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# New Anthropometric History: An Analysis of the Secular Trend in Height

Laurent Heyberger

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	Given Name	<b>Laurent</b>
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	Division	RECITS (Research Center), RECITS-UTBM
	Organization	Université de technologie de Belfort-Montbéliard
	Address	90 010, Belfort Cedex, France
	Email	laurent.heyberger@utbm.fr; heyberger@voila.fr

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## Chapter 14 1

# New Anthropometric History: An Analysis 2

# of the Secular Trend in Height 3

Laurent Heyberger 4

**Abstract** In using human-height measurements as a gauge of the biological standard of living of a given population, anthropometry (in this regard not unlike demography) offers an alternative to the standard indexes of economic history. For instance, anthropometry reveals that a paradoxical phenomenon occurred during industrialization in eighteenth-century Europe: a decline in human height – in tandem with downward trends in real wages and in temperatures – was accompanied by a population increase, thereby contradicting, for the first time, the famous Malthusian theory that population growth is eventually checked by widespread famine and disease. The decreasing human height in Europe and North America in the nineteenth century, in spite of improvements in the standard of living as measured in terms of real wages income, is a reminder of the negative consequences of the early industrialization that Marx, among others, decried. In contrast, while the standard indexes record economic stagnation during the first half of the twentieth century, height increased, reflecting improvements in public health, thanks largely to progress in the field of medicine. On another front, anthropometric history, with its reliance on impartial demographic index, permits an accurate appraisal of the economic performances of totalitarian regimes and, more generally, of the well-being of all those populations who have been excluded from the standard indexes of economic and social performance: most notably, Afro-American slaves, eighteenth-century European craftsmen and peasants, and nineteenth-century Western women. 5  
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### Abbreviations 22



AGS	Adolescent Growth Spurt	23
GDP	Gross Domestic Product	24
GNP	Gross National Product	25
HDI	Human Development Index	26
MHR	Minimum Height Requirement	27

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L. Heyberger (✉)

RECITS (Research Center), RECITS-UTBM, Université de technologie de Belfort-Montbéliard,  
90 010 Belfort Cedex, France  
e-mail: laurent.heyberger@utbm.fr; heyberger@voila.fr

t1.1 **Table 14.1** Key facts of industrialization

- t1.2 • Industrialization is a global process, including technological and economic changes, but also urbanization and
- t1.3 cultural changes such as the spread of literacy.
- t1.4 • Industrialization began, in the eighteenth century, with improvements in the productivity of the textile industry and
- t1.5 in agriculture, and it ended, in the twentieth century, with the tertiarisation of the economy.
- t1.6 • During industrialization, there was a dramatic productivity increase not only in the industrial sector, but also in
- t1.7 agriculture, thanks to technological changes.
- t1.8 • During the entire period of industrialization, there was a dramatic increase in the standard of living.
- t1.9 Industrialization is not just a  sion of improved productivity in the industrial sector but rather a global – economic,
- t1.10 social, and cultural – process .


28 **14.1 Introduction**

29 Beginning with the early industrialization (Table 14.1), in Europe, about 300 years ago, huge advances

30 in the sciences, industry, and medicine caused both an unprecedented population explosion and a

31 tremendous increase in average human height. This complex interaction between technological

32 improvements and acquired, reversible improvements in human biology is called techno-physio-

33 evolution by Nobel Prize Laureate Robert W. Fogel  why did the stature of Europeans, considered

34 as an index of the biological standard of living, decrease during most of the eighteenth century? Why

35 did North Americans and Australians remain quite tall (compared with Europeans) during industrial-

36 ization? Why did the United Kingdom, the USA, and Australia, experience significant declines in

37 height whereas Japan, France, and Sweden experienced the opposite? During the nineteenth century,

38 were there significant differences in the height trends for men and women, and for white Americans

39 and American slaves? As for anthropometric changes during the twentieth century, were there signifi-

40 cant height differences between the populations of democracies and those living under totalitarian

41 regimes? For 30 years, anthropometric historians have been exploring a variety of original data in

42 order to answer these and other such questions and thereby create a more accurate portrait not only of

43 Europeans but of the populations of all five continents.

44 **14.2 Stature and the Other Economic and Demographic**

45 **Historical Indexes**

46 **14.2.1 Stature and Other Economic Indexes**

47 In the analysis of historical trends in well-being, mean height serves a double function. On the one

48 hand, it obviates a reliance on extrapolations in the absence of standard indexes of the standard of

49 living. For instance, it is nearly impossible to calculate per capita GNP or even real wages (i.e., wage


50 estimates that take into account not only income but also the cost of living) for any eighteenth-

51 century population; nineteenth-century women, because their domestic work is not included in GNP

52 estimates; and for American slaves, since they earned no wages.

53 On the other hand, when estimates of GNP, per capita income, real wages, or other data are avail-

54 able, height data can complement the standard indexes; this is the case not only for “the early-

55 industrial-growth puzzle” of Europe and the USA  d for twentieth-century industrialized countries,

**Table 14.2** Provincial differences in the quality of life according to three measures in the Netherlands, 1820–1913

	Real incomes			Provincial rankings			HDI		
	1820	1850	1913	1820	1850	1913	1820	1850	1913
Urban core	110	109	111	8	8.7	2.7	0.542	0.451	0.722
Noord-Holland	113	110	111	10	7	1	0.568	0.430	0.716
Zuid-Holland	107	109	113	9	9	3	0.522	0.482	0.722
Utrecht	109	107	108	5	10	4	0.537	0.440	0.726
High income agricultural	117	104	85	8.3	5.5	5.7	0.542	0.434	0.648
Groningen	113	94	82	8	4	7	0.526	0.398	0.638
Friesland	125	111	84	6	1.5	2	0.538	0.418	0.639
Zeeland	113	108	88	11	11	8	0.561	0.485	0.666
inland provinces	76	78	73	3.4	4.7	8.2	0.425	0.395	0.607
Gelderland	81	87	97	2	6	6	0.450	0.402	0.689
Overijssel	84	82	77	7	3	5	0.422	0.424	0.613
Noord-Brabant	70	76	69	3	8	11	0.397	0.348	0.606
Limburg	61	67	63	1	5	9	0.394	0.368	0.591
Drenthe	82	79	58	4	1.5	10	0.464	0.432	0.535
The Netherlands	100	100	100	3.4	4.7	8.2	0.489	0.421	0.649

