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## On the Biological Standard of Living of Eighteenth-Century Americans: Taller, Richer, Healthier

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John Komlos:

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On the Biological Standard of Living of Eighteenth-Century Americans:  
Taller, Richer, Healthier

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Abstract:

This study analyses the physical stature of runaway apprentices and military deserters based on advertisements collected from 18<sup>th</sup>-century newspapers, in order to explore the biological welfare of colonial and early-national Americans. The results indicate that heights declined somewhat at mid-century, but increased substantially thereafter. The findings are generally in keeping with trends in mortality and in economic activity. The Americans were much taller than Europeans: by the 1780s adults were as much as 6.6 cm taller than Englishmen, and at age 16 American apprentices were some 12 cm taller than the poor children of London.

JEL: N11, N31, I12, I31

Key Words: Anthropometrics, Living Standards, 18<sup>th</sup> century, colonial US

While the extremely rapid – and historically unprecedented - population growth in the New World enables us to infer indirectly that the physical environment must have been quite propitious to the health of its inhabitants relative to that of Europe, reliable quantitative evidence substantiating this view in the colonial and early national periods remains somewhat sparse.<sup>1</sup> Conventional indicators of living standards such as income, wealth, and per-capita GNP are limited both regionally and temporally, or are based on either backward extrapolations of nineteenth century values or on Jones's monumental study of the wealth distribution at the time of the revolution (Jones, 1980).<sup>2</sup> Our knowledge of the demographic characteristics of the population is also incomplete prior to the first federal census of 1790, and regional and local studies enable us to make few generalizations with much confidence, particularly for the country as a whole. Though all estimates confirm that the fertility rate was extremely high – around seven to eight live births per married woman, - mortality trends are much more difficult to document, because regional and local variation was considerable (Haines, 2000, p. 163). There is consensus only in that mortality rates were lowest in New England and the Mid-Atlantic states followed by the Upper- and then by the Lower South. Yet, the lack of systematic information on the health (morbidity) of the population is an additional factor that inhibits broad generalizations about the biological welfare of eighteenth-century Americans (Duffy, 1953)

This limited evidential basis has led historians to the analysis of extant anthropometric evidence to gain further insights into this complex of issues. Among the first startling revelations of the this research program was the finding that the average height of soldiers who fought in the Revolutionary War was an astonishing 172.8 cm (68.0 inches), well above European standards for a very long time to come – even that of the aristocracy (Sokoloff and Villaflor, 1982, p. 457; Fogel, 1986, p. 511).<sup>3</sup> Sokoloff and

Villaflor's result made it crystal clear that the low population density and abundant natural resources of the New World combined with the diligence, hence productivity, of the American population, conferred considerable – until then unknown - biological advantages on its inhabitants.<sup>4</sup> Although these benefits may not have translated immediately into higher per-capita incomes per se, by the early national period, per capita income in the United States might well have exceed those then prevailing in the mother country (Prados de la Escosura, 2000; Steckel, 1999). Thus, very shortly after its founding, the U.S. population became not only the tallest, but also one of the richest in the world, and life expectancy, too, at least in New England was well above European norms.<sup>5</sup>

To be sure, the physical stature of a population ought not be conflated with the standard of living. Rather, it is useful to distinguish between conventional conceptualizations of living standards (based on monetary aggregates), and the biological well-being of a population. The biological standard of living is, thus, meant to indicate in a historical context how well the human organism thrive in its socio-economic and epidemiological environment. The concept is conceived so as to capture the biologically relevant quality-of-life component of welfare, and acknowledges explicitly that the human experience is inherently multidimensional: welfare encompasses more than the command over goods and services. Health in general, including the frequency and duration of sickness, the extent of exposure to diseases, and longevity all have a contribution to welfare independent of income.

The United Nations acknowledged these shortcomings of the conventional measures of living standards by formulating a human development index, that merges such factors as life expectancy, education, and, of course, income as well. As one of the reports stated, „Human development is the end -- economic growth a means. So, the

purpose of growth should be to enrich people's lives. But far too often it does not.... there is no automatic link between [economic] growth and human development (United Nations, 1996, p. 1). Hence, we use anthropometric indicators as proxy measures for biological welfare. To be sure, by no means do they measure the contribution of all goods and services to well-being, and therefore they lay no claim to being a universal indicator of living standards.

Physical stature is an ordinal measure of the biological standard of living. A certain level of height does not necessarily have a unique counterpart in other dimensions of well being, such as income, morbidity or mortality. It has, however, been documented that the relationship between height and morbidity is a "U" shaped function. Optimum height in developed economies is about 185 cm. Thereafter, increases in height become disadvantageous to health. Moreover stunting in childhood is associated with health outcomes throughout the life course (Costa and Steckel, 1997).

