GROWING TALL, BUT UNEQUAL: BIOLOGICAL WELL-BEING IN WORLD REGIONS AND ITS DETERMINANTS, 1810-1989*

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Abtract

Drawing on anthropometric information from 156 countries spanning the period 1810-1989, we find that regional height levels around the world were fairly uniform throughout most of the 19th century, with two exceptions: above-average levels in Anglo-Saxon settlement regions and below-average levels in Southeast Asia. After 1880, substantial divergences began to differentiate other regions. We assess the determinants of these divergences. Our analysis of dummy variables suggests that the inclusion of protein availability, disease environment, lactose tolerance, and geography reduces the unobservable world differences in height by more than a half. This doubles our ability to identify the causes of these levels and trends.

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Introduction

Human stature is now a well-established indicator for the biological standard of living, positively correlated as it is, along with good health and longevity, with a nutritious diet.[1] In the 1980s Robert F. Fogel, Richard Steckel, and John Komlos pioneered its use in the field of economic history, and a large body of literature in this and other fields has emerged since (Steckel 2009, Komlos and Baten 2004, Harris 1994). Anthropometric studies of individual countries have made a significant contribution to social-welfare economics over the past several decades, and have in turn served as the basis for a number of collective analyses, in which several such studies are presented and compared (e.g., Steckel and Floud 1997, Komlos and Baten 1998). This is the first attempt, however, to collate the entire body of anthropometric evidence, on a global scale.

In estimating height trends by world regions each of which comprises several nations, we aim to incorporate the maximum of previously published research. We find that 156 countries can be taken into account.[2] Height estimates are organised and analysed on the basis of birth decades wherever possible. However, continuous series are available for only some of these countries. Moreover, the series on individual countries, even some of those that are based on a substantial underlying number of cases, are prone to measurement error, since the the samples' regional and social composition are difficult to ascertain, and may introduce bias. To account for this potential bias, all problematic measurement issues are denoted with dummy variables, and their degree of bias will be carefully analysed.[3] For the estimation of world-region trends, data for a large number of countries is collected, with the result that most measurement errors are cancelled out. This unprecedented compilation project should facilitate further efforts of height analysis, providing as it does a realistic ground for further comparisons. As a main result, we find that regional height levels

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[1] The term "biological standard of living" was coined by Komlos in 1987.
One of the rare exceptions to the height-longevity correlation is that of the relatively short, because protein-deprived, Japanese prior to the economic boom of the 1960s; their longevity values were above average thanks to their high valuation of personal hygiene, the importance of which was underscored by health-related instruction in the schools.

[2] We include all countries with more than 400,000 inhabitants for which evidence is available, using 1990 borders, in order to permit comparison with Maddison’s 2001 GDP estimates.

[3] The underlying data set will soon be made public as part of the ClioInfra Project, a cooperative effort coordinated by Jan Luiten van Zanden and featuring partners in Utrecht, Amsterdam, Tübingen, and Debrecen. See www.iisg.nl/news/clio-infra.php

around the world were fairly uniform throughout most of the 19th century, with two exceptions: above-average levels in Anglo-Saxon settlement regions and below-average levels in Southeast Asia. After 1880, substantial divergences began to differentiate other regions -- making the world population taller, but more unequal.

The second major aim of this study is to shed light on one of the most important issues in anthropometric studies: the determinants of the biological standard of living on a global scale. That a population's average height is in large part a function of the disease environment and the availability of high-protein foodstuffs (chiefly meat and dairy products), and that lactose intolerance could play a role in this regard, is an issue that we consider. The impact of high-quality proteins and calcium on anthropometric values has been described in terms of a bottleneck (Baten 2010). The bottleneck concept implies that other food items necessary for a balanced diet, such as fruits, vegetable or grains, were much more easily available, whereas protein was expensive to produce in densely populated areas over most of the period under study. The historical record indicates that humans have always needed large amounts of protein to generate the antibodies needed to fight infectious disease, and today's underdeveloped countries are no exception. Especially milk helps to create antibodies (Grigg 1995). Added to this protein effect is that of the disease environment, which we will measure by means of infant-mortality rates.

We will also compare height trends with national income estimates. Because we consider GDP per capita to be an alternative indicator of biological well-being -- since it is a measure of purchasing power not only of high-quality foodstuffs but also, at least since the last century, medical goods and services -- we exclude it from our set of explanatory variables.

If economists are coming to use height as a valid complement to conventional welfare indicators, this is because it has some specific advantages. A given income level permits the purchase of a given quality as well as quantity of food and medical services, and is thereby correlated with health, which in turn is correlated with height. However, this income-height correlation is not one-to-one, modified as it is by important inputs not traded in the marketplace but provided as public goods, such as infant-nutrition programs and public hospitals, which account for slight deviations between purchasing power-based and height-based measures of biological well-being. Moreover, income fails to account for discrepancies within households. While it cannot account for every potential variable in a given population, the anthropometric approach permits economists and economic historians to capture important aspects of the biological standard of living (Komlos, 1985; Steckel, 1995), particularly in developing countries, hitherto neglected because reliable data were lacking. The well-known Maddison data set (2001), for example, provides only rough estimates for many such countries prior to 1910. While height is not without its deficiencies as a measure of the standard of living of a given population, it generates insights into global changes, and is particularly valuable as a countercheck as well as a complement to conventional indicators, permitting more reliable results than might otherwise be the case.

Life expectancy is among the many health indicators with which height is positively correlated. The economist Robert F. Fogel - drawing on the research of Waaler (1984), who measured several thousand Norwegian males and then followed them in a longitudinal study - reported in his Nobel Prize lecture (1993) that as late as the 1960s and 1970s a 17.5-cm height deficit meant for a Norwegian male a 71% higher risk of dying in the next period of their life: a staggering difference, especially when one considers that at the time Norway's nutritional ratings were unmatched. Having analysed height data for the birth cohorts of 1860, 1900, and 1950, Baten and Komlos (1998) concluded that every centimetre above and beyond a given population's average height translates into a life-expectancy increase of 1.2 years.[4] Thus a mere half-centimetre deviation from the average is significant, representing as it does six months of life. The correlation between height and longevity is even closer among children (Billewicz and MacGregor 1982, Martorell 1985).

The question of what role genetics, as well as nutrition, may play in determining a given population's average height was often raised in the early years of anthropometric research. It turns

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[4] The third cohort comprises those who have attained adulthood at some point between the 1970s and the present. The authors found any variation in the coefficient among the three cohorts to be negligible.

out that while genes are a key determinant of an individual's height, when it comes to groups of individuals genetic deviations from the mean cancel each other out. Moreover, there is considerable evidence that it is environmental conditions, not genes, which account for today's height gap between rich and poor populations, including those inhabiting a single nation. Habicht et al. (1974), for example, found that the height gap between the rich and poor sectors of a less-developed country (LDC), Nigeria, was even wider than that between an LDC's elite and a reference population in the United States.[5] Fiawoo (1979), in his study of Ghana, reached the same conclusion as Habicht, as did Eksmyr (1970), working with data on several Ethiopian ethnic groups, and Graitcer and Gentry (1981), when they considered Egypt, Haiti, and Togo. What is more, the height-distribution percentiles for children from rich families in this last study are in line with those for a rich country, namely the United States. Of course, not all height differentials are due exclusively to environmental conditions: African bushmen and pygmies, for example, spring to mind. While they account for only a small percentage of their respective nations' populations, we will nonetheless test for the magnitude of the genetics factor on a large scale. When we compare world-region dummy variables, with and without explanatory variables, we find that the inclusion of availability of protein availability, disease environment, lactose tolerance, and geography reduces the unobservable world-region differences in height by more than a half.

The paper is organised as follows. After a review of the literature, we will discuss some core methodological issues before moving to the first world region height estimates that cover the last two centuries. Section 4 discusses the height – GDP relationship, and the final section analyzes the determinants of height.

1. A selective review of the literature on individual countries and regions

We begin with a selective description of the more prominent studies on which our data set is based. Thanks to the existence of a considerable body of scholarly work, long-term time series are

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[5] The following review of the literature is based on Moradi and Baten (2005).

available for a considerable number of countries around the world; however, in other cases the documentation is limited to one or two benchmark years. The availability varies among world regions, but it is safe to say that in the past decade there has been an overall increase. Western Europe and European settlements have been the object of numerous studies, as our long list of references attests, and other world regions of a few (e.g., Floud 1994, Baten and Komlos 1998, Steckel and Floud 1997). Costa and Steckel (1997) combined all U.S. studies in a trend estimate that is based on a number of individual studies. More recently, Southern Europe has been added to the data set (A'Hearn 2003, Pesacchi 2008, Martínez-Carrión 1994). Garcia and Quintana-Domeque (2007) and then Hatton and Bray (2010) extended the European data set, and Whitwell, de Souza, and Nicholas (1997) have documented Australia.

Eastern Europe and Central Asia have been given a thorough anthropometric treatment by Mironov (1999, 2004) thanks to a combination of archival and contemporary anthropological data (see also Mironov and A'Hearn 2008). Mironov's estimates of Russian and various other Eastern European height trends provide a valuable overview of this world region, even if Wheatcroft (1999) has offered a different interpretation. As for central Asia, we can draw on the so-called demographic and health surveys (DHS) conducted from the 1980s onward that allow to cover birth decades after the 1940s, whereas it is thanks to anthropologists that we have data for the birth period 1960-89 in Eastern Europe (e.g., Bielicki and Hulanicka 1998, Vignerova and Blaha 1998). Among Komlos' many studies are several on those regions of southeastern Europe that once composed the Habsburg Empire (1985, 1989, 2007). Kopczyński has done likewise for Poland (2006).

For pre-1950 Latin America data on Argentina and Colombia have been provided by Salvatore (1998, 2004), Salvatore and Baten (1998), López-Alonso and Porras (2003), Meisel and Vega (2004a, 2004b), Carson (2005, 2008), and recently Baten and Carson (2010). Brazil, Peru, and Argentina have been recently studied by Baten, Pelger, and Twrdek (2009) and Twrdek and Manzel (2010). In addition, there is scattered information regarding the Indian populations in these and other countries (Bogin and Keep 1998).

India, Asia, the Middle East, and North Africa are only modestly documented. We have access to Indian height data not only for the early 20th century (Guntupalli and Baten 2006) but also for birth cohorts dating as far back as the early 19th century (Brennan, McDonald, and Shlomowitz 1994a, 1994b, 1997, 2000). Although the latter studies are based on labour-migrant heights, and hence not necessarily a representative sample of India, the authors offer persuasive arguments that these heights were equivalent to those of the population as a whole. For Japan we turn to Mosk 1996, Bassino 2006, Shay 1994, and Honda 1997, and for China to Morgan 2006, 2008; Baten and Hira 2008; and Baten, Ma, Morgan, and Wang 2010. The latest of several studies of the two Koreas is one of North Korea by Pak, Schwekendiek, and Kim (2010). As for Southeast Asia, a modest amount of data on this region is available (Vietnam: Bassino and Coclanis 2005; Indonesia: van der Eng 1995, Baten, Stegl, and van der Eng 2009; the Philippines: Murray 2002). The Middle East and North Africa of the late 19th and early 20th centuries have been documented in Stegl and Baten (2009). Data from the Demographic and Health Surveys (DHS) program allow a trend estimate for Turkey and Egypt during the period 1950-89, while the 1970s and 1980s have been the object of a number of anthropological studies.

African height data on freed slaves and military recruits permit a rough estimate for the early 19th century (Eltis 1982; Austin, Baten and van Leeuwen 2010). Eltis (1982) has argued that the height discrepancy between freed slaves and others was negligible, because height was not an important pricing criterion; while slave heights varied from region to region, regional prices did not reflect this variation. Furthermore, any height differences among freed slaves were diminished by Africa’s own demand demand for the strongest (and thus presumably the tallest) workers available, because Africa was a labor-scarce world region herself. At the same, there is no evidence that the slave market established anything like the military's minimum-height requirement. A comparison of soldiers' and slaves' height data indicates that the latter do not suffer from significant bias (Austin, Baten, and van Leeuwen 2010). For Africa during the period 1890-1930 a large number of anthropological studies are available: for example, one of two major Kenyan peoples, the Kikuyu and the Massai (Orr and Gilks 1931), as well as recent studies (Moradi 2009a, Austin, Baten, and Moradi 2008). The problem of potential survivor bias in the African DHS data sets, which span the years 1945-89, has been resolved by Moradi (2005).

2. Methodological issues

How can we estimate the world height trend over a period spanning nearly two centuries? To compensate for the fact that until the middle of the twentieth century data are scarce for countries where poverty and illiteracy prevailed, we solicited a large number of recent anthropological measurements, with the aim of representing 164 countries, but were obliged to exclude eight for lack of evidence (Table 1).[6] Needless to say, in some cases only a few birth decades are documented, and certain height estimates are compromised by measurement errors. But we have been as accurate as possible under the circumstances, recording height by province whenever possible, and adjusting our calculations to take into account any modifications of national borders. Only certain combinations of countries and birth decades are sufficiently well documented to contribute to our estimates for world regions and half centuries; for instance, no evidence is available for the Middle East and North Africa in the early 19th century, in large part because of the absence of precise height measurements in Ottoman Empire military data, the army having categorized each recruit as small, medium, or large -- and barefaced or bearded. In most other world regions, however, army data were available for the early 19th century. The year 1950 marks a turning-point in that from that moment on population censuses, health surveys, and similar sources include data on women -- in fact, considerably more than on men -- because institutions other than the military, particularly those related to the health sciences, begin to take interest in them. The fact that there is a correlation, if not a simple one, between male and female heights is by now beyond

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[6] Bahrain, Cape Verde, Djibouti, the Palestinian Territory, Qatar, Reunion, the United Arab Emirates, and finally the trio Mayotte, Saint Helena, and Western Sahara (aggregated as in Maddison 2001).

dispute (Baten and Murray 1999, Moradi and Guntupalli 2008) and it justifies our substituting one set for another when need be. Objections to this strategy might be raised by those who accept the female- resiliency hypothesis, which holds that for biological reasons the average height of a given female population is more resistant to adverse conditions than is that of their male counterparts. Some evidence of small pre-historic samples supported this hypothesis. However, drawing on the largest height sample available to date, Guntupalli (2005) has gone far to disprove this hypothesis for the last two centuries. Since the vast majority of historical height estimates are for males, we transform all estimates into male equivalents, estimating specific regression equations for each world region in order to account for potential differences (Appendix A).

It is reasonable to assume that a teen-age conscript from a malnourished population has yet to reach his maximal height. In such a case we calculate what it will be by applying the method presented in Baten and Komlos (1998).[7] Migrants, evidently not representative of the population into which they were born, are another potential source of bias; in some cases, the possession of skills and money motivate a person to migrate; in others, it is the lack of both that obliges such a move (Stolz and Baten 2010, Humphries and Leunig 2009). Such an ambiguous situation obliged us to generate reasonable adjustments. For example, if we could determine (thanks to data permitting us to compare the average height of migrants with the average height of the source population) the height selectivity of migrants from country A to country B, and if country C was very similar to country A in terms of development, then we adjusted the migrant height of country C by the same centimeter differential as country A migrants displayed, compared to the stayers of this country. However, this adjustment was necessary for only a small fraction of our sample, specifically, a mere 0.7%, out of the 1.5% of our sample observations based on migrant heights. The remaining 0.8%

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[7] See the notes to Table 1 in the work cited. The authors suggest the following adjustments, derived from Mackeprang's 19th-century-growth studies, for societies in which males in their teens and twenties have yet to achieve their maximal height (as a rule, above 170 cm). Those who were 18 years of age were estimated to have 2.4 cm to go; those age 19 1.7 cm, those age 20 0.9 cm, those age 21 0.4, and finally those age 22 only 0.1 cm. Clearly these estimates are not valid for all populations, since growth in late adolescence is largely a function of the individual's environment, but without such simplification comparison of heights in this age group would be impossible. Moreover, the results presented in Table B.1 of the appendix indicate that these estimates are generally valid.

were removed from all regressions.[8]

We have taken great care to identify all the biases that may have been generated by the institutional context -- enlistment in the military, incarceration in prisons, and sale in the slave trade, chiefly -- in which heights were recorded.[9] Voluntary soldier samples were included only if satisfactory statistical methods had been used to eliminate the height bias of truncated samples. As for other potential biases, one way to estimate their possible effect is to regress stature on a full set of birth decade and country dummy variables.

As for those institutional contexts that are specific to certain world regions and time periods, we have included them in a series of bias-analysis regressions, each designed to expose a potential bias typical of a given region or time period. For example, we had to rely on prison samples for Latin America and North America in the 19th century (Table 3), whereas for most European countries we could obtain conscript samples, which as a rule entail a broader portion of the social spectrum; and anthropological samples were virtually our sole source for certain world regions.[10]

Self-reported heights are particularly prevalent in industrial countries in the later 20th century. Since, according to a number of studies, male respondents tend to overestimate their own height, we have adopted the corrective recently proposed by Hatton and Bray (2010), and will test its accuracy.

When it comes to data sources for the study of height trends in the Middle East and Africa, there is a drawback of early anthropological surveys -- in that the importance of identifying individuals by birth cohort was not yet understood, because it was assumed that the physical measurements of a given population did not evolve from one decade to the next. The result is that, when dependent on anthropological data, we have been obliged to approximate birth decades, and accept the possibility that a small proportion of those individuals identified as belonging to a given

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[8] We also attempted to derive adult-height estimates from those of children but excluded these results, too, on account of their unreliability.

[9] We also did our best to rid our data set of social, ethnic, and regional biases.

[10] The cutoff criterion for including a world region and a half century was 10% with one notable exception: that of “aggregated ages,”for which we had to estimate the birth decade in which the majority of measured individuals were born; in this case we raised the level to 30%.

cohort in fact belonged in one of the two adjacent ones. Koepke and Baten (2005, 2008) and Stegl and Baten (2009) succeeded in estimating average heights in such cases by using a large number of studies that reflect in sum the changes over time. It should be noted though that time trends that result from such estimations resemble moving averages in that they smooth out the evolution of height averages. For example, if there was a height decline among a given population during the 1880s but only 70% of the individuals in the data set upon which we draw in order to analyse this decline in fact belonged to the 1880s cohort (the remaining 30% having been born in the previous one), the decline would appear to be smoother than, in fact, it was.

When we regress human stature on a full set of country and birth-decade dummies and on those potential-bias variables, the coefficients of the latter turn out to be insignificant (Table 4). The coefficients are also small in most cases, with the exception of the slave coefficient. But not only is the negative coefficient for slaves (our slave data being limited to early-19th-century Africa) statistically insignificant; the only comparison group consists of military recruits. Thus it may very well be in this special case of slaves that an insufficient amount of data, for the purposes of comparisons, accounts for the large coefficient. For other anthropometric studies, it is a very important result that prisoners and voluntary soldiers did not differ significantly from other height sources, because this had been an issue in many earlier studies.

In the interest of accuracy we also assessed the possible biases of aggregate age, late-adolescent growth, self-reported heights, and migrants with and without adjustment (Appendix, Table B.1). We found these potential biases to be insignificant, with the possible exception of positive coefficients for migrants, underlining the need not only to exclude unadjusted heights but also, by means of dummy variables, to control for any and all other potential biases.[11]

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[11] We also created dummy variables for the rare cases that we encountered of significant regional, ethnic, and social selectivity (e.g., workers in South Africa), and include those dummies in our regressions below. By "significant" we mean evidence (derived from more or less contemporary studies) of a one-centimetre (or greater) deviation from the national mean.

3. Estimates of height trends

Our estimates of world-region trends for the entire 1810-1989 period are based on the population-weighted averages of 156 countries, without interpolations (Figure 1). We used the standard world-region classifications with one exception: we aggregated the group comprising of North America, Australia, and New Zealand, because of certain demographic similarities (chiefly populations featuring European settlers and high cattle-per-capita values). We observe that this group at first had very high values but that toward the end of the 19th century they declined somewhat, converging with some of the other groups, but resuming their upward trend at the start of the next century. The first wave of globalisation, at the end of the 19th century, was not a boom for the populations of New World food-exporting regions. The shift of high-quality foodstuffs from local to export markets may not have been the only factor; immigration into these regions no doubt caused higher population pressure and changes in agricultural practices which in turn led to a decline in protein consumption per capita. Western Europe came close to their level during the 1950s and 1960s, which hence came to be known as its Golden Age of Western Europe. Eastern Europe and the socialist part of central Asia lagged somewhat behind Western Europe, whereas East Asia did quite well during the early 19th century, only to decline to the level of a middle group, composed of Latin America, Sub-Saharan Africa, and the Middle East. African heights were the only ones to decline during the period 1960-89 (cf. Moradi 2009b). The shortest heights worldwide were to be found in Southeast and South Asia.