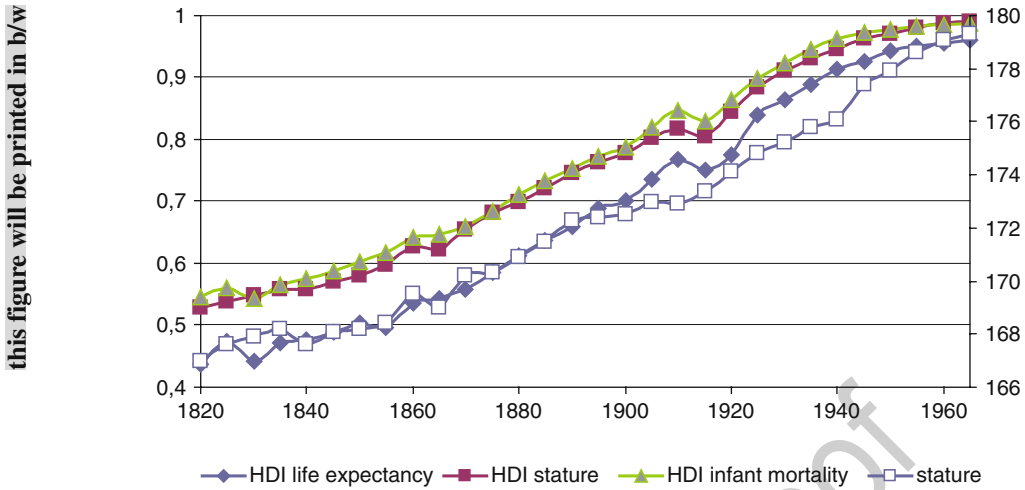
Here the HDI includes per capita GDP, life expectancy at the age of one, infant mortality, the literacy rate and mean height. This HDI describes a decline in the quality of life of city-dwellers in the mid-nineteenth century. This decline is not reflected in per capita real incomes. The negative externalities of modern economic growth and the growing social inequalities that accompany the early stages of industrialization go far to explain this gap. “Real income” means income estimates that take into account the cost of living (index 100 = national average). HDI stands for Human Development Index, GDP for Growth Domestic Product.  $N = 135$ . The “negative externalities” of modern economic growth are urban pollution, factory labour, diseases, and other threats to biological well-being.

**Table 14.3** Key facts of the HDI

1. The HDI usually comprises three measures of the standard of living: life expectancy, education, and per capita income.	t2.1
2. It is a non-weighted average of these three measures.	t2.2
3. It ranges from zero to one (the optimal standard of living).	t2.3
4. It was created in 1991 by the United Nations.	t2.4
5. It does not include the political dimensions of well-being (human rights).	t2.5
Like human height, the HDI provides an alternative to the standard economic indexes	t2.6

but also for communist countries, whose official statistics are based on a GDP calculation different from that used by liberal economists, and whose published data are not reliable.

Thus, in the Dutch case presented here (Table 14.2), during the nineteenth century, the HDI (Table 14.3) includes per capita GDP, life expectancy at the age of one, infant mortality, the literacy rate and mean height, but it does not point to the same conclusions as per capita GNP. The indexes are well synchronized for the beginning and the end of the period under consideration. Nevertheless, the HDI describes a decline in the quality of life of city-dwellers in the mid-nineteenth century (compared with their previous position but also with the inland and high-income agricultural provinces), a decline that is not reflected in per capita real incomes. The negative externalities of modern economic growth (urban pollution, factory labour, diseases and other threats to biological well-being) and the growing social inequalities that go with early industrialization go far to explain this gap between the standard economic indexes and anthropometric ones.



**Fig. 14.1** Human development indexes (HDI) and stature in Sweden, 1820–1965. On the historical scale, stature is closely correlated with other demographic indexes such as life expectancy, mortality, and infant mortality. Thus, substituting here life expectancy at age one for stature or for infant mortality when calculating the HDI provides almost identical results throughout the course of industrialization. “HDI” means Human Development Index. “Stature” means mean height (cm),  $n = 10$ . (Sandberg and Steckel 1997, with permission of the University of Chicago Press)

68 Thus, the aim of anthropometric history is to identify height trends among populations defined  
 69 by geography or social groups and to analyze these trends in terms of the standard indexes of eco-  
 70 nomic history.

71 **14.2.2 Stature and Other Demographic Indexes**

72 For numerous reasons, stature is closely correlated with education: educated parents tend to take better  
 73 care of their children during pregnancy and early childhood; they tend to provide their children with  
 74 relatively abundant cultural and economic capital; their children are spared the hardships of physical  
 75 labour and so on. The positive influence of education is noticeable even after control for income. In  
 76 other words, the link between literacy and stature is of an economic as well as cultural nature.

77 On the historical scale, stature is closely correlated with other demographic indexes: life expect-  
 78 tancy, mortality and infant mortality, which is a major component of the crude death rate and the life  
 79 expectancy. Thus, the Swedish case presented here (Fig. 14.1) shows that substituting life expect-  
 80 tancy at age one for stature or for infant mortality when calculating the HDI provides almost identi-  
 81 cal results for the entire 1820–1965 period, i.e., throughout industrialization. Stature can complement  
 82 or even replace other demographic indexes. Anthropometric history was born of a debate over the  
 83 cause of the decline in the mortality rate during industrialization: a debate between those who  
 84 claimed that the causes were nutritional and those who claimed that they were epidemiological.  
 85 Because of this lack of consensus, and for the sake of clarity, in Sects. 14.3 and 14.4 we present the  
 86 determinants of height according to crude nutrition (energy input) and net nutrition (input minus the  
 87 caloric expenditures caused by diseases, physical work, etc.).

**14.3 Practical Methods and Techniques** 88

**14.3.1 The Data Used by Anthropometric History** 89

Various problems arise when anthropometric historians process their data. Registers of convicts, migrant workers and (mostly eighteenth-century) army volunteers; nineteenth-century passports; nineteenth- and early-twentieth-century school surveys: all of these data sources are problematic because they are confined to one socio-economic group or another. Thus, the class composition of the sample must be compared with the closest census whenever possible. Furthermore, since prisons, military barracks and ships are especially crowded when times are hard, results have to be controlled for the year of measurement and the birth year, the category of the crime committed, etc. The use of statistical regression with several explanatory variables is one of the defining characteristics of anthropometric history.