That Americans were the tallest in the world in the eighteenth century – and remained so until the twentieth - mirrors the benefits of low population densities, a healthier disease environment, and the seemingly endless supply of highly productive arable land in the New World that provided an abundant source of nutrients including proteins beneficial to the human organism.<sup>6</sup> There were essentially no Malthusian constraints on population growth.<sup>7</sup> In vivid contrast, the rapid demographic expansion in Europe after c. 1760 brought about diminishing returns to labor in the agricultural sector, thereby impinging on the per capita availability of nutrients (Komlos, 1994, 1998).

The anthropometric evidence on eighteenth century Americans has been limited to two sources: military enlistment records and runaway slave advertisements. In order to broaden the evidential basis on the biological standard of living in colonial and early-

national America data were gleaned from newspaper advertisements pertaining to runaway apprentices and military deserters (ICPSR Data set no. 9721). This is the first estimate of the height of American youth in the 18<sup>th</sup> century as well as those of soldiers known to have been born in America. In contrast to previous studies, we also adjust our estimates in order to account for the fact that a minimum height requirement was imposed on soldiers.<sup>8</sup> The results indicate that heights declined somewhat at mid-century, but increased substantially thereafter. The findings are generally in keeping with trends in mortality and in economic activity. By the end of the century Americans were as much as 6.6 cm taller than Englishmen, and at age 16 American apprentices were some 12 cm taller than the poor children of London.

### The Sample

Advertisements for runaways were published regularly in newspapers in the hope of apprehending those who broke their obligations and fled either their masters (apprentices), or their military regiments.<sup>9</sup> The notices generally include the name, age, and physical description of the individuals in question, while the place of birth is mentioned much less frequently.<sup>10</sup> The references to physical stature of apprentices were based on the recollection of masters, and not on actual measurements.<sup>11</sup> This is unlikely to be a serious source of bias, insofar as masters had an incentive to recall the height of runaways as accurately as possible, because their return depended upon it.<sup>12</sup> In case of the deserters, the officers did not need to resort to memory to recall their physical stature, because they had a written record of it obtained at mustering.<sup>13</sup>

We presume that the height of the runaways did not differ systematically from those of the population from which they originated. In case of apprentices, this assumption is supported by the evidence that their height profile is situated precisely where one would expect on the basis of their social status and geographic origin. Insofar

as apprentices were mainly (84%) Northerners who were invariably shorter than Southerners, it is reasonable that the height profile of the apprentices was uniformly below those of Georgian convicts (Figure 1). Moreover, the anthropometric research of the last two decades has found without exception that height within a population correlated positively with social status. An exception to this generalization has not been found. As a consequence, it is quite reassuring that the apprentices were shorter than West Point cadets, whose families were undoubtedly better off than those of the apprentices.

### **Figure 1 About Here**

Similarly, there is reason to think that deserters were representative of all enlisted men. This is the case, because desertion, as running away in case of the apprentices, had a considerable psychological component, and must have depended in large part on group cohesion and treatment by the officer or master. In addition, knowledge of the terrain, access to a social support network, and such opportunistic considerations as timing of the flight must have been more important components of the willingness to run away than mere physical attributes. Though robustness might have given a slight advantage initially, it must have been minimal in comparison with the possibility of speedy apprehension with the use of horses and would have provided little, if any, advantage in evading legal authorities on route. It is also reassuring that, in the main, the average height of the military deserters is quite comparable to those found in muster rolls.<sup>14</sup> This implies that the inferences drawn on the basis of these data do not depend as much on the nature of the sample itself as on the procedure of analysis.



## **Table 1 About Here**

### Apprentices

Data were collected on runaway apprentices between the ages of 14 and 23 born between the 1730s and the turn of the nineteenth century (Table 1). These records are valuable because they provide the very first evidence on the physical stature of American youth at such an early date.<sup>15</sup> The social status of the apprentices cannot be ascertained from the advertisements, but they probably originated among the middling sorts.<sup>16</sup> The growth profile is estimated using regression analysis in which, in addition to the age of the apprentices, their decade of birth, place of birth (if known), and state in which the advertisement appeared were entered.<sup>17</sup> Those of unknown birthplaces were included in the analysis.<sup>18</sup> The results pertain to the apprentices resident in Pennsylvania, the state in which most of the advertisements were found.<sup>19</sup> The age-by-height-profile reveals an early and pronounced adolescent growth spurt (growth velocity) between ages 14 and 15 of 9.1 cm (3,6 in). Both the intensity of the growth spurt, and its early onset are signs of high nutritional status by contemporary norms (Table 2).<sup>20</sup> The trend over time indicates a considerable decline in nutritional status in the 1740s of some 2 cm, of which half was recovered immediately in the 1750s. Thereafter, heights remained constant until the 1790s (Figure 2).

