BONES OF CONTENTION

THE POLITICAL ECONOMY OF HEIGHT INEQUALITY

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Abstract

Human osteological data provide a rich, unmined source of information about the distribution of nutrition, and by extension, the distribution of political power and economic wealth, in societies of long ago. On the basis of data we have collected and analyzed, we find that the shift from a hunter–gatherer to a labor-intensive agriculture opened up inequalities that had discernible effects on human health and stature. But we also find that political institutions intervene decisively in affecting the distribution of resources within societies. Political institutions appear to be shaped not only by economic factors but also by military technology and vulnerability to invasion, leaving important questions for additional exploration.

1. INTRODUCTION

Inequality--its causes and its consequences--has been a long-standing concern in political economy. Yet, aside from some classical contributions (Aristotle, Machiavelli, Rousseau, Marx), most of what we currently know (or claim we know) about the political economy of inequality is focused on its evolution in the last half century, mostly in developed countries (Atkinson, Persson and Tabellini 2000, Esping-Andersen 1990, 1999; Kuznets, Williamson). Among other reasons, this puzzling lack of contemporary research on pre-World War II trends must be largely on account of insufficient data on inequality across human communities and over time.

In this paper we attempt to narrow this gap. We first explore theoretically the extent to which different political institutional regimes and levels of technological and economic development have affected the distribution of resources and assets in human communities. We then "test" our theoretical propositions since the appearance of human beings, relying on archeological data of skeletal remains. More specifically, we use dispersion measures of the height and health condition of human bones to proxy for the level of economic and political inequality. While economists and anthropologists have begun employing these data to track changes in living standards, the analysis of the distribution of resources using those observations has not yet been explored.

Human height varies both by genetic factors outside the reach of short run environmental intervention, and by levels of nutrition during the periods of pre- and adolescent growth spurts. According to Eveleth and Tanner (1976, p. 222), two people who would be the same adult height under optimal environmental circumstances could be of different heights if one was inadequately nourished during the rapid growth periods of childhood and adolescence. Because few human societies have had uniform access to adequate nutrition, we are able to take adult human height as a valuable indirect measure of the distribution of resources within society.

In the paper that follows, we first lay out some deductive propositions that generate predictions about height dispersion in different types of human communities. Section 3 introduces the social scientific use of height data in greater detail. In Section 4 we present data for a range of societies from pre-historical times to the present. The final section concludes.

2. THEORETICAL EXPECTATIONS

The level of inequality, and by extension, the distribution of resources including childhood nutrition, should be related to the structure of economic activities and the type of political regime. Here we sketch out our expectations of how political and economic factors ought to affect human equality, and hence relative height.

Pre-agrarian societies

In hunter-gatherer or pre-agrarian societies, inequality should be low. In that type of economic world, there is only one factor, labor, and it is mobile. Social groups are structured around extended families and political hierarchies are virtually non-existent. As the level of population density rises relative to the rate of productivity, violent competition tends to flare. In response to that competition, warfare may ensue. Still, it is cheaper for new groups to split from existing bands and move away to exploit new territories. The access to resources, although precarious or close to bare survival needs, remains relatively open and equal. Dispersion measures of height and health should be low.[1]

Agrarian societies

In an agrarian world, where both land and labor are the factors of production and there is some technological exploitation of land, the distribution of assets (and our dispersion measures) should vary as a function of three factors: population density, military technology, and political regime. Changes in the first two factors lead to the emergence of states -- and therefore to the possibility that inequality may rise (for the reasons we specify shortly). But the type of political regime defines the extent of inequality.

1. Land Abundance. Whenever the land/labor ratio is high and the military technology is primitive, the distribution of assets is generally equal and state structures are weak. As in pre-agrarian communities, if land is abundant, it is cheaper to move to new lands to avoid any clashes with either neighbors or relatives than to invest in any political arrangements to solve those conflicts. This is why frontier societies tend to be equal (and prone to democratic governance). Moreover, since military technology is simple, that is, the production of violence is labor intensive and does not rely on sophisticated weaponry (chariots, horses, heavy armor, etc.), self-defense is possible. Would-be predators attempting to use violence to extract rents from others could subjugate very few peasants at a time.[2]

[1] Comparing the Gini coefficients of 3 contemporary hunter-gatherer societies with classical Athens, Bollen and Paxton (1997) conclude that the former are all more egalitarian, particularly with respect to women.

[2] We do not distinguish here the independent impact of land, labor, and military technology separately. They are probably related analytically, in that density leads to more investment in warfare. We could in principle check this logic by looking at a few cases where geographical

2. Roving to Stationary Banditry. This egalitarian and 'stateless' world collapses after land becomes scarce or weapons grow more sophisticated. Political conflict arises in regions in which, with growing population density, the land/labor ratio declines. When less land is available, competition among farmers increases. In addition, the costs of invading and expropriating the neighbor, who is now geographically closer than in a sparsely populated world, diminish dramatically. Similarly, once military technology becomes complex, previously independent farmers are faced with a stark 'security dilemma' since they may be robbed not just by other farmers but by 'professional' bandits now endowed with the means to wreak havoc.[3]

As Olson pointed out (1993, 2000), in the presence of 'roving' bandits that systematically raid farming communities and rob their crops, farmers eventually give those bandits local sway in exchange for protection against other external predators. The price people are willing to pay for protection, or the resources they are willing to provide for mobilizing an army, will be greater the more vulnerable is the population to invasion and predation.

The provision of a political structure, that is, a stationary bandit's creation of an apparatus capable of protecting producers, has a fundamental impact on inequality. As North and Thomas (1974) point out, feudal manors in medieval Europe can be seen as an

isolation left a community alone for longer periods of time. Jared Diamond documents peaceable, and we would guess less hierarchical, communities that were wiped out suddenly as soon as the marauders figured out how to cross the waters. Marvin Harris finds some evidence for an increase in femicide, reflecting the greater value of males, in more war prone societies. We also expect more social stratification in response to the organizational needs of war mobilization, but whether this results in height dispersion depends on whether military technology is labor intensive, in which case we expect military prowess to be fluid across generations without leaving a trace in relative height, or capital intensive, in which case we expect access to it to be hereditarily protected.

[3] On the other hand, Hirschman (1981: 250-51) indicated that, if highly sophisticated weapons are available, a low land/labor ratio may in fact increase the incentives of those bandits to impose a slavery system precisely to curtail the exit options of the peasantry.

exchange of peasant labor for knightly protection, where the degree of perceived vulnerability to predators and the competition for peasant labor jointly determine the nobility's premium. But this characterization applies as well to Warring States China in the 3rd century B.C. or civil war Japan in the 15th century as well as it does to medieval Europe. Inequality should increase as military technologies become more capital-intensive. Even if warlords have overwhelming military advantage, however, they will confiscate only to the point where they optimize rents.

The nobility's premium will be higher in geographic locations without natural boundaries, where labor is relatively abundant, or where the nobility is able to collude to limit serf mobility (Ferejohn and Rosenbluth 2004). In regions that are protected by geographical barriers such as mountainous chains or seas, the cost of invasions by external bandits is high and the 'security dilemma' remains low. This may explain why areas such as the Swiss high valleys, Norway, and Iceland sustained rather equal agrarian societies.[4]

3. Aristocracy or Monarchy. Landed nobility is not the most efficient provider of military protection once infantry armies are introduced. Warfare grows to a large scale requiring full manpower mobilization, because the nobility is loathe to arm peasants and because despite the fact that foot soldiers are more "productive"compared to heavy cavalry as instruments of war relative to their cost. Once large infantries were introduced, centralized monarchies replaced feudal oligarchies where wars reached a certain scale, not

[4] Moreover, if farming involves a type of production strategy requiring cooperative practices that make farmers interdependent, the incentives to become a 'bandit' are low: the existence of communal activities implies that collective action problems are sparse and that farmers can coordinate to defend the status quo against an internal enemy; and that, second, by destroying many intercommunal ties, a strategy of expropriation may end up ruining the basis of production in the region. In other words, as we know from the folk theorem, the solution to a prisoners' dilemma game may end up in the noncooperative cell (requiring an authoritarian solution) or in the cooperative cell (where a self-governing community becomes viable).

only in Europe but in Asia and elsewhere. (For the lapse to feudalism in medieval Europe following the Roman Empire and the Carolingian kingdom, we attribute declining economies of scale from over-expansion.) territorial scale given existing technology.) We expect the inequality between landlords and peasants to have declined with monarchical absolutism as the king had to ensure a viable peasantry for his mass levy, though the king can still extract a sizable premium.

Data on inequality under feudal and monarchical regimes is scarce, though we have some is available on monarchies. Finegold (1987) reports that, at the death of Augustus (14 A.D.), the top 1/10,000 households of the Roman Empire received 1 percent of all income. (For comparison, the British royal family received 0.2 percent of all income in 1979-80.) In Mughal India around 1600 A.D., they received 5 percent of all income. In fact, the annual income of the Indian emperor was the equivalent of the wage of about 650,000 unskilled workers.

Intra-Family Inequality in Agrarian Societies

Although previous researchers often note size differentials between males and females, to date no work traces relative changes in size differentials over time within a given population. Sexual dimorphism, or morphological differences between males and females including size, has a genetic component determined in each species by the premium to size in competing for females. Monogamous species typically have the least sexual dimorphism. The human species is characterized by sexual dimorphism in the 10-15% range, consistent with the mild polygyny of human ancestry. We are interested here in the component of sexual dimorphism that is affected by nutrition, and that therefore casts light on the relative valuation of males and females within a society.

We expect that the rationing of nutrition to children across the sexes reflects both the different caloric needs of boys and girls given their work output, and the longer run "expected value" of a boy or girl. It is more efficient to give boys more calories if they are expending more energy for the community. The longer run "expected value" of the sexes is a more complex concept because it includes the efficient use of a community's human capital (male brawn is more valuable in cultivation when land is scarce), but also the relative bargaining power of males and females given the sexual division of labor (male brawn is mobile while child rearing is a family-specific investment). It is impossible empirically to disentangle these completely, but we feel justified in thinking that at least some component of the "expected value" is observable from height data because of the limited differences in the physical capabilities of children during the time that nutrition has its greatest impact on adult height. We also know from comparative evidence of femicide (the killing or fatal undernourishing of baby girls) that families make these horrific decisions based on cost calculations that are either explicit or that become embedded in social norms (Hrdy 1999; Sen 1985).

All else equal, we expect that sexual dimorphism would be relatively low in hunter-gather societies, where males and females are both mobile in the sense that each is economically viable independently of the other. A shift to sedentary cultivation that disproportionately utilizes male brawn should increase sexual dimorphism, especially where land is scarce. In high land/labor agrarian economies, women tend their own plots and can survive without the husband. As population grows denser and agriculture becomes more dependent on human brawn and increasing use of technology, the woman's role becomes even more specialized in child rearing and food processing rather than food production. Industrialization, to the extent that it reduces the brawn premium, should lead to a stronger bargaining position for females and hence less femicide and less sexual dimorphism.

Emergence of Mobile Assets

So far, we have considered purely fixed-assets economies and their underlying distributional parameters. However, over time, inventors generate new types of assets, such as wheels, boats, alphabets, double-bookkeeping or aspirins. These new assets, which are, at least in part, not specific to the territory where they generate returns, have fundamental consequences for the distribution of assets across society.

1. Mobile assets increase the bargaining power of their holders vis-à-vis other political actors (and, particularly, states) because the former can credibly move their assets abroad in response to any excessive level of confiscation. In short, they have more outside options than owners of fixed assets. As the mobility of assets rises, tax rates on (and expropriation of) capital should decline. Moreover, trade may lead to a more diversified economy with lower barriers between sectors and classes. Thus, trading (and industrial) communities should exhibit lower variation in bone size.[5]

2. The emergence of non-specific assets also changes in a direct way the distribution of assets across the population. The process of investment that leads from invention to new commercial and industrial activities takes place, to start with, among certain entrepreneurs that postpone some consumption to invest in new assets. As those new assets generate higher returns than more traditional activities, there is a growing disparity of incomes

between the new investors and the rest of society and thus more inequality. Yet, at the same time, higher earnings in non-agrarian sectors gradually attract more individuals to these new activities. A growing proportion of the population decides to invest in the acquisition of those new types of assets, such as human capital, that grant higher salaries. Moreover, the higher returns in manufacturing industries spread to larger segments of the population and, with an increasing supply of educated workers, the wage gaps between skilled and unskilled workers that widened at the beginning of the industrial revolution narrow again. Thus, the progression from agrarian to modernized economies treads the path of Kuznets' inequality curve -- inequality first grows with a shift in the structure of the economy and then declines progressively(Williamson 1991).

To summarize, as both assets become more mobile and their distribution more equal, authoritarian regimes decline and bone sizes become more equal across individuals.[6] In fact, the political shift toward democracy reinforces the trend toward equality because liberal institutions tend to invest more in human capital formation and welfare states (Boix 2003).

3. HEIGHT

Before turning to our empirical findings on the distribution of height within human communities, we lay out what social scientists have found about shifts in average height over time. It is generally agreed that there is an important environmental component to height for societies with inadequate resources to nourish everyone adequately (Steckel 1995). Table 1 reproduces data collected by economist Robert Fogel that shows calorie

[5] Geddes and Lueck (2002) show that women gained suffrage earlier along coastal regions.
[6] Technological changes in the production of goods (where labor-intensive activities are replaced by sophisticated tools) and in warfare (where also capital-intensive weapons have a widening advantage over infantry) reduce the gap between men and women.

consumption by decile in France and England by 1790. In France the bottom 10 percent of the labor force lacked the energy for regular work, and the next 10 percent had enough energy for less than three hours of light work daily. Individual heights must have been different across deciles in a systematic way.