However, the world-region estimates using only recorded measurements may be biased if samples are not random for the region in question: that is, if there were variations in the amount of reliable data available for each country in that region. To compensate for any such missing values, we applied the best possible interpolation strategy: whereever possible, we identified a benchmark level estimate for each country that allows obtaining levels that are close to true height values for the country to be interpolated. We then used the variation over time of other, nearby countries with similar characteristics. Linear interpolation was to be avoided, because of the risk that it might obscure certain fluctuations: for instance, declines that occurred in certain countries during the second half of the 19th century. Instead, we opted for backward- and forward-projection techniques, using the country-specific benchmark years and obtaining the changes between benchmark and estimated decades from a similar and neighboring country. For example, the change from the 1870s to the 1880s in Iraq is more similar to the change in Iran over the same period, than one would conclude from the results of a linear interpolation in Iraq between 1870 and 1890. Keeping the height level with the 1870 Iraq benchmark guarantees its accuracy. (The interpolated values are represented by the white cells in Table A.1 of the appendix, with the exception of the Middle East 1810-49 and South Asia 1810-29, for which no reasonable interpolation was possible.) The correlation between world-region trends based exclusively on real-height values and the series that include interpolations is quite close (Figure 2).

We can distinguish several groups of world regions.

(1) The Anglo-Saxon settlements had very high anthropometric values for much of the period under study, not converging with lower ones until the late 19th century, and then only moderately.

(2) Both Western Europe and those countries in Eastern Europe and central Asia that had ever experienced socialist rule recorded a strong upward trend after the 1880s. However, once the U.S.S.R. came into being the differential between these two regions increased (Komlos 1999, Mironov 2006; it is the latter's estimates that we apply). In contrast, levels in Latin America, the Middle East, and North Africa were at relatively high levels in the 19th century but during the 20th century experienced only modest increases (Salvatore 2004).

(3) East Asia and Sub Saharan Africa remained throughout the entire period near the global average except East Asia during the late 19th century (Figures 1 and 2). Africa is the only world region in which the average height has steadily declined over the last two decades (Moradi 2005).

(4) Finally, both South and Southeast Asia remained at a low level throughout the period under

study. While no upward trend of any significance occurred in South Asia since the end of the 19th century, Southeast Asia experienced a slight upward trend, but at the start its heights were even lower level than were those of its neighbour (Brennan/McDonald/Shlomowitz 1994a, 1994b, 1997, 2000; Guntupalli and Baten 2006; Baten, Stegl and van der Eng 2010). In sum, we find that after the 1880s global heights increased on average, but also became more unequal.

4. Height and GDP

Height and GDP are complementary measures of the standard of living. GDP per capita is a measure of a nation's purchasing power, whereas height is more closely correlated with nutrition, health care, and inequality. Their interdependence has initially been stressed in the literature (Fogel et al. 1982), but over the past two decades evidence has emerged indicating that they should be regarded as independent indicators. Significant deviations have been found not only between height and GDP but also between height and real wages for unskilled labour (Margo and Steckel 1983, Komlos 1996). However, these findings are based largely on U.K. and U.S. data, and the correlation between real wages and heights was actually much closer elsewhere (Baten 2000).

A simple scattergram indicates some positive correlation between real GDP per capita and height (the correlation coefficient is 0.64, the p-value 0.00; Figure 3). The bulk of observations is between 160 and 180 cm, indicating that height averages are located in this range throughout the period under study. There being only a few cases at the low end of the scale, between 155 and 160 cm (mostly in Central America and Southeast Asia), and above 180 cm at the high end. Japanese values are exceptional in that they are marked by lower height than expected from GDP. But within Japanese observations there is a positive correlation over time between GDP and height. Deviations on the lower right include three countries of the African Sahel zone (Chad, Burkina Faso, Mali). Deaton (2007) suggests that selective survival of children may account for this deviation, whereas Steckel (2009) argues that the subsistence-level existence of a portion of the population and black-market activity should not be discounted, since they skew national income estimates. Moradi and

Baten (2005) argue that local protein consumption was the most likely cause, since poor families unable to sell their protein-rich produce, for lack of a market, end up consuming it themselves. In fact, Chad, Burkina Faso, and Mali are paradigmatic cases of high protein production per capita and low market integration: short on purchasing power, they are nonetheless, thanks to their high-protein diet, relatively tall.

The relatively close overall correspondence between height and GDP – apart from the deviation above which can be explained by local protein consumption patterns -- also serves here as a plausibility-check that the new height estimates are reasonable.

5. Determinants of height

In the following analysis, we have chosen to focus on what we term "proximate" determinants: protein availability, the disease environment, lactose tolerance, and altitude. In contrast, factors such as productivity, institutional design, income, education, trade, religion and similar variables would be more underlying causes which might determine the proximate ones of disease environment, the consumption of high quality foodstuffs and the lactose tolerance. We did not include the underlying, but the proximate determinants in our analysis. Only civil war and demography were included as more indirect determinants, because we wanted to control for the exceptional situation of civil war, and for the potential inequality effects of political autocracy.

We use panel data comprising exclusively genuine observations (i.e., no interpolations), checking for the existence of unit problems by considering the residuals of our regression by means of the Fisher test (Maddala and Wu 1999), which results in a chi2(112) value 268.63, p-value 0.00. As the null hypothesis of the Fisher test is formulated in such a way that the series are non-stationary, we conclude that there is no unit-root problem.

We include a range of variables to control for the availability of animal protein per capita, always a bottleneck factor when it comes to human nutrition, because a protein calorie requires a larger input than does a grain calorie (Baten 1999, 2010; for the sources, see Appendix D). In a bivariate graphical analysis of the cross-section of the 1900 birth decade, cattle per capita suggests a positive correlation (Figure 4) -- with three modest deviations to the lower right: Argentina, and to a lesser extent Cuba and Madagascar. Argentina's population may have been deprived of protein because the country exported most of its cattle products, and Cuba and Madagascar displayed similar mechanism during the early 20th century at least.[12]

The per capita availability of livestock is a useful protein-related indicator, since cattle is a valuable supplier of both meat and milk (Table 5). The effect of cattle per capita is positive and significant, the standard-deviation effect accounting for a significant height difference, of roughly half a centimeter (Table 6).

This protein indicator is available for a large number of observations, but because it does not account for productivity per head of cattle we developed a second model that replaces cattle per capita by the annual output of meat per capita, and a third model that permits us to estimate the amount of milk per capita. As a result, we were able to determine that animal-protein availability had a positive impact on height; the coefficient's level is consistently significant. The standard-deviation effect of the milk variable is some 50% higher than those of the cattle and meat variables (Table 6).

We include the infant mortality rates to control for disease environment (Appendix D). The results confirm our expectations: a problematic disease environment is associated with lower heights, the standard-deviation effect being about twice the size of the protein effect.

Democracy was included to assess the possible effect of political institutions on the distribution of nutrition and health resources: could it be that, say, the biological standard of living in oil-producing countries run by non-democratic governments tends to be lower than in similarly wealthy countries? The coefficient is positive but to an insignificant degree, so the answer would seem to be no. The same conclusion holds for civil war (at least when all of the other variables were included).

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[12] We experimented with cattle trade share data that might have helped to clarify this issue, but since the data were scanty the results were not decisive, and so they are not presented here.

A variable whose direct effect has been hypothesised in anthropological studies is the share of mountainous areas in a given region, but a consensus has yet to be reached. For example, Harrison and Schmidt (1989) argued that humans who live at high altitudes (such as Peruvians in the Andes) tend to be relatively short, contradicting previous studies of the Alps, the Scottish Highlands, and the French Jura. If Harrison and Schmidt do not prevail, it could be in part because the disease environment in such regions benefits from underpopulation; in addition, high-altitude Europeans in particular would have benefited from their proximity to protein production (Baten 1999). Having controlled for protein proximity and disease effect, we side with Harrison and Schmidt, although the effect is only slight. Since mountain dwellers in LDCs are relatively poor and mountains reduce agricultural productivity and raise infrastructure costs, economic variables no doubt also contribute to this pattern.

Both protein and the disease environment turned out to be significant, and with the expected signs, when included alone (Table 5, Columns 4 and 5). These two columns also include our estimation of fixed effects, reputed to be a particularly rigourous test of statistical relationships. Moreover, fixed effects control for national cultural differences and other forms of unobservable heterogeneity, with the result that the coefficients of protein availability and disease environment are even larger than in the random-effects regressions.[13] The R-squares are somewhat larger in the case of the regression in which the only variable is the disease environment.

Autocorrelation structure

Since there is a risk of autocorrelation (despite the fact that unit roots are not a problem) we estimated by means of a panel-data model using feasible GLS, with an AR(1) autocorrelation

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[13] However, the larger number of observations available for those regressions with only one explanatory variable may indicate that countries and time periods other than those in Table 5, Columns 1-3, should be included as well.
A joint test of infant mortality and cattle per capita is not possible -- the sample size would be too small to permit accurate estimates of fixed effects, since they emphasise changes over time as opposed to cross-sectional differences. (Moreover, in all macroeconomic regressions changes over time feature a relatively high measurement-error rate; see Durlauf 2004.)

structure (Table 7); the coefficients of the protein-availability indicators proved to be even greater than were those in the models estimated in Table 5. The disease environment registers as insignificant on one occasion, in Column 3, on account of the relatively small number of cases for which milk-production estimates were available, but otherwise the results are robust.

Lactose tolerance or protein effect?

We use three proxy indicators for the availability of high-quality protein: cattle per capita, meat consumption, and milk consumption, which is in part a function of lactose tolerance (defined as the ability of those over the age of seven to consume considerable quantities of milk without experiencing digestive problems). In his bold attempt to explain the evolution of capitalism in terms of cattle-raising patterns, Crotty (2001) argued that a largely lactose-intolerant population could not make sufficient use of dairy cattle, since lactose-intolerant adults tend to exclude milk from their children's diets. East Asians (east of Tibet and Rajasthan), American Indians, and certain Africans are prone to lactose intolerance. The situation in southern Europe is ambiguous; one study named Spain among those countries with the lowest intolerance levels (30% or less), another categorised Greece among those countries where the intolerance level is moderate (30-70%), and Italy and Turkey were rated among those with the highest levels (Mace et al. 2003). However, even lactose-intolerant people can digest fermented milk products such as kefir and lassi. Moreover, a lactose-intolerant individual's intestinal bacteria can be gradually modified until they are able to digest a maximum of one cup of milk a day -- more than most economies have been able to provide. In South Korea, where lactose intolerance has long prevailed, milk consumption has increased through such deliberate modification, to the point that it has become a status symbol.[14]

There is a systematic correlation between lactose tolerance today and height around 1880 (Figure 5). Papua New Guinea, Vietnam, Indonesia, Congo, and Japan had low height values, whereas in Sweden, Niger, New Zealand, and Denmark both lactose tolerance and average-height

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[14] We thank Barry Bogin of the University of Michigan and S. Pak of Seoul National University, for their observations on this issue.

levels were at the other end of the scale. The explanation for those countries -- Morocco, Cyprus, Nigeria, and Ethiopia -- where the people tend to be tall but lactose intolerant (and where, not coincidentally, the protein-per-capita rate is quite high) may be that lactose-intolerant adults provide their children with adequate protein from sources other than milk, and perhaps with modest amounts of milk as well. On the other hand, the populations of Yemen, Colombia, and Spain tend to be lactose tolerant but short, perhaps on account of a low overall protein-consumption rate; low cattle-per-capita values during the 19th century help to account for this discrepancy in Yemen and Spain, if not Colombia (Stegl and Baten 2009).

It is relatively easy to determine whether lactose tolerance and protein availability are more influential, since they can be tested directly in a horse-race. In fact, we find that these two variables have historically exerted an influence on heights (Table 8, Column 1). While their coefficients are of roughly similar size, the standard-deviation of lactose tolerance is only one third of the cattle-per-capita variable (Table 6). But we also need to take into account potential interaction effects. It seems reasonable to assume that the significance of the cattle-per-capita rate in a given population is greater if the parents are lactose tolerant than if they are not. While an interaction effect between the two turns negative when the two variables are included, the coefficient is small, if statistically significant. In separate regressions that include only one of the two explanatory variables, they retain their significance (Tables 3, Columns 2 and 3).

Endogeneity

Because lactose tolerance is genetic and hence was generally exogenous during the period under study, the lactose-tolerance variable also allows us to conduct an endogeneity test of the protein-availability variable. Over the long term this variable may be to some degree endogenous, too, since in cattle-producing countries the survival rate of the children of lactose-tolerant individuals would have been relatively high, and hence their genetic makeup would have been passed down through the generations.

Instrumenting cattle per capita with lactose tolerance, we obtain a significantly positive coefficient even larger than the aforementioned cattle coefficients (Table 9), indicating that the protein-availability indicator is probably an exogenous variable. The first stage results documented in the notes below the table indicate that lactose tolerance could be a valid instrument for the potentially endogenous variable cattle per capita.

Between 1870 and 1949 the coefficient is significant. In the period 1950-89, the p-value is 0.12, just short of statistical significance, although it must be cautioned that this calculation is based on only 124 observations.

The disease environment is insignificant in those regressions. One could imagine that the disease environment rate may be endogenous as well. However, since the infant-mortality rate is considered to be the most exogenous among all of the disease-environment indicators, and because good instruments for the disease environment in so many countries are not easily available, we do not instrument it here.

Early and late developments

Thanks to a sufficient number of observations, we could distinguish a middle (1870-1950) and a late (1950-89) period (Table 10).[15] We would expect to find a decline in the importance of local protein production and health advantages during the late period, thanks to the development of refrigeration and other storage methods that would permit an expansion of the international market in both foodstuffs and medical materials.

We find that in the period 1870-1950 both the country-specific output of protein and our disease proxy had a fairly large coefficient, indicating that the effect of 1% change was greater than during the period 1950-89, when, in fact, the coefficients for both diminished (Table 10, Column 3). However, if we confine our analysis to those countries included in our data for both periods, the apparent effect proves to be nothing more than a statistical artifact due to the selection process,

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[15] As for the early period, 1810-70, there was an insufficient number of countries providing all of the explanatory variables to permit accurate analysis.

permitting us to conclude that both variables had a long-term effect.

A lower-bound estimate of the effects of genetic potential, food behaviour, intergenerational effects, culture, and other currently unobservable factors

We also included a full set of birth-decade and world-region dummies in most of the aforementioned regressions. The comparison of the latter in regressions with and without explanatory variables permits us to estimate the size of various unobservable characteristics. While the early generations of anthropologists firmly believed in the existence of races (a term later replaced by "genetic potential") today there is a consensus among the leaders in the field that height potential is primarily a function of environmental factors (Bogin 1988).

Secondly, human preferences and behaviour related to food might play a role. Especially in rich industrial societies, the consumption of red meat and other protein-rich foodstuffs seems to stagnate or decline. There are a number of stories about food taboos in poor countries as well, which supposedly caused some ethnicities and religious groups to consume less protein than they could have done. Two of the most famous religious taboos are the Hinduist ban on beef, and the Muslim ban on pork. However, the question is whether those taboos would have a strong effect given that substitution of other protein sources might be possible.

The third possible factor is that of intergenerational size limits. Cole (2003) has argued that Japanese height levels could not quickly catch up with Western ones because of a biological check mechanism on the size of a baby relative to that of the mother. The body prevents the foetus from growing too large, if the birth channel of the mother is not as large. Another intergenerational factor might be dietary habits. For example, dietary habits of migrants may persist in a second generation, even after moving to a new environment with different relative prices; the offspring of migrants from low-protein to high-protein regions may continue to eat the low-protein dishes favoured by their parents.

A final word of caution: just as average income is only a rough indicator of a population's well-being, cattle per capita is only a rough indicator of protein availability, since, thanks to the pressure of the export market, little meat may, in fact, end up in local markets. Perhaps even more important, the output of protein per animal varies.

Those and some other potential unobservable factors should be reflected in world region dummy variables in regressions, after the effect of observable explanatory variables has been removed by including those. We therefore compare two such sets of regressions, that is, one with and the other without explanatory variables. Western Europe is the constant.Among the other world regions, there is a sharp decline in the coefficients if the explanatory variables are included. For example, when differences in cattle per capita, lactose intolerance, and similar factors are not controlled for, East Asians' heights are lower by 8.2 cm, but when they are the difference is only 4 cm. We should note that, because measurement error produces a downward bias to coefficient size, the shrinkage of the coefficient may yield a lower-bound estimate of the effect of explanatory variables. Similarly, the coefficients of Latin America, South Asia, and Africa diminished by about 50%, that of Southeast Asia somewhat less. When explanatory variables were controlled for, the Middle East and Eastern European coefficients diminished to the point of insignificance. The region comprising North America, Australia, and New Zealand was characterised by a positive coefficient relative to Western Europe. These results indicate that the explanatory variables proposed in this study reduce the size of world-region coefficients and thereby enlarge our understanding of the causes of global height differences to the same, considerable, degree.

Conclusion

Drawing on anthropometric information from 156 countries spanning the period 1810-1989, we find that regional height levels around the world were fairly uniform throughout most of the 19th century, with two exceptions: above-average levels in Anglo-Saxon settlement regions and below-average levels in Southeast Asia. After 1880, substantial divergences began to differentiate other regions. We find that most of the anthropometric divergence between today’s industrial and developing nations took place after this period. While the impressive height level that the region comprising the Middle East and North Africa had enjoyed prior to that point fell back in relative terms, South and Southeast Asia remained from the outset at the back of the pack. Africa performed surprisingly well during the period 1900-65 but has struggled since. In short, after 1880 the world population became taller on average, but more unequal.

If height trends are any indication (and by now it is beyond doubt that they are), the first wave of globalisation, at the end of the 19th century, was not a boom for the populations of New World food-exporting regions. The shift of high-quality foodstuffs from local to export markets may not have been the only factor; immigration into these regions no doubt caused higher population pressure and changes in agricultural practices which in turn led to a decline in protein consumption per capita.

This study introduced a new data set on heights in 156 countries, which was used to estimate height trends by world region and which will be made publicly available. We found that the major determinants of biological well-being, and hence height, are the quality of nutrition, the rate of lactose tolerance, and the disease environment, whereas geography is a minor one. In addition, we discovered that lactose intolerance and protein availability -- issues not previously addressed in the literature -- had effects independent of one another, and we found solid evidence that sets in doubt earlier notions, promulgated by the first generation of anthropologists, that fundamental food-related behaviour is a function of genetic constraints. This study thus makes possible for the first time the application of anthropometric estimates to patterns of biological well-being on a global scale. Our results thus constitute a conclusion, but a beginning as well.

References

A’Hearn, Brian (2003). Anthropometric Evidence on Living Standards in Northern Italy, 1730-1860. *Journal of Economic History 63,* 351-381.

Austin, Gareth, Joerg Baten, and Bas van Leeuwen (2010). The Biological Standard of Living in Early 19th Century West Africa: New Anthropometric Evidence. Working paper London School of Economics /Tuebingen/Utrecht.

Austin, Gareth, Joerg Baten, and Alexander Moradi (2008). Exploring the evolution of living standards in Ghana, 1880-2000: An anthropometric approach.” Working paper, London School of Economics /Tuebingen/Oxford.

Bassino, Jean-Pascal (2006). Inequality in Japan (1892-1941). Physical Stature, Income and Health. *Economics and Human Biology* 4 (1), 62-88.

Bassino, Jean-Pascal and Coclanis, Peter (2005). “Secular Trend and Regional Inequality in Biological Welfare in(first author (Permission granted by first author to use data from this paper).

Baten, Joerg (1999). *Ernährung und wirtschaftliche Entwicklung in Bayern, 1730-1880* [Nutrition and Economic Development in Bavaria, 1730-1880]. Stuttgart: Steiner.

Baten, Joerg (2000). Height and Real Wages: An International Comparison. In *Jahrbuch fuer Wirtschaftsgeschichte* 2000 (1), 17-32.