## **Table 2 and Figure 2 about here**

The height-by-age profile of the white adolescents is comparable to those of runaway slaves of the eighteenth century and consistently above those of slaves transported from the upper to the lower South in the nineteenth century (Figure 1 and Table 2). Their height advantage is particularly noticeable at age 20, by which time the apprentices were 2.6 cm (1.0 in) taller than the transported slaves. The inference is that the free youth probably did enjoy some nutritional advantages over their slave

counterparts, but not overwhelmingly so. This is particularly the case inasmuch as the slave adolescent growth spurt tended to be smaller (among the transported slaves) and occurred at a later age of 16 or 17 (in both slave samples) than among the apprentices. Nonetheless, the similarity between the height profiles implies that free parents probably did not provide far greater amounts of nutrients to their children than did slave owners for their human property.<sup>21</sup> Both groups were rather short by modern standards until they reached adolescence,<sup>22</sup> when catch-up growth occurred as they entered the labor force,<sup>23</sup> and received additional nutrients as a form of remuneration, or efficiency wages (Steckel, 1987).<sup>24</sup>

The apprentices were consistently much shorter than 19<sup>th</sup> century white youth, including both the middle-class cadets of the West Point Military Academy, and the Georgia convicts (Figure 1). This is not surprising, given that the cadets came from higher-status families, and that Southerners were invariably taller than Northerners. Yet, by age 20 the apprentices were able to catch up to the stature of Georgia youth. International comparisons reveal the immense nutritional advantages of the New World: the lower-class American apprentices were as tall as contemporary middle-class German youth, and at age 15 and 16 by as much as 8 cm (3.1 in) taller than their lower-class German counterparts (Figure 3).

### **Table 3 and Figure 3 about here**

#### Soldiers

Nearly 4,000 observations were collected pertaining to American army deserters.<sup>25</sup> Sailors, Europeans, and those of unknown provenance are excluded from the analysis (Table 3).<sup>26</sup> We confine our investigation to adults born in America, but do not include the handful of men known to have been born in the Lower South (N = 15) in order to obtain as accurate a trend as possible.<sup>27</sup> We do not include data with unknown

ages or unknown birthplaces. In contrast to Sokoloff and Villaflor's and to Fogel's procedure, we discard the few observations (.03 %) to the left of the minimum height requirement (mhr) of 65 inches (165.1 cm) in order to control for variations in the stringency with which this regulation was enforced, and also exclude men of unknown provenance.<sup>28</sup> Those older than 20 are included in the truncated OLS regression, and dummy variables control for ages 20 to 22.<sup>29</sup> Those known to have been born in a town (N = 27) were 1.7 cm shorter on average (sig. = 0.1). The reported trend (based on 516 observations) pertains to the height of rural northern adults (older than 23 years). The regression results were adjusted in two ways: 0.5 cm was subtracted in order to allow for the possibility that the advertised heights were intended to describe the deserters with their boots on, and secondly, the results were adjusted to account for the fact that the men smaller than the mhr were not accepted into the military, and hence are absent from the sample. Thus, the findings do not pertain to soldiers, but, instead, reflect the estimated average height of the American population of free Northern men from whom the soldiers were recruited. The basic result, robust across all specifications, is that physical stature declined in the first half of the century by some 4.3 cm (1.7 in) and reached a trough of 169.6 cm (66.8 in) among the birth cohorts of the 1740s (Figure 4). Estimated heights increased thereafter continuously and substantially until reaching 173.9 cm (68.5 in) in the 1780s. A reversal of 2.7 cm (1.1 in) is evident at the end of the century.<sup>30</sup> The trend in the height of young soldiers cannot be estimated accurately on account of the small number of observations<sup>31</sup> (N = 96 for ages 17-20). It is, nonetheless, worthy of note that a marked decline is evident at mid-century among the youth as well.<sup>32</sup>

**Figures 4 and 5 about here**

To be sure, the substantial decline in heights until mid-century is based on a handful of observations until 1739 (N = 92).<sup>33</sup> Yet, it is important in this regard that the decline corresponds quite well to the decline in the physical stature of apprentices, though their trend diverges considerably thereafter. Moreover, it is also noteworthy that the distribution of heights in the early period is quite similar to the one obtained at the end of the century, when heights again rose to levels comparable to the early part of the century (Figure 5). This resemblance suggests that our sample is not distorted by the small number of observations among the birth cohorts of the 1720s and 1730s. We also have very tall men among the 1720s and 1780s birth cohorts with mean raw height before adjustment of 175.2 cm. These heights are comparable to the amazing mean of 177.3 cm reported on the basis of 14 skeletal remains found at Ft. William Henry of soldiers who died around mid-century and must have been born at the beginning of the period under current examination (Stegmann, 1986). The distributions reveal additionally, that in the middle period there were clearly a larger number of shorter men in the 65 - 67 inches category. This suggests also that the middle period had an excessive number of shorter men.