Evidence

Two types of evidence can be employed to gauge the height of human populations: skeletal remains from human settlements as reported by existing archeological and anthropological research; and direct measurement of heights in living individuals, mostly from census data and military records.[7] Data from skeletal remains provide a rare glimpse into the size of prehistoric populations, but these data suffer from two problems. First, archaeologists and anthropologists rarely find complete skeletons, let alone in the numbers necessary to draw statistically valid inferences about the populations under study. If only more societies thought to mummify! Second, there are methods to estimate heights from skeletal remains, mainly from the bones of the extremities, but the formulae are specific to particular ethnic groups, having been derived from large statistical samples of living people. We only have functional forms for some groups (modern whites, blacks, Japanese, and

[7] Data on military recruits are available starting in the late 18th century for Denmark, Norway and the United States, in the first half of the 19th century for Belgium, Britain, France and Sweden, and for the second half of the 19th century for Germany, Italy, Japan, Netherlands, Portugal, Spain and Switzerland. The anthropologist Franz Boas created an extraordinary data base in the late 19th century of hundreds of Native American Indians which we employ in the pages below.

Mesoamericans). Heights, and particularly the variance in the distribution, are sensitive to which height estimation formulae are used.

Full height measurements are accurate as far as they go, but they are available only starting in the late 18th century (and, exceptionally, in the early 18th century for France) and, until censuses appeared, primarily for military recruits and prison populations.

Our approach is two-pronged. We make use of both skeletal and measured height data, but to be conservative, we rely heavily on Franz Boas's data collected for living Native Americans from various tribes in the 19th century that approximate the conditions of pre-contemporary or even pre-modern societies. We supplement the findings of those data with inferences derived from skeletally estimated height data.

The Evolution of Height

Here we recapitulate what is known about the evolution of average human height over time. As shown in Figure 1, both men and women were taller in pre-agrarian societies than in agrarian societies. In Paleolithic and Mesolithic sites, femur lengths seem to indicate a height around 175 cm for men and of 165 cm for women. These values are in the range of average heights today.

Pre-agrarian individuals were tall as a result of their abundant and diverse diet (naturally related to very low density levels and the strict use of birth control strategies to escape from Malthusian crisis). Paleontologists and anthropologists have documented that foragers typically had a far more diverse diet, relying on scores of plant and animal species, compared to agriculturalists who came to rely on a few staples for their diet (Bogin 2001; Lee 1984; Hayden 1981; Gould 1981; Hill and Hurtado 1989). The narrowing of the food

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base in agricultural societies led to growing deficiencies of some essential nutrients. These deficiencies turn up as biological stress in the form of bone lesions due to anemia (porotic hyperostosis), incomplete enamel formation in teeth (hypoplasias), loss of bone mass, bone lesions from infections, and stunted growth (Goodman et al. 1988; Ortman). Bogin (2001, 164), citing Goodman et al., reports that the community interred in the Dickson Mounds of the Illinois River Valley suffered from a fourfold increase in iron deficiency and a threefold increase in infectious disease and a dramatic increase in poor dental enamel over the 350 year period when they shifted from foraging to sedentary agriculture.

The economic transformation spurred by the industrial revolution had two consequences. In the short run, it led to a decline in average heights as rural dwellers moved to densely crowed, unhealthy urban centers. This decline in heights has been well studied by economists Richard Steckel, John Komlos, anthropologist Judith Sture, and others who that poverty, via malnutrition, increases the susceptibility to disease. In the long run, however, growing per capita incomes and the improvement of public sanitation resulted in better nutrition and health conditions, and, eventually, an increase in average heights. As income rises, improved health and nutrition boosts height closer to the genetic potential until increased income has no additional effect (Steckel 1995).

[Table 2 here]

Table 2 provides evidence on the positive correlation between height and income in contemporary times.

Height Distribution in Pre-Agrarian Societies

To test our hypotheses about the distribution of assets and the economic and political causes of inequality, we observe the dispersion in heights in human settlements as reported by existing archeological and anthropological research. We turn first to inequality in pre-agrarian societies, for which we use data on the height (and other physical measurements) of 19th century Native Americans. With the support of federal funds, anthropologist Franz Boas and his research assistants collected data on the age, height and other anthropomorphic traits of about 16,000 Native Americans from about 290 tribes. The Boas collection, which remained missing until 1974 and was then rediscovered and processed by [name of Tennessee anthropologist here], is extraordinarily variegated in the political, economic and social traits of its tribes. The systems of economic subsistence of the latter range from the gathering and hunting practices of the Tahltan in the Canadian sub arctic cordillera, the fishing and fur trading villages in the Northwest and the buffalo hunters in the American Plains, to the agricultural sedentary villages of the Zunis in New Mexico. Similarly, the differences in their degree of social complexity and political organization are quite striking. Some Canadian subarctic tribes were still relatively primitive at the time of the Boas enterprise: they consisted of very small bands (formed by two or three households) that hunted and gathered over expansive areas, had no overarching chiefdoms and at most participated in occasional encounters with other bands in the summer. By contrast, the Pueblo Indians relied on a stable political structure, in the hands of warrior-priests, which controlled a specific territorial area in a systematic manner with the standard tools (sanctions, force, and executions) of a modern state.

Although our intention to explore the effects of the evolution of political and economic institutions on height would be better served through the temporal analysis of a particular tribe, the cross-section examination of our data set should give a good approximation of the evolution from pre-agrarian societies to simple, relatively non-stratified agrarian economies.

The Boas project took place at a time when most tribes had been in contact with European settlers or at least white governments. Many of those tribes had entered compacts with the American and the Canadian governments that had relocated them into reservation areas. Many of our tribes had been already shocked, in some cases decimated, by European diseases, had been transformed by the incentives opened to them by trade, and even affected by European diet. In an extreme case such as the Sioux, for example, the federal government decided to supply them with a fixed, and quite generous, amount of food after moving them onto reservations. Still, most of the impact of the new settlers seems to have occurred in the 1850s and 1860s. Given that the Boas data reports the age of the measured individual, we have been able to examine those cohorts that grew before those decades. Because their statures do not appear to deviate from the whole sample of adults (older than 18, i.e. those born before 1875 approximately), we use the full data set in this paper.

The average height of all the tribes is 168.8 cm for men and 155.9 cm for women. Mirroring the plurality of their social and political arrangements, the average male height of tribes ranges from a minimum of 160.8 cm (the Wailaki in California) to 175.4 cm (the Cheyenne in the Plains). Average female height goes from 149.7 cm (the Yuki in California) to 163.5 cm (the Sauk in the Northeast).

In accordance with our expectations about the consequences of a pre-agrarian, diversified diet, and strong methods of population control, most tribes are relatively tall, at least relative to contemporary heights in Europe. A similar Boas data set for European immigrants into the United States shows that Southern European and Jewish men averaged 164 cm, Polish men averaged 165 cm, Hungarian men, 166 cm, and Slovak men, 168 cm.

The tallest tribes were concentrated in the Plains and in the coasts. The shortest lived in the geographical fringes of the sample: either in the Southwest, among the Pueblos, or in the Arctic regions, among Eskimos and Native Indians in very cold areas. (The correlation coefficient between average male height and deviation from parallel 45^o is -0.50. The correlation coefficient with average female height is -.38.) Tall tribes had a diet derived from hunting and fishing and foraged food, and in a few cases, some agriculture. Short tribes experienced important dietary constraints: Eskimos only lived on meat and fish, and Southwest Indians relied heavily on a few agrarian products.

To examine intra-tribal inequality, we examine the coefficient of height variation. Tribes appear to be relatively equal. The coefficient of variation of men's height in the United States is 3.66 (for 18-year-old boys in 1977), a similar coefficient of variation for egalitarian Iceland (Palsson 1973). Presumably American income inequality does not show up in height data because the American poor are not calorie-deficient. Coefficients of variation among Native Americans are also low, but for populations that had considerably less excess. About 3/4 of the tribes had a coefficient of variation lower than 3.66 (and 90 percent below 4). Around half of all tribes have a coefficient of variation of 3.3 or lower. The results for women are very similar.

[Figures 2 and 3 here]

As a further check on the distribution of statures, Figure 2 reproduces the kernel density functions of male height for the Sioux (for which the number of observations is highest), the Tahltan (which have the lowest coefficient of variation in male height) and the

Pueblo tribe of the Zunis. None of them seem to present a distribution with a (right) tail which would depict a richer strata of men. Evidence discussed later identifies such a social segment in agrarian societies with coercive states. Figure 3 reproduces the same density functions for Sioux, Tahltan and Zuni populations.

As shown in Figures 4 and 5, the coefficient of variation is uncorrelated with average height. This suggests that taller (or shorter) men (or women) are not associated with different distributions of wealth.

To explore the determinants of differences in intra-tribe variation in height, we have regressed the coefficient of variation on several measures coding level of warfare, use of horses, extension of agricultural practices, gender and wealth inequality. For the level of warfare, we follow Mishkin's work. The other variables have been coded following the information contained in the Handbook of North American Indians. None of the variables are statistically significant.

Sexual Dimorphism among Native North Americans

We consider next the extent and causes of sexual dimorphism among Native Americans. We calculate the index of sexual dimorphism or ISD as:

ISD = 100 * (male height-female height)/male height.

Contrary to other studies, which have found female body size to be more or less universally about 10 percent smaller than male body size (Rogers and Mukherjee 1992), sexual dimorphism varies substantially in the Boas data set. Its values range from 3.64 among the Lilloet to almost 12 among the Choctaw of Goodland Island. The average ISD is

7.55, not so different from current values of 7.41 in the United States or 7.47 among Basques.

As Figure 6 shows, sexual dimorphism is strongly and positively correlated with male height. The correlation coefficient is 0.51 and it is statistically significant at the 1 percent level. By contrast, sexual dimorphism is not correlated with intra-tribe variance in male heights (measured through their coefficient of variation).

[Figures 6 and 7 here]

This positive relationship between male height and sexual dimorphism seems to hold in other samples of pre-agrarian societies. Figure 7 reproduces a similar positive correlation between sexual dimorphism in African tribes using data reported in Eveleth and Tanner (1976). But, as we point out later, it takes the reverse direction in advanced societies. Sexual dimorphism typically grows with male height in pre-modern societies because male height is more sensitive than female height to nutritional deprivation. When resources are more widely available, both men and women grow but men grow by more (Hamilton 1982). [LAST SENTENCE SEEMS TO BE IN CONTRADICTION WITH PREVIOUS ONE]

Agrarian regimes. Stratification and inequality.

To explore the impact of the transition from pre-agrarian to agrarian societies, we report results from several types of political economies. We examine in turn the Zuni Pueblo, Mayan city-states, Mycenae, Ancient Egypt, and Japan. We finally explore the evolution of height inequality in Medieval and Modern Europe.

The Zuni Pueblo

We take the Zuni to be representative of a simple, relatively non-stratified agrarian political economy. We have records of skeletal remains spanning from AD 600 to AD 1680 as well as the Boas measurements in the late 19^{th} century. According to reports from Spanish explorers and from 19^{th} century ethnographers, the Zuni Pueblo, which is located in the northwestern New Mexico, is a sedentary group that has tended to settle in large, multistoried pueblos around the Zuni river. Although the Spanish tried to conquer and evangelize them in the 17^{th} century, an Indian uprising eventually expelled the Spanish from the region in the 1680s. During the 18^{th} century the Zunis had little sustained contact with the Spanish colonial power. By mid-19^{th} century, they were still self-sufficient from a political and economic point of view and structured in five large permanent settlements. Trade and political relationships with the United States only started in a systematic manner in the 1880s. This led to a devastating smallpox epidemic in 1892-93 and towards livestock cultivation as their main source of livelihood at the turn of the century. By the 1880s, the Zunis were still in control of a ‘committee’ of senior priests, mainly former warriors who had taken scalps from their enemies.

Table 3 displays the mean, standard deviation and coefficient of variation of male and female heights in the four periods as well as the index of sexual dimorphism. The data, which show remarkable stability, convey both relative intra-gender and inter-gender equality. The coefficient of variation of male height is almost a third lower than its value in modern societies. The index of sexual dimorphism is about a tenth lower than contemporary values.

Figure 8 displays the kernel distribution of the male height in Hawikku, San Cristobal and Zuni locations. Heights are heavily concentrated around the mean without any tails that could indicate the presence of a segment of taller, more powerful men.

Mayan Cities

As Table 4 conveys, we have access to data from a number of Mayan sites over quite a span of time (from 300 A.D. until today). The interpretation of their remains and the characterization of pre-colonial Mayan states are, however, controversial. Traditionally, Mayan city-states were thought to be strongly stratified, theocratic polities (Haviland 1967). More recently, however, several scholars have suggested that Mayan lived in mildly stratified cities, with a small priestly and warrior elite and important urban middle strata [CHECK REFERENCE OF BOOK 'MESOAMERICAN ELITES'].

Table 4 reports data for heights from the preclassic period (before 300 A.D.) to modern times (20th century populations). For the political economy change between pre and early classic period (300-1000 AD), which corresponds to the peak of Mayan civilization, Table 4 reports dispersion measures, derived from the skeletal remains gathered in Steckel (2002). Both Mayan men and women were short even in the classic period – statures, however, dropped between 2 and 5 cm in colonial times and then by another 2 to 3 cm in the postcolonial centuries

The classic data reveal a more equal society than the standard theory has suggested. The variation coefficient for men is less than 2 (the lowest in all our data). For women it stands at 2.47 for our largest sample (in urban Copan). Mayan cities were small – Copan peaked at 27,000 in the 9th century and then fell to a third of that number by AD 1,000.

Compared with the large polities of Europe that emerged after the military revolution of the Renaissance period, stratification could not have very extreme and indeed it was not.