Baten, Joerg (2009). “Protein supply and nutritional status in nineteenth century Bavaria, Prussia and France”; *Economics and Human Biology* 7 (2), 165-180.

Baten, Joerg, Carson, Scott A. 2010. Latin American anthropometrics, past and present – An overview. Economics and Human Biology 8(2), 141-144

Baten, Joerg/Hira Sandew. 2008.Anthropometric Trends in Southern China, 1830-1864. *Australian Economic History Review* 48 (3), 209-226.

Baten, Joerg, Komlos, John.(1998). "Height and the Standard of Living," *Journal of Economic History* 57 (3), 866-870.

Baten, Joerg, Debin Ma, Stephen Morgan, and Qing Wang (2010) “Evolution of Living Standards and Human Capital in China in the 18-20th Centuries: Evidences from Real Wages, Age-heaping, and Anthropometrics” *Explorations in Economic History* 47 (3): *347-359.*

Baten, Joerg, John Murray (2000). "Heights of Men and Women in Nineteenth Century Bavaria: Economic, Nutritional, and Disease Influences," in *Explorations in Economic History* 37), 351-369

Baten, Joerg, Ines Pelger, and Linda Twrdek (2009). “The Anthropometric History of Brazil, Lima (Peru), and Argentina during the 19th and early 20th Century” *Economics and Human Biology 7-4,* 319-333.

Baten, Joerg, Mojgan Stegl and Pierre van der Eng (2009): “Long-Term Changes in the Biological Standard of Living in Indonesia: New Anthropometric Evidence, 1770s-2000s”; Working Paper Tuebingen/Australian National University.

Bielicki, T., Hulanicka, B. (1998). „Secular Trend in Stature and Age at Menarche in Poland“, in Bodzar, B.E. and Susanne, C. (eds.) Secular Growth Changes in Europe. Budapest: Eötvö Univ. Press, 263-279.

Billewicz, W. Z. and MacGregor, I. A. (1982). A birth-to-maturity study of heights and weights in two West African (Cambian) villages, 1951-1975. *Annals of Human Biology* 9, 309-320.

Bogin, Barry (1988). Patterns of Human Growth. Cambridge: Cambridge University Press.

Bogin, Barry, Keep, Ryan (1998). Eight Thousand Years of Human Growth in Latin America: Economic and Political History Revealed by Anthropometry. In: Komlos, John/Baten, Joerg, eds.The Biological Standard of Living in Comparative Perspective Stuttgart: Steiner.

Brennan, L., MacDonald, J., Shlomowitz, R. (1994a). The Heights and Economic Wellbeing of North Indians under British Rule. Social Science History 18, 271-307.

Brennan, L., McDonald, J., Shlomowitz, R. (1994b). Trends in the economic well-being of South Indians under British rule: the anthropometric evidence. Explorations in Economic History 31, 225–260.

Brennan, L., McDonald, J., Shlomowitz, R., (1997). Towards an anthropometric history of Indian under British rule. Research in Economic History 17, 185–246.

Brennan, L., McDonald, J., Shlomowitz, R., (2000). Change in the stature of North Indians from British rule. Jahrbuch fuer Wirtschaftsgeschichte, 129–148.

Carson, Scott A. (2005). The Biological Standard of Living in 19th Century Mexico and in the American West, Economics and Human Biology 3(3), 405-419.

Carson, Scott A. (2008). The Stature and Body Mass of Mexicans in the Nineteenth-Century United States. , *The Journal of Interdisciplinary History* 39 (2), 211-232

Cole, T.J. (2003). The secular trend in human physical growth: a biological view. Economics and Human Biology 1, 161–168.

Costa, Dora L. and Steckel, Richard H. (1997). “Long-term Trends in Health, Welfare, and Economic Growth in the United States,” In Health and Welfare during industrialization, Richard H. Steckel and Roderick Floud (eds.). Chicago: University of Chicago Press.

Crotty, R., (2001). When Histories Collide. New York: Altamira Press, Rowman and Littlefield Publishers.

Deaton, Angus (2007). Height, health, and development. Proceedings of the National Academies of Science 104 (33), 13232–13237.

Durlauf, Steven N., Johnson, Paul A., Temple Jonathan R. W., (2004). Growth Econometrics. Working paper, University of Wisconsin.

Eksmyr, R. (1970). Anthropometry in Privileged Ethiopian Preschool Children. Acta Paediatrica Scandinavica 59, 157-163.

Eltis, David. (1982). Nutritional Trends in Africa and the Americas: Heights of African, 1819-1839. Journal of Interdisciplinary History 12, 453-475.

Fiawoo, D.K., (1979). Physical growth and the school environment: a west African example. In: Stini, W.A. (Ed.), Physiological and Morphological Adaptation and Evolution. Mouton, The Hague, 301–314.

Floud, Roderick (1994). "The Heights of Europeans since 1750: A New Source for European Economic History. In John Komlos (ed.) Stature, Living Standards, and Economic Development. Essays in Anthropometric History. Chicago: University of Chicago Press, 9-24.

Fogel, Robert W., Engerman, Stanley L., and James Trussell (1982), "Exploring the Uses of Data on Height: The Analysis of Long-Term Trends in Nutrition, Labor Welfare, and Labor Productivity." Social Science History 6, 401-421.

Garcia, J., Quintana-Domeque, C. (2007). The evolution of adult height in Europe: a brief note. Economics and Human Biology 5, 340-349.

Graitcr, P. and E. Gentry (1981). Measuring Children: One Reference for All. *The Lancet* 8 August 1981, 297-299.

Grigg, David (1995). The Pattern of World Protein Consumption, Geoforum 26 (1), 1-17

Guntupalli, A. (2005). Essays on Indian Anthropometric Development. Ph.D. disseration Dissertation, Univ. Tuebingen.

Guntupalli, Aravinda Meera/Baten, Joerg (2006). The Development and Inequality of Heights in North, West and East India, 1915-44. *Explorations in Economic History* 43 (4): 578-608**..**

Gustafson A. and Lindenfors P. (2004). Human size evolution: no evolutionary allometric relationship between male and female stature. Journal of Human Evolution 47:253-266.

Habicht, J.P., Martorell, R., Yarbrough, C., Malina, R.M., & Klein, R.E. (1974). Height and Weight Standards for Preschool Children: How Relevant are Ethnic Differences? *The Lancet* 6, 611-615.

Harris, Bernard. (1994). “Health, Height, and History: An Overview of Recent Developments in Anthropometric History.” *Social History of Medicine* 7, 297-320.

Harrison, G.A. and L.H. Schmitt (1989). Variability in Stature Growth. *Annals of Human Biology 16,* 45-51.

Hatton, T. and Bernice E. Bray (2010). “Long run trends in the heights of European men, 19th–20th centuries,” *Economics and Human Biology* (forthcoming).

Honda, G. (1997). “Differential Structure, Differential Health: Industrialization in Japan, 1868-1940,” In Steckel, R., Floud, R., (eds. Health and Welfare during Industrialization. Chicago: University of Chicago Press.

Humphries, Jane and Timothy Leunig (2009). Was Dick Whittington taller than those he left behind? Anthropometric measures, migration and the quality of life in early nineteenth century London. Explorations in Economic History; 46 (1),120-131.

Koepke, N. and Joerg Baten (2005). "The Biological Standard of Living in Europe During the Last Two Millennia," European Review of Economic History 9-1 (2005), 61-95.

Koepke, N. and Joerg Baten (2008). “Agricultural Specialization and Height in Ancient and Medieval Europe,” Explorations in Economic History 45, 127-146.

Kopczynski, Michał (2006). “Agrarian reforms, agrarian crisis and the biological standard of living in Poland, 1844–1892,” *Economics and Human Biology* 5 (3), 458-470.

Komlos, John (1985). “Stature and Nutrition in the Habsburg Monarchy: The Standard of Living and Economic Development in the Eighteenth Century,” *American Historical Review* 90 (5), 1149-61.

Komlos, John (1989). *Nutrition and Economic Development in the Eighteenth-Century Habsburg Monarchy: An Anthropometric History*. Princeton: Princeton University Press.

Komlos, John (1996). "Anomalies in Economic History: Reflections on the Antebellum Puzzle." *Journal of Economic History* 56 (1), 202-214.

Komlos, John (1999). “On the Biological Standard of Living in Russia and the Soviet Union”, *Slavic Review* 58 (1), 71-79.

Komlos, John (2007). “Anthropometric Evidence on Economic Growth, Biological Well Being, and Regional Convergence in the Habsburg Monarchy, 1850 – 1910,” *Cliometrica* 1 (3), 211-237.

Komlos, John/Baten, Joerg (2004). "Looking Backward and Looking Forward: Anthropometric Research and the Development of Social Science History,” in *Social Science History*, 1-24

Komlos, John/Baten, Joerg, eds. (1998). *The Biological Standard of Living in Comparative Perspective*,. Stuttgart 1998.

López-Alonso, Moramay/Condey, Rául Porras (2003). “The Ups and Downs of Mexican Economic Growth: the Biological Standard of Living and Inequality 1870-1950,” *Economics and Human Biology* 1-2, 169-186.

Mace, R., Jordan, F., Holden, C. (2003). “Testing Evolutionary Hypotheses about Human Biological Adaption Using Cross-Cultural Comparison,” *Comparative Biochemistry and Physiology, Part A: Molecular & integrative physiology* 136 (1), 85-94.

Maddala, G.S. and Wu, Shaowen. (1999). “A Comparative Study of Unit Root Tests With Panel Data and A New Simple Test.” *Oxford Bulletin of Economics and Statistics* 61, 631-652.

Maddison, A. (2001). *The World Economy: A Millennial Perspective*. OECD, Paris.

Margo, Robert and Richard H. Steckel (1983) "Heights of Native Born Northern Whites during the Antebellum Period." *Journal of Economic History* 43, 167-74.

Martínez-Carrión, J.M.M. (1994) “Stature, Welfare, and Economic Growth, in Nineteenth-Century Spain: The Case of Murcia.” In John Komlos (ed.) *Stature, Living Standards, and Economic Development. Essays in anthropometric History*. Chicago: University of Chicago Press, 76-92.

Martorell, R. (1985). “Child Growth Retardation: A Discussion of its Causes and its Relationship to Health,” In K. Blaxter and J. C. Waterlow, eds. *Nutritional Adaptation in Man*, John Libbey, London, 13-29.

Meisel, Adolfo/Vega, Margarita (2005). “The biological standard of living (and its convergence) in Colombia, 1870–2003 A tropical success story.” *Economic and Human Biology* 5-1, 100-122.

Meisel, Adolfo/Vega, Margarita (2004b). “The Stature if the Colombian Elite Before the Onset of Industrialization, 1870-1910. Working Paper Banco de la Republica de Colombia.

Mironov, Boris N. (1999). "New Approaches to Old Problems: The Well-Being of the Population of Russia from 1821 to 1910 as Measured by Physical Stature," *Slavic Review* 58 (1),1-26.

Mironov, Boris N. (2004) "Zhiznennyi uroven' Sovetskoi Rossii pri Staline po antropometricheskim dannym," in Ekonomicheskaia istoria. Ezhegodnik. Moskva: ROSSPEN, 2004. S. 565-588. [B. N. Mironov, "The Nutrition Standard of Life in the Soviet Russia under Stalin on the Anthropometric Data," in The Economic History. A Year-book. 2004. Moscow: ROSSPEN, 2004, 565-588.: data on those measured 1927, born 1907. Author provided data.]

Mironov, Boris N. (2006). Data Set on Russian Heights, provided by email. See also Mironov 2004, 2008.

Mironov, Boris and Brian A’Hearn. (2008). “Russian Living Standards under the Tsars: Anthropometric Evidence from the Volga,” *Journal of Economic History* 68:3, 900-929.

Moradi, Alexander (2005). *Height, Political Violence and Economic Development in Africa 1950-2000,* Ph.D. thesis Tuebingen, available on University Library Tuebingen server.

Moradi, Alexander/Baten, Joerg (2005). “Inequality in Sub-Saharan Africa 1950-80: New Estimates and New Results”, *World Development* 33 (8), 1233-1265.

Moradi, Alexander (2009a): Towards an Objective Account of Nutrition and Health in Colonial Kenya: A Study of Stature in African Army Recruits and Civilians, 1880–1980. The Journal of Economic History 69, 719-754

Moradi, Alexander (2009b): Nutritional status and economic development in sub-Saharan Africa, 1950–1980; *Economics and Human Biology*8 (1), 16-29.

Moradi, A. and A. M. Guntupalli (forthcoming). What Does Gender Dimorphism in Stature Tell Us About Discrimination in Rural India, 1930-1975? *Gender Bias: Health, Nutrition and Work*. M. Pal, P. Bharati, B. Ghosh, and T. S. Vasulu. New Delhi: Oxford University Press.

Morgan, Stephen (2006). “The biological standard of living in South China during the 19th century: Estimates using data from Australian immigration and prison records,” Paper prepared for the Asia/Pacific Economic and Business History Conference, QUT, Brisbane, 16-18 February 2006.

Mosk, Carl (1996). *Making Health Work; Human Growth in Modern Japan*, Berkeley: University of California Press.

Murray, John E. (2002). “Height and Weight of Early 20th Century Filipino Men”, *Annals of Human Biology* 29 (3), 326-333.

Orr, J. B. and J. L. Gilks (1931). Studies of Nutrition: The Physique and Health of Two African Tribes. London, Medical Research Council, Special Report Series No. 155. (Thanks to A. Moradi for providing this report.)

Pak, Sunyoung, Schwekendiek, Daniel and Kim, Hee Kyoung (2010). “Height and Living Standards in North Korea, 1930s-1980s.” *Economic History Review* (forthcoming)

Peracchi, Franco. 2008. "Height and Economic Development in Italy, 1730-1980." *American Economic Review*, 98(2): 475–81.

Salvatore, R., (1998). “Heights and welfare in late-colonial and post-independence Argentina,” In Komlos, J., Baten, J. (Eds.), *The Biological Standard of Living in Comparative Perspective*. Stuttgart: Franz Steiner Verlag.

Salvatore, Ricardo (2004), “Stature, Nutrition, and Regional Convergence: The Argentine Northwest in the Twentieth Century”, *Social Science History* 28-2, 231-248.

Salvatore, Ricardo and Jörg Baten (1998). “A Most Difficult Case of Estimation: Argentinian Heights, 1770-1840,” in John Komlos and Jörg Baten, eds., *The Biological Standard of Living in Comparative Perspective.* Stuttgart: Franz Steiner, 90-96.

Shay, Ted (1994). “The level of Living in Japan, 1885-1938: New Evidence,” In Komlos, John (ed.) *Stature, Living Standards, and Economic Development: Essays in Anthropometric History*, Chicago: University of Chicago Press.

Steckel Richard H. and Roderick Floud, eds. (1997). *Health and Welfare during Industrialization*. Chicago: University of Chicago Press.

Steckel, Richard (1995). “Stature and the Standard of Living,” *Journal of Economic Literature,* 1903-40.

Steckel, Richard (2009). “Heights and human welfare: Recent developments and new directions. *Explorations in Economic History* 46, 1-23.

Stegl, Mojgan and Joerg Baten (2009). “Tall and Shrinking Muslims, Short and Growing Europeans: an Anthropometric History of the Middle East, 1840-2007,” *Explorations in Economic History* 46 (2009), pp. 132-148.

Stolz, Yvonne and Joerg Baten (2010) “Brain Drain, Numeracy and Skill Premia during the Era of Mass Migration: Testing the Roy-Borjas Model.” Working paper University of Tuebingen.

Twrdek, Linda and Kerstin Manzel (2010): The seed of abundance and misery: Peruvian living standards from the early republican period to the end of the guano era (1820–1880). *Economics and Human Biology* 8 (2), 145-152.

Van der Eng, Pierre (1995). „An Inventory of secular changes in human growth in Indonesia," In John Komlos, ed., *The biological standard of living on three continents: further explorations in anthropometric history*. Boulder, Colorado: Westview Press, 1995.

Vignerová, J./ Bláha, P. (1998). "The Growth of the Czech Child During the Past 40 Years", in Bodzar, B.E. and Susanne, C., eds., *Secular Growth Changes in Europe*. Budapest: Eötvö University Press, 263-279.

Waaler, Hans T. (1984). „Height, weight, and mortality: the Norwegian experience," *Acta Med Scand.* 1 (56), supplement 679.

Wanner, Martin (2005). *Körpergrößen von Nichteuropäern*. Diploma thesis, University of Tuebingen.

Wheatcroft, S.G. (1999). "The great leap upwards: anthropometric data and indicators of crises and secular change in Soviet welfare levels, 1880–1860," *Slavic Review,* 58 (1), 27–60.

Whitwell, Greg/de Souza, Christine/Nicholas, Stephen (1997). "Height, Health, and Economic Growth in Australia, 1860-1940," In Steckel, R.H. and Floud, R. (eds.) *Health and Welfare during Industrialization*. The University of Chicago Press, 379-422.

Figure 1: Height development by world region (no interpolations, weighted by population size)

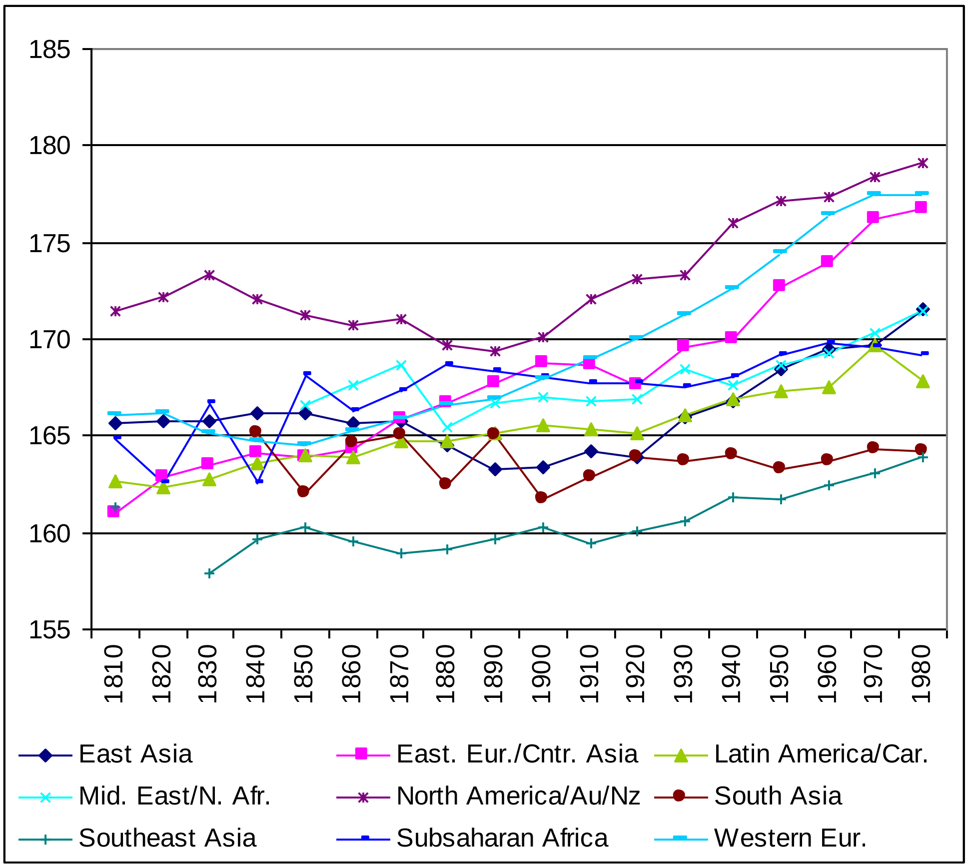
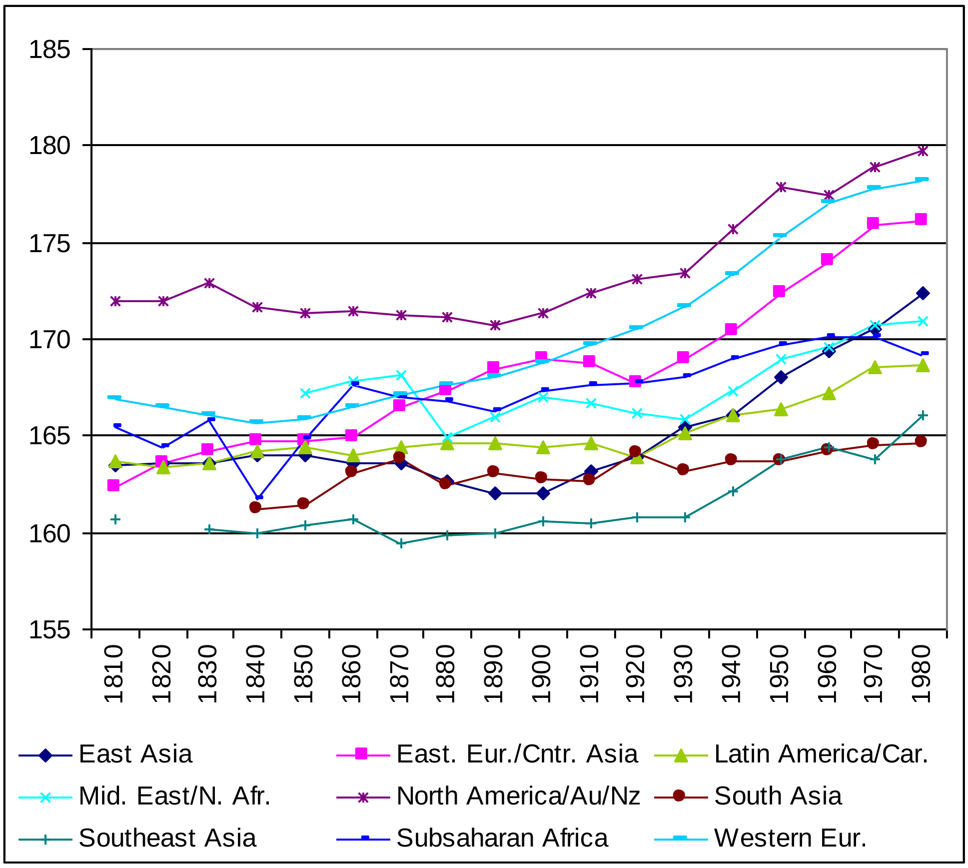


Figure 2: Height development by world region (using interpolations, weighted by population size)



Note: Migrant heights are included; see Table 1.