Admittedly, the negative trend does diverge from the results reported previously for the first half of the eighteenth century, according to which heights were either increasing slightly, or were remaining constant (Figure 4).<sup>34</sup> This discrepancy could be due to the fact that prior analysis was not confined to soldiers born in the New World.<sup>35</sup> Moreover, heights of runaway slaves and the apprentices did not decline in stature (Figure 2). What could explain this divergence? The slaves were born overwhelmingly in the South, while the soldiers mostly in the North, so a divergence in the trends might be due partly to the different geographic provenance. The differences in the trend in the height of apprentices and that of soldiers might be due to the fact that adults could

benefit from a number of extra years of nutritional intake. If food consumption changed primarily in the late teens and early twenties, then it is more likely to have shown up among the adults than among the youth. Nonetheless, all in all, the trend ought to be considered somewhat controversial until further evidence is available.

The results on the adults appear more reliable after mid-century, because the number of observations is much larger. The trend is clearly positive until in the 1780s by which time the same height was reached as in the 1720s. These estimates essentially corroborate earlier findings: the other studies also found that height of soldiers increased until the 1780s only to decline in the 1790s (Figure 4).<sup>36</sup> This implies, in turn, that the biological well being of Americans born after the revolution must have improved substantially.

### Conclusion

Anthropometric history enables us to illuminate the interaction of complex demographic, economic, and biological processes for an epoch when other indicators of well-being are rare, not extant at all, or are controversial. In spite of all their limitations, the new height data under consideration provide rare, even if not very sharply focused glimpses into the early history of the biological standard of living in the New World. The analysis is based on two distinct data sets: on apprentice youth and on soldiers who deserted. In case of the apprentices, this is the very first evidence on free American youth in the 18<sup>th</sup> century, and it situates for the American growth profile in a domestic and international context. Evidently, American youth were much better nourished than their European counterparts. Admittedly, the data set does have its own limitations. It has few number of observations at the beginning of the period under discussion and at younger ages. Hence, the tentative nature of some of the conclusions should be taken into consideration in future research.

The height profile of the free apprentices reveals that their nutritional status was quite similar to that of the slave population in the New World, and to that of middle class youth in the Old. This implies, in turn, that the nutritional intake of children in lower-class free American families must have been fairly similar to those of slave children. In both cases children were apparently not given much protein-rich food until they entered the labor force as teenagers (Steckel, 1987; Rees, Komlos, Lang, Woitek, 2001).<sup>37</sup> However, insofar as mortality among slave youth was at twice the level of free children, the generalization obviously does not apply to living standards in general (Bodenhorn, 1998, Table 3; Steckel, 1986). American apprentices, who were not among the elite by any means, and whose social status could, on average, be described as middling-sort, were as tall as middle-class German youth, and much taller than their lower class European counterparts (Figure 3).<sup>38</sup>

The advantage of our analysis of the military data is that it is confined to the height of men known to have been born in America. Sokoloff and Villaflor did not restrict their analysis to American-born men, and Fogel probably did not either. As a consequence, they were unable to estimate changes in American physical stature precisely (Figure 4). Furthermore, they also did not correct for the fact that the military enforced a minimum height requirement that meant that shorter men were excluded from their sample. Part of the increased volatility in heights reported above can be ascribed to the fact that we have adjusted our estimates for the truncated height distribution due to the minimum height requirement. For example, Fogel's height estimates increase by 1.5 cm between 1750 and 1780, while our estimates increase by 2.7 cm, but 1 cm of the latter increment was due to the adjustment for the truncation bias. Our "raw" estimates increase by only 1.7 cm, almost identical to prior estimates (Figure 9). Nonetheless, both the previous and current results confirm the biological

advantages of the New World already in the 18<sup>th</sup> century: the height of Americans were comparable, in fact, to many modern populations.

Admittedly, more archival research is needed before we can ascertain with greater confidence the secular trend in the biological standard of living of the population of the British Colonies of North America prior to the middle of the eighteenth century. The small number of height observations in our sample prior to 1739 (N = 92 soldiers, and N = 32 apprentices) do not lead to confident inferences for the first half of the 18<sup>th</sup> century, beyond raising the possibility of a falling trend.<sup>39</sup> Yet, the soldiers born in the 1740s and 1750s were short relative not only to the earlier cohorts, but also to later ones, and it is reassuring that the decline among the 1740s birth cohort is similar among both the soldiers and the apprentices.