[Table 4]

[Figures 9 and 10.here]

Figures 9 and 10 display the kernel distribution of rural and urban populations for men and women respectively. Men in rural areas are shorter and the dispersion is minimal – the skeletal remains come from areas with "modest dwellings of perishable materials dispersed in rural areas away from the urban core" and probably belong to "agricultural laborers and part-time craftspeople" (Steckel et al. 2002: 289). In the urban settlements there is more dispersion – this matches the fact that the remains come from large urban compounds inhabited by wealthy individuals and their servants. For women, dispersion is similar in rural and urban areas. In short, what we find is an urban core with a stratified society (of nobles and warriors and their servants – and perhaps a class of craftsmen) as an enclave in the middle of a very poor and very equal rural economy.

Mycenae and Egypt

As representative of ancient agrarian states, we report data for Mycenae and Egypt under the New Kingdom. Mycenae in the Middle Bronze period had a powerful militarized monarchy with a Homeric aristocracy. Differences in height were remarkable. According to Angel (1984), the estimated stature of kings and people buried in kings' tombs was 172.5 cm. Commoners averaged 166.1 cm. Among women, the upper strata averaged 160.1 cm and the commoners 153.5. As Angel (1984) pointed out, these differences cannot be attributed to ethnic origin since the royalty "show[s] the same striking diversity of morphology (and implied origins) as the general population, then in the process of absorbing Indo-Europeans and other settlers, including some from Africa". Instead "the 4 percent increase in stature and in pelvic depth and the 30 percent increase in skull base height in the royalty, their thicker and more rounded long bones, and the five-fold improvement in their dental health all show nutritional improvement that must involve more meat protein than the average citizen got." (Angel 1984: 66)

For Egypt we have direct measurement of mummies, most of which are pharaohs or their spouses, as well as the complete skeletons of commoners and a vast number of femurs for the latter. The data for royal mummies comes from "The Royal Mummies" (1912) and corresponds to the dynasties of the New Kingdom. It includes 18 men and 13 women. The data for commoners are reported in Masali (1973) and include individuals in the upper Nile Valley (Asiut, Gebelen and Aswan). Masali calculates the results based on 260 complete skeletons and a much larger sample of femur.

[Table 5 here]

Table 5 reports the data for mummies, complete skeletons and estimated measures (employing different estimation methods, which depend on the underlying racial characteristics attributed to Egyptians). Comparisons have to be made with care since both mummies and complete skeletons differ considerably from actual living stature because soft tissue shrinks with mummification. Their average height loss, depending on the Pharaoh's level of activity and therefore the amount of soft tissue, would have been about 10 cm, of which 6 to 7.5 cm would come from the spine and the rest from soles and knees.[8] Skeletons also shrink about 10 cm as a result of loss of all soft tissue.

[8] Personal communication from Rose Drew of the Yale Physical Anthropology Lab.

Notice that, for commoners, skeletal length plus about 10 cm of shrinkage coincides with the estimated heights (again, calculated using a larger sample of femurs). Thus, one could attribute an average height of 166 cm. to common men and 157 cm. to common men. Royal mummies are in turn 166 cm. and 156 cm. long respectively. Even if we use a conservative estimate according to which royal mummies shrank 8 cm., there emerge important differences between kings and commoners. Pharaohs were 7 to 10 cm. taller than common males. Women belonging to the royal family were about 6 cm taller than common females. Height differences were substantial in the highly stratified Egyptian polity, as we would expect. Sexual dimorphism, by contrast, was low. The index of sexual dimorphism for royal mummies was 6.02. For commoners, it stood below 6 for most estimated statures.

Japan

We have collected height data for people living on the Japanese islands from 850 B.C. to the 19th century, calculated from bone measurements. Using the Fujii method of calculation that is derived from Japanese populations, analysis of remains from a number of burial mounds suggests that the early hunter gatherer population (the Jomon people, who lived in Japan from at least 4000 B.C, probably earlier) were more evenly sized (male heights ranging from 149 to 169 cm.) and less sexually dimorphic (ISD 6.29) than the agricultural Yayoi who supplanted them in the 4th century B.C. (male heights from 145 to 180 cm., and ISD of 6.48) (Matsushita 1994; Yamada 2003; Nihon Minzoku Bunka no Seisei). Because some of the Yayoi may have been of different genetic stock, and because different height estimation formulae (Pearson, though this was not developed from Japanese populations) almost erase the difference in dimorphism, we take this as suggestive but not conclusive evidence for the effects of sedentary agriculture on intra-male inequality and women's relative status (Yamada 1997).

[Table 6 here]

Sexual dimorphism appears to have grown in later centuries as agriculture became more labor intensive and as society became disrupted by warfare, though our data don't allow us to weight these factors. Commoner and low-ranking warrior families from the war-wracked medieval period (13th –16th centuries) had a dimorphism index of 7.59 and a fairly narrow height dispersion among men comparable to those of Jomon communities (148-168 cm)(Hiramoto 1972, 222; Nakahashi and Nagai 1985). Access to nutrition may not have been so different for medieval farmers and lower level samurai. Unlike the stable and stratified Tokugawa social order that followed it, medieval Japan was plagued by endemic civil war, social upheaval, and upward social mobility, whereby many rural families became part of the warrior class.

We expected more evidence of nutritional variation between the Tokugawa shogun and Edo commoners (17th –19th centuries) but find that the shogun for whom we have available data were surprisingly short. Three of the four shogun for whom we have height data, Tokugawa Iyenobu (1662-1712; 162 cm.), Iyeshige (1711-1761; 153 cm.), Iyeyoshi (1793-1853; 153 cm.), and Iyemochi (1846-1866; 154 cm.) were shorter than the average height of 157 cm. for commoners in the Edo period. Either commoners were adequately nourished, or as some scholars have suggested, the Buddhist strictures of the Tokugawa family prevented them from consuming sufficient quantities of protein (Matsushita 1994; Suzuki 1985).

Medieval and Modern Europe and Settler Colonies

Medieval and modern European societies offer us a picture of pre-industrial societies characterized by an eminently rural economy (about 90 percent of the population lived in the countryside) with some well-defined urban and commercial settlements and rather fluid and changing political institutions. Until the Late Middle Ages, Europe was covered by small, weak political structures, organized through overlapping jurisdictions. Feudalism (either in its strict 'manorial' system or in its more general definition as a system of aristocratic governance) resulted in a three-order society, with a thin rural nobility, an overwhelming population of farmers and laborers, and the clergy (itself reproducing the hierarchically-constructed structure of nobles and peasants). At the margins of this system, there were vibrant but still small urban centers and incipient royal courts (Duby, etc.).

With the expansion of commerce and the invention of the cannon, Europe moved from the feudal order to a system of sovereign states, with strong royal dynasties that often co-opted the old nobility within absolutist institutions. Within this new scenario dominated by centralized states and thicker commercial networks, Europe housed a diversity of solutions. In the West, feudalism gave way to a more modern agrarian system, based on the recognition of the Roman concept of absolute property rights, money-based transactions, and the emergence of a free class of farmers. Between the Netherlands and Italy, there was a dense urban core with independent, smallish city-states (Tilly 1990). In Eastern Europe, the nobility successfully engineered a second feudal revolution in the 16^{th} and 17^{th} centuries in response to population crisis and religious wars. Serfdom was reestablished within the framework of hierarchical political institutions in Prussia, Russia, and Austria-Hungary (Anderson 1974), and within a nobility-dominated system in Poland.

Ancien Régime States

Extensive data from Poland, gathered from 53 cemeteries, encompassing 3000 individuals and spanning from the 10^{th} to the 19^{th} centuries, can help us assess the evolution of inequality over time in feudal countries with some detail. We complement this data with published data on German and Austrian-Hungarian nobles and peasants. We then turn to observations from rural communities in England and, rural and urban cemeteries in Denmark for medieval economies that moved to more commercial, modern economic system. We finally examine the United States case and published data on German and Austrian-Hungarian nobles and peasants.

[Figures 11 to 13 here]

Figures 11 and 12 show the evolution of male and female heights in Poland from the central centuries of the Middle Ages (10^{th}-14^{th} centuries) to the Modern-Baroque period. We distinguish for each period between high-status, rural, city, small town and Jewish cemeteries. Until the population crisis of the 14^{th} century, we observe some systematic but small differences between social segments. High-status men were 2.1 cm. taller than rural populations; urban dwellers lay in between. Among women differences were slightly narrower (1.7 cm.). After the Black Plague and the refeudalization of Eastern Europe, height differences between high-status and rural dwellers increased dramatically. In the Late Middle Ages, the difference almost doubled to 3.8 cm. among men. In the 17^{th} and 18^{th} centuries, at the peak of the serfdom system, high-status men were 5.4 cm. taller and high-status women were 2 cm. taller than peasant folk. The difference with Jewish populations is even larger --7.7 cm and 4.2 cm. respectively--though this is likely to reflect assortive mating in large degree.

Differences in height due to income and nutrition are essentially inter-class. Within rural communities, equality is the norm: the coefficient of variation of male heights is 3.3. Figure 13 displays the kernel density of individuals in the cemetery of Ostrow Lednicki (14^{th}-17^{th} centuries), for which we have individual data. Height distributions are fairly concentrated around the mean.

[Table 7 here]

Germany seems to tell a similar story (Table 7). Based on conscription data, Komlos reports that in the 1760s-1790s German aristocrats at age 17 averaged 164.3 cm, compared to 159.9 for middle class recruits and 151.1 for German peasants, though this gap probably closed as the peasants experienced some delayed growth (Komlos 1989: 94). Komlos says the relationship between income and height seems looser in the Hapsburg empire, where soldiers recruited from agricultural areas of Hungary (163.4 cm.) , Galicia (163.3 cm.), and Moravia (163.9 cm.) were taller than those recruited from economically more developed regions of Bohemia (161.4cm.) and Lower Austria (162.4cm. (Komlos 1989: 97-99). Many studies confirm that populations in close proximity to food sources are taller relative to income than urban dwellers, and that average stature declined in the early stages of industrialization before increasing (Sture). But aggregate data that do not control for individual income are less useful for our purposes.

<u>Britain</u>

Table 8 reproduces average heights for British and Irish recruits in the East India Company's Army during the period 1800-1815. Differences among urban and rural men were extremely small. Irish countrymen seem to be slightly taller than the rest. However, within each type, inequality was higher than today's standards; coefficients of variation range from 4 to 4.87.

[Table 8 here]

These recruits came from the lowest segments of the population, although the data have been readjusted using the BQE system. Data for the upper strata of British society are scarce. We know, however, that for boys at age 15, the London poor averaged 147 cm while the English gentry boys attending the Sandhurst Military Academy were already 163 cm tall (Komlos 1989: 95).

United States

Nineteenth-century United States offers us the best approximation of an agrarian democratic society. Table 9 presents average heights for Ohio guardsmen by their occupational origin: professionals, farmers, clerical workers, skilled workers and laborers. The largest gap in average heights, that between professional and laborer, was 2.2 cm. As Steckel and Haurin (1994) have stressed, various considerations may have influenced mean heights by occupation. To the extent that choice of occupations by children was correlated with the wealth, occupation, and literacy of parents, one would expect that environmental conditions during childhood influenced heights by occupation. Still, what is remarkable in the data is how minor height inequality was. Notice also that within each occupational segment, the coefficient of variation is similar to or lower than today's coefficient of variation. The small occupational differences observed in the heights of the Ohio National Guard are in line with results for American data in other time periods. Union troops in the Civil War who were farmers were only 2 cm. taller than laborers.

[Table 9 here]

Figure 14 complements these data with the kernel distributions of heights in two North American communities in the Great Lakes in the 1840s: the middle class city of Belleville and the skeletal remains of the cemetery of the poorhouse of Highland Park. Both data sets (of about 200 individuals each) come from Steckel et al. (2002). The two distributions overlap almost exactly; the only noteworthy difference being a one-centimeter gap between the averages of the two populations.

[Figure 14 here]

These data are also valuable because, in contrast with conscription data, they include women's heights and allow us to calculate the level of sexual dimorphism. This turns out to be lower than today's level, at 7.3 for Belleville and 6.2 for the poorhouse.

Slave Economies

We close this section with a brief reference to the distribution of heights among in 19th century economies with slaves. Researchers who have gathered information on average heights for North American slaves have noticed that they were relatively tall, with a mean of 166 cm. at 18 and therefore almost as tall as European upper classes.

[Figures 15 and 16 here]

Employing data gathered in Steckel's project "The Backbone of History", we compare the distribution of heights for American white elites, black slaves and black freepersons in mid-19th century in Figures 15 and 16. On average African-American slaves were shorter than American whites: at age 18, enslaved men were about 5 cm shorter than West Point Cadets according to data reported in Komlos (1989). African slaves show considerable variation, perhaps on account of their different ethnic backgrounds as well as how they were treated. Enslaved women were 7 cm shorter than white women. This wider gap in heights (and thus sharper sexual dimorphism among slaves) is likely to be related to investment decisions made by their owners as a function of their specialization.

Interestingly enough, free blacks caught up very quickly with whites. Their average height, at 171.5 cm is only half a centimeter lower than white's mean stature. This catch-up did not occur, however, among black women. Free African-American females grew by an average of 2 cm., remaining about 5 cm shorter than Charleston's white elites (Margo and Steckel 1982).

Inequality today

Height data lose power to illuminate social inequalities for societies where access to nutrition is above a subsistence threshold for society's poorest stratum. Such is probably the case for today's developed countries. Table 10 reports data on height dispersion in contemporary societies. In line with much larger incomes, which have lifted all past food restrictions, heights are much bigger. Height inequality has declined in relation to feudal or absolutist societies. The coefficients of variation pivot around 3.5-3.7 in most developed countries.

[Table 10 here]

Similarly, we should expect declining sexual dimorphism with more income and height in developed societies. This is born out in Figure 18, which depicts the relationship between average male height and sexual dimorphism in advanced economies.

In developing countries, however, where access to food and hygiene is less universal, and where poor families have to ration food among their children, we might expect to see height differentials by economic status. In poor, labor-intensive agricultural countries, we would also expect to see exaggerated sexual dimorphism. Indeed, female infanticide in India and elsewhere, to which Amartya Sen and others have drawn our attention, often results from the selective feeding of infants (Sen 1999: 197; Hrdy 1999).