Figure 3: Correlation between (log) income per capita and height. Sources GDP: Maddison (2001); Heights: see Data Appendix

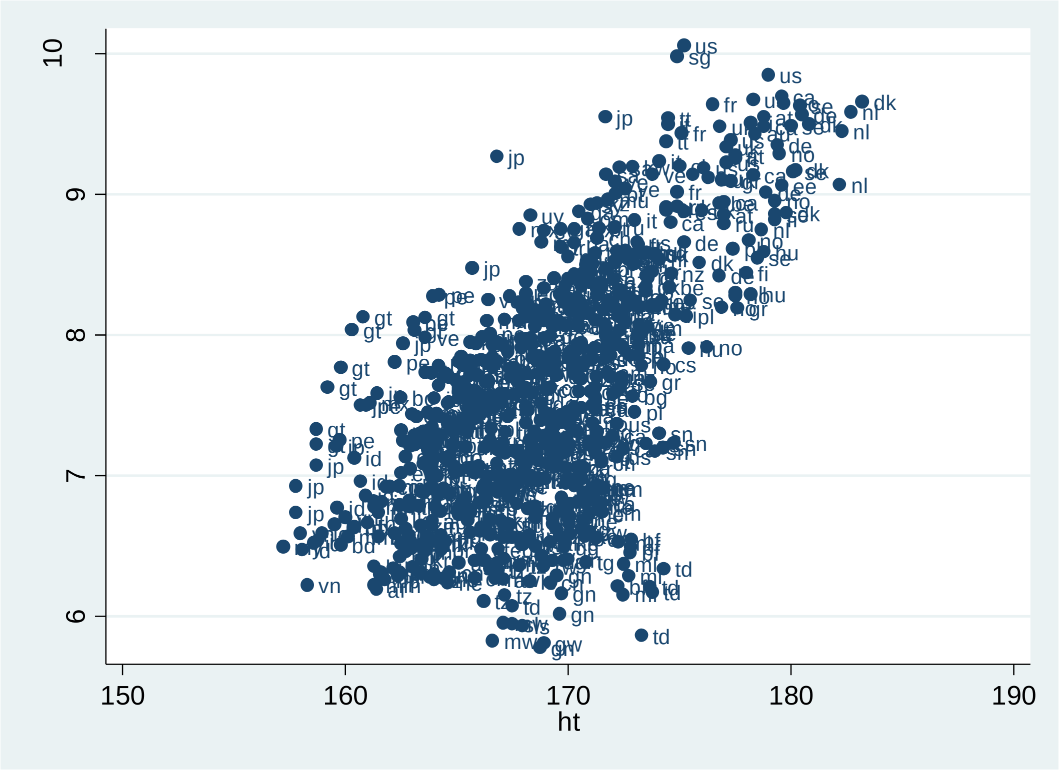


Figure 4: Correlation between (log) cattle per capita and height in 1900

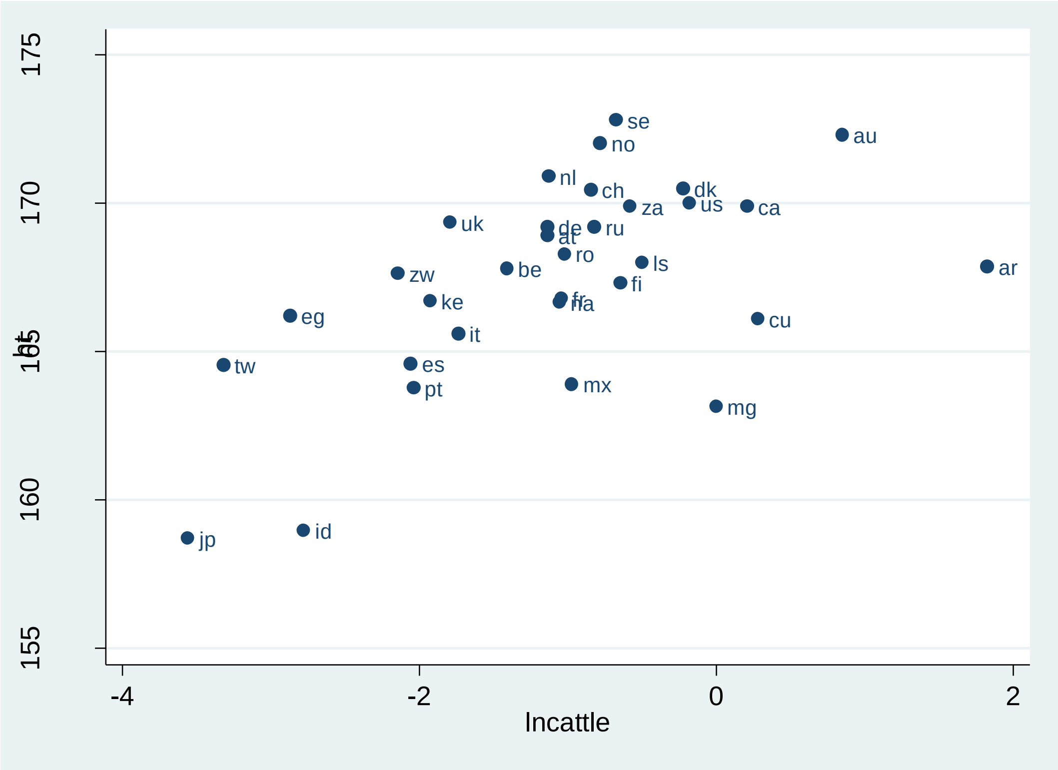


Figure 5: Lactose tolerance today and average height around 1880

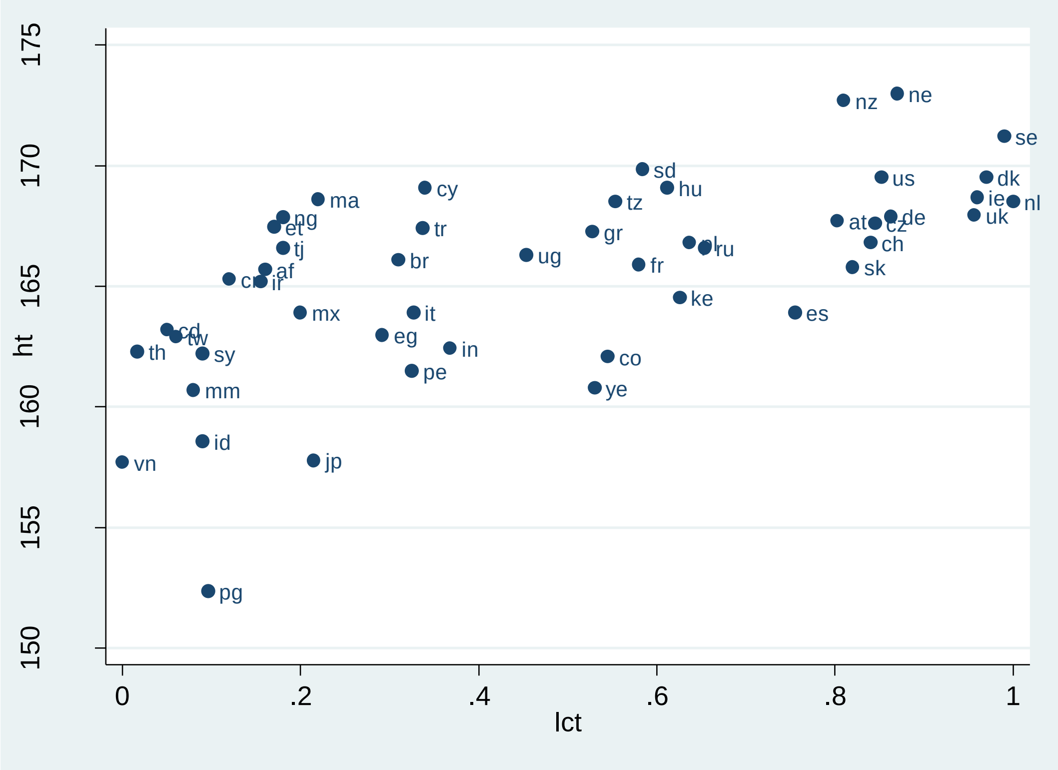


Table 1: Number of birth decades documented by country

Country	N	Country	N	Country	N
Afghanistan	3	Germany	18	Norway	18
Albania	3	Ghana	13	Oman	0
Algeria	3	Greece	10	Pakistan	8
Angola	7	Guatemala	8	Palestinian Territory	0
Argentina	15	Guinea	10	Panama	1
Armenia	9	Guinea-Bissau	8	Papua New Guinea	5
Australia	10	Guyana	5	Paraguay	2
Austria	14	Haiti	6	Peru	14
Azerbaijan	6	Honduras	4	Philippines	8
Bahrain	0	Hong Kong	2	Poland	12
Bangladesh	7	Hungary	11	Portugal	18
Belarus	3	India	14	Puerto Rico	5
Belgium	10	Indonesia	16	Qatar	0
Benin	8	Iran	11	Reunion	0
Bolivia	8	Iraq	4	Romania	7
Bosnia and Herzegovina	0	Ireland	14	Russian Federation	18
Botswana	2	Israel	4	Rwanda	7
Brazil	18	Italy	18	Saudi Arabia	4
Bulgaria	4	Jamaica	6	Senegal	13
Burkina Faso	16	Japan	11	Serbia and Montenegro	5
Burundi	2	Jordan	5	Sierra Leone	8
Cambodia	14	Kazakhstan	11	Singapore	1
Cameroon	13	Kenya	9	Slovakia	7
Canada	18	Korea (North)	9	Slovenia	4
Cape Verde	0	Korea (South)	9	Somalia	6
Central African Republic	8	Kuwait	0	South Africa	10
Chad	10	Kyrgyzstan	9	Spain	16
Chile	2	Laos	11	Sri Lanka	3
China	18	Latvia	5	Sudan	7
Colombia	12	Lebanon	5	Swaziland	5
Comoros	3	Lesotho	5	Sweden	16
Congo	10	Liberia	7	Switzerland	9
Costa Rica	2	Libya	2	Syria	5
Cote D'Ivoire (Ivory Coast)	13	Lithuania	2	Taiwan	13
Croatia (Hrvatska)	12	Macedonia	4	Tajikistan	6
Cuba	7	Madagascar	8	Tanzania	11
Cyprus	4	Malawi	8	Thailand	8
Czech Republic	16	Malaysia	6	Togo	7
Democratic Republic of the Congo	11	Mali	12	Trinidad and Tobago	1
Denmark	16	Mauritania	4	Tunisia	2
Djibouti	0	Mauritius	0	Turkey	13
Dominican Republic	4	Mayotte, Saint Helena, West Sahara	0	Turkmenistan	3
East Timor	1	Mexico	17	Uganda	10
Ecuador	0	Moldova	5	Ukraine	6
Egypt	12	Mongolia	2	United Arab Emirates	0
El Salvador	0	Morocco	6	United Kingdom	18
Equatorial Guinea	1	Mozambique	10	United States	17
Eritrea	3	Myanmar	9	Uruguay	2
Estonia	8	Namibia	7	Uzbekistan	8
Ethiopia	10	Nepal	8	Venezuela	6
Finland	13	Netherlands	18	Viet Nam	12

France	18	New Zealand (Aotearoa)	5	Yemen	6
Gabon	7	Nicaragua	4	Zambia	5
Gambia	1	Niger	11	Zimbabwe	6
Georgia	3	Nigeria	12		

Note: Migrant heights (unadjusted) were included on the following countries in this Table, but not in the following Tables and Figures, except where noted (in parentheses the number of birth decades: Algeria (2), Armenia(1), Bangladesh (4), Croatia (Hrvatska) (1), Czech Republic (1), India (6), Israel (1), Korea (North) (6), Malawi (1), Mozambique (1), Pakistan (1), Poland (2), Romania (1). Sources: see Data Appendix

Table 2: Share of possible birth-decade and coutnry observations covered by real data

	1810-1849	1850-1899	1900-1949	1950-1989
East Asia	0.89	0.94	0.98	0.99
East. Eur./Cntr. Asia	0.62	0.76	0.61	0.59
Latin America/Car.	0.61	0.66	0.79	0.74
Mid. East/N. Afr.	0.00	0.60	0.55	0.61
North America/Au/Nz	0.74	1.00	0.97	0.96
South Asia	0.24	0.95	0.71	0.87
Southeast Asia	0.30	0.94	0.84	0.54
Sub-Saharan Africa	0.19	0.40	0.77	0.86
Western Eur.	0.91	0.96	0.97	0.95

Sources: see Data Appendix. Migrant heights were included in this Table.

Table 3: Share of sample measurements taken in prison by world region and half century

	1810-49	1850-99	1900-49	1950-89
East Asia	0	0	0	0
East. Eur./Cntr. Asia	0	0	0	0
Latin America/Car.	0.813	0.375	0.039	0
Mid. East/N. Afr.	n.a.	0	0	0
North America/Au/Nz	0	0.263	0	0
South Asia	0	0	0	0
Southeast Asia	0	0	0	0
Sub-Saharan Africa	0	0	0	0
Western Eur.	0.020	0	0.014	0

Sources: see Data Appendix

Table 4: Potential biases caused by the institutional context of measurement

	(1)	(2)	(3)	(4)
Voluntary soldiers	-0.31			
	(0.28)			
Women		0.31		
		(0.47)		
Prisoners			0.82	
			(0.21)	
Slaves				-2.45
				(0.44)
Time-fixed effects	YES	YES	YES	YES
Country-fixed effects	YES	YES	YES	YES
Constant	166.63***	165.04***	163.03***	162.95***
	(0)	(0)	(0)	(0.000010)
N	91	401	416	67
R-square	0.79	0.83	0.90	0.96

Note: Robust standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10%. The cutoff criterion for including a world region and half century was usually 10%. Only in the case of "aggregated ages," for which we had to estimate the birth decade in which the majority of measured indivduals were born, we resorted to a 30% criterion. The other constant refers to all other observations in which the potential bias does not appear. Sources: see Data Appendix D.

Table 5: Determinants of height (panel models)

	(1)	(2)	(3)	(4)	(5)
Which protein indicator	Cattle	Meat	Milk	Cattle	None
Cattle (log p.c.)	0.44*			0.63**	
	(0.078)			(0.013)	
Meat (log p.c.)		0.41*			
		(0.067)			
Milk (log p.c.)			0.37***		
			(0.007)		
Infant mortality	-1.63***	-1.33***	-1.36***		-1.66***
	(0.000)	(0.000)	(0.000)		(0.000)
Democracy	0.03				
	(0.85)				
Mountains	-0.03**	-0.05***	-0.07***		
	(0.034)	(0.009)	(0.002)		
Civil War	0.26				
	(0.470)				
Time-fixed effects	YES	YES	YES	YES	YES
World region-fixed effects	YES	YES	NO	YES, FE	YES, FE
Constant	171.56***	179.29***	178.90***	162.61***	173.64***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	414	219	200	604	551
Number of countries	76	58	53	103	106
R-squared (within)	0.92	0.88	0.90	0.83	0.91
R-squared (overall)	0.73	0.79	0.60	0.23	0.38

Note: Robust standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10 percent. Estimates in column 1-3 are random effects panel estimates, column 4 and 5 feature fixed effects. Sources: see Data Appendix D.

Table 6: Descriptive statistics (cases included as in Model 1 of Table 5, except milk and meat)

Variable	Obs	Mean	Std. Dev.	Min	Max
Height	414	169.49	4.60	156.00	182.30
Cattle (log)	414	-1.03	1.08	-4.93	2.14
Infant mortality (log)	414	4.54	0.75	1.76	5.76
Democracy	414	6.21	3.84	0.00	10.00
Mountain share	414	17.45	19.14	0.00	82.20
Civil war	414	0.04	0.20	0	1
Meat (log)	219	-10.69	1.03	-14.05	-8.15
Milk (log)	200	-8.98	1.62	-15.58	-5.87
Lactose tolerance	293	0.59	0.31	0	1
Eastern Eur./C Asia	414	0.06	0.24	0	1
Latin America/Car.	414	0.17	0.37	0	1
Middle East/N Afr.	414	0.04	0.19	0	1
North America/Au/Nz	414	0.08	0.27	0	1
Sub-Saharan Africa	414	0.18	0.39	0	1
East Asia	414	0.05	0.21	0	1
South Asia	414	0.00	0.05	0	1
Southeast Asia	414	0.02	0.15	0	1

Sources: see Data Appendix D.

Table 7: Determinants of height. Panel data model using feasible GLS, with an AR(1) autocorrelation structure

	(1)	(2)	(3)
Which protein indicator	Cattle	Meat	Milk
Cattle (log p.c.)	0.82***		
	(0.000)		
Meat (log p.c.)		2.99**	
		(0.046)	
Milk (log p.c.)			0.64***
			(0.005)
Infant mortality	-1.73***	-1.58***	-0.53
	(0.000)	(0.000)	(0.270)
Mountains	-0.04***	-0.06***	-0.05***
	(0.000)	(0.000)	(0.000)
Civil War	-0.04		
	(0.900)		
Time-fixed effects	YES	YES	YES
World region-fixed effects	YES	YES	YES
Constant	182.84***	192.55***	185.01***
	(0.000)	(0.000)	(0.000)
Observations	411	213	192
Number of countries	71	52	45
Wald Chi-sq	1052	858	703
p-val. Chi-sq	0.00	0.00	0.00

Note: Standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10%. Sources: see Data Appendix D.

Table 8: Horse race: is there a direct protein effect, lactose intolerance, or an interaction?

	(1)	(2)	(3)
Cattle	1.29***	0.57***	
	(0.0034)	(0.0059)	
Lactose tolerance	1.50***		0.66***
	(0.000085)		(0.0000021)
Cattle*lactose tolerance	-0.23***		
	(0.0074)		
Infant mortality	-2.46***	-2.66***	-2.24***
	(0)	(0)	(0)
Time fixed effects	YES	YES	YES
Constant	167.93***	174.91***	172.56***
	(0)	(0)	(0)
N	296	417	357
R-square	0.89	0.88	0.89

Note: Robust standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10 percent. Sources: see Data Appendix D.