#### **Figures 6, 7, 8 about here**

Yet, a number of collateral evidence suggests that the data under analysis should be taken seriously. For example, evidence on gnp and on life expectancy during the first half of the century lends credence to the mid-century diminution in physical stature. Estimates of per capita gnp, even if approximations, indicate a marked decline during the revolution (Figure 6) (McCusker, 2000, p. 156).<sup>40</sup> Similarly with life expectancy: in Massachusetts, the state for which colonial mortality rates are best documented, life expectancy declined during the first half of the century (Haines, 2000, p. 4).<sup>41</sup> Furthermore, the inhabitants of several colonial towns, including Andover, MA (1735-50), Boston (1745-1755), and Philadelphia (1745-1764), experienced a marked, even if temporary, increase in mortality (Figure 7) (Gemery, 2000, Table 5). Moreover, Kasakoff and Adams (2000, 117) document a substantial decline in period life expectancy in the 1750s with rapid improvement thereafter, reaching a peak at the end of the century<sup>42</sup> (Figure 8). Obviously, the shortest soldiers in this sample, born in the

1740s, would have lived through the decade of the 1750s, and if the disease experience in this decade was as unusually adverse, as the Kasakoff and Adams study suggests, then the decline-in-height thesis does gain in plausibility. If lagged by a decade, their longevity series has an extremely close correspondence with the height trends found in this study. All in all, the demographic evidence suggests that the epidemiological environment was by no means improving consistently during the first half of the century, and was probably even deteriorating markedly, even if sporadically, thus corroborating to some extent our finding of a negative height trend in this period among the soldiers. (Figures 7 and 8).

In contrast to the results pertaining to the first half of the century under discussion, it is quite probable that the biological standard of living was improving substantially among Northern free men born after mid-century, corroborating earlier findings in both the level and trend in heights, and correlating quite well with reported significant gains in life expectancy (Gemery, 2000, Table 5; Fogel, 1986, p. 465). The increase in New-World adult heights is also in keeping with the limited evidence we have on dietary trends.<sup>43</sup> We rely in this regard more on the evidence in the trend among soldiers than among the apprentices, because adult height reflects the nutritional intake of a longer period than those of the youth, and consequently, provide a more accurate history of nutritional status.

Moreover, American men who were born during the first half of the century were only slightly taller than their English cousins, but their height advantage increased significantly thereafter.<sup>44</sup> Insofar as European heights decreased, while American heights increased after mid-century, the height advantage of the latter became quite pronounced by the 1780s: possibly as much as 5.5 cm (Table 4). This anthropometric



evidence provides new insights on the relative advantages in biological well-being of the New World population.