We leave for future research to see whether and how alternative political institutions affect the results predicted by systems of economic production. Based on what we have learned about the past, we have reason to expect that they do. The results, based on living populations, would also provide a valuable check on the inferences we draw from height data of ancient populations about which we know far less.

Conclusions

Human osteological data provide a potentially rich, if imperfect, source of knowledge about times and places beyond the reach of more conventional tools of social science inquiry. Our data reinforce some conventional understandings for which previous scholarship has had insufficient data to substantiate. They also suggest a reconsideration of some other standard tenets of political economy that have not been put sufficiently to the test.

First, it seems clear that the shift of hunter gather societies to sedentary agriculture often introduced inequalities, both among men and between women and men, severe enough to affect the distribution of human health and stature, as scholars have long thought. Although we do not have as much time series data as we would like, comparisons between different types of agrarian societies seems to show that the level of intra-male inequality exceeds probable productivity differences among farmers, and instead reflects the development of coercive political machinery that builds up around the protection of storable assets. The rise in sexual dimorphism that accompanies labor-intensive agriculture may reflect both the societies' efficient allocation of nutrition, and the drop in females' bargaining position that attends an increased sexual division of labor in which the female invests disproportionately in immobile (to other households) assets such as children.

The second unsurprising finding is that rulers and aristocrats in large, centralized states have typically been able to command the resources that have made their offspring physically larger than commoners, even when they have been from the same genetic stock. Scholars have long suspected that this was true, but we have put some numbers on a fairly wide range of examples.

Less anticipated but also not startling, at least for political scientists, is the decisiveness with which we found political institutions to intervene between economic structure and distributional outcomes, as in the case of the relatively egalitarian systems of the Zuni and 19th-century United States. Sedentary agriculture, even of a labor intensive sort, may be paired with a sharply hierarchical political structure that unequally distributes resources, or it may be tempered by a more democratic governance system. Skepticism about trying to endogenize political apparatus entirely to economic structure seems in order, though we are curious to learn more about how economic systems, military technology, and governance structures are related.

We have not been able to find data to test, as we would have liked, the proposition that monarchies take a smaller premium, proxied by a nutritional gap, than aristocracies. We expect that a more thorough combing of available sources from early modern Europe, tracing the rise of absolutism in France, Prussia, and Russia, for example might provide some leverage on this question. The Zuni and the 19^{th} century U.S. might represent two ends of a large U-shape curve, where military vulnerability and the development of military technology pushes political systems to oligarchy and monarchy before pressures for mass military mobilization flattens the hierarchy out again. But this is speculation.

We hardly need to underscore that the data we have compiled and analyzed here are fragmentary, and much data collection and analysis remains to be done. Our data are incomplete in a number of respects that are important for checking our theoretical propositions: we lack reliable time series data for most populations, and even for the purposes of cross-sectional analysis, we do not have representative samples of all of the analytical categories that we would like to test. We hope, at a minimum, we have sparked enough interest so that others will join the search.

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TABLE 1. A COMPARISON OF PROBABLE FRENCH AND ENGLISH DISTRIBUTIONS OF THE DAILY CONSUMPTION OF KILOGRAM CALORIES TOWARDS THE END OF THE 18TH CENTURY

Decile	France, 1785	England, 1790
Highest	3,672	4,329
Ninth	2,981	3,514
Eighth	2,676	3,155
Seventh	2,457	2,897
Sixth	2,276	2,684
Fifth	2,114	2,492
Fourth	1,958	2,309
Third	1,798	2,120
Second	1,614	1,903
First	1,310	1,545

Taken from Fogel (1994), Table 2, page 374.

TABLE 2. ESTIMATED RELATIONSHIP BETWEEN AVERAGE HEIGHT AND PER CAPITA INCOME

Per Capita Income (1985 U.S $) a	Adult Men (in cm)	Adult Women (in cm)
1,000	163.2	151.8
2,000	166.0	154.6
3,000	167.6	156.2
4,000	168.7	157.3
5,000	169.6	158.2
6,000	170.4	158.9
8,000	171.5	160.1
10,000	172.4	161.0
12,000	173.1	161.7

a. International price. Summers and Heston (1991).

Taken from Steckel (1995), Table 4, page 1915. Heights are estimated from a regression model for a population with European ancestors.

TABLE 4. HEIGHT IN MESOAMERICA

		Adult men				Adult women				Sexual
		mean	number	st.dev	cv	mean	number	st.dev	cv	Dimorphism
PRECLASSIC										
Altar de sacrificios	a	166.6	4			148.3	2			10.98
Yucatan Maya	b	164.4	7			151.2	2			8.03
CLASSIC										
Jaina	e	160.6	12	2.41	1.50	151	12	4.67	3.09	5.80
Altar de sacrificios	a	159	3							
Xcaret	e	164.5	2	2.83	1.72	154	3	9.10	5.91	6.38
Copan urban	e	162.8	36	3.21	1.97	155.5	46	3.85	2.47	4.48
Copan rural	e	160.1	9	2.93	1.83	154.9	13	3.43	2.21	3.25
Yucatan - Maya	b	162.1	22			151.8	14			6.35
LATE CLASSIC										
Barton Ramie	c	156.6	10			145.7	6			6.96
POSTCLASSIC										
Yucatan - Maya	b	161.5	25			148.4	5			8.11
COLONIAL MAYA										
Tipu	b	160.3	149			148.3	106			7.49
Xcaret	e	157.3	15			145.5	31			7.50
MODERN MAYA										
Yucatan	d	155.2	128			142.8	94			7.99

Sources:

a Saul 1972.
b Marquez and Del Angel 1997.
c Cohen et al. 1989.
d Steggerda 1941.
e Own estimates based on Steckel et al. (2002).

TABLE 5. ANCIENT EGYPT

				Men			Women			
				Mean	SD	CV	Mean	SD	CV	
Direct measurement	Royal Mummies		a	1662	55	3.33	1562	56.2	3.60	6.02
Direct measurement	Commoners	skeletal length	b	1570			1480			5.73
Estimates	Commoners	T+G, white	b	1680			1570			6.55
		T+G, black	b	1640			1570			4.27
		Manouvrier	b	1660			1570			5.42
		Pearson	b	1620			1530			5.56

a The Royal Mummies
b Masali 1971

TABLE 6. HEIGHT IN JAPAN

		Men				Women				
Era	Formula to calculate height	Obs	Mean	Std. Dev.	CV	Obs	Mean	Std. Dev.	CV	Sexual dimorphism
Jomon	Pearson	87	159.93	3.25	2.03	91	148.56	3.61	2.43	7.11
Yayoi	Pearson	151	161.89	4.36	2.69	105	150.40	4.31	2.87	7.10
Kofun	Pearson	48	162.53	3.44	2.11	21	150.18	4.17	2.78	7.60
Medieval	Pearson	20	159.81	4.18	2.61	29	146.66	3.48	2.37	8.23
Kinsei	Pearson	1	158.06	.		1	145.34	.		8.05
Edo	Pearson	36	159.16	3.73	2.34	31	146.76	3.53	2.41	7.79
Jomon	Fujii	87	158.20	4.27	2.70	91	148.24	4.15	2.80	6.29
Yayoi	Fujii	151	160.77	5.73	3.56	105	150.36	4.97	3.30	6.48
Kofun	Fujii	48	161.61	4.51	2.79	21	150.11	4.81	3.20	7.12
Medieval	Fujii	20	158.05	5.49	3.47	29	146.05	4.01	2.74	7.59
Kinsei	Fujii	1	155.74	.		1	144.53	.		7.20
Edo	Fujii	36	157.19	4.90	3.12	31	146.17	4.07	2.78	7.01

TABLE 7. HEIGHT OF BOYS IN AUSTRIA-HUNGARY AND GERMANY

	Period	Age at Last Birthday in Years	
		17	18
German Peasant	1790s	151.1	
German Middle Class 1760-1780	1760-80	159.9	163
1760/80 German Aristocrats	1760-80	164.3	167
1800 Habsburg Monarchy	1800		162

Source: Komlos 1989.

TABLE 8. MEN HEIGHTS IN BRITAIN, EARLY 19TH CENTURY

		Height	Standard Deviation	Coefficient of Variation
England and Wales	Rural	164.92	6.78	4.11
Ulster	Rural	164.92	8.03	4.87
Rest of Ireland	Rural	166.32	6.30	3.79
Irish laborers	Rural	165.63	6.63	4.00
England and wales	Urban	164.97	7.11	4.31
British laborers	Urban	164.21	7.21	4.39
Ireland	Urban	164.69	7.32	4.39

Source: Mokyr and O'Grada.

TABLE 9. HEIGHT AMONG OHIO RECRUITS, 19TH CENTURY

		Height	Standard Deviation	Coefficient of Variation
Occupation	Laborer	173.28	6.58	3.80
	Other	173.66	6.20	3.57
	Skilled Worker	174.04	5.97	3.43
	Clerical worker	174.07	5.72	3.28
	Farmer	174.70	6.53	3.74
	Professional	175.51	6.38	3.63
Location	Rural	174.22	6.27	3.60
	Urban	173.69	6.17	3.55

Source. Steckel and Haurin 1994.

TABLE 10. HEIGHT OF 18-YEAR OLD BOYS IN CONTEMPORARY SOCIETIES

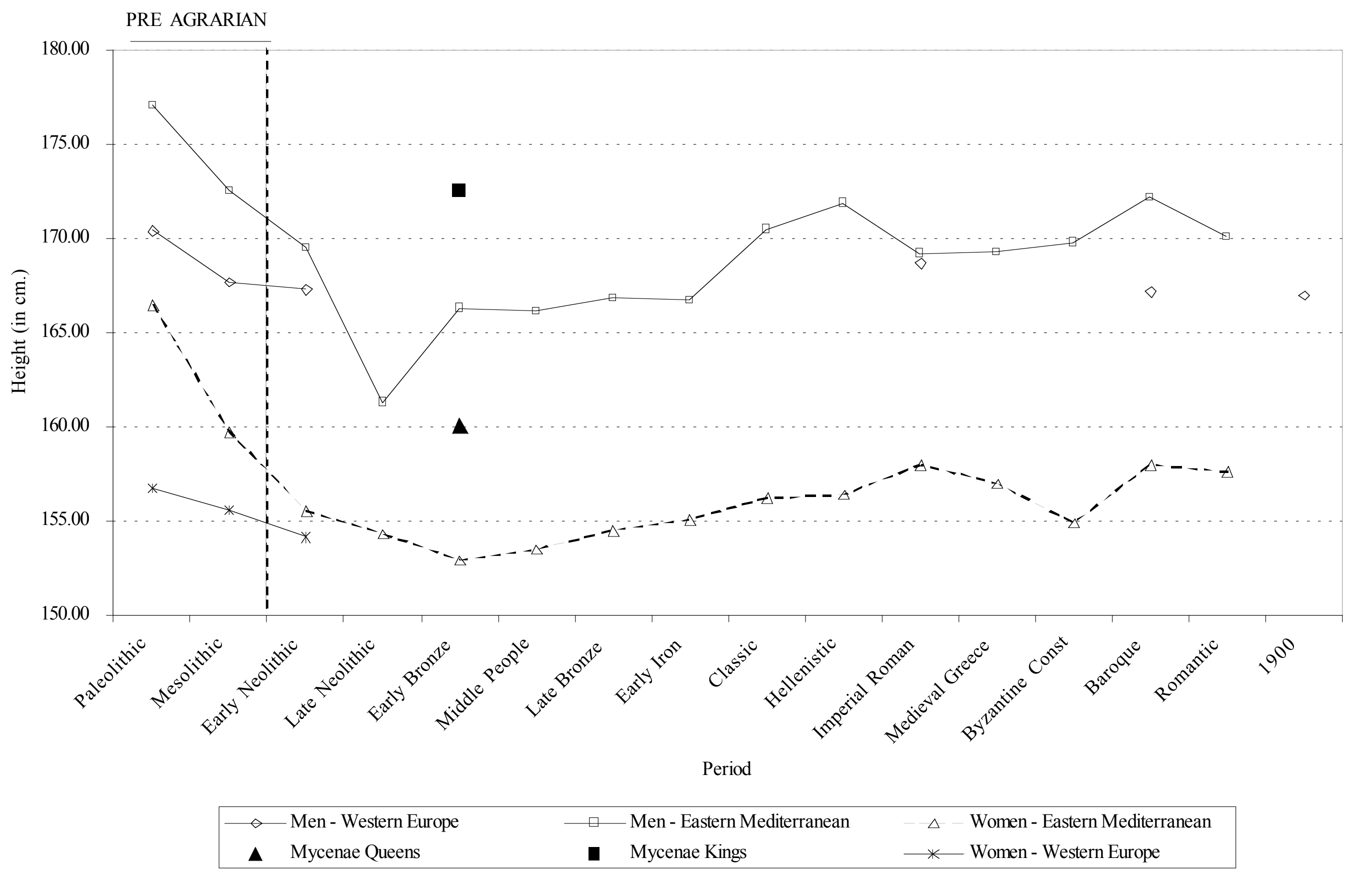
				Median	Mean	St. Dev.	CV
EUROPE							
Belgium	national		a		176.5	5.4	3.06
Denmark	national		a		179.0	6.3	3.52
France	Paris		a		175.0	6.0	3.43
Hungary	national		a		175.3	6.7	3.82
Ireland	Dublin & rural towns		a	175.5		6.4	3.65
Netherlands	national		a		180.9	6.7	3.70
Poland	Warsaw CS		a		176.8	6.4	3.62
Spain	Bilbao		a	175.6		6.0	3.42
Yugoslavia	Croatia		a		177.6	6.6	3.72
Yugoslavia	Zagreb		a		175.1	7.7	4.40
Yugoslavia	Kormend		a		172.8	6.4	3.70
Iceland	Born in:	Living in:					
	Isolated Farms	Isolated Farms	b		175.07	6.51	3.72
	Isolated Farms	Small Towns	b		173.79	6.53	3.76

	Isolated Farms	Reykijavik	b	176.58	5.86	3.32
	Small Towns	Small Towns	b	174.29	6.36	3.65
	Small Towns	Reykijavik	b	176.86	6.25	3.53
	Reykijavik	Reykijavik	b	177.86	5.6	3.15
NORTH AMERICA						
United States	European ancestry		a	176.8	6.6	3.73
	African ancestry			175.1	6.8	3.88
AFRICA						
Kenya	Turkana		a	162.1	10.0	6.17
Namibia	Rehoboth Basters		a	168.6	7.5	4.45
South Africa	Soweto	Richardson, 1977	a	164.4	6.6	4.01

a. Eveleth and Tanner 1990

b. Palsson 1974.