Table 9: Cattle instrumented with lactose intolerance

	(1)	(2)	(3)
Period	1810-1989	1870-1949	1950-1989
Cattle	3.91***	2.37**	6.42
	(0.00033)	(0.014)	(0.19)
Infant mortality	0.37	-1.06	2.59
	(0.56)	(0.38)	(0.25)
Mountainous	-0.04***	-0.03**	-0.06*
	(0.00012)	(0.038)	(0.070)
Time-fixed effects	YES	YES	YES
Region-fixed effects	YES	YES	YES
Constant	149.70***	169.90***	152.39***
	(0)	(0)	(0)
N	296	133	124
R-square	0.69	0.72	0.39

Note: Robust standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10%. Sources: see Data Appendix

The First-stage regression summary statistics are as follows:

Regr.model	Adj. R-sq.	Robust F(1,251)	Prob > F
(1)	0.6381	11.754	0.001
(2)	0.7470	28.227	0.000
(3)	0.6327	1.189	0.278

Table 10: Determinants of height, early and late periods (panel data model using feasible GLS, with an AR(1) autocorrelation structure)

	(1)	(2)	(3)	(4)
Which protein indicator	Overall	Early	Late	Late (cases early
Cattle (log p.c.)	0.81***	1.61***	0.50*	3.78***
	(0.000)	(0.000)	(0.064)	(0.000)
Infant mortality	-1.71***	-3.79***	-0.88	-1.56**
	(0.000)	(0.000)	(0.120)	(0.024)
Mountains	-0.04***	0.00	-0.05***	0.02
	(0.000)	(0.950)	(0.000)	(0.370)
Time-fixed effects	YES	YES	YES	YES
World region-fixed effects	YES	YES	YES	YES
Constant	175.86***	190.03***	181.30***	186.59***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	411	167	186	72
Number of cono	71	37	60	24
Wald Chi-sq	1033	348	568	764
p-val. Chi-sq.	0.00	0.00	0.00	0.00

Note: Standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10%. Sources: see Data Appendix D.

Table 11: Lower-bound estimates of the effects of genetic potentials, food behaviour, intergenerational effects, culture, and other unobservable factors

	Effects of genetics etc. (regr. with explan. var.)	Overall region effect (without expl. var.)
East Asia	-3.97***	-8.22***
	(0.0011)	(0)
East. Eur./Cntr. Asia	0.15	-0.98*
	(0.78)	(0.051)
Latin America/Car.	-4.44***	-8.33***
	(0.00000024)	(0)
Mid. East/N. Afr.	-0.98	-5.98***
	(0.23)	(0)
North America/Au/Nz	1.84***	2.71***
	(0.00015)	(0.00000044)
South Asia	-3.83***	-7.16***
	(0.00000019)	(0)
Southeast Asia	-7.54***	-13.11***
	(0)	(0)
Sub-Saharan Africa	-2.20**	-5.60***
	(0.010)	(0)
Western Eur.	Reference	Reference

Note: Included explanatory variables are cattle, infant mortality, mountain, civil war, lactose, birth decade. OLS estimation. Standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10%. Sources: see Data Appendix D.

Appendix A.1: How to estimate male heights on the basis of female height by world region (this and the following appendixes can be placed in the internet if necessary)

	Americas	Asia (exc. SE)	Europe	SE Asia/Pacific	Sub-Sah Africa
Female	1.05***	0.94***	0.97***	1.02***	1.11***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	3.63	20.53	16.53*	6.59	-6.72
	(0.740)	(0.370)	(0.061)	(0.370)	(0.120)
Observations	45	13	22	36	38
R-squared	0.88	0.87	0.88	0.92	0.97

Robust standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10 percent. Sources: see Data Appendix

Those regressions are based on the data provided in Gustafson and Lindenfors' (2004), a data set on male and female height, which is currently the standard anthropological data set for this kind of question. For Africa, we relied on the estimates of Moradi (2009b).

Appendix B.1: Other potential biases caused by the institutional context of measurement

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Aggregated age	0.13							
	(0.61)							
Age 18		0.84						
		(0.16)						
Age 19			-0.64					
			(0.26)					
Age 20				-0.84				
				(0.13)				
Age 21					-0.08			
					(0.92)			
Self-reported						0.52		
						(0.19)		
Migrant (unadj.)							2.13	
							(0.15)	
Migrant (adj.)								1.23
								(0.21)
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Country fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Constant	161.86***	168.60***	164.92***	175.32***	167.49***	165.70***	177.25***	166.10***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	1401	396	121	127	121	63	66	66
R-square	0.81	0.89	0.78	0.94	0.79	0.83	0.96	0.94

Standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10% . Sources: see Data Appendix

Appendix C: How to estimate GDP on the basis of the height data set

The original idea of anthropometric research during the 1980s was to find a proxy indicator for GDP per capita. However, since some prominent countries displayed deviations between height and GDP development, this approach was not actively pursued in the literature afterwards. The correlation coefficients in our global dataset turn out, in fact, to be quite high, encouraging us to use height to estimate GDP (“HtGDP") If GDP estimates for a given country are unavailable, those HtGDPs might provide an indication of the standard of living. Moreover, given the strong demand for instrumental variables, our data set provided may allow for the application of models in which GDP but not HtGDP may be endogenous.

We regressed our height estimates on Maddison’s (2001) estimates of log GDP per capita first for all birth decades with sufficient observations (Table C.1). We note larger coefficients after 1950. Hence, we used two panels for the periods 1870-1949 and 1950-89. There were two problematic countries, requiring us to exclude them from some of the following calculations: Japan, where the influence of genetic height potentials or intergenerational effects is probably greatest; and Guatemala, because our early height data refer to Indios only. In fact, however, whether or not they are excluded has little if any effect (Table C.2, Columns 2 and 3). Similarly, fixed-effects estimation and OLS yield similar results. A marginal, one-centimeter, height increase is somewhat more prevalent in the period 1950-89 than in earlier ones; however, it should be noted that the constant has a lower value.

The fixed-effects regression (Table C.2, Column 3) prompts us to recommend the following conversion for the period 1870-1949:

$$(1) \qquad \mathrm{Ln(GDP)} = -10.094 + 0.105 * \mathrm{Height}$$

For the period after 1950, the formula in Column 4 might be applied; for the period before 1870, formula (3) is our recommendation.

Table C.1: Height regressed on GDP per capita, for individual birth decades

Birth dec.	Coeff.	p-val.	N	R-sq
1870	0.10***	(0.000)	38	0.38
1880	0.11***	(0.000)	20	0.51
1890	0.12***	(0.000)	25	0.44
1900	0.13***	(0.000)	30	0.48
1910	0.14***	(0.000)	38	0.57
1920	0.11***	(0.000)	28	0.56
1930	0.09***	(0.000)	32	0.46
1940	0.10***	(0.000)	31	0.61
1950	0.12***	(0.000)	75	0.33
1960	0.13***	(0.000)	74	0.44
1970	0.15***	(0.000)	78	0.46
1980	0.15***	(0.000)	79	0.52

Robust standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10%. Sources: see Data Appendix

Table C.2: Regressions of log GDP on height

	(1)	(2)	(3)	(4)
Period	1870-1949	1870-1949	1870-1949	1950-1989
Estimation	OLS	FE	FE	OLS
Countries excl.	JP/GT	JP/GT	None	JP/GT
Height	0.119***	0.102***	0.105***	0.143***
	(0)	(0)	(0)	(0)
Constant	-12.384***	-9.615***	-10.094***	-16.717***
	(0)	(9.20e-10)	(1.84e-10)	(0)
Observations	242	242	251	306
R-squared	0.53	0.46	0.47	0.44

Robust standard errors in brackets. *, **, *** refer to significance levels of 1, 5, and 10%. Sources: see Data Appendix

Appendix D: Data Appendix

References for explanatory variables:

Democracy:

Marshall, Monty G., and Jaggers, K.(2008): Polity IV Project: data set. last accessed March 31st, 2010.

Civil War:

data is from the Correlates of War Project, see Singer, J. David and Melvin Small (1972): The Wages of War, 1816-1965: A Statistical Handbook. New York. Or see http://www.correlatesofwar.org last accessed March 31st, 2010.http://www.systemicpeace.org/polity/polity4.htm#top

Mountainous terrain

indicates the percentage of a country's land area coveredby mountains. Source: Collier, Paul and Anke Hoeffler (2004): Greed and grievance in civil war. Oxford Economic Papers. 56(4): 563-595

Infant Mortality and Cattle per Capita:

Mitchell, B.R. International Historical Statistics: The Americas and Australasia. London: Macmillan, 1983

Mitchell, B.R. International Historical Statistics: European Historical Statistics 1750-1975. London: MacMillan, 1980

Mitchell, B.R. International Historical Statistics: Africa and Asia. London: Macmillan, 1982

World Bank Development Indicators, Washington, DC: Bank, 1994-1995

Infant Mortality:

Chesnais, J-C. La Transition Demographique. PUF, Paris 1986.

Collver, O. Andrew: Birth Rates in Latin America: New Estimates of Historical Trends and Fluctuations. Berkeley, Calif. : Univ. of Calif., Inst. of Internat. Studies, 1965

Cattle per Capita, Milk and Meat:

Federico, Giovanni: Feeding the world: an economic history of agriculture, 1800-2000. Princeton University Press, 2005

Hübner's geographisch-statistische Tabellen aller Länder dieser Erde. Wien: Seidel (several years)

Lactose intolerance:

Flatz, Gebhard : The Genetic Polymophism of Intestinal Lactase Activity in Adult Humans; in: Scriver, C.R. et al. (eds.): The Metabolic and Molecular Bases of Inherited Desease, Seventh Edition, Mc Graw-Hill, New York. 1995

Ingram, C.J.E. et al. (2009): Lactose digestion and the evolutionary genetics of lactase persistence, Hum Genetics 124:579–591

Table D.1: World regions, individual countries, and birth decades: coverage of the data set (yellow indicates that real data was available and was accepted)

Note: Migrant heights (unadjusted), with the number of birth decades in parentheses, in the following countries: Algeria (2), Armenia(1), Bangladesh (4), Croatia (Hrvatska) (1), Czech Republic (1), India (6), Israel (1), Korea (North) (6), Malawi (1), Mozambique (1), Pakistan (1), Poland (2), Romania (1). Sources: see Data Appendix

wreg	**co**	**1810**	**1820**	**1830**	**1840**	**1850**	**1860**	**1870**	**1880**	**1890**	**1900**	**1910**	**1920**	**1930**	**1940**	**1950**	**1960**	**1970**	**1980**
ea	**cn**	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨
ea	**hk**													🟨	🟨				
ea	**jp**								🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨
ea	**kp**								🟨	🟨	🟨			🟨	🟨	🟨	🟨	🟨	🟨
ea	**kr**							🟨	🟨	🟨	🟨				🟨	🟨	🟨	🟨	🟨
ea	**mn**											🟨		🟨					
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References for height sources included

The following list first reports the author's last names with year of publication, then the authors with first names, finally the title of the study. Some additional titles, especially on Europe and North America, were considered in our study for comparison, but as they were considered by previous compilations (such as Costa and Steckel, Hatton and Brey, etc.), they are not cited here for reasons of brevity.

A'Hearn 1998,A'Hearn, Brian,The Antebellum Puzzle Revisited: A New Look at the Physical Stature of Union Army Recruits during the Civil War', in J Komlos & J Baten (eds.), *The Biological Standard of Living in Comparative Perspective*, Stuttgart, 250-267

A'Hearn 2003,A'Hearn, Brian,Anthropometric Evidence on Living Standards in Northern Italy, 1730-1860.' Journal of Economic History 63, 351-381.

A'Hearn 2006,A'Hearn, Brian,Data set on Italian Conscripts, friendly provided by Brian A'Hearn, on the Background see A'Hearn 2003.

Abdushelishvili 1968,Abdushelishvili, M. G. & Ginzburg, V.v. & Miklashevskaia, N.n. & Trofimova, T.a. ,Contributions to the physical anthropology of central asia and the caucasus', *Russian Translation Series of the Peabody Museum of Archeology and Ethnology*, Harvard University, vol. 3, no.2

Alter Neven Oris 2004,Alter, George & Neven, Muriel & Oris, Michel,Stature in Transition: A Micro-level Study from Nineteenth-Century Belgium. Social Science History 28-2, 231-247

Andrews 1943,Andrews, James M.,Evolutionary Trends in body build. Data from Thailand (Siam)' in *Studies in the Anthropology of Oceania and Asia,* Papers of the Peabody Museum of American Archaeology and Ethnology, vol. 20

Ashcroft Ling Lovell Miall 1966,Ashcroft & Ling & Lovell & Miall ,Heights and Weights of Adults in Rural and Urban Areas of Jamaica', *British Journal of Preventive Social Medicine*, vol. 20, no.1, 22–26.

Aul 1964,Aul, J.,Tartu Riikliku Olikooli Toimetised', *Antropologija estoncev*, Tartu.

Aul 1997,Aul, J.,Über die Sexualdimorphismus der anthropologischen Merkmale von Schulkindern, Jugendlichen und Erwachsenen', Papers on Anthropology VII, University of Tartu, Centre of Physical Anthropology

Austin 1979,Austin, Donald,Work Capacity and Body Morphology of Bantu and Pygmid Groups of Western Zaire', *Human Biology vol.* 51, no. 1, p.79.

Austin Baten van Leeuwen 2007,Austin, Gareth & Baten, Joerg & van Leeuwen, Bas,The Biological Standard of Living in Early 19th-Century West Africa: New Anthropometric Evidence. Working Paper LSE/Utrecht/Tuebingen

Austin Moradi Baten 2007,Moradi, Alexander & Austin, Gareth & Baten, Joerg ,Institutions, Policies and Living Standards in Ghana, 1870-1970/2000 - Lessons from Spatial and Temporal Patterns in Body Stature. Working Paper LSE/Oxford/Tuebingen

Austr. Bureau of Statistics 1998,Australian Bureau of Statistics,How Australians Measure Up. ABS Cat No. 4359.0. Australian Bureau of Statistics, Canberra.

Backmann 1924,Backmann, Gaston,Die Körperlänge der Letten' Upsala Läkareförenings Förhandlingar, Uppsala.

Bailey Carter Mirwald 1982,Bailey, D.A. & Carter & Mirwald 1982,Somatotypes of Canadian Men and Women' , *Human Biology*, vol. 54, no. 4, p.813.

Bassino 2009,Bassino, Jean-Pascal,Data Set on Japanese Student Heights, Obtained via John Komlos

Basu 1976,Basu, M.,Morphology, Serology, Dermatoglyphics, and Microevolution of some village populations in Haiti, West Indies' , *Human Biology*, vol. 48, no. 2, p.245.

Basu 1985,Basu, M.,Anthropological profile of the Muslims of Calcutta', Anthropological Survey of India, Govt. of India, Calcutta.

Basu Gupta 1990,Basu, Amitabha & Gupta, Ranjan,Human Biology of Asian Highland Populations in the Global Context. India and World Literature. Maurya, Abhai, 1990.

Baten 1999,Baten, Joerg,Ernährung und wirtschaftliche Entwicklung in Bayern, 1730 - 1880, Stuttgart, Steiner.

Baten 2006,Baten, Joerg,Data Set on Bavarian conscripts and convicts and Arnsberg conscripts, see http://www.uni-tuebingen.de/uni/wwl/dhheight.html; on the background of Arnsberg conscripts, see Baten Fertig 2010

Baten Carson 2010,Baten, Joerg & Carson, Scott,Latin American Anthropometrics, Past and Present– an Overview. EHB 2010

Baten Fertig 2010,Baten, Joerg & Fertig, Georg,Did the Railway Increase Inequality? A Micro-Regional Analysis of Heights in the Hinterland of the Booming Ruhr Area During the Late 19th Century', Working Paper

Baten Ma Morgan Wang 2010,Baten, Joerg & Ma, Debin & Morgan, Stephen & Wang, Qing,Evolution of living standards and human capital in China in the 18–20th centuries: Evidences from real wages, age-heaping, and anthropometrics. In Explorations in Economic History 47, 82-97

Baten Pelger Twrdek 2010,Baten, Joerg & Pelger, Ines & Twrdek, Linda (2010),The Anthropometric History of Argentina, Brazil and Peru during the 19th and Early 20th Century', *Economics and Human Biology* 7-2, 319-333.

Baten Reis Stolz 2010,Baten, Joerg & Reis, Jaime & Stolz, Yvonne,Portuguese Livings Standards 1720-1980 – Heights, Income and Human Capital', University of Tuebingen Working Paper.

Baten Stegl Van Der Eng 2009,Baten, Joerg & Stegl, Mojgan & Van der Eng, Pierre,Long Term Changes in the Biological Standard of Living in Indonesia: New Anthropometric Evidence, 1770s-2000s', University of Tuebingen Working Paper.

Bean 1909a,Bean, Robert,Filipino Ears-A Classification of ear types', *The Philippine Journal of Science*, vol. 4, no. 1

Bean 1909b,Bean, Robert,Filipino Types: Found in Malecon Morgue', *The Philippine Journal of Science*, vol. 4, no. 1

Bean 1909c,Bean, Robert,Filipino Types: Racial Anatomy in Taytay', *The Philippine Journal of Science*, vol. 4, no.1

Bean Planta 1911,Bean, Robert & Planta, Frederico,The Men of Cainta', *The Philippine Journal of Science*, vol. 4, no. 1

Benoist 1962,Benoist, J.,Anthropologie physique de la population de l'Ile de la Tortue (Haïti), contribution à l'étude de l'origine des Noirs des Antilles Françaises', *Bulletins et Mémoires de la Société d'anthropologie de Paris*, vol 11, no.3, 315-335.

Benoist 1971,Benoist, J.,Le gradients écologique du rapport poids/surface chez des groupes d´Israeliens d´origines différentes', *Revue de la Société de Biométrie humaine,* 36-45.

Bhasin 1974,Bhasin, M.K.,A genetic study on the Newards of Nepal valley. *American Journal of Physical Anthropology* 40-1, 67-74

Boldsen 1990,Boldsen, Jesper,Height Variation in Denmark A.D. 1100-1988. In: Iregreen, Elisabeth & Liljekvist, Rune (eds.): Populations of the Nordic Countries. Proceedings of the Second Seminar of Nordic Physical Anthropology, Lund 1990

Breitinger 1934,Breitinger, Emil,Körperform und sportliche Leistung Jugendlicher. Körpermasse, sportliche Leistungen und deren korrelative Abhängigkeit bei 3319 Schülern Münchener höherer Lehrveranstaltungen', Inaugural Dissertation (PhD thesis), University of Munich.

Brennan MacDonald Shlomowitz 1994a,Brennan, L. & MacDonald, J. & Shlomowitz R.,The Heights and Economic Wellbeing of North Indian under British Rule', *Social Science History, vol.* 18, pp. 271-307

Brennan MacDonald Shlomowitz 1994b,Brennan, L. & MacDonald, J. & Shlomowitz R.,Trends in the economic well-being of South Indians under British rule: the anthropometric evidence', *Explorations in Economic History, vol.* 31, pp. 225–260.

Brennan MacDonald Shlomowitz 1997,Brennan, L. & MacDonald, J. & Shlomowitz R.,Towards an anthropometric history of Indian under British rule', *Research in Economic History, vol.* 17, pp. 185–246.

Brennan MacDonald Shlomowitz 2000,Brennan, L. & MacDonald, J. & Shlomowitz R.,Change in the stature of North Indians from British rule', *Jahrbuch fuer Wirtschaftsgeschichte*, pp. 129–148.

Brennan MacDonald Shlomowitz 2006,Brennan, L. & MacDonald, J. & Shlomowitz R.,Data Set on Indian Stature, friendly provided via email, on the Background see Brennan MacDonald Shlomowitz 1997

Brennecke 1935,Brennecke, Theophil,Untersuchungen über Körperlänge, Brustumfang und rechten Oberarmumfang an Stellungspflichtigen des Kantons Basel-Stadt, Philosophischer Verlag, Basel

BRFSS Annual Survey Data 1995,Behavioral Risk Factor Surveillance System Annual Survey Data,Behavioral Risk Factor Surveillance System Annual Survey Data

Bryn Schreiner 1929,Bryn, H. & Schreiner, K. E.,Die Somatologie der Norweger. Nach Untersuchungen an Rekruten', Skrifter Utgitt av det norske Videnskaps-Akademi i Oslo, Oslo.