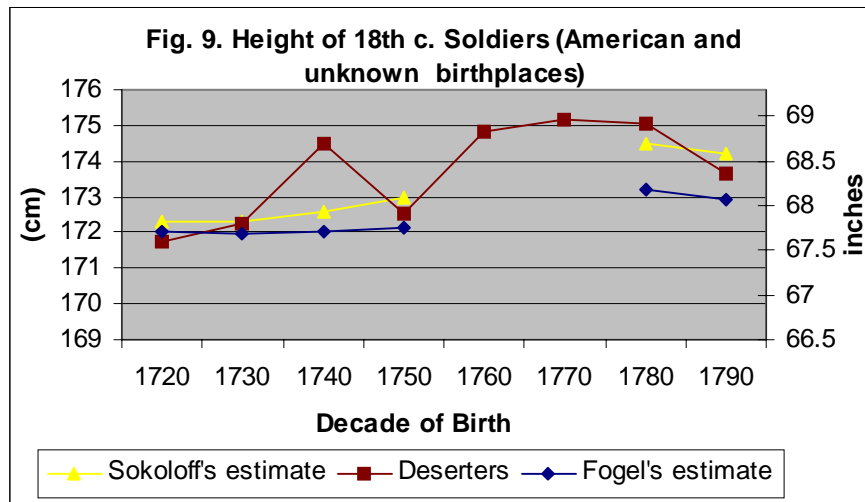
#### **Table 4 about here**

More research is obviously needed to resolve the inconsistencies between the various estimates, but much speaks for taking the evidence at hand as the best estimates available. The increasing trend in the physical stature of American adult men corroborates the commonly accepted notion that the economy of the colonies was growing robustly during the second half of the century, interrupted - temporarily, to be sure - by the disruptive effects of the revolution (McCusker and Menard, 1991, p. 268). Not only socially and politically was America exceptional from the very beginning of the New Republic: it had abundant natural resources, including productive soil, a temperate climate, low population density, and an improving epidemiological environment in which the human organism could thrive.<sup>45</sup> The generations of Americans born after the birth of the new republic was no doubt taller, richer, and healthier than the populations left behind in the Old World. This was by no means a small achievement at the threshold of the industrial age, a time when Europeans were increasingly feeling the binding Malthusian resource constraints associated with the demographic revolution.<sup>46</sup> Consequently, Europeans experienced a widespread decline in physical stature, in marked contrast to their relatives across the sea. The American apprentices at the turn of the nineteenth century literally dwarfed the “Oliver Twists” of London by a full 12 cm (at age 15) (Figure 3), and even relatively well nourished Austrian boys were 7 cm below American standards. These results reveal most vividly the biological advantages of the new continent. No wonder then, that so many Europeans were tempted to cross the ocean in subsequent centuries in search not only of a more rewarding, but also a more robust and healthier life.

## Acknowledgement

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## Appendix



## Newspapers consulted

CT: The Connecticut Gazette (New Haven, 1755-1759, 1763-1820); The Connecticut

Courant (1764-1820)

DC: Washington Advertiser and National Intelligencer (1801-1814)

DE: The Delaware Gazette; or The Faithful Centinel (1785-1790)

GA: The Augusta Chronicle and Gazette of the State (1789-1806); The Gazette of the

State of Georgia (Savannah, 1763-1796) The Georgia Gazette (Savannah, 1763-

1796); The Royal Georgia Gazette (Savannah, 1779-1781)

KY: The Kentucky Gazette (Lexington, 1787-1820); Knoxville Gazette (1792-1803)

LA: The Louisiana Gazette (New Orleans, 1804-1812); Moniteur de la Louisiane 1802-

1803, 1811-1812)

MA: Boston Chronicle (1767-1770); Boston Evening Post and Chronicle (1752-1783);  
The Boston Gazette and Weekly Republican Journal (1719-1798); Boston  
Independent Ledger (1778-1781); Boston Evening Post (1735-1784); Boston  
Independent Ledger (1778-1786); The Boston News-Letter (1704-1776); Boston  
Patriot (1809-1820); New England Chronicle (Boston, 1776-1820); New England  
Weekly Journal (Boston, 1727-1741)

MD: Maryland Gazette (1729-1789)

NC: The Cape Fear Mercury (Wilmington, 1769-1775); The North Carolina Gazette (New Bern, 1751-1784)

NH: The New Hampshire Gazette (Portsmouth, 1756-1820)

NJ: The New Jersey Gazette (1777-1786)

NY: New York Gazette (1726-1739); New York Gazette or Weekly Postboy (1744-1773); New York Mercury (1752-1768); New York Weekly Journal (1733-1751)

PA: American Weekly Mercury (Philadelphia, 1719-1746); Carlisle Gazette (1785-1816); Freeman's Journal (Philadelphia (1781-1790); Pennsylvania Gazette (1768-1775); PA Journal (Philadelphia, 1742-1793) Pennsylvania Journal and Weekly Advertiser (1773-1793); Pennsylvania Packet and The General Advertiser (Philadelphia, 1771-1790); Pittsburgh Gazette (1786-1825); Wöchentliche Phil. Staatsbote (1762-1779)

RI: The Newport Mercury or Weekly Advertiser (1758-1820); Providence Gazette (1762-1825)

SC: Charleston Gazette (1778-1780); The South Carolina Gazette (Charleston, 1732-1753)

VA: The Virginia Gazette (Williamsburg, 1736-1780); Virginia Herald and Fredericksburg Advertiser (1792-1810)

VT: Vermont Gazette (1783-1792)