Figure 1. Heights in Western Europe and Eastern Mediterranean



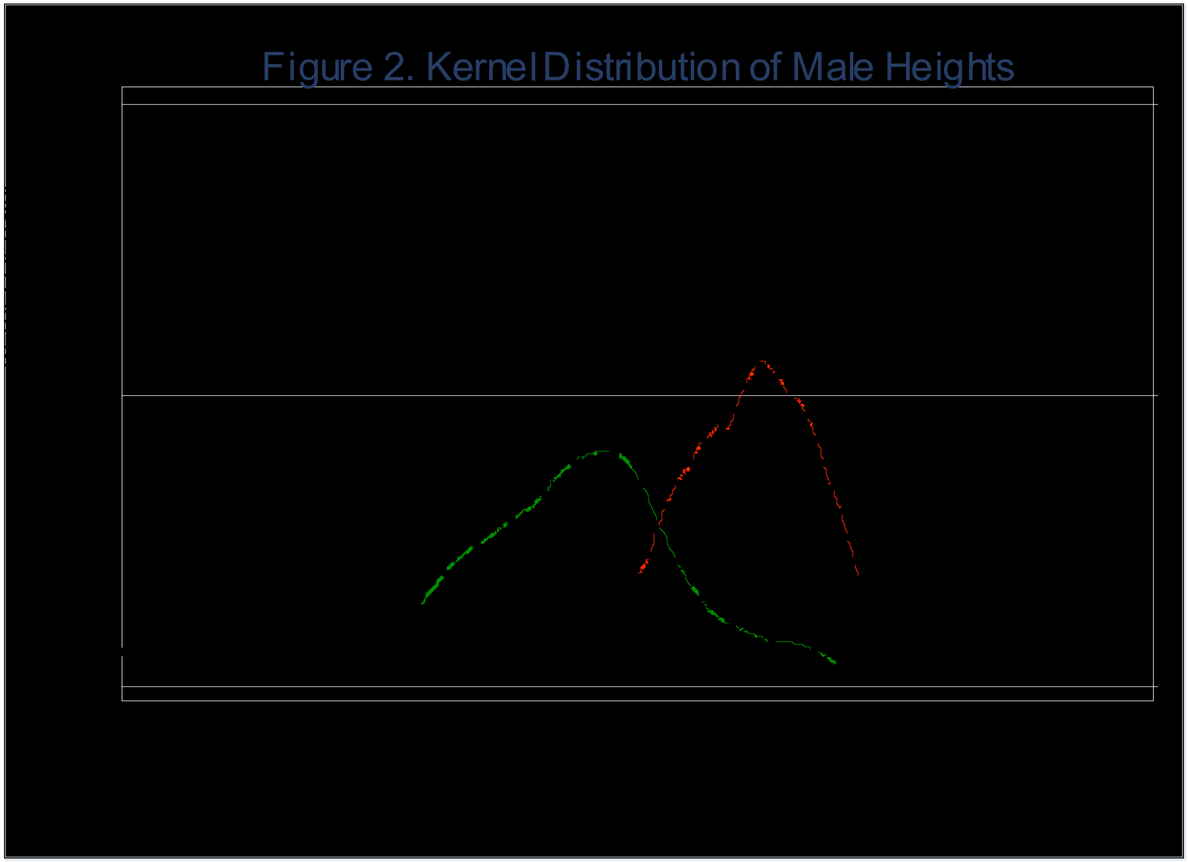


Figure 2. Kernel Distribution of Male Heights

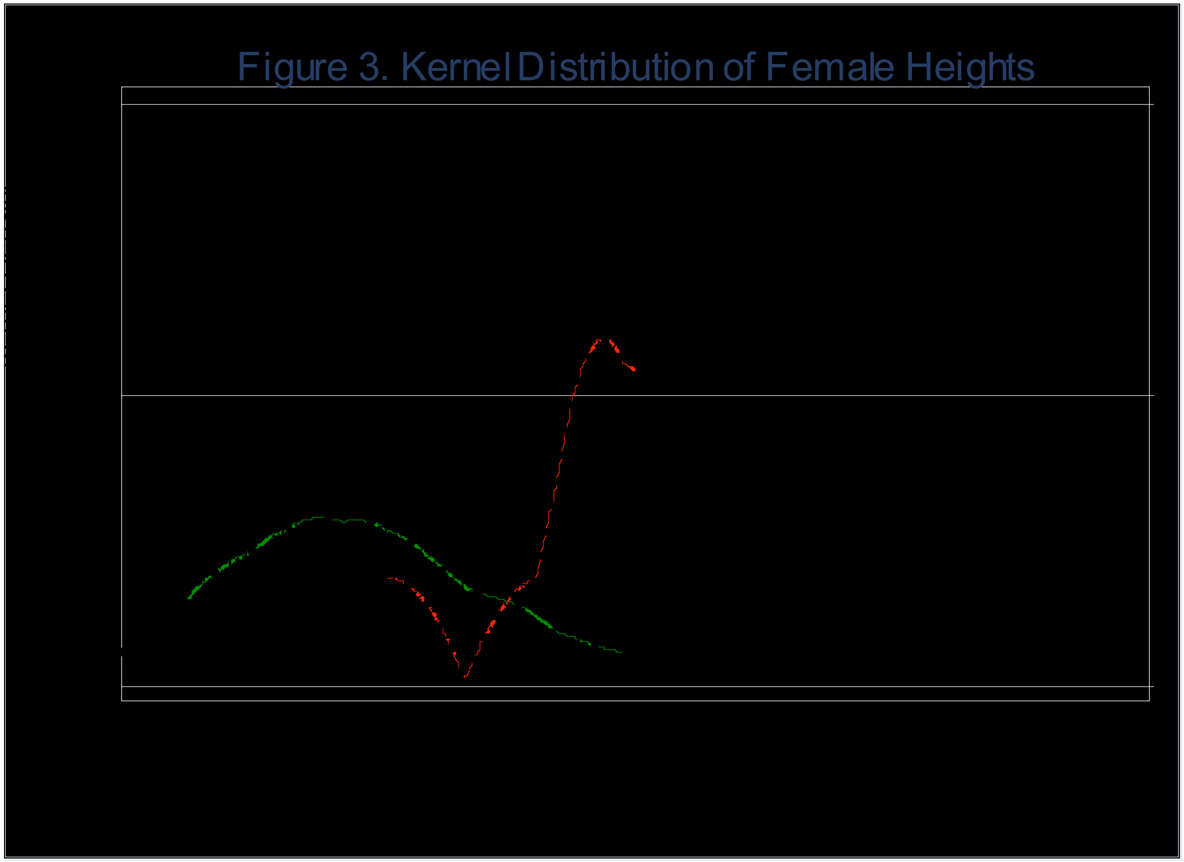


Figure 3. Kernel Distribution of Female Heights

Figure 4. Male Height and Coefficient of Variation among Native Americans

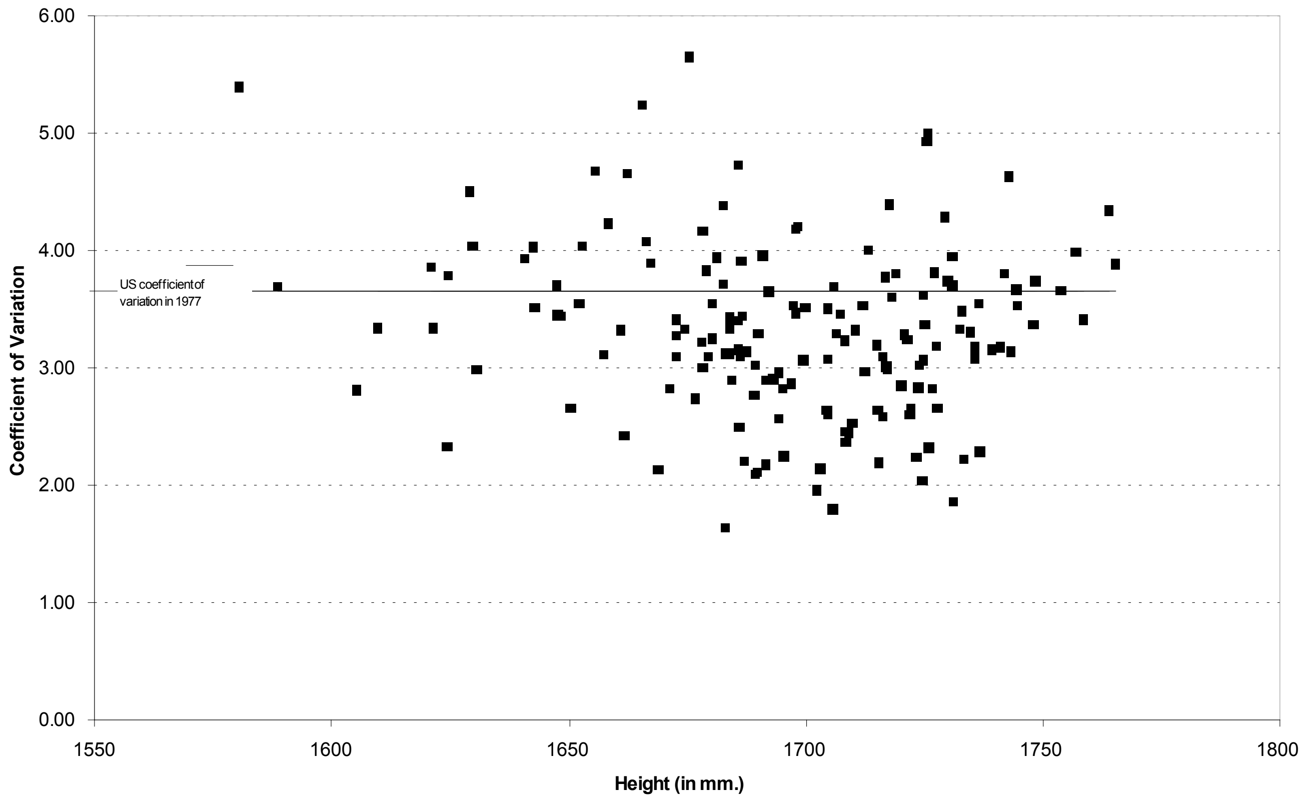