Contrary to the above-mentioned sources, conscription registers, available in Europe since the end of the eighteenth century, provide information about nearly all of the men in a given birth cohort. Furthermore, there was a widespread problem of incomplete height records, partly on account of absenteeism, in France and Italy throughout the nineteenth century.

**14.3.2 The Problem of the Minimum Height Requirement** 103

Military sources pose a particular problem in the case of volunteer armies: the existence of a MHR, below which measurements are rarely recorded. Throughout the eighteenth century, the MHR and the mean height of a given population were nearly identical. The identification of the truncation point of the sample is made through visual inspection of the relevant distribution histograms, which are always expressed in the original unit of measure. Most of the statistical methods used when dealing with this problem are based on the assumption that stature follows a normal distribution pattern. However, the distortion of the curve on the left-hand side (over-representation of numbers below mean height due to bad living conditions, mainly during the AGS) makes it preferable to use, when possible, a method that does not pose the hypothesis of the Gaussian distribution and therefore does not lead to an overestimation of the mean height.

**14.3.3 Anthropometric History and Auxology** 114

Offering continuous and homogeneous serial data is one aim of historians. Thus observations are standardized, the age of subjects being limited from 23 to 49, as a rule. This policy raises auxological problems, since the AGS of all the subjects did not occur simultaneously and did not have the same amplitude that they would today, but instead varied according to the region, era, and group in question. As a result, the policy has been modified: measurements made during adulthood are now quoted according to the year of birth, since variations in adult height are best explained by living conditions in early childhood.

The maximum socio-economic influence on final height is experienced in the most intensive biological-growth periods: mostly in utero and in early childhood but also during adolescence. Nevertheless, stature is a synthetic index of the standard of living, whereas one knows precisely in which year a GDP or any other index is measured; correspondences between anthropometric and economic data must be made with great care.

126 Historians in certain fields include in their research an analysis of human skeletons belonging to  
127 pre seventeenth-century populations, unaccompanied by any corroborative written data. Thanks to  
128 such research the frontiers of anthropometric history now stretch from the Roman Empire by way of  
129 medieval Europe to precolonial America. The study of human skeletons remains, for now, a marginal  
130 aspect of anthropometric history.

## 131 **14.4 Explaining Mean Height from the Historical Point of View:** 132 **The Part Played by Inputs**

133 Mean height can be considered as an index of net nutrition, that is, total nutritional input minus the  
134 energy expended on maintaining a basal metabolism, on physical effort and on disease resistance.  
135 Although biological and medical studies stress the importance of the synergy in this double process  
136 of input and caloric expenditure, historical studies depend on sources that provide explanatory vari-  
137 ables only on the aggregate scale, thereby underestimating its importance. For the sake of clarity, we  
138 shall examine separately the respective roles of inputs and expenditures.

### 139 **14.4.1 Stature, Income and Crude Nutrition**

140 The close correlation between per capita income and mean height in the nineteenth and twentieth  
141 centuries underlines the positive influence of inputs on stature. Nevertheless, some populations have  
142 been taller than their per capita income would lead one to expect: chiefly, those of early-nineteenth-  
143 century Ireland and America; this anomaly was thanks to a protein-rich diet and a healthy environ-  
144 ment, and therefore was not directly correlated with income.

145 The positive influence of crude nutrition has been proved in many cases, mostly in the eighteenth  
146 and nineteenth centuries. For instance in Italy, the increase of food intake explains 60% of the anthro-  
147 pometric growth between 1854 and 1913, whereas an improvement in environmental conditions  
148 generally explains 30% of this growth. In antebellum America, county-level records indicate a posi-  
149 tive correlation between surplus food production and stature. This correlation was particularly evi-  
150 dent in the peripheral states, which were not yet fully integrated into a nationwide market, and  
151 where, therefore, produce was still consumed locally. The positive effects of crude nutrition are con-  
152 firmed when one adds to the equation the mortality variable, considered as an index of the quality of  
153 the epidemiological environment. At this point it becomes evident that crude nutrition and diseases  
154 have a synergic effect on stature.

155 During early industrialization, city-dwellers' nutrition was inferior to that of country dwellers, largely  
156 because the cost of transportation increased the cost of food. This discrepancy diminished in the second  
157 half of the nineteenth century, with the arrival of railways and, later, refrigerated cars and boats, which  
158 also made it possible for city dwellers to add perishable dairy products and more meat to their diet.

### 159 **14.4.2 Anthropometric Convergence and Divergence**

160 The study of anthropometric convergence and divergence among socially or geographically distinct  
161 groups allows one to test the economic theory of Kuznets, according to which social and geographic  
162 discrepancies during industrialization formed an inverted-U-shaped curve: at first relatively small;



they steadily increased, eventually levelled off, and then steadily declined. This pattern is found elsewhere as well; early in the industrialization process, an increase in income among the wealthiest part of the population translates into an increase in GNP, but has little or no influence on mean height. Since the quantity and quality of the food consumed by the well-to-do was already satisfactory, its increase did not translate into an increase in average height. On the other hand, even just a small increase in income among the lower classes is reflected in anthropometric measurements, because they used the money to purchase nutritious food, which had previously been beyond their means. Thus, the inequalities in the distribution of wealth which accompanied the rise of modern capitalism would seem to have translated into class-defined inequalities in stature. The British enclosure movement (eighteenth century), like the privatisation of communal lands in Saxony (early nineteenth century) and in Mexico and southern India (late nineteenth century), deprived peasants of essential nutritional resources and thus contributed to the decline or the stagnation in stature among the poorest portion of the British population at that time.

In the Belgian province of Liège, the height difference between the richest and the poorest reached a peak of 8 cm. in the first half of the nineteenth century and later declined, primarily because of a height increase among the poor. The same phenomenon occurred more or less simultaneously in the USA, the UK, and France. The discrepancy was particularly striking among children; the young son of an English lord would have had a 15-cm. height advantage over a street urchin like Oliver Twist. Height data for the early nineteenth century parallel income data; farm and textile labourers are the shortest, white-collar professionals are the tallest, and craftsmen are found somewhere in between. However, the proximity of nutrients still played a positive role, as testified by the fact that farmers and foodstuff traders were taller than their income would suggest.