Büchi 1965,Büchi, E.G.,Anthropologie des Tibétains. École française d'Extême-Orient, Paris, 1965, pp. 2-106

Buxton 1920,Buxton, L.H.Dudley ,The Anthropology of Cyprus', *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, vol. 50.

Carson 2005,Carson, Scott A.,The Biological Standard of Living in 19th-Century Mexico and in the American West. In: Economics and Human Biology 5-1, pp. 405-419

Carson 2007,Carson, Scott A.,Mexican body mass index values in the late-19th-century American West', *Economics and Human Biology*, vol. 5, no.1, pp. 37-47 .

Chabeuf 1959,Chabeuf, M.,*Anthropologie Physique du Moyen-Congo at du Gabon méridional'. Bulletin et Mémoires de la Société d´anthropologie de Paris X Serie: 10*-2, pp. 97-185

Chabeuf 1967,Chabeuf, M.,Les caractères physiques de sept populations malgaches', *Bulletins et Mémoires de la Société d'Anthropologie de Pari*s, vol. 4, no. 2, pp. 181 - 208.

Chabeuf 1969,Chabeuf, M.,Contribution à l'anthropologie des Vietnamiens méridionaux', *Bulletins et Mémoires de la Société d'Anthropologie de Paris*, vol. 1, no. 2, pp. 155 - 176.

Challu 2009,Challu, Amilcar,Agricultural Crisis and Biological Well-Being in Mexico, 1730-1835', Historia Agraria 47, pp. 17-45

Chalmers 1898,Chalmers, James,Anthropometrical Observations on Some Natives of the Papuan Gulf', *The Journal of the Anthropological Institute of Great Britain and Ireland*, vol. 27, pp.335-342

Chamla 1964,Chamla, M. C.,L'accroissement de la stature en France de 1880 à 1960: comparaison avec les pays d'Europe occidentale', *Bulletins et Mémoires de la Société d'Anthropologie de Paris*, vol. 6, no. 2, pp. 201 - 278

Chamla 1972,Chamla, M. C.,Variations biométriques avec láge chez des ouvriers algériens', *Biométrie Humaines* , vol 7, pp.41-55.

Chervin 1907,Chervin, A.,Anthropologie Bolivienne, Tome II, Anthropometrie, Paris Imprimerie Nationale.

Cipriani 1939,Cipriani,*Arabi dello Yemen e dell'Higiaz, Firenze* : Centro di Studi Coloniali, Archivio per l'antropologia e la etnologia / Società Italiana d'Antropologia e Etnologia

Clements Pickett 1957,Clements, E. M. B. & Pickett K. G. ,Stature and Weight of Men from England and Wales in 1941', *British Journal of Preventive Social Medicine*, vol. 11,, pp. 51-60.

Cogneau Rouanet 2009,Cogneau, Denis & Rouanet, Lea,Living Conditions in Cote d´Ivoir, Ghana and Western Africa 1925-1985: What Survey Data on Height Stature Tell Us? WP DT/2009/12, at ideas.repec.org

Conradt Virchow 1887,Conradt, I. & Virchow, R.,Tabellarische Übersicht der an Negern des Adeli-Landes ausgeführten Aufnahmen. *Verhandl. d. Gesellsch. f. Anthrop.*, pp. 164-18.

Coon 1931,Coon, Carleton S.,Tribes of the Rif, Peabody Museum of Harvard University

Coon 1974,Coon, Carleton S.,The Mountains of Giants. A Racial and Cultural Study of the North Albanian Mountain Ghegs, published by the Peabody Museum of American Archaeology and Ethnology, New York, vol. 23.

Costa Fogel 1998,Costa, Dora & Fogel, Robert,Internet Data Collection: Human Stature of Union Army Recruits, see http://www.uni-tuebingen.de/uni/wwl/dhheight.html

Costa Steckel 1997,Costa, Dora & Steckel, Richard,Long-Term Trends in Health, Welfare, and Economic Growth in the United States, in Steckel, R. and Floud., R. Health and Welfare during Industrialization. Chicago and London. Univ. of Chicago Press, 1997, pp. 47-89

Cranfield Inwood 2007,Cranfield, John & Inwood, Kris,The great transformation: A long-run perspective on physical well-being in Canada', *Economics and Human Biology, no.* 5, pp. 204–228.

Crayen 2006,Crayen, Dorothee,Heights in South Africa', University of Tuebingen Working Paper

Crognier 1967,Crognier, E.,Données biometriques sur l'état de nutrition d'une population africaine tropicale: les Sara du Tchad', *Biometrie Humaine IV,* no. 1-2, pp. 27-54.

Czekanowski 1910,Czekanowski, J.,Verwandschaftsbeziehungen der zentralafrikanischen Pygmäen. Die anthropologische Stellung der Batwa', *Korespondentblatt der Deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, vol. 16.

Danubio Amicone Vargiu 2005,Danubio, Maria E. & Amicone, Elisa & Vargiu, Rita,Height and BMI of Italian immigrants, to the USA, 1908–1970', *Economics and Human Biology, vol.* 3, pp. 33–43.

Dart 1937,Dart, Raymond A.,The physical characters of the auni-khomani bushmen', *Bantu Studies, vol. 11, p. 177.*

Davenport Steggerda 1929,Davenport, C.B. & Steggerda, Morris,Race Crossing in Jamaica, Carnegie Institution of Washington.

De Lestrange 1950,de Lestrange, M. ,Contribution à l'étude de l'anthropologie des Noirs d'A. 0. F. — II. Anthropométrie de 1023 Coniagui, Bassari, Badyaranké et Fulakunda de Guinée française', *Bulletins et Mémoires de la Société d'Anthropologie de Paris*, vol. 1, no. 1, pp. 99 - 136.

Debets 1970,Debets, Georgij F.,Physical anthropology of Afghanistan, Cambridge, Peabody Museum.

Demographic and Health Surveys,Demographic and Health Surveys,Demographic and Health Surveys Internet Pages www.measuredhs.com

Dick 1995,Dick, Trevor,Heights, Nutrition, and Per Capita Income: Canada', Komlos, J (ed.) *The biological standard of living on three continents: further explorations in anthropometric history,* Boulder, Colorado, Westview.

Doering 1898,Döring, H.,Anthropologisches von der deutschen Togo-Expedition', *Zeitschrift für Ethnologie 28*. 1898

Drontschilow 1914,Drontschilow, Krum,Beiträge zur Anthropologie der Bulgaren', in Ranke, J & Thilenius, G (eds) *Archiv fuer Anthropologie*, vol. 13., p. 43.

Drukker Van Meerten 1995,Drukker, Jan Willem & Van Meerten, M.A.,Beyond Villerme and Quetelet: The Quantitative Relation between Sex- and Age-Specific Hieght and Real Per Capita Income, in: Komlos, John (ed.) (1995a) The Biological Standard of Living on Three Continents: Further Essays in Anthropometric History. Boulder: Westview Press, pp. 25-57

Drukker Tassenaar 1997,Drukker, Jan Willem & Tassenaar, Vincent,The Case of the Shrinking Dutchmen: another Example of the 'Early-Industrial-Growth Puzzle',' in R. Steckel and R. Floud (eds.) Health and Welfare during Industrialization. Chicago: University of Chicago Press, pp. 331-378.

Eickstedt 1920,Eickstedt, Egon,Rassenelemente der Sikh', *Zeitschrift für Ethnologie* 52/53.

Eickstedt 1926,Eickstedt, Egon,Zur Anthropologie der Garhwali im Himalaya', *Mitteilungen der anthropologischen Gesellschaft in Wien, vol. 16.*

Eltis 1982,Eltis, David,Nutritional Trends in Africa and the Americas: Heights of African, 1819-1839', *Journal of Interdisciplinary History, vol.* 12, pp. 453-475.

Eltis 2009,Eltis, David,Internet Data Set, friendly provided on his internet page. On the Background, see Eltis 1982

Erismann 1888,Erismann, F.,Untersuchungen über die körperliche Entwicklung der Arbeiterbevölkerung in Zentralrussland. Archiv für soziale Gesetzgebung 1, pp. 98-484

Eurobarometer 1996,Eurobarometer,Internet Data Collection: Statistics on Human Stature in Europe

Eveleth Tanner 1990,Eveleth, P.B. & Tanner, J.M.,Worldwide variation in human growth. Cambridge: Cambridge University Press.

Facchhini 1998,Facchhini, F.,Body Composition in Central Asia Populations: Fat Patterning Variation in the Kazakhs of the Tien Shan Mountains and the Uighurs of Semericia', *American Journal of Human Biology,* vol. 10, pp. 241–247.

Faulhaber 1970,Faulhaber, J. ,*Anthropometry of living indians'. In R Wauchope (ed.): Handbook of Middle American Indians.* Austin: The University of Texas Press, Vol. 9, pp. 82-104.

Fetter Hajnis 1962,Fetter, Vojtech & Hajnis, Karel,Základní Somatomerické Charakteristiky Dospelých Cvicencu II. Celostátní Spartakiády', *Acta Universitatis Carolinae Medica 1962*, p. 13ff

Field 1948,Field, Henry,Contributions to the anthropology of the Soviet Union, Washington, DC, Smithsonian Institution.

Field 1952,Field, Henry,Contributions to the Anthropology of the Faiyum, Sinai, Sudan, Kenya, Univ. of California Press

Field 1953,Field, Henry,*Contributions to the Anthropology of the Caucasus.* Peabody Museum of American Archaeology and Ethnology, Harvard University, 1953.

Field 1955,Field, Henry,*An anthropological reconnaissance in west Pakistan. Chicago: Peabody Museum 1955*

Fischer 1913,Fischer, Eugen,*Die Rehobother Bastards und das Bastardisierungsproblem beim Menschen',* Anthropologische und ethnografische Studien am Rehobother Bastardvolk in Deutsch-Suedwest-Afrika. Kgl. Preuß. Akademie der Wissenschaften.

Floud 1994,Floud, Roderick,*The Heights of Europeans since 1750: A New Source for European Economic History,' in Komlos, John (ed.) Stature, Liv*ing Standards, and Economic Development. Essays in Anthropometric History. Chicago: The University of Chicago Press, pp. 9-24.

Floud Wachter 1982,Floud, R. & Wachter, K.,Poverty and Physical Stature: Evidence on the Standard of Living of London Boys 1770-1870', *Social Science History, vol.* 6, pp. 422-452.

Floud Wachter Gregory 1990,Floud, Roderick & Wachter, Kenneth & Annabel Gregory,*Height, Health and History. Nutritional Status in the United Kingdom*, 1750-1870. Cambridge: Cambridge University Press.

Floud Wachter Gregory 1991,Floud, Roderick & Wachter, Kenneth & Annabel Gregory,*Data Set Friendly Provided via the Essex Social Science Data Archive, on the Background see Floud Wachter Gregory 1990*

Fogel Engerman Trussell 1982,Fogel, R.W., Engerman,S.L., Trussell, J.,Exploring the Uses of Data on Height: The Analysis of Long-Term Trends in Nutrition, Labor Welfare, and Labor Productivity', *Social Science History*, vol. 6, no. 4, pp. 401-421. 1982

Frisancho 1976,Frisancho, Roberto A.,Growth and Morphology at high Altitude', in: Baker, PT & Little, MA (eds.) *Man in the Andes - A Multidisciplinary Story of High-Altitude Quechua,* Dowden, Hutchinson & Ross, Stroudsburg.

Fritsch 1872,Fritsch, Gustav D.,,Die Eingeborenen Süd-Afrikas, Atlas, Breslau, Hirt.

Fthenakis 1968,Fthenakis, W.,Problem der körperlichen und seelischen Akzeleration in Griechenland, Diss. LMU Muenchen

Gaillard Poutrin 1914,Gaillard, R.; Poutrin, L.,Étude anthropologique des populations des régions du Tchad et du Kanem', Extrait des Documents Scientifiques de la Mission Tilho, tome III, Paris.

Galloway 1937,Galloway, Alexander,A contribution to the physical anthropology of the Ovambo. S. Afr. J. Sci. 34, 351-364.

Ganguly 1976,Ganguly, Pranab,Physical Anthropology of the Nicobarese', *Anthropological Survey of India,* Government of India, Calcutta, India.

Gillin 1967,Gillin, John,*The Barama River Caribs of British Guyana', Papers of the Peabpdy Museum of American Archeology and Ethnology,* Harvard University, vol. 14, no. 2.

Godoy Goodman Levins Caram Seyfried 2007,Godoy, Ricardo A.; Goodman, Elizabeth; Levins, Richard; Caram, Mariana; Seyfried, Craig,Adult male height in an American colony: Puerto Rico and the USA mainland compared, 1886–1955', *Economics and Human Biology*, vol. 5, pp. 82–99.

Godoy Leonard Reyes-García Goodman McDade Huanca Tanner Vadez 2006,Godoy, Ricardo A. & Leonard, William R. & Reyes-García, Victoria & Goodman, Elizabeth & McDade, Thomas & Huanca, Tomás & Tanner, Susan & Vadez, Vincent,Physical stature of adult Tsimane' Amerindians, Bolivian Amazon in the 20th century', *Economics and Human Biology*, vol. 4, no. 2, pp. 184-205.

Guntupalli Baten 2006,Guntupalli, Aravinda Meera & Baten, Jörg,The Development and Inequality of Heights in North, West and East India 1915-44', *Explorations in Economic History*, vol. 43, no. 4, pp. 578-608.

Gyenis Joubert 2004,Gyenis, Gyula & Joubert, Kálmán,Socioeconomic determinants of anthropometric trends among Hungarian youth', *Economics and Human Biology, vol.* 2, pp. 321–333.

Hagen 1898,Hagen, B.,Anthropologischer Atlas Ostasiatischer und Melanesischer Völker, Wiesbaden 1898.

Haghdoost Mirzazadeh Alikhani 2008,Haghdoost, AA & Mirzazadeh, A. & Alikhani, S. ,Secular Trend of Height Variations in Iranian Population Born between 1940 and 1984; Iranian J Publ Health, Vol. 37, No.1, 2008, pp.1-7

Hammel Gullickson 2005,Hammel, Eugene A. and Gullickson, A. ,Maternal Mortality as an Indicator of the Standard of Living in Eighteenth- and Nineteenth-Century Slavonia. In Allen, R. & Bengtsson, T. & Dribe, M., eds. Living Standards in the Past. New Perspectives in Asia and Europe (Oxford: Oxford University Press).

Harrison 1969,Harrison, G. A. ,The Effects of Altitudinal variation in Ethiopian Populations', *Philosophical Transactions of the Royal Society of London*, series B, vol. 256, Biological Sciences.

Hasle Boldsen 1991,Hasle, Henrik & Boldsen, Jesper L.,Childhood conditions and adult height', *Journal of Biosocial Science, vol.* 23, pp. 107-112.

Hasluck Morant 1929,Hasluck, Margaret M. & Morant, G. M.,Measurements of Macedonian Men', *Biometrika*, vol. 21, No. 1/4, pp. 322-336.

Hatton 2009,Hatton, Timothy,A New Dataset on Long Run Trends in the Heights of European Males. Working Paper ANU

Hauschild Wagenseil 1931,Hauschild, M.W. & Wagenseil,F.,Anthropologische Untersuchungen an anatolischen Türken', *Zeitschrift für Morphologie und Anthropologie*, vol. 29.

Hertzberg 1963,Hertzberg, H. T. E.,Anthropometric survey of Turkey, Greece and Italy, Pergamon Press.

Heyberger 2007,Heyberger, Laurent,Toward an anthropometric history of provincial France, 1780–1920', *Economics and Human Biology* vol. 5, pp. 229–254.

Hiernaux 1964,Hiernaux, J.,Luba du Katanga et Luba du Kasai (Congo); comparaison de deux populations de même origine'. *Bulletins et Mémoires de la Société d'Anthropologie de Paris,* vol. 6, no. 4, pp. 611 - 622.

Hiernaux 1965,Hiernaux, J.,Note sur les Tutsi de l'Itombwe', *Bulletins et Mémoires de la Société d'Anthropologie de Paris,* vol. 7, no. 4, pp. 361 - 379.

Hiernaux 1968,Hiernaux, J.,La diversité humaine en Afrique subsaharienne : recherches biologiques, Ed. de l'Inst. de Sociologie, Univ. Libre, Bruxelles.

Hiernaux 1972,Hiernaux, J.,A Comparison of Growth and Physique in Rural, Urban and Industrial Groups of Similar Ethnic Origin: A Few Case Studies from the Congo and Chad', Vorster, D J M (ed), *Human Biology of environmental Change.*

Hildebrandt 1875a,Hildebrandt, J.M.,Einige Körpermasse ostafrikanischer Volksstämme', *Zeitschrift für Ethnologie VII*.

Hildebrandt 1875b,Hildebrandt, J.M.,Vorläufige Bemerkungen über die Somal', *Zeitschrift für Ethnologie VII.*

Hodinova 2007,Hodinova, Katherina,Determinanten der fruehen Humankapitalbildung in ost- und mitteleuropaeischen Regionen. Diploma Thesis, University of Tuebingen.

Hooton Dupertuis 1955,Hooton, Earnest A.& Dupertuis, C. Wesley,The physical anthropology of Ireland, The Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, Massachusetts.

Hossain Lestrel Ohtsuki 2005,Hossain, Golam & Lestrel, Pete E. & Ohtsuki, Fumio,Secular changes in head dimensions of Japanese adult male students over eight decades', *Journal of Comparative Human Biology, vol.* 55, pp. 239-250.

Huizinga 1968a,Huizinga J. ,Human biological observations on some african populations of the thorn Savanna belt I', *Proceedings of the koninklijke nederlandse Akademie van Wetenschappen Series C Biological an d medical Series,* vol. 71, pp. 356-390.

Huizinga 1968b,Huizinga J. ,New physical anthropological evidence bearing on the relationship between Dogon;Kurumba and the extinct west African Tellem populations', *Proceedings of the koninklijke nederlandse Akademie van Wetenschappen Series C Biological and medical Series,* vol. 71, pp. 16-30.

Huizinga Birnie-Teller 1966,Huizinga J. & N.F. Birnie-Teller,Some anthropometric data on male and female DogonI,II', *Proceedings of* *the koninklijke nederlandse Akademie van Wetenschappen Series C Biological an d medical Series,* vol. 69, pp. 675-695.

Hultkrantz 1927,Hultkrantz, J.V.,Über die Zunahme der Körpergröße in Schweden in den Jahren 1840 - 1926', *Nova acta Regiae Societatis Scientiarum Upsaliensis* ; vol. extra ord. ed. 4., Uppsala.

Inwood Oxley Roberts 2010,Inwood, Kris & Oxley, Les & & Roberts, Evan ,Physical stature and its interpretation in nineteenth century New Zealand. Australian Economic History Review (forthcoming)

Interdepartmental Committee on Nutrition 1963a,Interdepartmental Committee on Nutrition for National Defense,Venezuela. Nutrition Survey May-June 1963. Washington.

Jaeger Zellner Kromeyer-Hauschild Luedde Eisele Hebebrand 2001,Jäger, U. & Zellner, K & Kromeyer-Hauschild, K. & Lüdde, R. & Eisele, R. & Hebebrand, J.,Körperhöhe, Körpergewicht und Body Mass Index bei deutschen Wehrpflichtigen. Historischer Rückblick und aktueller Stand', *Anthropologischer Anzeiger, vol.* 59, no. 3, pp. 251-273.

Janghorbani Amini Willett Gouya Delavari Alikhani Mahdavi 2007,Janghorbani, M. & Amini, M. & Willett, W.C. & Gouya, M.M. & Delavari, A. & Alikhani, S. & Mahdavi, A.,First Nationwide Survey of Prevalence of Overweight, Underweight, and Abdominal Obesity in Iranian Adults', *Obesity, vol.* 15, pp. 2797–2808; doi: 10.1038/oby.2007.332.

Jantz Kimmerle Baraybar 2008,Jantz, Richard L. & Kimmerle, Erin H. & Baraybar, Jose Pablo,Sexing and Stature Estimation Criteria for Balkan Populations', *Journal of Forensic Science*, vol. 53, no. 3.

Jarcho 1935,Jarcho, A.,Die Altersveränderungen der Rassenmerkmale bei den Erwachsenen', *Anthropologischer Anzeiger XII.*

Jayasekara 1988,Jayasekara, Rohan et al.,Adolescent Growth in Stature among Sinhalese Males: Preliminary Results of a Cross-Sectional Study', H*uman Biology*, vol. 60, no. 6, p.825.