Figure 5. Female Height and Coefficient of Variation among Native Americans

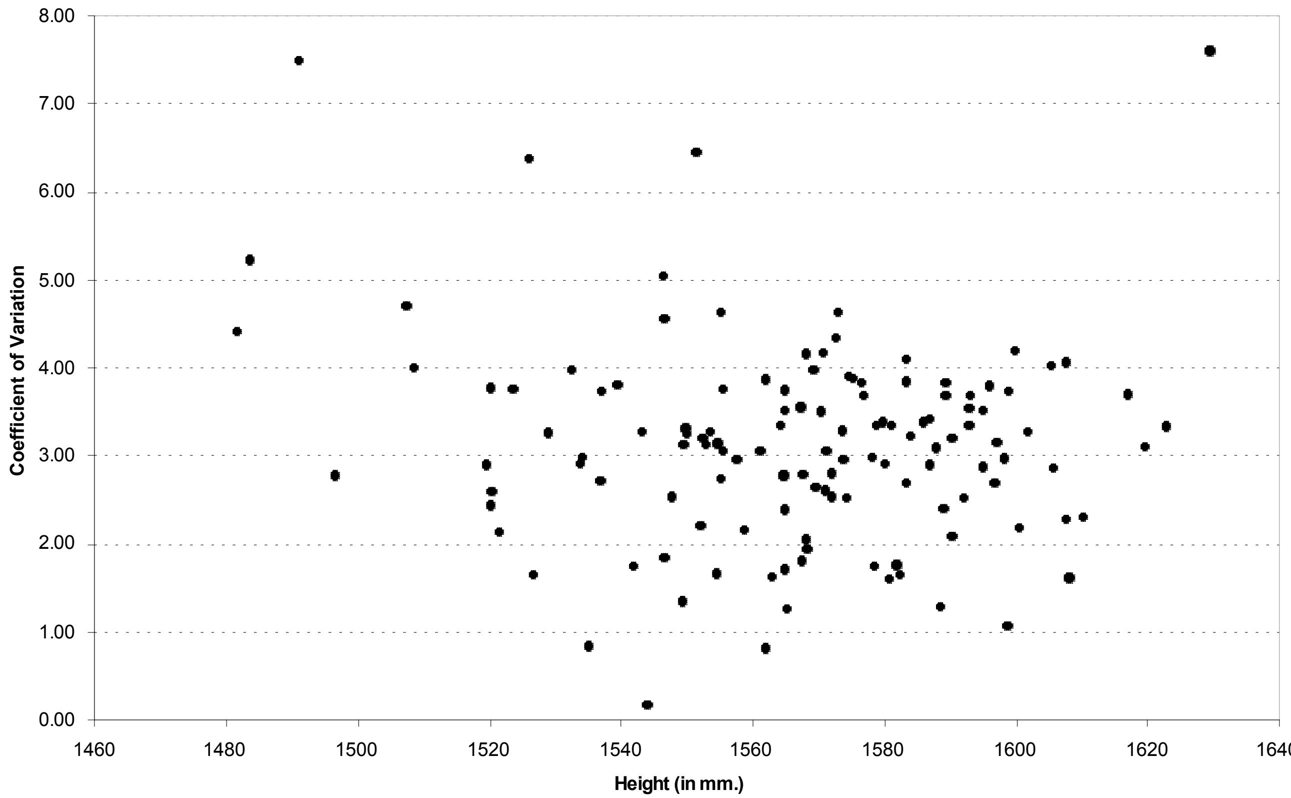


Figure 6. Male Height and Sexual Dimorphism among Native Americans

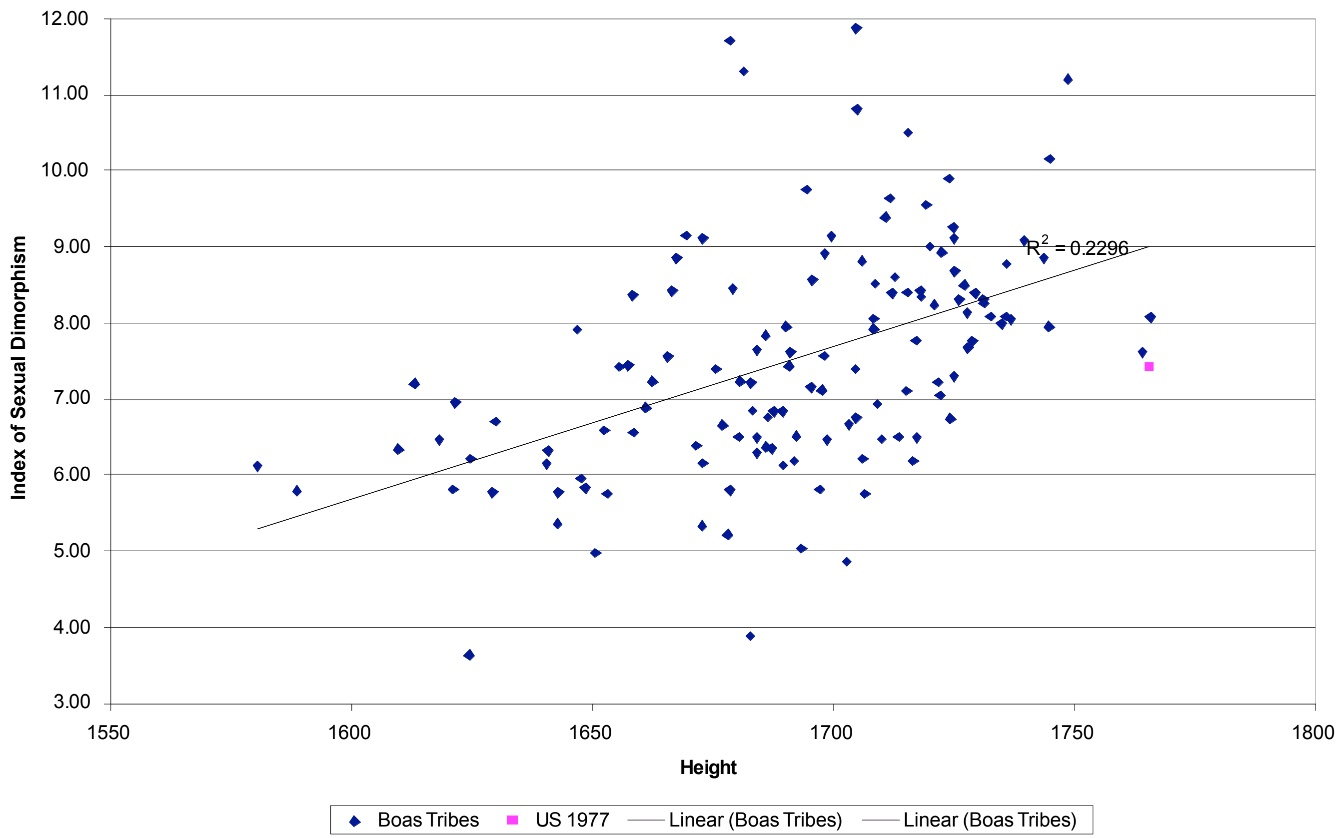


Figure 7. Male Height and Sexual Dimorphism in Africa

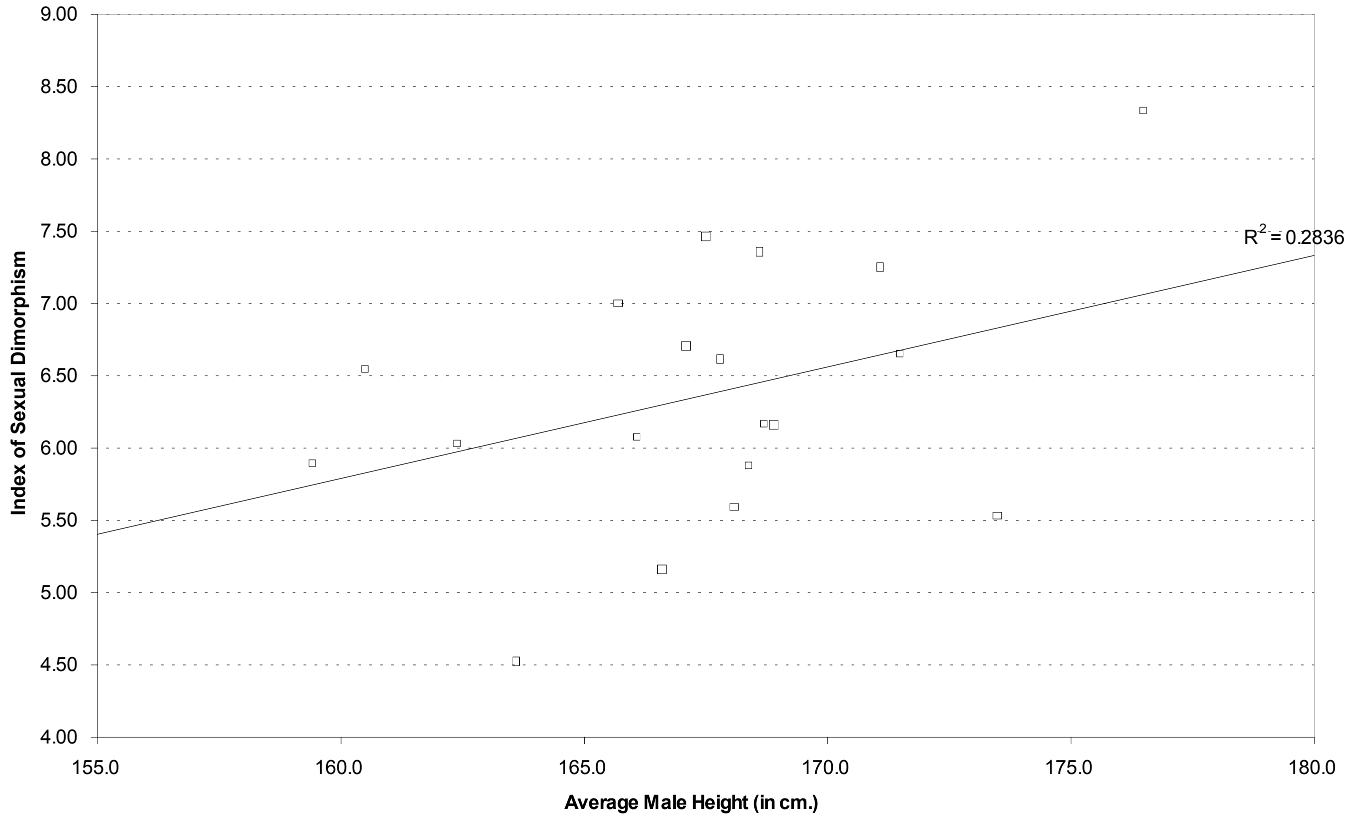
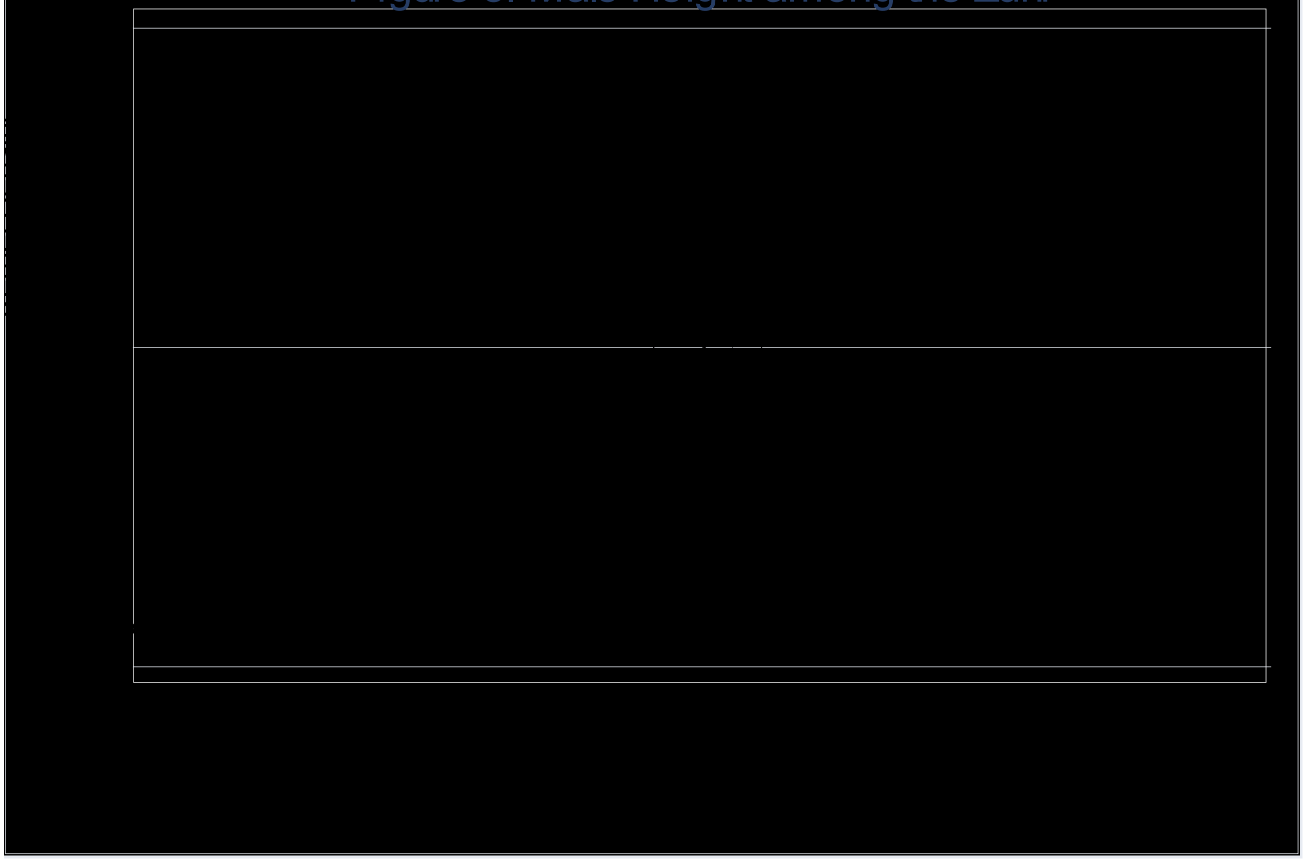


