

Long Bone Dimensions as an Index of Socioeconomic Change in Ancient Asian Populations

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Abstract

During the Holocene, body size decreased throughout the world with the economic shift from hunting and gathering to agriculture and the rise of densely aggregated urban populations. During the twentieth century, these declines have been reversed by secular trends toward body size increase in many areas. Although the decline in body size with the rise of agricultural societies has been well documented through studies of long bones from archaeological sites in the Western Hemisphere and Europe, less is known about the historical patterns of body size change in ancient African and Asian populations.

In this study we use new bioarchaeological data and published reports to reconstruct the regional patterns of change in body size that occurred with the rise of urban, agriculturally-based societies in Asia. Several broad patterns are apparent in these data. Femoral dimension indicate that in Asia a decline in body size occurred with agricultural intensification and urbanization that was comparable to that seen in Western Hemisphere and European societies. On the Asian mainland there are also clinal patterns with taller statures among the pastoralists of the Xinjiang region in northwestern China and shorter statures among the agriculturalists further south in China and Southeast Asia. In the Himalayan region stature varies inversely with altitude. Our research on Chinese collections reveals a complicated pattern of regional temporal-spatial variation that is likely to be explained by socioeconomic factors related to fluctuations in food production and status-related differences in resource access.

Introduction

Adam Smith, Thomas Malthus, and Karl Marx all assumed that longstanding inequalities in living conditions existed between Eastern and Western societies and proffered socioeconomic theories to explain the assumed superiority of the living conditions of Europeans relative to Asians. In recent years, economists have begun to question the assumption that differences in the quality of life of people living in the East and West stemmed from the stifling effects of an "Asiatic mode of production" that emerged before the Industrial Revolution, perhaps even millennia ago.

Materials and Methods

In this paper we explore this question of when and where significant differences in living conditions began to emerge between Western Europe and other parts of the world using height as a quality of life index. Height is a useful proxy for the standard of living because it reflects a person's dietary history minus claims on made on that nutritional input made by the metabolic costs of maintaining the body, physical activity, and disease during the developmental period (Steckel et al. 2002).

From a methodological perspective, height has several advantages as a health index; height is standard anthropometric observation made on living subjects and height also can be easily estimated for ancient populations based on measurements of long bone lengths. In this study we use new bioarchaeological data and published reports to compare changes in adult height associated with the rise of sedentary, agriculturally-based societies, throughout the world.

For recent populations, data were obtained from published heights in anthropometric reports (e.g. Baernstein Kennedy 1990). To reveal regional patterns reports of average values for local populations were combined by weighting mean heights by the number of individuals observed. For ancient populations, stature estimates were made based on long bone length measurements using appropriate, population-specific regression equations (Fujii 1960, Formicola and Franceschi 1996, Trotter and Gleser 1958).

Chinese Heights

There is a positive correlation between the age of skeletal collections in years before present (B.P.) and height for both males ($r=0.35$) and females ($r=0.66$) (Fig. 1). The correlation between the age of collections and estimated height is statistically significant for females ($p=0.13$) but not for males ($p=0.35$). This suggests that the diminution in height in is largely a product of a long term trend toward a decline in the quality of life of women relative to men.

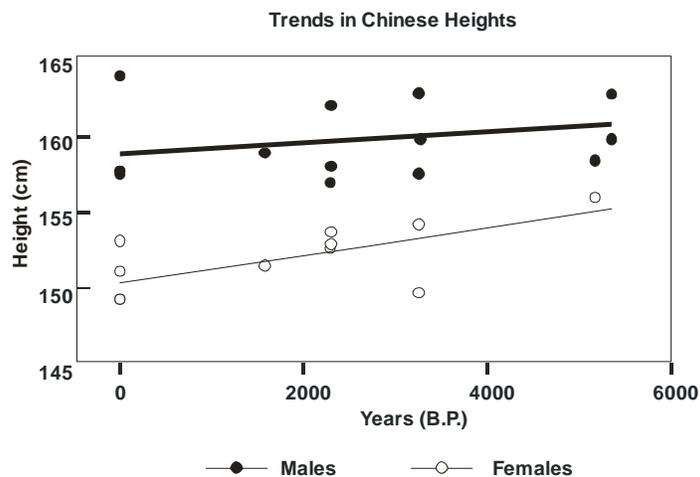


Figure 1: Trends in Chinese heights estimated from long bone dimensions

Recent Secular Trends in Chinese Heights

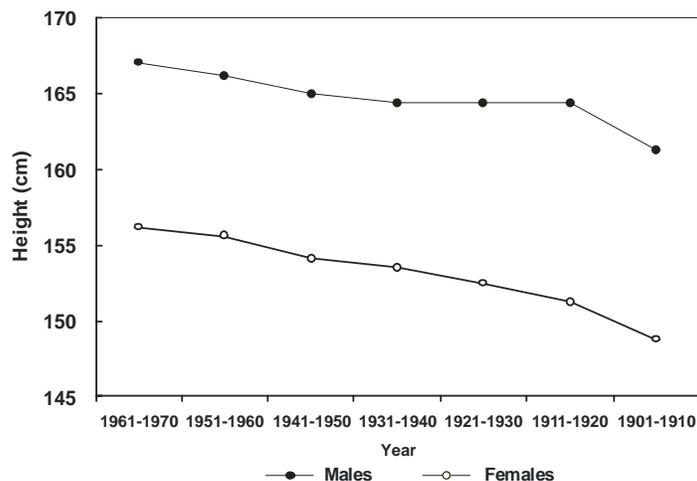


Figure 2: Recent secular trends in height in China. Data from Yan (1999)

Recent Chinese Secular Trends

At a much more refined time scale, it is clear that the long term trend toward height decrease began to reverse in China during the twentieth century. Data collected by Yan (1999) show that adult heights in China increased 5.8cm in men and 7.4cm in women during the period from 1900 to 1970. These height gains in less than a century are larger than the diminution in height suggested by our archaeological data from the preceding millennia.