Contrary to most techniques for measuring the standard of living, those of anthropometric history include the analysis of height trends according to gender, thereby elucidating patterns of energy input and caloric expenditure within the household. It seems that women are more sensitive to economic cycles than men, perhaps because of nutritional and other health-related discrimination, or perhaps because of an innate biological process of adaptation to deprivation. For instance, in Scotland in the 1840s, a decade marked by severe malnutrition, the average height of women steadily declined, whereas that of men, paradoxically, soared. The same phenomenon occurred among emancipated slaves in Maryland. In early-nineteenth-century Bavaria, the average height of women paralleled the unequal distribution of agricultural products among districts more closely than did that of men. However, there are at least two exceptions to this rule: in Australia in the first half of the twentieth century, and in nineteenth-century India, there was no discernible difference between the sexes when it comes to nutrition-related changes in average height. Unfortunately, since military files are the primary source of information available to anthropometric historians, data on women are scarce, and therefore a well-documented analysis of sex-specific height trends remains elusive.

**14.5 Explaining Mean Height from the Historical Point of View: The Part Played by Energy Expenditures**

**14.5.1 Stature and Urbanization**

As Rousseau and Dickens observed, the industrialization was especially hard on city dwellers, whose below-average caloric input and above-average caloric expenditure account for their below-average height. As the twentieth century approached, however, improvements in medicine and hygiene on

205 the one hand and a diminution in the physical hardships of industrial labour (tertiarisation) on the  
206 other resulted in a reversal of this trend.

207 During the early years of the industrialization, the European city was an environment with noth-  
208 ing but negative potential for physical human growth: lack of sewage systems and poor sanitation  
209 generally combined with overcrowded living conditions and child labour to create a disease-ridden,  
210 malnourished, physically diminished population. The fact that this was a world-wide phenomenon  
211 explains why nineteenth-century city-dwellers were shorter than their rural counterparts not only in  
212 the UK, but in Italy, Canada, Australia, Austria, Japan and the USA, as well.

213 There were some exceptions, but they were confined to countries where an archaic social struc-  
214 ture persisted, where cities therefore could remain relatively small, and traditional trades were able  
215 to survive (this was the case in Spain, Germany, and Russia). The height decline among New Yorkers  
216 was, despite a dramatic increase in the city's population, less than that among residents of other  
217 American cities thanks to its dominant role in the national and international wheat market, which had  
218 obliged the establishment of an efficient system of food distribution as early as the 1850s.

219 In accordance with a fundamental economic principle, countries that are late to industrialize have an  
220 advantage over those countries that were pioneers, because they can learn from the pioneers' problems  
221 and remedies. This advantage is reflected in their citizens' superior rate of anthropometric growth. For  
222 example, Japan began to industrialize only after other, industrialized nations had instituted public-  
223 health policies and researchers had proven that germs caused the spread of infectious diseases; the  
224 average height of its population, therefore, did not decline (Fig. 14.5). This was also the case in Sweden,  
225 Germany, Austria, Hungary, Poland, the Iberian Peninsula, Italy and Argentina (Steckel 2009).

## 226 **14.5.2 Stature, Diseases, Child Labour and Medical Care**

227 Japanese prefectural records for the years between the two World Wars reveal direct correlation  
228 between improvements in health services and increases in stature. In the case of backward economies,  
229 such as that of early-nineteenth-century Sweden, even just a modest increase in public-health spending  
230 may have had beneficial effects, reflected in height statistics. In France during the latter half of the  
231 nineteenth century, as well as in the first half of the twentieth century in Japan, an increase in the number  
232 of midwives in a given region was directly correlated with an increase in average height. This correla-  
233 tion demonstrates the importance of good health care in early childhood and confirms the hypothesis  
234 that, during the first year of life, such care has a greater impact on growth than does crude nutrition.

235 The impact of energy expenditure is more difficult to quantify on a historical scale than is the role  
236 of nutritional input. Nevertheless, it seems that malaria and other diseases linked to irrigated agriculture  
237 played a role in the stagnation or decline in height that occurred in India and in South-East Spain during  
238 the during the nineteenth-century and in Burma during the rice boom at the end of the century.

239 In the USA, the fact that the steepest decrease in height occurred in the coal-producing states  
240 (mainly in the Midwest) in the 1870s–1890s could be explained by the spread of respiratory diseases.  
241 In the UK, the prevalence of tuberculosis, prior to the 1860s in towns and cities may have contributed  
242 to a height decline, and the fact that the subsequent eradication of tuberculosis was accompanied by a  
243 height increase may not have been merely coincidental. In Australia, the radical decline in stature  
244 during the 1890s may have been partly due to the many epidemics, including Melbourne's typhoid  
245 fever, that afflicted urban areas.

246 Finally, child labour may have a negative influence on stature but is very difficult to measure on  
247 the historical scale and offers little help to those anthropometric historians trying to solve the early-  
248 industrial-growth-puzzle.