Figure 8. Male Height among the Zuni



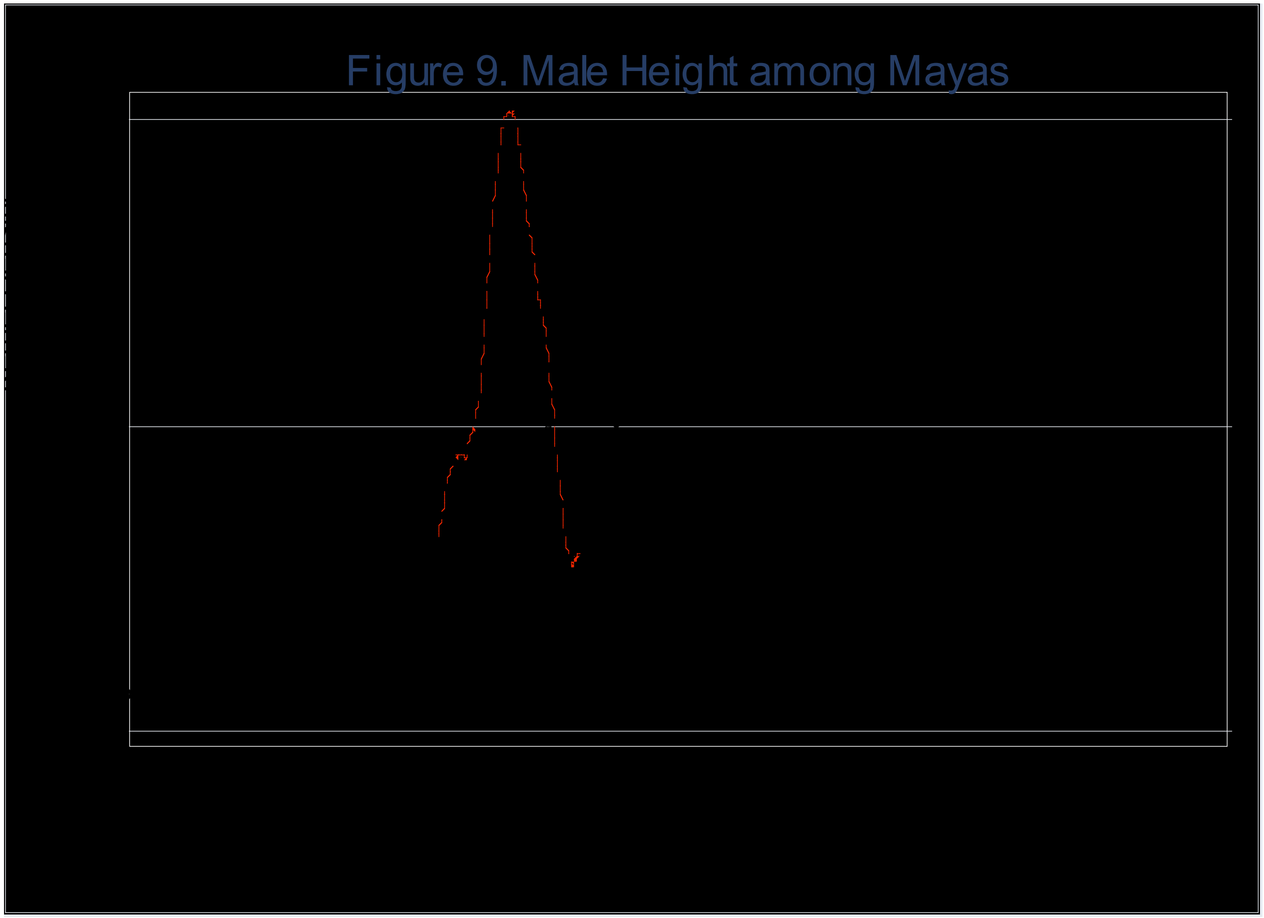


Figure 9. Male Height among Mayas

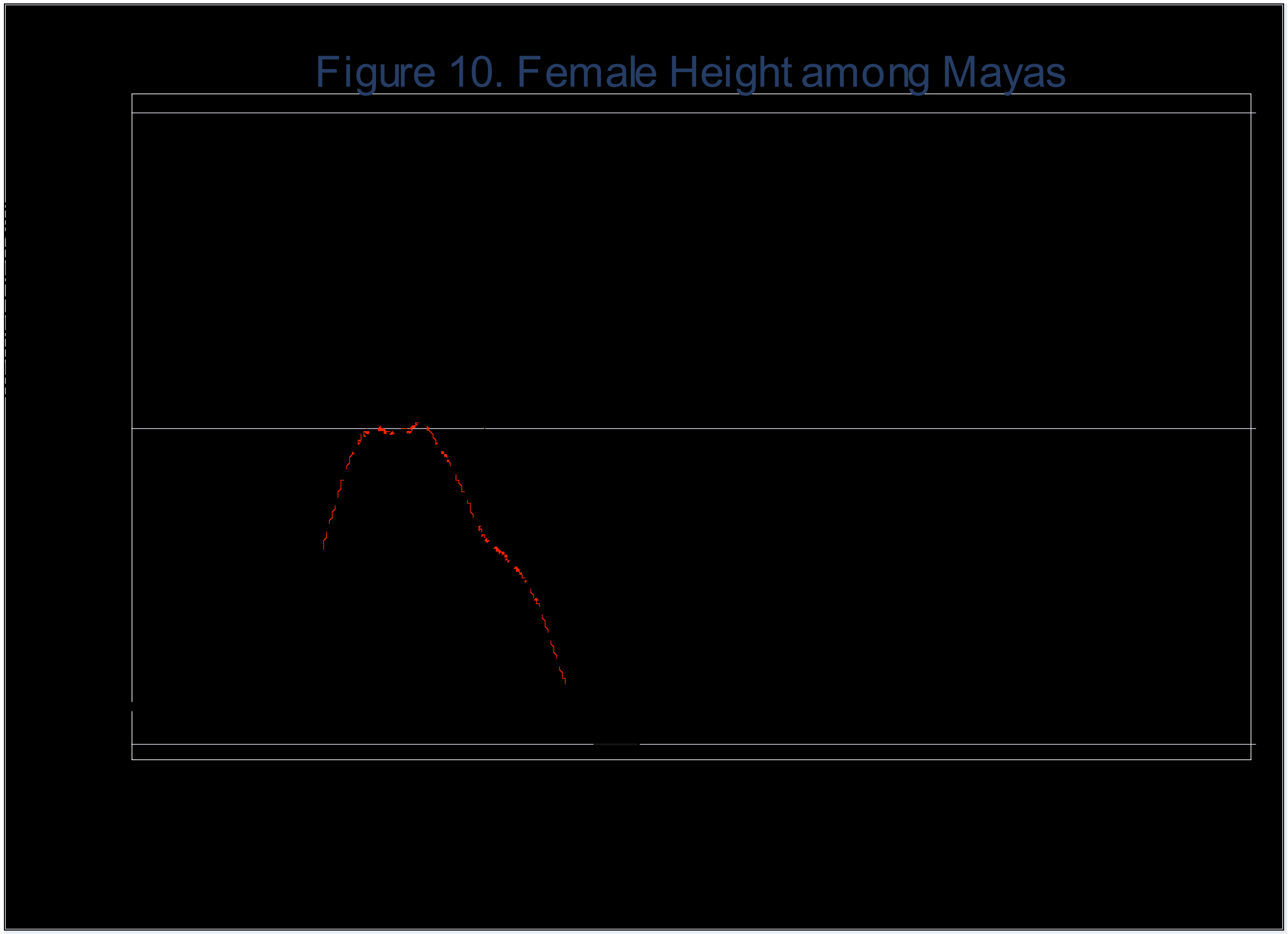


Figure 10. Female Height among Mayas

Figure 11. Male Height in Poland

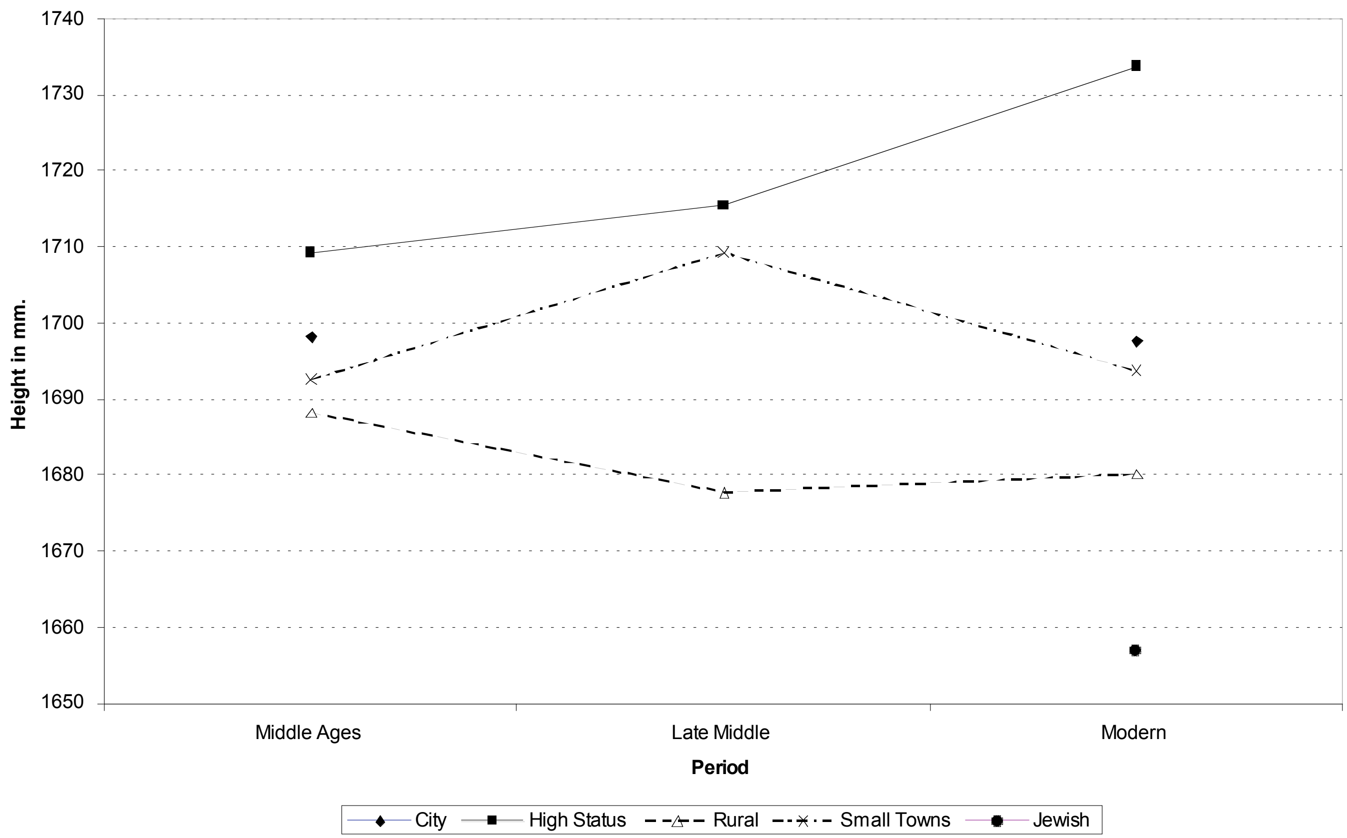
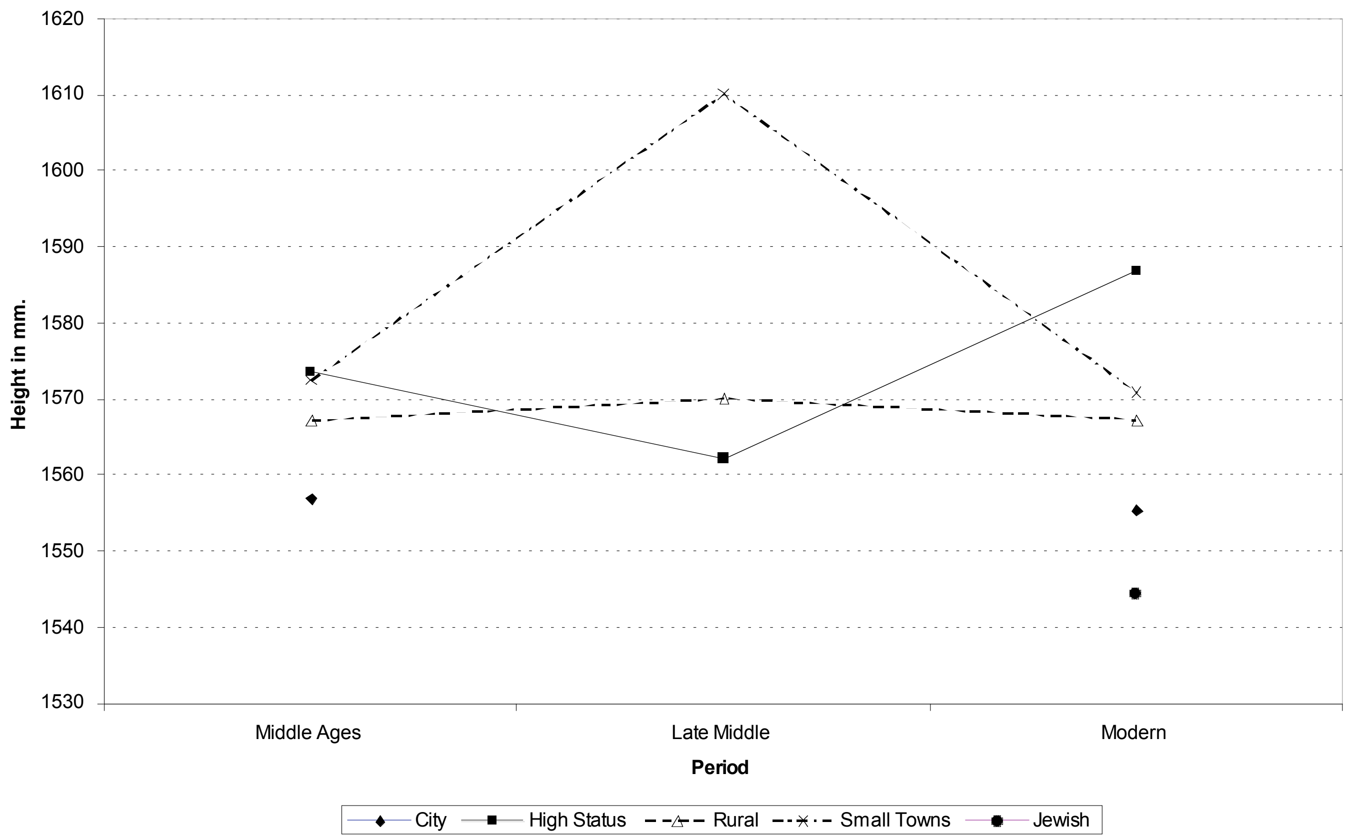