Johnson 1970,Johnson, T.O.,Height and Weight Patterns of an Urban African Population Sample in Nigeria. Tropical and Geographical Medicine 22, pp. 65-76

Jordan 1979,Jordán, José R.,Desarrollo Humano en Cuba, Instituto de la Infancia, La Habana.

Joyce 1926,Joyce, T.A.,Note on the Physical Anthropology of the Pamirs and Amu-Daria Basin', *The Journal of the Royal Anthropological Institute of Great Britain and Ireland,* vol. 56 , pp. 105-133.

Juergens 1967,Jürgens, H.W.,Examination of the physical development of Tanzanian youth, Anthropological Institute, IFO-Institut für Wirtschaftsforschung, Afrika-Studienstelle, Kiel.

Kac Ventura Santos 1997,Kac, Gilberto & Ventura Santos, Ricardo,Secular trend in height in enlisted men and recruits from the Brazilian Navy born from 1970 to 1977', *Cad. Saúde Públ*, Rio de Janeiro, vol. 13, no. 3, pp. 479-487.

Kajanoja 1971,Kajanoja, Pauli,A Study in the Morphology of the Finns and ist relation to the settlement of Finland', *Annales Academiae Scientarum*, Series A, V. Medica 146.

Kajava 1927,Kajava, Y,Rasseneigenschaften der Lappen Finlands; Suomalaisen Tiedeakatemian Toimituksia', *Annales Academie Scientiarum Fennicae, vol.* 25, Helsinki.

Kemsley 1951,Kemsley, W. F. F.,Weight and Height of a Population in 1943', *Annals of eugenics, vol.* 15, pp. 161-183.

Kiil 1939,Kiil, Vilhelm,Stature and Growth of Norwegian Men during the Past Two Hundred Years. Oslo 1939

Kimura 1984,Kimura, Kunihiko,Studies on Growth and Development in Japan', *Yearbook of Physical Anthropology, vol.* 27, pp. 179-214.

Kimura 1993,Kumra, Mitsuhiko,Standards of Living in Colonial Korea: Did the Masses Become Worse Off or Better Off Under Japanese Rule? Journal of Econ. History 53-3, pp. 629-652

Kirchengast Winkler 1995,Kirchengast, Sylvia & Winkler, Eike-Meinrad,Kirchengast, Sylvia, Differential Reproductive Success and Body Dimensions in Kavango Males from Urban and Rural Areas in Northern Namibia', *Human Biology*, vol. 67, no. 2, p.291.

Komlos 1985,Komlos, John,Stature and Nutrition in the Habsburg Monarchy: The Standard of Living and Economic Development in the Eighteenth Century', *The American Historical Review*, vol. 90, no. 5, pp. 1149-1161.

Komlos 1989,Komlos, John,Nutrition and Economic Development in the Eighteenth-Century Habsburg Monarchy: An Anthropometric History. Princeton: Princeton University Press.

Komlos 2006,Komlos, John,Data Set on Georgia Convicts, on the Background See Komlos Coclanis 1997, see http://www.uni-tuebingen.de/uni/wwl/dhheight.html

Komlos 2008,Komlos, John,Data Set on Habsburg Empire Heights

Komlos 2008b,Komlos, John,Anthropometric evidence on economic growth, biological well-being and regional convergence in the Habsburg Monarchy, c. 1850–1910, Cliometrica 2008, DOI 10.1007/s11698-007-001-5

Komlos 2009,Komlos, John,Recent Trends, Working Paper Munich [allows to calculate average of White and Black]

Komlos Coclanis 1997,Komlos, J., Coclanis, P.,On the Puzzling Cycle in the Biological Standard of Living: The Case of Antebellum Georgia', *Explorations in Economic History,* vol. 34, no. 4, pp. 433-459.

Kopczynski 2007,Kopczyński, Michał,Agrarian reforms, agrarian crisis and the biological standard of living in Poland, 1844–1892', *Economics & Human Biology*, vol. 5, no. 3, pp. 458-470.

Kopczynski 2009,Kopczyński, Michał,Data Collection on Polish Stature: Provided by Friendly Email Communication (on the Background, see Kopczy´nski 2007)

Korean Research Institute of Standard and Science 2004,Korean Research Institute of Standard and Science,Internet Page of the National Anthropometric Survey of Korea 2003 (in Korean) available under http://sizekorea.kats.go.kr, last accessed Jan 16th, 2009

Kraemer 1915,Krämer, Augustin,Zwei sehr kleine Pygmäenschädel von Neuguinean und meine Messungen an Buschmännern in Südafrika 1906', Ranke, J & Thilenius, G (eds) *Archiv für Anthropologie, vol. 13*.

Lai Yaung 1987,Lai, E.S. & Yaung, C.-L.,A survey of growth and sexual development of adolescent students in Changua City. Growth of body height and weight', *Proceedings of the National Science Council*, Republic of China/ Part B, Life sciences.

Laing 1964,Laing, J.G.D.,A height/weight table for African Mine Labourers', *Journal of the South African Institute of Mining and Metallurgy*.

Lalouel 1950,Lalouel, J.,Les Babinga du Bas-Oubangi. Bulletin et Mßemoires des la Société d'anthropologique de Paris X.ser, vol.1. No. 1-3, 1950, pp. 60-98

Laska-Mierzejewska 1970,Laska-Mierzejewska, T,Morphological and Developmental Difference Between Negro and White Cuban Youths' , *Human Biology,* vol. 42, no.4, p.581.

Latham Stephenson Hall Wolgemuth Eliottl Cromuton 1983,Latham, M. C. & Stephenson, L. S. & Hall, A., Wolgemuth & J. C., Eliottl.T. C. & Cromuton. D.W.T.,Parasitic infections, anaemia and nuritional status: a study of their interrelationships and the effect of prophylaxis and treatment on workers in Kwale District, Kenya', *Transactions of the Royal Society of Tropical Medicine and Hygiene,* vol. 17, pp. 41-48.

Lebzelter 1923,Lebzelter, V.,Beiträge zur physischen Anthropologie der Balkanhalbinsel; 1. Teil', *Mitteilungen der anthropologischen Gesellschaft in Wien*, vol. 53.

Lee 1978,Lee, Sang-Do,A study of the differences and characteristics between the nations, in the measured values of the human body and the working area. International Journal of Production Research 1978, Vol. 16, No. 4, pp 335 - 347.

Leys Joyce 1913,Leys, Norman M. and Joyce, T. A.,Note on a Series of Physical Measurements from East Africa', *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, vol. 43, pp. 195-267

Lintsi et al. 1997,Lintsi M. & Saluste L. & Kaarma H. & Koskel S. & Aluoja A. & Liivamägi J. & Mehilane L. & Vasar V. ,Characteristic Traits of Anthropometry in 17-18 Year old Schoolboys of Tartu. IN: Papers on Anthropology VII

Lintsi Kaarma 2006,Lintsi M. & Kaarma H. ,Growth of Estonian seventeen-year-old boys during the last Two Centuries. Economics and Human Biology 4-1, pp. 89–103

Littlewood 1972,Littlewood, R. A.,Physical anthropology of the Eastern Highlands of New Guinea', *Anthropological studies in the eastern highlands of New Guinea,* vol. 2, Seattle, University of Washington Press.

Lobsiger-Dellenbach 1951,Lobsiger-Dellenbach, Marquerite,Contribution a l'études anthropologique de l'Afrique occidentale francaise (colonie du Niger)' *Archive Suisses d'Anthropologie Génerale* 16-1 (1951)

Lopez 1950,López, Juan Severino ,La Estatura Masculina en la Ciudad de Buenos Aires', *Anales del Instituto Étnico Nacional 3*. Ministerio del Interior. Buenos Aires, Argentina. P. 113-38

Lopez-Alonso Condey 2003,Lopez-Alonso, Moramay & Condey, Raul P. 2003,The Ups and Downs of Mexican Economic Growth: the Biological Standard of Living and Inequality 1870-1950, Economics and Human biology 1-2, pp. 169-186.

Lorentz 1923,Lorentz, H.A.,

Nova Guinea : résultats des expéditions scientifiques à la Nouvelle Guinée; Leiden : Brill.

Lundman 1939,Lundman, Bertil,Über die fortgesetzte Zunahme der Körperhöhe in Schweden 1926 bis 1936', *Zeitschrift für Rassenkunde*, vol. 9.

Mackeprang 1923,Mackeprang, E.,Statistikens Terori. I. Anthropometri; G. E. C. Gads Forlag, Kobenhavn.

Malcolm 1925,Malcolm, L.W.G.,Notes on the Physical Anthropology of certain West African Tribes', *Mitteilungen der Anthropologischen Gesellschaft in Wien*, vol. 55.

Manolis Neroutsos Zafeiratos 1995,Manolis, S. & Neroutsos, A. & Zafeiratos, C.,Secular changes in body formation of greek students', *Human Evolution*, vol. 10, no. 3pp. 199-204.

Manzel Twrdek 2010,Manzel, Kerstin & Twrdek, Linda,The Seed of Abundance and Misery Peruvian Living Standards from the Early Republican Period to the End of the Guano Era. Manzel, K.: *Essays on Human Capital in Latin America*, UB Tuebingen

Martin 1905,Martin, Rudolf,Die Inlandstämme der malayischen Halbinsel, Jena, Verlag von Gustav Fischer.

Martínez-Carrion 1994,Martínez-Carrion, José M.,Stature, Welfare, and Economic Growth in Nineteenth -Century Spain: The Case of Murcia', in Komlos, J (ed.) *Stature, living standards and economic development : essays in anthropometric history,* Chicago, Ill. University of Chicago Press

Martínez-Carrion 2002,Martínez-Carrion, José M.,El nivel de vida en la España rural. Siglos XVIIIXX, Alicante, Publicaciones de la Universidad de Alicante.

Martínez-Carrion Perez-Castejon 1998,Martínez-Carrion, Jose M. & Perez-Castejon, Juan J.,Height and Standards of Living during the Industrialization of Spain: the Case of Elche. In: European Review of Economic History 2-2, pp. 201-230

Matsumura 1925,Matsumura,On the cephalic index and stature of the Japanese and their local differences' ; *J Fak Sci Imp Univ Tokyo Sec 1*, pp. 1-312;

Maynard Turner 1914,Maynard, G.D.& Turner, G.A.,Anthropological notes on Bantu Natives from Portuguese East Africa', *Publications of the South African Institute for Medical Research*, Johannesburg.

Mazumdar 1976,Mazumdar, S. K.,A Biometric Study on the Tribes of North-Western Himalayan Region', *Anthropological Survey of India.*

Meineke 2008,Meineke, Lisa,Italien. Diploma Thesis Tuebingen.

Meisel Vega 2007,Meisel, Adolfo & Vega, Margarita,The biological standard of living (and ist convergence) in Colombia, 1870–2003 - A tropical success story', *Economics and Human Biology*, vol. 5, pp.100–122

Mense,Mense, Zeitschrift.fuer Ethnologie und Urgeschichte 1886, S.738-753

Mense,Mense, Zeitschrift für Ethnologie 1887 S. 624-680

Meredith 1971,Meredith, Howard V.,Worldwide Somatic Comparisons among Contemporary Human Groups of Adult Females, in American Journal of Physical Anthropology, 34: 89.132.

Mesa Fuster Sanchez-Andres Marrodan 1993,Mesa, Maria Soleuad & Fuster, Vicente & Sánchez-Andrés, Angeles & Marrodán, Dolores,Secular Changes in Stature and Biacromial and Bicristal Diameters of Young Adult Spanish Males', *American Journal of*

Human Biology, vol. 5, pp. 705-709.

Miklashevskaia 1973,Miklashevskaia, Natasa N.,Growth and development in high altitude regions of Southern Kirghiza, U.S.S.R.; Miami, Fla. : Field Research Projects

Mironov 1999,Mironov, Boris,New Approaches to Old Problems: The Well-Being of the Population of Russia from 1821 to 1910 as Measured by Physical Stature, Slavic Review. Vol. 58. No. 1. Spring 1999, pp. 1-26.

Mironov 2004,Mironov, Boris,Living Standards in Soviet Russia under Stalin: on the Data of the Stature of the Russian Population. Conference Paper Economics and Human Biology.

Mironov 2004b,Mironov, Boris,The Nutrition Standard of Life in the Soviet Russia under Stalin on the Anthropometric Data,' The Economic History. A Yearbook [in Russian]. 2004. Moscow: ROSSPEN, 2004, pp. 565-588

Mironov 2006,Mironov, Boris,Data Set on Russian Heights, provided by email. On the Details, see Mironov 2004, 2008 and his Anthropometric History of Russia

Mironov A Hearn 2008,Mironov, Boris & A'Hearn; Brian,Russian Living Standards under the Tsars: Anthropometric Evidence from the Volga', *Journal of Economic History*, vol. 68, pp. 900-929.

Miszkiewicz 1961,Miszkiewicz, Brunon,Anthropologische Struktur der Mazedonischen Bevölkerung, Wroclaw.

Mokyr O Grada 1994,Mokyr, J. & O Grada,The Heights of the British and the Irish c. 1800 - 1815: Evidence from Recruits to the East India Company's Army', in Komlos, John (ed.) *Stature, living standards and economic development : essays in anthropometric history,* Chicago, Ill. University of Chicago Press.

Mokyr O Grada 1996,Mokyr, J. & O Grada,Height and Health in the United Kingdom 1815-1860: Evidence from the East India Company Army. In: Explorations in Economic History 33-2 (1996), p. 141-168.

Monasterio Signorini 2008,Monasterio, Leonardo M. & Signorini, Mateus,As condicoes de vida dos Gauchos entre 1889-1920: uma analise anthropometrica. Working Paper UFPel.

Montero 2009,Montero, Hector Garcia,Antropometría y niveles de vida en el Madrid rural, 1837-1915. Historia Agraria 47, pp. 91-124

Moradi, Alexander 2009.Towards an Objective Account of Nutrition and Health in Colonial Kenya: A Study of Stature in African Army Recruits and Civilians, 1880-1980, in Journal of Economic History 69-3, pp. 719-754

Morgan 2003,Morgan, S. L.,Chinese Stature and Health Surveys of Adult Employees during the 20th Century. Conference Paper Economics and Human Biology 2003

Morgan 2004,Morgan, S. L.,Economic growth and the biological standard of living in China, 1880–1930', *Economics and Human Biology,* vol. 2, pp. 197–218.

Morgan 2006,Morgan, S. L.,Height, health and welfare in South China over the past two centuries', Working Paper for "The Third International Conference on Economics and Human Biology, Strasbourg, France, June 22-24, 2006"

Morgan Liu 2007,Morgan, S. & Liu,Was Japanese Colonialism Good for the Welfare of Taiwanese? Stature and the Standard of Living', *The China Quarterly, vol. 192, pp.990-1013.*

Murray 1997,Murray, John E. ,Standards of the Present for People of the Past: Height, Weight, and Mortality among Men of Amherst College, 1834-1949', *The Journal of Economic History*, vol. 57, no. 3, pp. 585-606.

Nicholas 2009,Nicholas, Stephen,Data Set Friendly Provided by Email, on the Background see Whitwell de Souza Nicholas 1997

Nicholas Steckel 1991,Nicholas, Stephen & Steckel, Richard ,Heights and Living Standards of English Workers During the Early Years of Industrialisation, 1770-1815', *Journal of Economic History,* vol. 51, pp. 937-57.

Nickul 1927,Nickul, Karl,Einige Körpermaße finnischer Wehrpflichtiger; Suomalaisen Tiedeakatemian', *Annales Academiae Scientarum Fennicae,* vol. 25, Helsinki.

Nummela 2000,Nummela, Ilkka,Pätkä Vai Ei? Suomalaisen Pituuskasvun Historiaa. Jyväskylä: Kansi.

Nurse 1969,Nurse, G.T.,Height and History in Malawi, Government Press, Zomba, Malawi.

Oezer 2008,Oezer, Basak Koca,Secular Trend in Body Height and Weight of Turkish Adults. Anthropological Science 116-3, pp. 191-199

Olds 2003,Olds, Kelly B.,The biological standard of living in Taiwan under Japanese occupation. Economics and Human Biology, 1, 187-206.

Olivier 1991,Olivier, G.,La stature des français en 1990', *Bulletins et Mémoires de la Société d'anthropologie de Paris*, vol. 3, no. 1, p. 145 - 150.

Olivier Devine 1985,Olivier, G.; Devine G.,Données nouvelles sur la stature et la corpulence en France', *Cahiers d'anthropologie et biométrie humaine*, vol. 3, no1-2, pp. 111-123.

Orr Gilks 1931,Orr, J.B. & Gilks, J.L.,The Physique and Helath of Two African Tribes. London.

Oschinsky 1954,Oschinsky, L.,*The Racial Affinities of the Baganda and other Bantu Tribes of British East Africa.* Cambridge.

Oshanin 1964a,Oshanin, L. V.,Anthropological composition of the population of Central Asia : and the ethnogenesis of its peoples', *Russian translation series of the Peabody Museum of Archaeology and Ethnology,* vol. 2, Peabody Museum.

Oshanin 1964b,Oshanin, L. V.,Anthropological composition of the population of Central Asia : and the ethnogenesis of its peoples', *Russian translation series of the Peabody Museum of Archaeology and Ethnology,* vol. 3, Peabody Museum.

Oxley 2004,Oxley, Deborah,Living Standards of Women in Prefamine Ireland', Social Science History 28-2, pp. 271-296.

Padez 2007,Padez, C.,Secular Trend in Portugal', *Journal of Human Ecology*, vol. 22, no. 1, pp. 15-22.

Padez Johnston 1999,Padez, C. & Johnston, F.,Secular trends in male adult height 1904-1996 in relation to place of residence and parent's educational level in Portugal', *Annals of Human Biology*, vol. 26, no. 3, pp. 287 – 298.

Paissel 1901,Paissel, W. E. ,Materialien zur Anthropologie der Tarantschen; Archiv fuer Anthropologie XXVI

Pak 2004,Pak, Sunyoung,The biological standard of living in the two Koreas', *Economics & Human Biology*, vol. 2, pp. 510-521.

Pak Schwekendiek Kim 2010,Pak, Sunyoung & Schwekendiek, Daniel & Kim, Hee Kyoung ,Height and Living Standards in North

Korea, 1930s-1980s', Economic History Review (forthcoming)

Pales 1952,Pales Léon,Raciologie comparative des populations de l'A. O. F.', *Bulletins et Mémoires de la Société d'anthropologie de Paris*, X° Série. Tome 3 fascicules 1-2, pp. 3-39.

Pales St.Pereuse 1953,Pales Léon & M. Tassin de Saint-Péreuse,Raciologie comparative des populations de l'A. O. F.', *Bulletins et Mémoires de la Société d'anthropologie de Paris, X° Série. Tome 4 fascicule 3-4, 1953. pp. 185-497.*

Pales Chippaux 1943,Pales, Léon & C. Chippaux,Contribution a l'etude de la stature chez les indigenes de Madagascar. Bulletins et Mémoires de la Société d'anthropologie de Paris 1943, vol 4-4, pp.54-65

Papadimitriou et al 2002,Papadimitriou, Anastasios et al. ‚Secular growth changes in the Hellenic population in the twentieth century; Hormones 2002, 1(4):245-250

Pearl 1905,Pearl, Raymond,Biometrical Studies on Man: I. Variation and Correlation in Brain-Weight', *Biometrika*, vol. 4, no. 1/2, pp. 13-104.

Pineau 1993,Pineau, J.C.,La stature en France depuis un siècle: évolution générale et régionale', *Bulletins et Mémoires de la Société d'anthropologie de Paris*, vol. 5, np. 1, pp. 257 - 268.

Poech 1926,Pöch, H.,Beiträge zur Anthropologie der ukrainischn Wolhynier', *Mitteilungen der anthropologischen Gesellschaft Wien,* vol. 56.

Polish Acad. of Sciences in Warszawa 1961,Polish Acad. of Sciences in Warszawa,*Publications of the second Arabic-Polish anthropological expedition. Warshaw/Cairo*

Powys 1901,Powys, A.O.,Data for the Problem of Evolution in Man. Anthropometric Data from Australia', *Biometrika*, vol. 1, no. 1, pp. 30-49.