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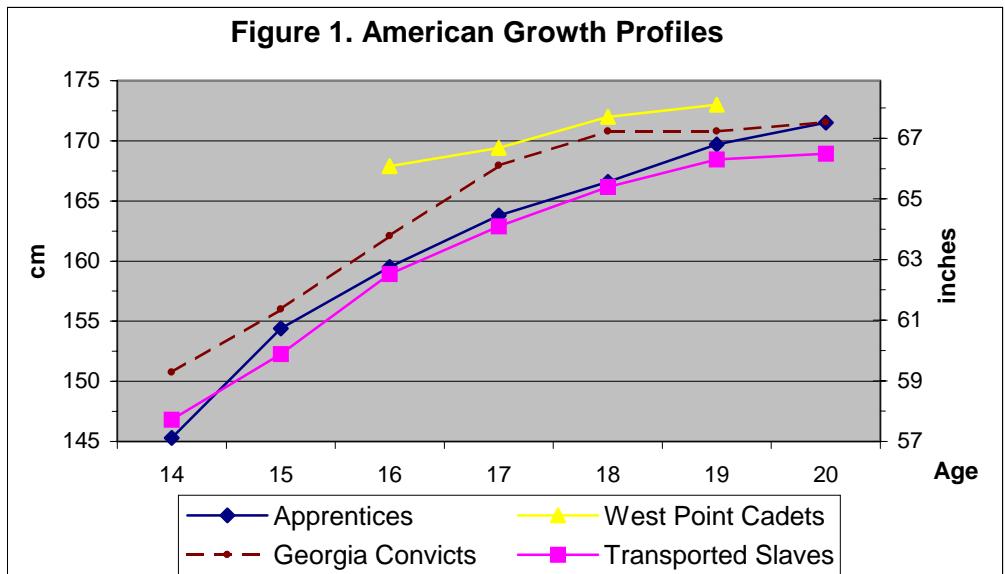
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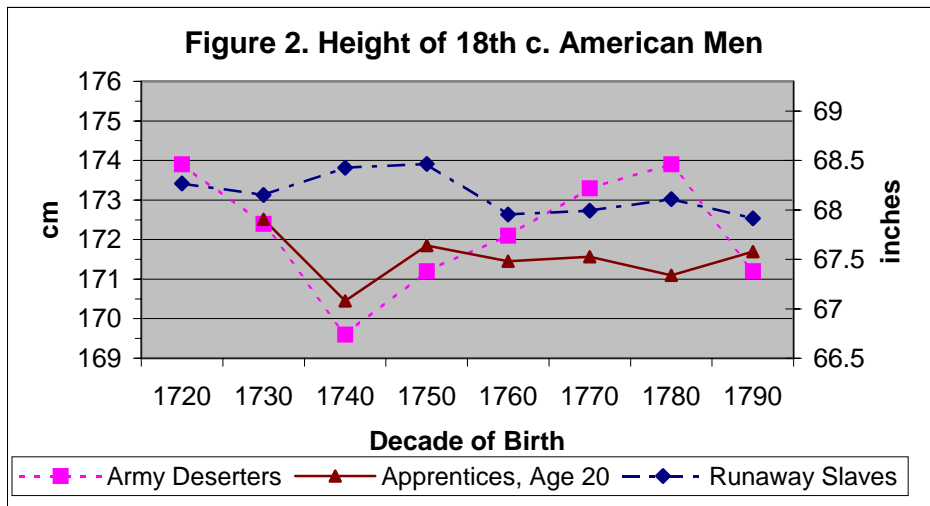
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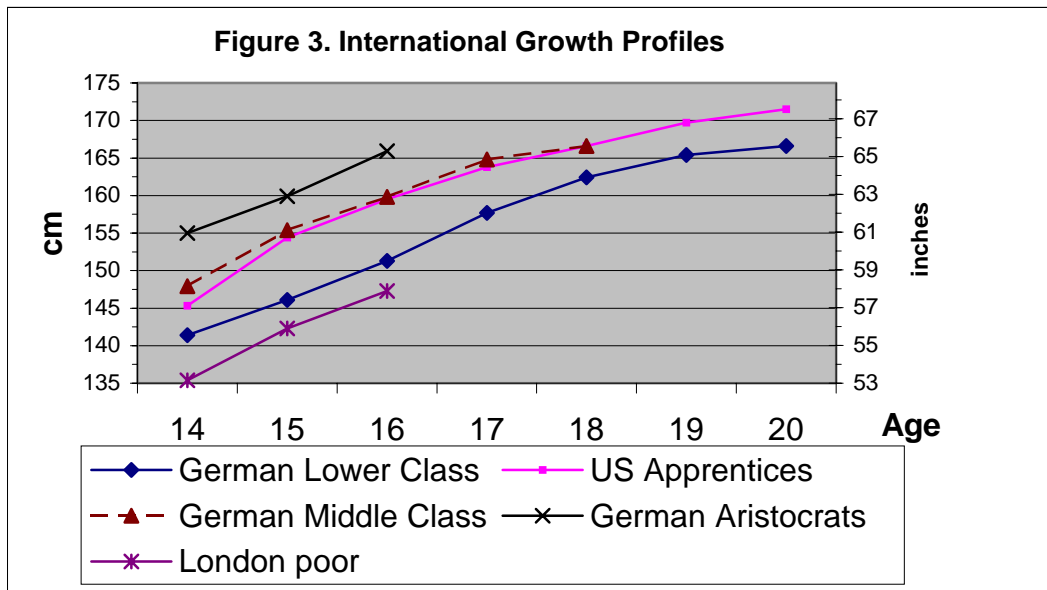
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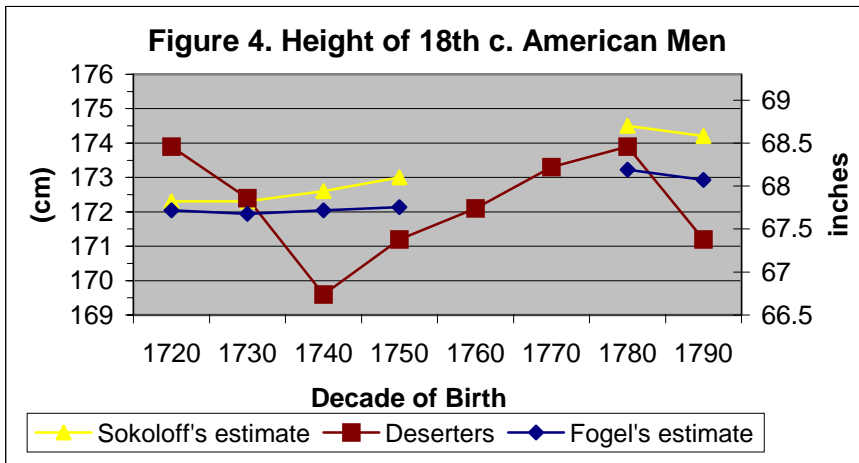
Sources: Table 1; Steckel, 1979; Komlos, 1987; Komlos and Coclanis, 1997.



