studies in the 1980s showed that the social differences in heights remained quite pronounced in Mexico at a time when such differences were becoming smaller in Europe and North America (Table 5).

The dictatorship of Porfirio Díaz, the 1910 revolution, and the change in Mexican society and economy that came thereafter did not improve the biological living standard of the working classes. The divergence in the living standards between the rich and poor prior to

³³ This result is comparable to that of the French population in the eve of the 1789 revolution. "The students at the *École Polytechnique* enjoyed a 7 cm advantage over their lower class brethren" (Komlos et al., unpublished).

³⁴ "The lack of secular . . . [change was] perhaps related to the persistence of traditional agricultural practices, relatively poor farmland and limited economic resources for the improvement of agriculture" (Malina et al., 1983, p. 437).

³⁵ "[. . .] the lack of statural increase in the young men is not expected, given the improvements in regional health and economic conditions". They also offer the hypothesis that "[. . .] It is also possible that the Yucatec people have become genetically shortened because of selection pressure for smaller size through 20 centuries, and that an increase of Yucatec stature to US or British standards is not to be expected, even under ideal circumstances" (Mc Cullough, 1982, pp. 222–223). However, this kind of selection pressure did not exist in other parts of Mexico; thus, it is inappropriate to apply this type of explanation to the rest of Mexico.

the revolution corresponds with arguments found in traditional historiography. The trend in heights showed that endemic inequality prevented the popular classes from enjoying the benefits of economic growth in Mexico until the very end of the 80-year period considered here. This is an important finding, given that this was a period of substantial improvement in the quality of life in the developed world, where the investment in public utilities in the cities made them healthier places to live. The innovation in medical science such as vaccines and antibiotics lowered infant mortality considerably and increased life expectancy. The improvement in transportation reduced the relative price of foodstuffs and made them available to more people. All these changes also took place in Mexico to some extent, but the different trajectories in the evolution of the biological well being of the rich and the poor indicate that they were unavailable to the majority of the population. Hence, the anthropometric history of Mexico substantiates, in the main, the literature on its relative backwardness and unequal distribution of income.

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