14.6 The Early-Industrial-Growth-Puzzle

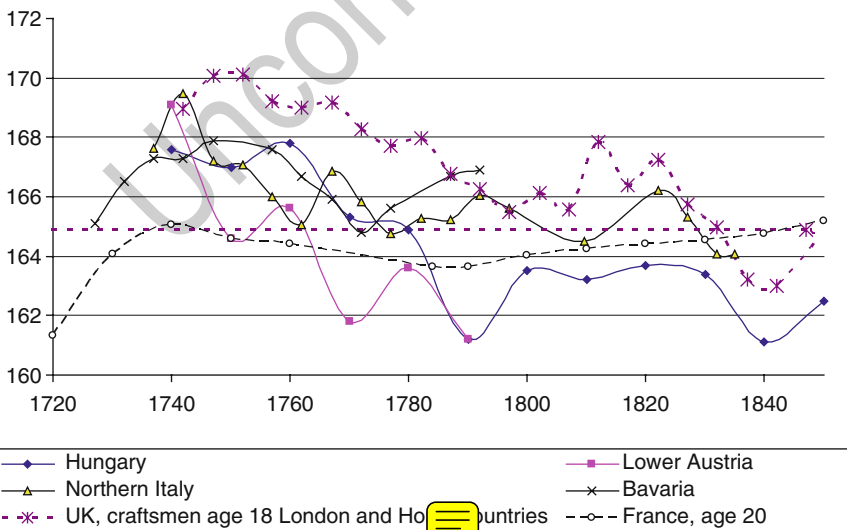
249

The social and economic history of the eighteenth- and nineteenth-century features the self-regulating relationship between population and resources, first described by Thomas Robert Malthus in 1798, on the one hand, and the more immediate human cost of the early industrialization on the other. In both matters, anthropometric history provides new evidence. It highlights two main periods during which height declined in Europe: the 1760s to the 1800s (Figs. 14.2 and 14.3) and the 1830s to the 1860s. This second decline extended to the USA, where it persisted into the 1890s.

14.6.1 The First European Decline in Height (Eighteenth Century)

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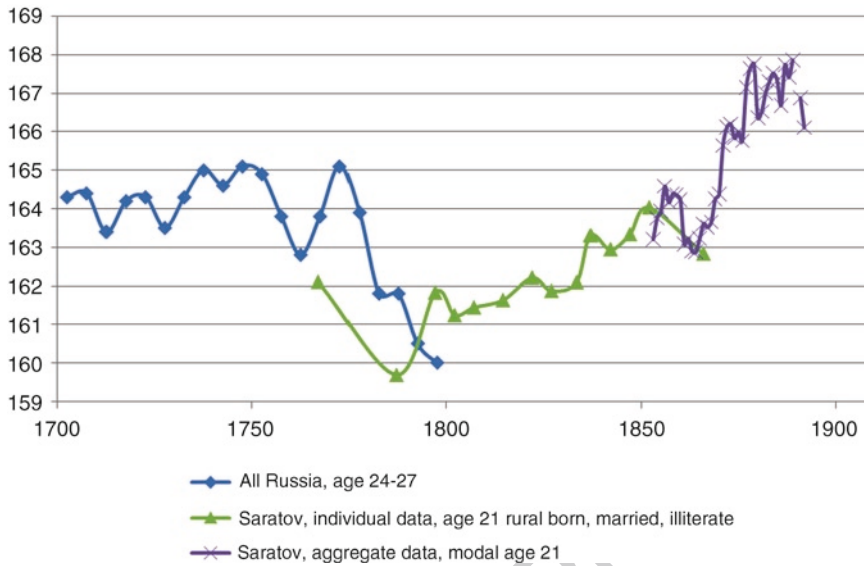
The first period of anthropometric decline shows a considerable decrease in real wages (Table 14.4), and therefore in purchasing power, simultaneous with falling temperatures and a growing population. The decline in grain production, on account of cooler temperatures, not only caused an increase in the price of bread but also had a negative impact on cattle production. Because of increased productivity in the industrial sector (chiefly textiles), the price of manufactured goods increased at a slower rate than that of agricultural products, and, for instance in Great Britain, the price of grain-based products increased at a slower rate than that of meat. Grains, therefore, were substituted for meat, making for a diet poorer in animal protein and richer in carbohydrates. The price for this dietary shift – a secondary consequence of the early industrialization (chiefly the textile industry)– was a decrease in average human height; on the positive side, it permitted the population to increase without falling into the Malthusian trap, that of a massive population decline due to starvation and epidemic disease.



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**Fig. 14.2** The early-industrial-growth-puzzle in Europe, eighteenth–nineteenth centuries. During industrialization in eighteenth-century Europe, a decline in human height went in tandem with downward trends in real wages and in temperatures. A second decline occurred during the first half of the nineteenth century, in tandem with upward trends in GDP and in real wages, hence the phrase “early industrial-growth puzzle.” Mean heights, cm,  $n = 83$ . (A’Hearn 2003; Baten 1999; Cinnirella 2008; 1989 Komlos, 2003; Weir 1997)

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**Fig. 14.3** Secular trend of stature in Russia, eighteenth–nineteenth centuries. Not unlike Europe, Saratov, a province of southern Russia, experienced a decline in height in the second half of the eighteenth century. Nevertheless, Saratov experienced no height decrease during the first half of the nineteenth century. Mean heights, cm, 1700–1900. (Mironov 2005; Mironov and A’Hearn 2008)

t4.1 **Table 14.4** Key facts of real income

- t4.2 • Income consists not only of wages, but also of all other sources of income (sales from domestic production, etc.).
- t4.3 • Income is real (as opposed to nominal) when income estimates take into account not only income but also the cost
- t4.4 of living, i.e., prices.
- t4.5 • When nominal income increases more than nominal prices, then the purchasing power of the worker increases.
- t4.6 • When nominal income increases less than nominal prices, then the purchasing power of the worker, and hence his
- t4.7 real income, decreases.
- t4.8 • The trend in real income depends mainly on which products are chosen for inclusion in the basket of products
- t4.9 that is used to calculate whether there has been a decline in nominal income.

t4.10 Real income is used to estimate the trend in the standard of living by taking into account the trend in prices

268 **14.6.2 The Decline in Height in Europe and America**

269 **in the Nineteenth Century**

270 During the 3 decades preceding the Civil War, the height of Americans declined and their mortality

271 rate increased, despite sustained economic growth. This paradox is known as the “Antebellum

272 Puzzle” since it had not occurred during the first, European, period of decline, in the late eighteenth

273 century. There was a significant decline in height at this time in the UK, as well, even as the early

274 industrialization got under way: hence the phrase “early-industrial-growth-puzzle” height declines

275 were also recorded during the first half of the nineteenth century in Italy, Hungary, the Netherlands,

276 Saxony, and some regions of France.

277 The solution to the Antebellum Puzzle may lie in the notion of net nutrition. Transcontinental

278 migration may help generate wealth, but it also results in a loss of microbial resistance of the human

279 bodies and therefore in the spread of cholera, typhoid, typhus, malaria, and dysentery, which shared

responsibility for both the declining height and the increasing mortality. An American company on a railway or on a waterway was able to profit thereby, but the height of its population declined, thereby confirming the hypothesis that height decreased on account of diseases that exploited the spreading network of transportation routes. In addition, the export to distant markets of meat products, high in protein that had previously been consumed locally had a negative effect on the nutrition, and therefore the height, of people living in peripheral regions.