Prazuck Fisch Pichard Sidibe 1901,Prazuck, T. & Fisch A. & Pichard, E. & Sidibe, Y.,Lack of Secular Change in Male Adult Stature in Rural Mali', *American Journal of physical Anthropology*, vol. 75, pp. 471-475.

Puccioni 1931,Puccioni, Nello,Anthropologia e Etnografia della genti della Somalia Vol.1', *Antropometria,* Bologna.

Quiroga 1998,Quiroga, Gloria V.,Height Evolution in Spain, 1893-1954. An Analysis by Regions and Professions. in Komlos, John/Baten, Joerg, eds. (1998): *The Biological Standard of Living in Comparative Perspective*, Stuttgart 1998, pp. 359-383.

Ramon Munoz 2009,Ramon-Munoz, Josep-Maria,Bienestar biológico y crecimiento agrario en la Cataluña rural,1840-1936

Radlauer 1915,Radlauer, Curt,Anthropologische Studien an Somali', *Archiv für Anthropologie XIII*.

Relethforth Less 1981,Relethford, John H. & Lees, Francis C.,The Effects of Aging and Secular Trend on Adult Stature in Rural Western Ireland', *American Journal of physical Anthropology*, vol. 55, pp. 81-88.

Relethforth 1981,Relethford, John H. ,The Effects of Aging and Secular Change in Rural Western Ireland", American Journal of Physical Anthropology 55:81-88

Risley 1906,Risley, Herbert H.,Anthropometric Data from Burma, Ethnographic Survey of India, Office of the superintendent, Government Printing, Calcutta, India.

Risley 1969,Risley, Herbert,The People of India - 2. ed., ed. by W. Crooke. - Delhi : Oriental Books Repr. Co., 1969

Roberts 1954,Roberts, D. F.,The Cretans. A geographical analysis of some aspects of their physical anthropology', *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, vol. 84, no. 1/2, pp. 145-157.

Roberts 1957,Roberts, D. F.,Contribuzione alla etnologia die "Pre-Niloti": i Mabaan a paragone die Niloti', *Rivista di Antropologia*, vol. 44, pp. 317-324.

Rosenbaum 1988,Rosenbaum, S.,"100 Years of Heights and Weights," Journal of the Royal Statistical Society, Series A, 151, pp. 276-309.

Rubalcava Teruel 2006,Rubalcava, Luis & Teruel, Graciela,"User's Guide for the Mexican Family Life Survey First Wave"

Ruelle 1904,Ruelle, E.,Notes anthropologiques, ethnographiques et sociologiques sur quelques populations noires du 2e territoire militaire. L'Anthropologie 45 : 519-62, 657-703

Russell 1976,Russell, Marcia,Parent-Child and Sibling-Sibling correlations of height and weight in a rural Guatemalan Population of preschool children', *Human Biology*, vol. 48, no. 3, p.501.

Sabatini 1936,Sabatini, Arturo,Anthropologie der Tébu von Kufra', *Zeitschrift fuer Rassenkunde,* vol. 3.

Salvatore 2004a,Salvatore, Ricardo,Stature, Nutrition, and Regional Convergence: The Argentine Northwest in the Twentieth Century", Social Science History 28-2, pp. 231-248

Salvatore 2004b,Salvatore, Ricardo,Stature decline and recovery in a food-rich export economy: Argentina 1900–1934, EEH 41, 233-255

Salvatore 2007,Salvatore, Ricardo,Heights, nutrition and well-being in Argentina, ca. 1850–1950. Preliminary results. Journal of Iberian and Latin American Economic History 25 (1), 53–86.

Salvatore Baten 1998,Salvatore, Ricardo & Baten, Joerg,A Most Difficult Case of Estimation: Argentinian Heights, 1770-1840', in Komlos J. & Baten J. (eds.): *The Biological Standard of Living in Comparative Perspective*. Stuttgart, pp. 90-96.

Sandberg Steckel 1987,Sandberg,Lars G.; Steckel, Richard H.,Heights and economic history: the Swedish case', *Annals of Human Biology*, vol. 14, no. 2, pp. 101 – 109.

Sandberg Steckel 1997,Sandberg, Lars & Richard Steckel ,Was Industrialization Hazardous to Your Health? Not in Sweden! In Richard Steckel and Roderick Floud (eds.) Health and Welfare during Industrialization. Chicago: University of Chicago Press, pp. 127-160.

Sanna Floris Cosseddu 1993,Sanna, E.; Floris, G. and Cosseddu, G.G.,Secular trend in height in Sardinian conscripts drafted from 1879-1883 to 1983-1986', *Anthropologischer Anzeiger,* vol. 51, no. 3, pp. 225-232.

Santos David 1972,Santos David, J.H. 1972,Height growth of melanodermic natives in Northeastern Lunda (Angola.' South African Journal of Medical Science. 37-3: pp. 49-60.

Sapounaki-Dracaki 1998,Sapounaki-Dracaki, Lydia,Heights and Nutritonal Status in Greece", in Komlos, John/Baten, Joerg, eds. (1998)*The Biological Standard of Living in Comparative Perspective*,. Stuttgart 1998, pp. 408-412.

Sasse 1914,Sasse, J.,Zur Anthropometrie der Bewohner der holländisch-friesischen Insel Terschelling', *Zeitschrift für Morphologie und Anthropologie,* vol. 18.

Schebesta 1952,Schebesta, Paul,Die Negrito Asiens, Band I, St. Gabriel Verlag, Wien.

Schebesta Lebzelter 1933,Schebesta, P. & Lebzelter, V.,Anthropology of the Central African pygmies in the Belgian CongoM', *Czech Academy of Sciences and Arts*, Prague.

Scheiber 1881,Scheiber, S.H.,Untersuchungen über den mittleren Wuchs der Menschen in Ungarn. Arch. für Arthr. 8, pp. 233-267

Schellong 1891,Schellong, O.,Beiträge zur Anthropologie der Papuas', *Zeitschrift fuer Ethnologie,* vol. 23.

Schreider 1950,Schreider, E,Les variations raciales et sexuelles du tronc humain', *L´Anthropologie*, vol. 58.

Schultze 1928,Schultze, Leonhard,Zur Kenntnis des Körpers der Hottentotten und Buschmänner', *Denkschriften der Medizinisch-Naturwissenschaftlichen Gesellschaft zu Jena*, vol. 17. 1928

Seiner 1928,Seiner, Franz,Beobachtungen und Messungen an Buschleuten', *Zeitschrift für Ethnologie,* vol. 44. 1928

Seligmann 1910,Seligmann, C.G.,The Physical Characters of the Nuba of Kordofan', *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, vol.40. 1910

Seltzer 1936,Seltzer, Carl,The Racial Characteristics of Syrians and Armenians', *Papers of the Peabody Museum of american Archaeology and Ethnology*, vol. 13, no. 3, Harvard University.

Seric 2007,Seric, Denis,Konvergenz und Divergenz des biologischen Lebensstandards in Afrika, vom späten 19. bis Mitte des 20. Jahrhunderts, Unpubl. Diploma Thesis Tuebingen (compiling data mainly from Hiernaux's African Compilation, but including some additional titles)

Shanklin 1938,Shanklin, William M.,Anthropometry of Syrian males', *Journal of the Royal Anthropological Institute of Great Britain and Ireland*, vol. 68, pp. 379-414.

Shirokogoroff 1968,Shirokogoroff, S. M.,Anthropology of Northern China', *Royal Asiatic Society*, Extra vol. 2.

Silvertoinen Lahelma Lundberg Rahkonen 2001,Silvertoinen, Karri & Lahelma, Eero & Lundberg, Olle & Rahkonen, Ossi,Body height, birth cohort and social background in Finland and Sweden', *The European Journal of Public Health*, vol. 11, no. 2, pp. 124-129.

Singh 1972,Singh, Raghbir,Somatometric study of the Punjabi Hindu Khatri (male) with special emphasis on growth (cross-sectional) and relationship between arm girth and body weigth measurements; Ed. by Henry Field. - Miami, Fla. : Field Research Projects, 1972

Sirajuddin 1993,Sirajuddin, Shaik Mohamed,Human biology of the Chenchus of Andhra Pradesh : a demo-morpho-genetic study / S. M. Sirajuddin. - Calcutta : Anthropological Survey of India.

Skaric-Juric Ginsburg Kobyliansky Malkin Smolej Narancic Rudan 2003,Skaric-Juric, Tatjana & Ginsburg, Emil & Kobyliansky, Eugene & Malkin, Ida & Smolej Narancic Nina & Rudan, Pavao,Complex Segregation Analysis of Body Height, Weight and BMI in Pedigree Data from Middle Dalmatia, Croatia; *Coll. Antropol*., vol. 27, no. 1, pp. 135–149.

Sobral 1990,Sobral, Francisco,Secular Changes in Stature in Southern Portugal between 1930 and 1980 According to Conscript Data' , *Human Biology*, vol. 62, no. 4, p.491.

Stanisev 1970,Stanisev, D.,Somatomerische Tabellen der mittleren jährlichen Werte von 57 Körpermerkmalen bei 3- bis 18-jährigen Jungen und Mädchen und bei im Mittel 23-jährigen Männern und Frauen der bulgarischen Stadt Plovdiv', *Folia Medica* Tomus, vol. 12.

Steckel Haurin 1994,Steckel, R.H. & Haurin, Donald R.,Health and Nutrition in the American Midwest: Evidence from Height of Ohio National Guardsmen, 1850-1910', in Komlos, J. (ed) S*tature, living standards and economic development : essays in anthropometric history*; University of Chicago Press.

Stefancic Tomazo-Ravnik 1998,Stefancic, M.; Tomazo-Ravnik, T.,Fifty-two years of secular trend in Ljubljana school children; in Bodzsár, EB & Susanne, C (eds.): *Secular growth changes in Europe*; Budapest : Eötvös Univ. Press.

Stegl Baten 2008,Stegl, Mojgan & Baten, Jörg,Data Set on Middle East Heights, on the Background see Stegl and Baten 2009

Stegl Baten 2009,Stegl, Mojgan & Baten, Jörg,Tall and Shrinking Muslims, Short and Growing Europeans: The Long-Run Welfare Development of the Middle East, 1840-1980:, *Explorations in Economic History,* vol. 46.

Stoev Yordanov 1998,Stoev, Racho & Yordanov, Yordan,Secular Trend in Bulgaria; in: Bodzár, B.E. and Susanne, C. (Eds.) Secular Growth Changes in Europe Eötvos Univ. Press, Budapest, pp. 65-73

Stolz 2008,Stolz, Yvonne,The Biological Standard of Living in Angola and Guinea-Bissau, 1890-1940', University of Tuebingen Working Paper.

Stolz Baten Reis 2009,Stolz, Yvonne & Baten, Jörg & Reis, Jaime,The Biological Standard of Living in Portugal, 1720-1980

Strauss Thomas 1998,Strauss, John & Thomas, Duncan,Health, Nutrition and Development. Journal of Economic Literature 36-2, pp. 766-817

Strouhal 1980,Strouhal, Eugen,Anthropometry of Egyptian Nubians', in Schwidetzky, I. & Chiarelli, B. & Necrasov, O. (eds.) *Physical Anthropometry of European Populations*.

Stuhlmann Simon 1895,Stuhlmann & Simon,Anthropologische Aufnahmen des Herrn Stuhlmann und Simon aus Ost-Africa', *Zeitschrift für Ethnologie*, vol. 27.

Sukkar 1976,Sukkar, M.Y.,Skinfold thickness and body fat in adult Fur men and women of Western Sudan. *Human Biology* 1976; 48: 315–321

Sunder 2003,Sunder, Marco,The Making of Giants in a Welfare State: The Norwegian Experience in the 20th Century." Economics and Human Biology 1.

Susanne 1979,Susanne, C.,Comparative Biometrical Study of Stature and Weight of Italian Migrants in Belgium', *American Journal of Physical Anthropology, vol. 50, no. 3, pp. 349 - 355.*

Talbot 1913,Talbot, P. Amaury,Measurements of Nkokolle, Cross River, Southern Nigeria', *Man*, Vol. 13, pp. 201-202.

Talbot 1916,Talbot, P. Amaury,Notes on the Anthropometry of Some Central Sudan Tribes', *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, vol. 46, pp. 173-182.

Talbot Mulhall 1962,Talbot, P. Amaury/ Mulhall, H.,The Physical Anthropology of Sou*thern Nigeria. A Biometric Study in Statistical Method. Cambridge University Press.*

Thieme 1959,Thieme, Frederick P.,The Puerto Rican Population. A Study in Human Biology', *Anthropological Papers, Museum of Anthropology*, University of Michigan, no. 13.

Thomas 1932,Thomas, Bertram,Arabia Felix - Across the empty Quarter of Arabia, London.

Tobias 1962,Tobias, P.V.,On the increasing stature of the Bushmen, Anthropos 57 (1962), pp. 801–810.

Tobias 1972,Tobias, P.V.,Growth and stature in South African populations. In: D.J.M. Vorster, Editor, The Human Biology of Environmental Change, International Biological Programme—Human Adaptability, Blantyre, Malawi Meeting, 1971 (1972), pp. 96–104.

Torun 2002,Torun, Benjamin & Stein, Aryeh D. & Schroeder, Dirk & Grajeda[a, Ruben &] Conlisk, Andrea & Rodriguez, Monica & Mendez[a,] Humberto & Martorell, Reynaldo,Rural-to-urban migration and cardiovascular disease risk factors in young Guatemalan adults', *International Journal of Epidemiology*, vol. 31, pp. 218-226.

Trevor 1947,Trevor, J. C.,The Physical Characters of the Sandawe', *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, vol. 77, no. 1, pp. 61-78.

Twarog 1997,Twarog, Sophia,Heights and Living Standards in Germany, 1850-1939: The Case of Württemberg. In Health and Welfare during Industrialization, edited by R Steckel and R. Floud. Chicago: The University of Chicago Press.

Twiesselmann 1969,Twiesselmann, F.,Development biometrique de l. enfant a l'adulte: etude de 12 mesures corporelles et de 16 mesures céphaliques chez 14.299 écoliers bruxellois âgés de 3 à 25 ans; Presses Universitaires de Bruxelles, Bruxelles.

Twrdek Baten 2010,Twrdek, Linda & Baten, Joerg,Selectivity of Argentina’s Immigrants'; University of Tübingen Working Paper.

Twrdek Manzel 2010,Twrdek, Linda & Manzel, Kerstin,The Seed of Abundance and Misery. Peruvian Living Standards from the Early Republican Period to the End of the Guano Era', University of Tuebingen Working Paper.

U.S. Department of Health 1976,U.S. Department of Health 1976,NHANES Survey 1976-80

Udjus 1964,Udjus, Ludvig Gudmund,Anthropological Changes in Norwegian Men in the Twentieth Century, Univeritetsforlagets Trykningssentral.

Ujfalvy 1884,Ujfalvy, Eugen Karl von,Aus dem westlichen Himalaya. Erlebnisse und Forschungen. Leipzig, F.A. Brockhaus.

Uruguay 1973,Uruguay,A report by the Interdepartmental Committee on Nutrition for National Defense.

Valenzuela Avendano 1979,Valenzuela, C.Y & Avendaño, A,Antropometría y maduración sexual de escolares de un área de Santiago de Chile / Anthropometry and sexual maturation of students in an area of Santiago de Chile Boletín de la Oficina Sanitaria Panamericana.

Van De Ginste 1946,Van De Ginste, Fernand,Anthropometric Study of the Bapende and Basuku of the Belgian Congo', *American journal of Physical Anthropology,* vol. 4, no. 2, pp. 125-152.

Van Wieringen 1972,van Wieringen, J. C.,Secular changes of growth, Netherlands Institute for Preventive Medicine TNO, Leiden.

Vildes 1924,Vildes, Janis,Materiali par lībiešu antropoloģiju', *Acta Universitatis Latviensis*, vol. 11.

Villarejos et al 1971,Villarejos, Victor M. et al.,Heights and Weights of Children in Urban and Rural Costa Rica; The Journal of Tropical Pediatrics and Environmental Child Health 17-1

Virchow 1891,Virchow, R.,Zur Anthropologie der Westafrikaner, besonders der Togo-Stämme', *Zeitschrift für Ethnologie*, vol 23.

Virchow 1923,Virchow, R.,Die altpreussische Bevölkerung, namentlich Letten und Litauer, sowie deren Häuser', *Zeitschrift für Ethnologie*, vol. 2.

Waaler Schiotz 1932,Waaler Schiotz,Körpergröße, Gewicht und sportliche Leistungskraft norwegischer Rekruten', *Anthropologischer Anzeiger.*

Waddell 1900,Waddell,The Tribes of the Brahmaputra Valley', *Journal of the Asiatic Society of Bengal 69-3*

Waldhauer 1879,Waldhauer, Ferdinand,Zur Anthropologie der Liven. Dorpat, v. Schnakenburgs L. u. T--Anstalt

Wastl 1957,Wastl,Beiträge zur Anthropologie der Negrito von Ost-Luzon', *Anthropos*, vol. 52.

Watanabe Kondo Matsunaga 1975,Watanabe, S. & Kondo,S. & Matsunaga, E.,Watanabe, S.; Kondo,S. & Matsunaga,E. (1975): Human Adaptability Volume 2. Anthropological and Genetic Studies on the Japanese, University of Tokyo Press; 1975, Tokyo

Webb Kuh Pajak Kubinova Malyutina Bobak 2008,Webb, Elisabeth A. & Kuh, Diana & Pajak, Andrzej & Kubinova, Ruzena & Malyutina, Sofia & Bobak, Martin,Estimation of secular trends in adult height, and childhood socioeconomic circumstances in three Eastern European populations', *Economics & Human Biology*, vol. 6, no. 2, pp. 228-236.

Weber Seidler Wilfing Hauser 1995,Weber, G. & Seidler, H. & Wilfing, H. & Hauser, G.,Secular change in height in Austria: an effect of population stratification?', *Annals of Human Biology*, vol. 22, no. 4, pp. 277 – 288.

Weinberg 1902,Weinberg, Richard,Vaterländisch-anthropologische Studien: Körpergröße estnischer Rekruten. Tartu.

Weisbach 1878,Weisbach,Körpermessungen verschiedener Menschenrassen, Verlag von Wiegandt, Hemppel & Parey, Berlin.

Weisbach 1889,Weisbach,Die Zigeuner', *Mitteilungen der Anthropologischen Gesellschaft in Wien*, vol 19.

Weisbach 1903,Weisbach,Die Slovenen', *Mitteilungen der Anthropologischen Gesellschaft in Wien*, vol. 33.

Weissenburg 1909,Weissenburg,Die autochthone Bevölkerung Palästinas in anthropologischer Beziehung', *Zeitschrift für Demographie und Statistik der Juden,* vol. 5, no. 9.

Wells 1952,Wells,Physical Measurements of Northern Bushmen', *Man*, vol. 52, pp. 53-56.

Weninger 1927,Weninger,Eine morphologisch-anthropologische Studie : durchgeführt an 100 westafrikanischen Negern als Beitrag zur Anthropologie von Afrika, Anthropologische Gesellschaft Wien.

Weninger 1951,Weninger,Armenier: Ein Beitrag zur Anthropologie der Kaukasusvölker; Wien : Rohrer.

Weninger Weninger 1959,Weninger & Weninger,Anthropologische Beobachtungen an Georgiern (Transkaukasien); Wien : Rohrer.

Whitwell de Souza Nicholas 1997,Whitwell, Greg & de Souza, Christine & Nicholas, Stephen,Height, Health, and Economic Growth in Australia, 1860-1940', in Steckel, Richard & Floud, Roderick: Health and Welfare During Industrialization. Chicago: U Chicago Press, pp. 379.422.

WHO/UNESCO,WHO/UNESCO,WHO/UNESCO Internet Pages

Woenno-Stat. Sbornik 1871,Woenno-Stat. Sbornik,Woenno-Stat. Sbornik

Wolf 1886,Wolf, L.,Anthropologische Forschungen im Congo-Gebiet' in Zeitschrift fuer Ethnologie 1886, p.24-33

Wu 1994,Wu, Jilau, How severe was the Great Depression? Evidence from the Pittburgh Region', in Komlos, J. (ed) *Stature, living standards and economic development: essays in anthropometric history,* Chicago, Ill. University of Chicago Press.