Figure 12. Female Height in Poland



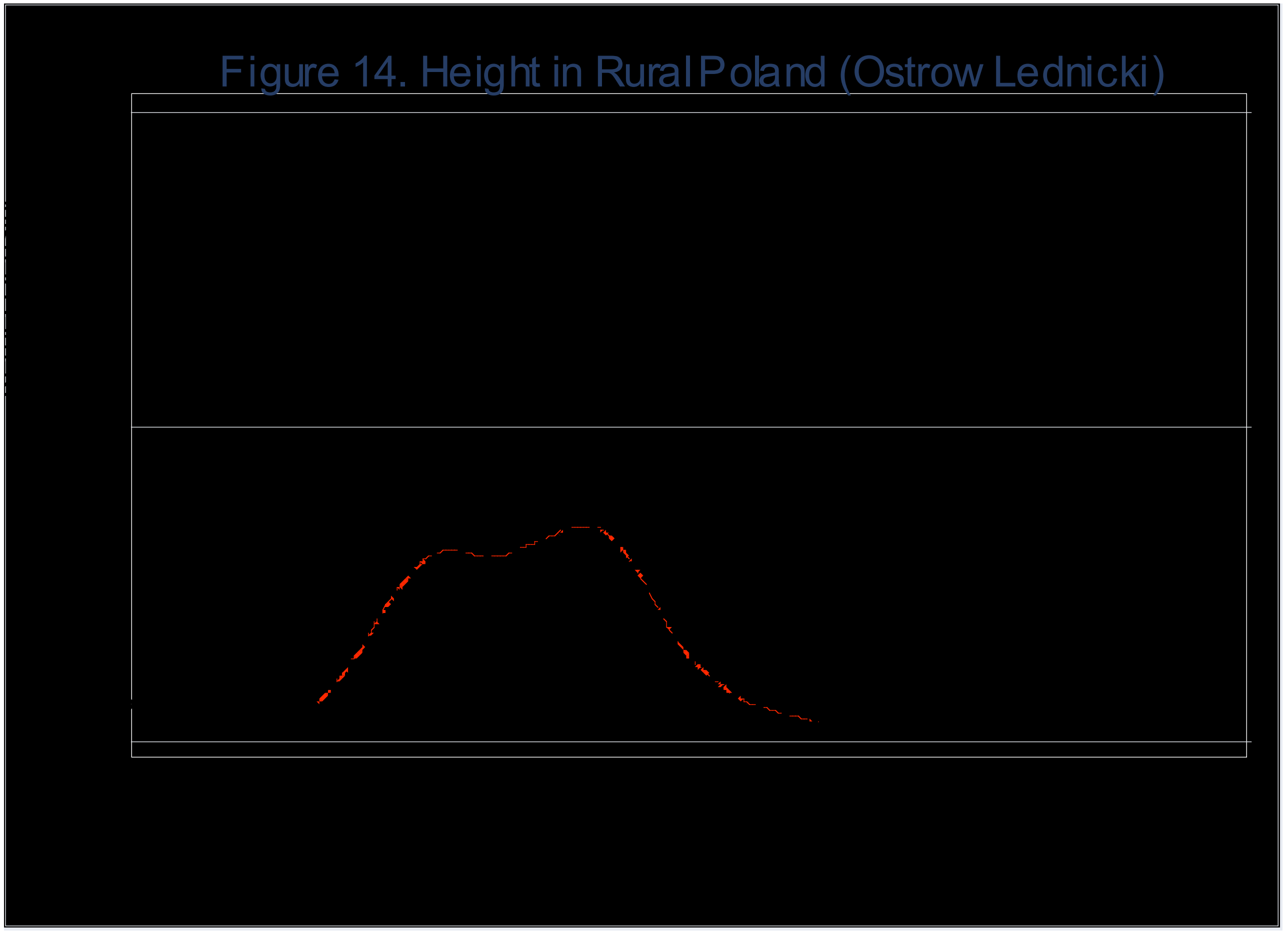
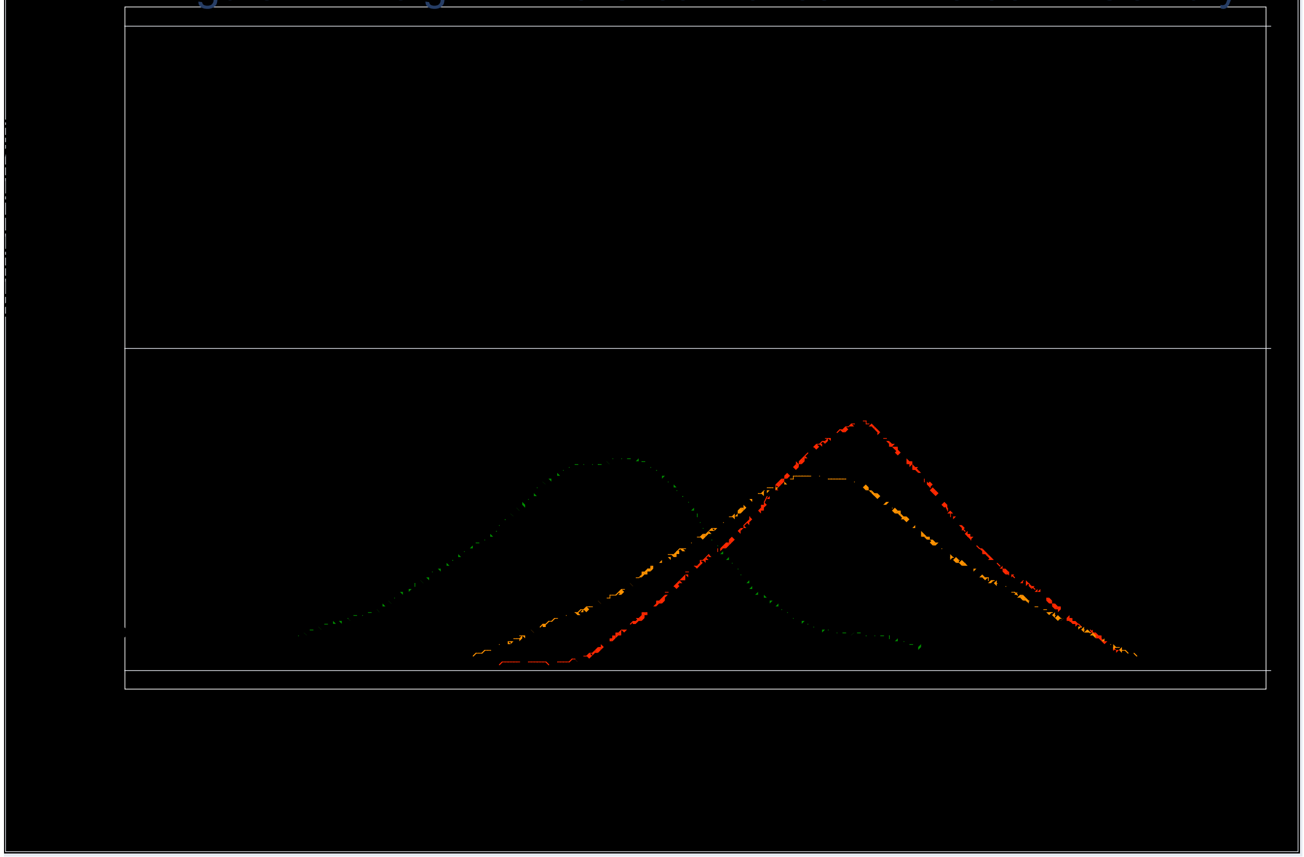


Figure 14. Height in Rural Poland (Ostrow Lednicki)

Figure 14. Height in the Great Lakes - Nineteenth Century



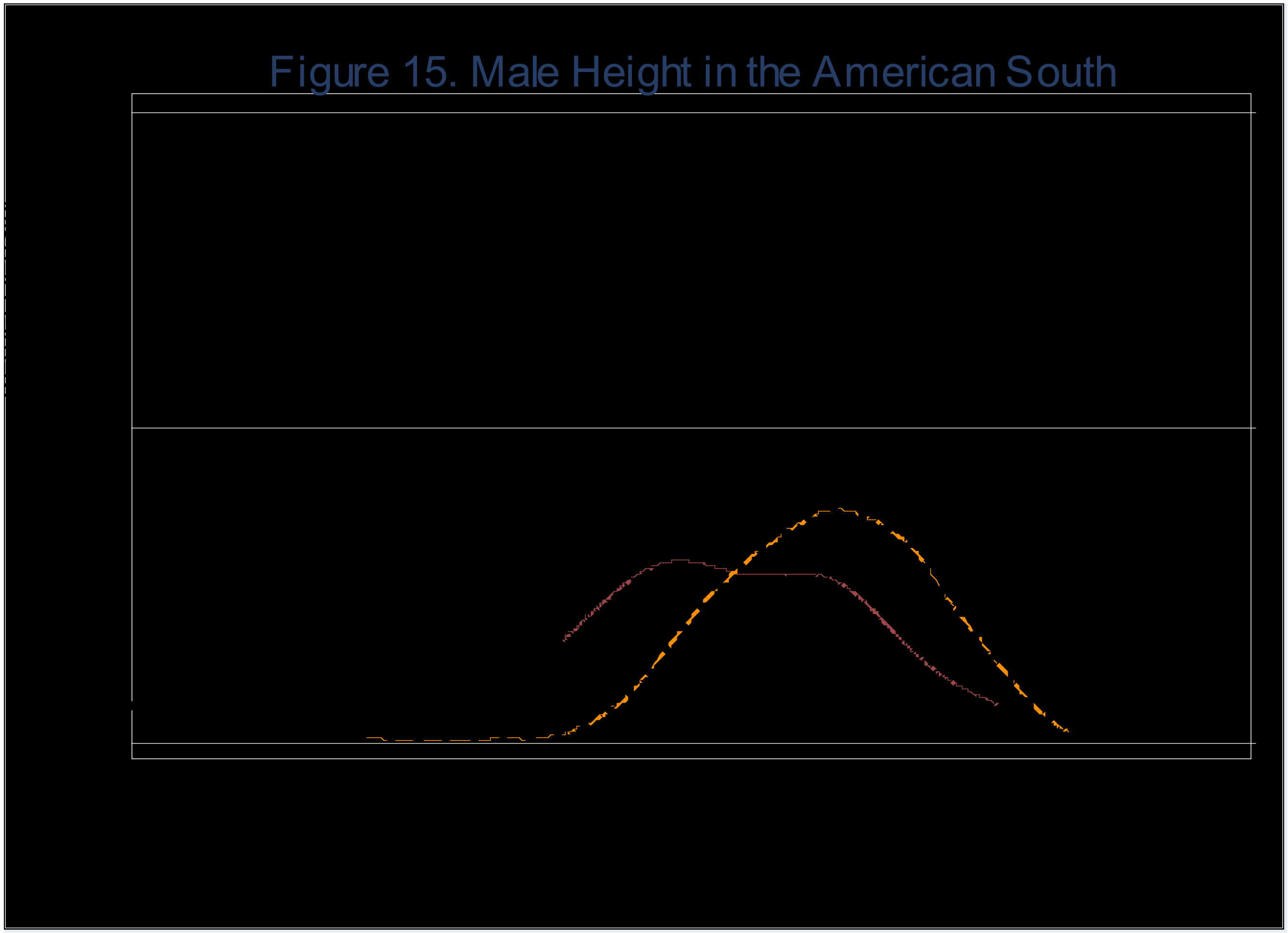


Figure 15. Male Height in the American South

Figure 16. Female Height in the American South

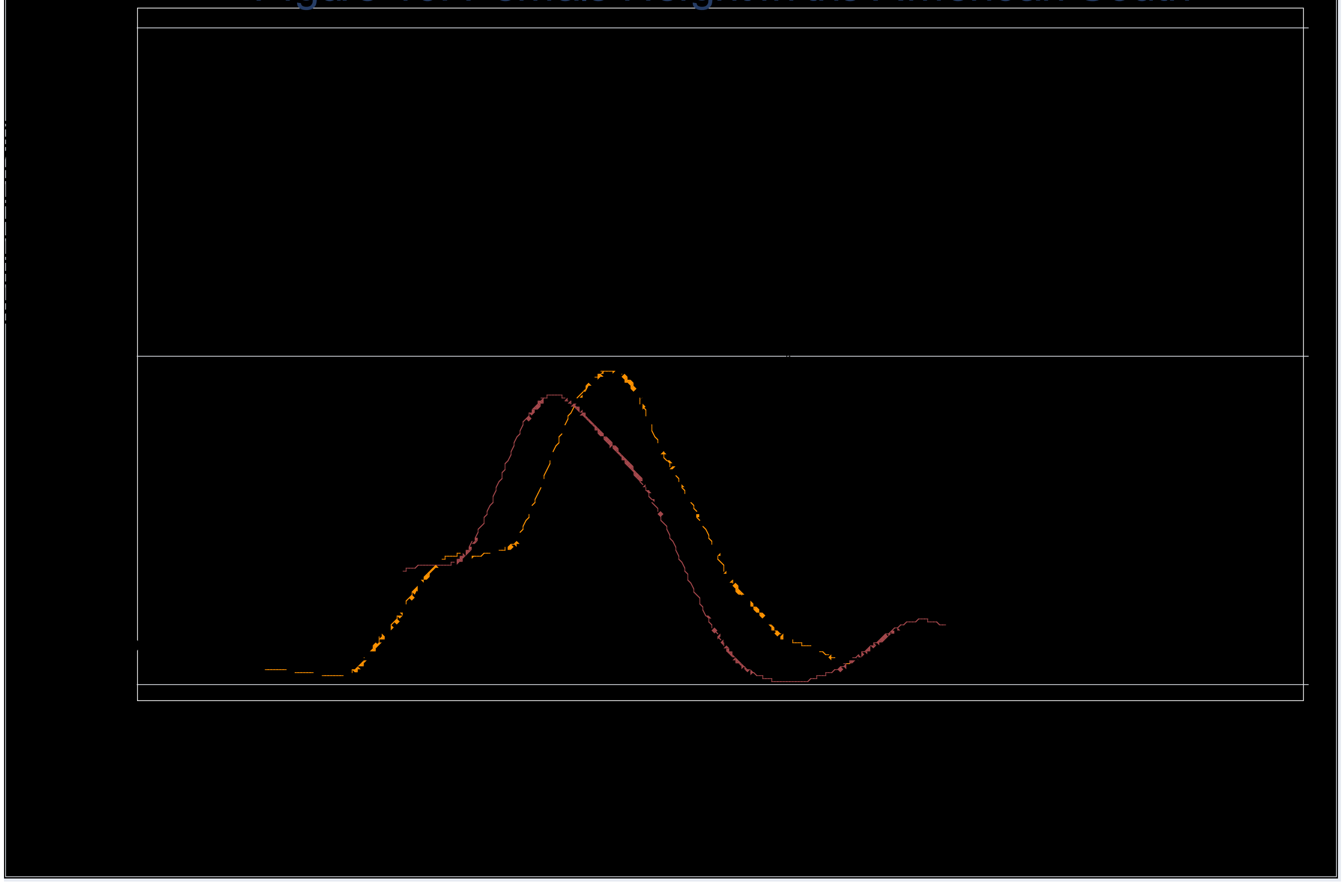


Figure 17. Male Heights and Sexual Dimorphism in Europe