The fact that only slaves maintained their stature suggests that height loss was primarily due to deficiencies in crude nutrition, for if the height loss were only epidemiological in origin, slaves' height, like everybody else's, would have declined on account of widespread diseases, whereas in fact the only blacks to register a height decrease were freed slaves. Adult slaves were a valuable commodity – their price rose by 64% relative to that of food – so (while slave children were kept undernourished, their diet improving only once they were old enough to work) their owners invested in the maintenance of their physical health.

Mexico and Canada experienced the same decline in height in the second half of the nineteenth century (in fact, Mexico's height decline extended into the twentieth century), although these countries were far less industrialized than the USA. Political turmoil helps to explain the Mexican trend; however the Canadian one is primarily due to urbanization. Australia is another example of a young country in which the development of towns, which as a rule is accompanied by a deterioration in sanitary conditions, led to epidemiological problems that account for the otherwise paradoxical phenomenon of declining height during a period of economic growth (Table 14.5 and Fig. 14.4). The extensive economic systems of three relatively young countries – the USA, Australia, and Canada – meant that at first most of their inhabitants enjoyed a high biological standard of living. Subsequently, at the end of the nineteenth century, urbanization and the development of national markets facilitated the spread of infectious diseases and thus led to decline in height, whereas in Europe height figures turned around after having hit, at mid-century, a record low.

Some European countries were spared a major decline in height during the nineteenth century. France, where industrialization began relatively early and was not concentrated in big cities was the first country to experience the demographic transition, featured a new ability on the part of parents to invest in their children's health. Sweden, where industrialization had even less of an impact than in France, enjoyed an exceptionally high rate of literacy. Along with Denmark, nineteenth-century Sweden experienced no major decline in height.

### **14.6.3 The Trends in Height in Asia and Other Parts of the World in the Nineteenth Century**

The decline in height did not extend beyond Europe and the USA; for instance, Saratov, a province of southern Russia, experienced no height decrease during the first half of the nineteenth century, nor did Argentina. This contradicts the standard, bleak image of postcolonial South America (Table 14.5). The same holds true for India (Table 14.5). Along with other demographic indexes, the stature index permits a reconsideration of the standard notion that the economic divergence between Europe and Asia dates as far back as the end of the eighteenth century. This pessimistic vision of Asia's socio-economic history, based largely on the estimations of economic performance presented by the famous economist Maddison, has been reconsidered in light of the current acceleration of Chinese economic growth. Records reveal that during the first half of the nineteenth century, average height in southern China stagnated but did not decline (Table 14.5, Figs. 14.2, 14.4, and 14.5). It was only after the first Opium War (1839–1842), by means of which

t5.1 **Table 14.5** Key points of the decline in stature during industrialization in Europe, America, Asia, and Australia,  
 t5.2 eighteenth–twentieth centuries

t5.3		Decline	Birth cohorts	
t5.4	Country	in stature	(approx. dates)	Amount of decline (cm)
t5.5	Argentina	No	1785–1839 and 1916–1950	
t5.6	Australia	Yes	1867–1893	3
t5.7	Lower Austria	Yes	1730–1799	7,9
t5.8	Belgium (Liège province)	Yes	1800–1869	1.2–3.5 (local estimates)
t5.9	Burma			
t5.10	Lower Burma	Yes	1868–1882	2.1
t5.11	Upper Burma	No	1848–1882	
t5.12	Canada	Yes	1800–1899	Ill-defined
t5.13	China	Yes		
t5.14	southern part		1840–1859	1.5
t5.15			1860–1879	1.4
t5.16	Denmark	No	1830–1962	
t5.17	France	Yes	1717–1724	2.6
t5.18			1741–1760	1.5
t5.19	Mulhouse (Alsace)		1796–1821	1.2
t5.20	Limousin (central part)		1790–1799	2.7
t5.21	Brie (near Paris)		1781–1793	1.9
t5.22			1852–1879	1.3
t5.23	Germany	Yes	1705–1744	4
t5.24	Saxony		1750–1763	1.2
t5.25			1770–1784	1.1
t5.26			1780–1839	8.1
t5.27	Bavaria		1750–1779	2.7
t5.28	Württemberg		1860–1872	2.5
t5.29			1879–1885	2
t5.30	Hungary	Yes	1740–1799	6.8
t5.31	Age 21–22		1820–1849	2.6
t5.32	India	No	1794–1899	
t5.33	Italy (northern part)	Yes	1740–1779	4.7
t5.34			1790–1819	1.6
t5.35			1820–1834	2.1
t5.36	Japan	No	1872–1965	
t5.37	Mexico	Yes		
t5.38	(northern part)		1850–1889	2.5
t5.39	The Netherlands	Yes	1810–1837	3.5
t5.40	Russia	Yes	1740–1799	5.4
t5.41	Saratov province		1755–1794	2.4
t5.42			1850–1877	1.2
t5.43	(central part)		1899–1909	2.8
t5.44			1913–1918	1.2
t5.45			1923–1934	1.8
t5.46	Spain (South-East)	Yes		
t5.47	Murcia	urban	1851–1873	1.4
t5.48		rural	1846–1873	1.7
t5.49	Sweden	Yes	1740–1780	Ill-defined
t5.50	Taiwan	Yes	1863–1883	1.6
t5.51	UK			
t5.52	(Men)	Yes	1750–1799	4.6
t5.53			1815–1859	5.3

(continued)

Table 14.5 (continued)

Country	Decline in stature	Birth cohorts (approx. dates)	Amount of decline (cm)
(Women)	Yes	1790–1815	2.5
		1835–1855	2.5
US	Yes	1830–1890	4