South Asian Heights

Data on the heights of the modern and ancient inhabitants of South Asia show similarities to some similarities to the long-term trend toward height decrease in women relative to men seen to the north in China. This increase in sexual dimorphism appears to reverse during the Iron Age, but the small sample size from this period (2 females and 3 males) provides an insufficient basis for any substantive conclusions. However, it is clear that a substantial height decrease did occur in South Asian population between the Iron Age and modern times.

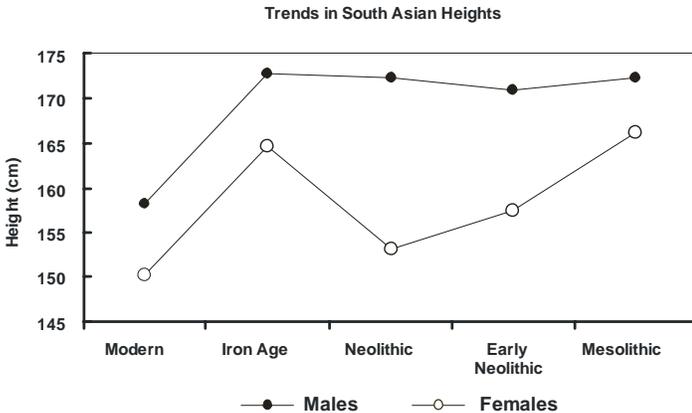


Figure 3: Trends in South Asian Heights. Based on data from Baernstein and Kennedy (1990).

Japanese Heights

Skeletal data on height trends in Japan present a similar picture to that seen in mainland Asian populations. Data presented by Fujii (1960) suggest that the heights of both men and women decreased significantly during the medieval period in Japan. In contrast to China and India, this secular trend in height seems to have affected males and females to the same extent.

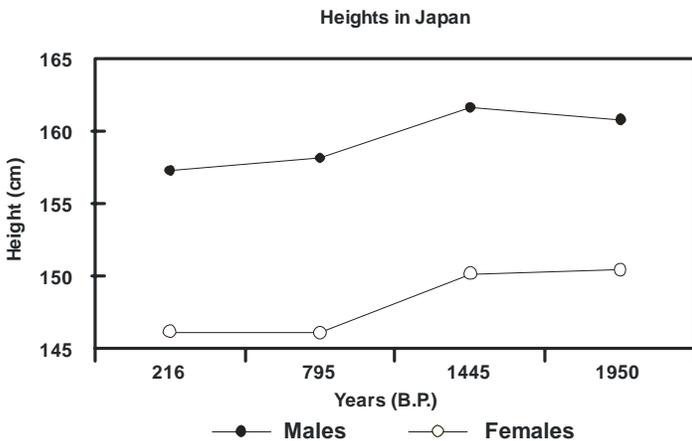


Figure 4: Height reduction in Japan during the last two millennia. Data from Fujii (1960).

European Heights

The historical data currently available for the European population are dominated by observations on males (e.g. Steckel 2005, Maat 2005). As a result, there is little basis for examining the trends in sexual dimorphism documented in our Asian samples. The data on European male heights during the last 2000 years show a decline that is more precipitous than that we have documented in our Chinese samples which appear to have been constant for several millennia. The absolute values, on the other hand, are different; during the last 2000 years the heights of European males averaged 170.9 cm (5 foot 7 inches) which is substantially greater than the 159.6 cm (5 foot 3 inches) average value our data suggest for Chinese males.

Trends in European Male Heights

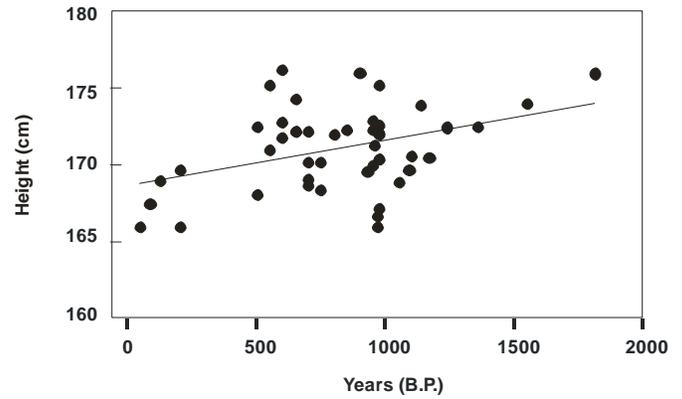


Figure 5: Trends in the heights of European males during the past 2000 years.

Conclusions

Our data on historical trends in the stature of Western European and Asian populations do not clearly support the assumptions of Western economic theorists such as Adam Smith, Thomas Malthus, and Karl Marx, who assumed that longstanding inequalities in living conditions existed between Eastern and Western societies that were products of despotic political systems that stifled free trade and private land ownership. Although, on average, the heights of people living in Asia appear to have been smaller than those of Europeans for at least several millennia, the trends in our height data do not support the idea that the institution of the capitalist economic system of European countries had any appreciable salutatory effect on the quality of life of life of people living in Europe relative to those in eastern Asia. Our stature data suggest that in both areas there have been long term trends toward height reduction associated with the challenges associated with population growth and urbanization in both areas.

Acknowledgments

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