A'Hearn (2003), Alter et al. (2004), Bassino and Coclans (2008), Bassino (2009), 1999 personal communication, Baten (1999); Boldsen and Søgaard (1998); Cinnirella (2008a, b); Cranfield and Inwood (2007); Drukker and T... (1997); Heintel et al. (1998); Heyberger (2005); Komlos (1989, 2003); Martinez-Carrión and Perez Castejón (2008); Mironov (2005); Mironov and A'Hearn (2008); Morgan (2009); Olds (2003); Salvatore (1998, 2009); Steckel and Floud (1997); Wheatcroft (1999); Whitwell et al. (1997). Almost all countries experienced a decline in height during industrialization, in 10 countries or regions. The decline is reported if exceeding 1 cm. On the historical scale, populations can gain – or lose – on average 1–1.5 mm per year. If the answer in col. 2 is “No,” dates in col. 3 refer to the extreme dates of the quoted study

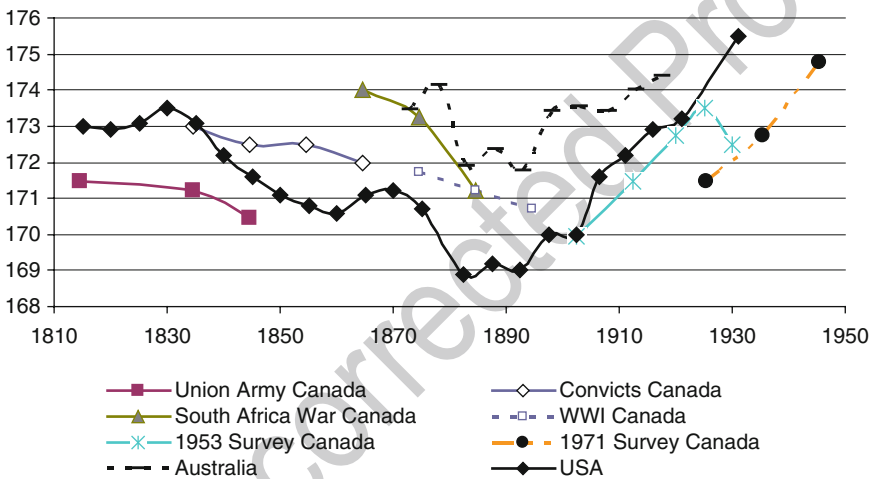
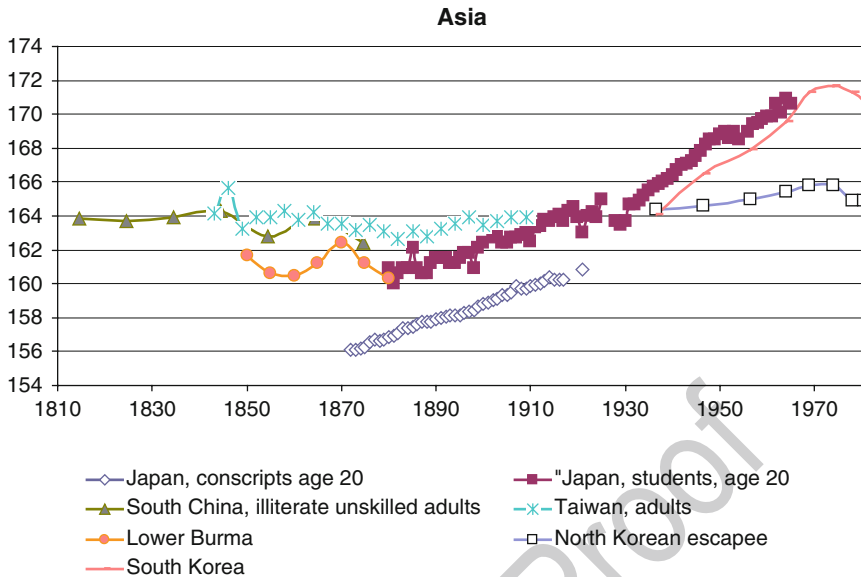


Fig. 14.4 The Antebellum Puzzle in “young countries”, nineteenth–twentieth centuries. During the nineteenth century there was a decline in height caused by urbanization and the development of national markets not only in the USA, but also in Canada and Australia. This height decline occurred in spite of improvements in the standard of living, whether it was measured in terms of real wages, of income, or of GDP: hence the phrase “Antebellum Puzzle”. Mean heights, cm, ... (Cranfield and Inwood 2007; Steckel 1991; Whitwell, de Souza, Nicholas 1997)

the British forced China to open its ports to foreign trade, that stature started to decline. However, this decline was not directly due to the intrusion of foreigners, as Marxist historians would have it, but rather to chronic social unrest in southern China throughout the second half of the century. Northern China was one of the few regions worldwide that experienced a height decline between the late 1890s and the late 1920s. An increase in income in northern India, due to the opening of the market during the third quarter of the century, was reflected in a height increase, which slowed down slightly toward the end of the century and then stagnated until the 1950s, as the population expanded. When the late period of the British colonization did not provide any improvements in the biological standard of living.

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**Fig. 14.5** Secular trend of stature in Asia, nineteenth–twentieth centuries. During the nineteenth century Asia, unlike Europe and America, experienced no major decline in height. However, in the second half of the twentieth century there was a secular upward trend in height throughout Asia, with the exception of North Korea. Mean height, cm, 1810–1970 (Bassino and Coclanis 2008; Bassino 2009, personal communication; Morgan 2004,2009 ; Olds 2003; Pak 2004)

### 333 14.7 Anthropometric History of the Twentieth Century: Political Issues

334 The economic history of the twentieth century is primarily about governmental, public policy, not  
 335 private-business cycles. Anthropometric history can expose the truth about Nazism, communism,  
 336 colonialism, liberalism: ideologies that boasted of their successes on the standard-of-living front.  
 337 Data used to be derived primarily from registers or studies of adults; now, most data are on children  
 338 and adolescents and are more abundant than previous data, thanks to the records kept by primary and  
 339 secondary schools, which are more numerous than ever. The height of a child or an adolescent is in  
 340 the short term a far more sensitive indicator of biological well-being than is the height of an adult.  
 341 Thus, height data on children and adolescents provides the most accurate gauge of the success of  
 342 public-health policies of the countries under study.

343 The purpose of historical research is not to justify injustice –or justice-. The height of American  
 344 slaves in the nineteenth century does not make slavery any less immoral. In the same way, the dete-  
 345 rioration of anthropometric indexes, which is much more notable during the economic crisis of the  
 346 first 30 years of the USSR than during the smaller – but equally disastrous – Nazi economic autarchy  
 347 of the 1930s, cannot be used to assess a so-called superiority of one model over another.

#### 348 14.7.1 Trends in Height in the Major Western Liberal Democracies

349 In the Western world, the agricultural depression of the years 1873–1896 caused anthropometric  
 350 indexes to decline but this was not, surprisingly, the case with the Great Depression for the major  
 351 Western liberal democracies – the USA, the UK, and France – in spite of the emergence of a new



scourge: mass-unemployment. One explanation is the fact that these three countries had invested in improved public-health policies in the late nineteenth century, providing their citizens with a socio-medical safety net, albeit a minimal one. Such investments are not included in the GDP of the 1930s: hence the lag between standard indexes and anthropometric ones, which measure the standard of living. Argentina provides a similar example: a decline in the cost of food helps explain a height increase during the 1930s, in contrast with the subsequent Peronist years. Again, anthropometric indexes provide a historical perspective that raises questions about the adequacy of standard ones.

**14.7.2 Trends in Height in Totalitarian and Authoritarian Regimes** 360

In contrast, children, adolescents or even – more rarely – adults suffered a height decrease during the 1930s in the following countries: the USSR, with its planned economy; Germany, because of the Nazi autarchy; Spain, where the Civil War raged; and Japan, engaged in expansionist military actions. This was also the case for the 1940s and 1970s, as far as the USSR is concerned. Nevertheless, the standard economic indexes paint a rather rosy picture of these countries, not very different from that of the positive political propaganda of the time. Mao’s Great Leap Forward (1958–1961) was accompanied by a decline in the height of adolescents that persisted until 1965: scarcely surprising in light of the fact that the resulting famine claimed around 30 million victims.

**14.7.3 Anthropometric History and Colonialism** 369

The height of Koreans declined during the 1920s, when the country was under Japanese colonial rule and a considerable amount of its rice was exported to Japan. In contrast, Taiwan actually recorded a height increase during the first years of Japanese rule; this may be because of Japanese efforts to improve sanitary conditions, in an effort to stamp out malaria. Australia offers a simpler scenario: the height of male Aborigines, relegated to the fringes of society, and confined to camps, stagnated at the beginning of the century, whereas the height of whites increased.

**14.7.4 The Second Half of the Twentieth Century: Anthropometric History, the Welfare State and the End of Communism** 376  
377

During the twentieth century, the geographical and class patterns in human heights that marked the nineteenth century began to blur. In early-nineteenth-century Great Britain, the working class was on average five inches shorter than the upper class; this gap has narrowed to one inch. After the Second World War, Southern Europe (Greece, Italy, the Iberian Peninsula) caught up with Northern Europe (Austria, Belgium, Denmark, Finland, Ireland, Sweden), despite the fact that the latter continued to experience a height increase. The rise of the welfare state meant a reduction of inequalities and thus a record-breaking adult height in Scandinavia; its demise in the USA helps to explain the current obesity epidemic there.

In Russia, the transition from communism to capitalism had negative consequences, reflected in the anthropometric indexes for babies born shortly after the dissolution of the USSR, in 1991. This

388 phenomenon, very rare in the twentieth century, confirms the idea of a chaotic Russian transition in  
389 contrast with the better-managed Chinese one, a pairing popularized by Nobel Prize Laureate Joseph  
390 Stiglitz in *Globalization's Discontents* (2002). At the same time in North Korea, one of the few  
391 communist countries still in existence, the anthropometric indexes of children began to decline after  
392 having held their own for several decades, in sharp contrast with similar indexes for South Korea,  
393 despite the fact that the two populations share one genetic heritage (Fig. 14.5).

394 The life sciences and anthropometric history have much to gain by increasing their cooperative  
395 efforts. The life sciences can provide data on a vast array of contemporary socio-economic determi-  
396 nants of height. In turn, anthropometric history can provide historical data that offer new perspec-  
397 tives on current socio-economic policies: not only their causes, but also their possible consequences  
398 (Steckel 2009).

### 399 Summary Points

- 400 • An index of the biological standard of living.  
401 Contrary to the standard indexes of the standard of living such as per capita Growth Domestic  
402 Product, consumption, and wages, the mean-height index helps to account for the negative exter-  
403 nalities of modern economic growth. The mean-height index is especially useful when it comes  
404 to analyzing eighteenth- and nineteenth-century populations for which indexes are either unreli-  
405 able or simply nonexistent.
- 406 • The existence of the Minimum Height Requirement (MHR) represents the main statistical diffi-  
407 culty that anthropometric history has had to overcome. Reliable methods of analysis are now  
408 available to resolve this problem.
- 409 • Not only overall income and food-consumption levels, but also their distribution among social  
410 and ethnic groups and between the sexes must be taken into account –whenever possible- in any  
411 analysis of height trends in a given population over the course of history.
- 412 • The high price and scarcity of nutritious food, overcrowded and unsanitary housing, spreading  
413 diseases, and inhuman labour conditions go far to explain the decline in average height among  
414 city dwellers during the early years of the industrialization.
- 415 • During the second half of the eighteenth century, as a result of mounting population pressure and  
416 falling temperatures affecting European countries' mainly agrarian economies, the height of  
417 Europeans declined. However, the direst consequences of the population principle proposed by  
418 Malthus were not realized, thanks to certain beneficial aspects of the early industrialization but at  
419 the cost of malnutrition caused by a decline in the nutritional quality of most Europeans' diets.
- 420 • Whereas the standard economic indexes emphasize a steady improvement in the first half of the  
421 nineteenth century, the stature of Americans and Europeans declined; this is the human cost of the  
422 early industrialization, paid by city-dwellers as well as their rural counterparts. At the same time,  
423 heights in China and India remained constant.
- 424 • Under twentieth-century totalitarian and authoritarian regimes, children and adolescents paid the  
425 human cost of the political decisions made by dictators. This was the case in Hitler's Germany,  
426 Stalin's USSR, and Mao's China.

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# Author Queries

Chapter No.: 14      0001279043

Queries	Details Required	Author's Response
AU1	Please provide article titles for all journals.	
AU2	Please provide in-text citation of Reference  nnan et al. (1994, 1997), Komlos (1998, 2004), Fogel (2004), Steckel (1998).	

Uncorrected Proof