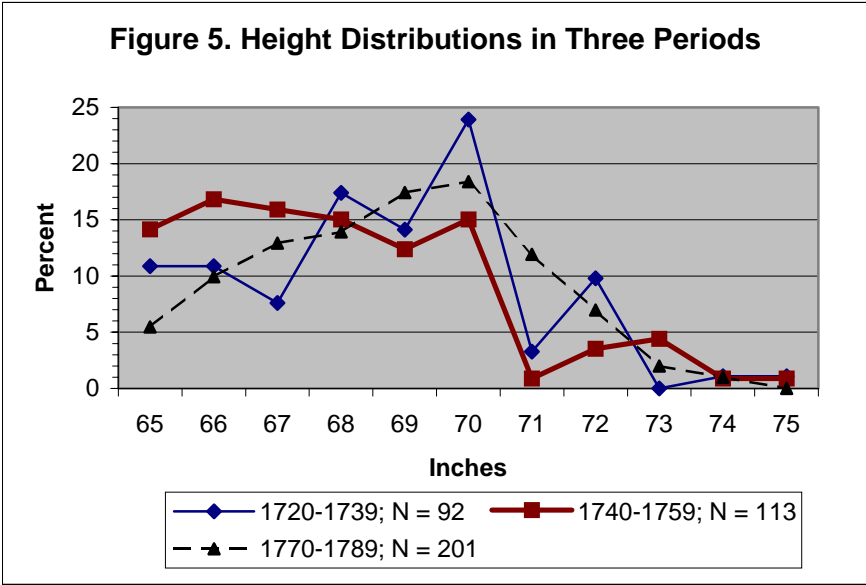
Source: Table 1; Komlos, 1994, p. 108.



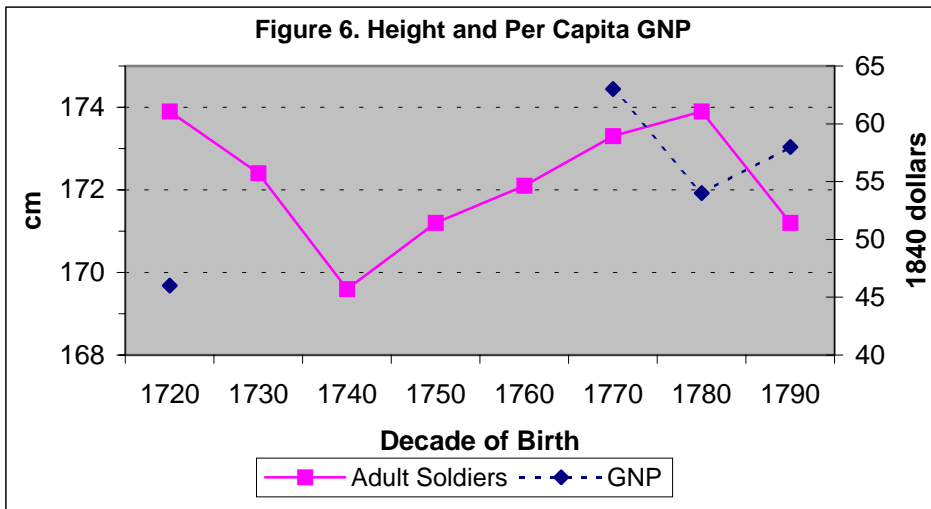
Sources: Table 1; Komlos, 1990; Komlos, 1993.



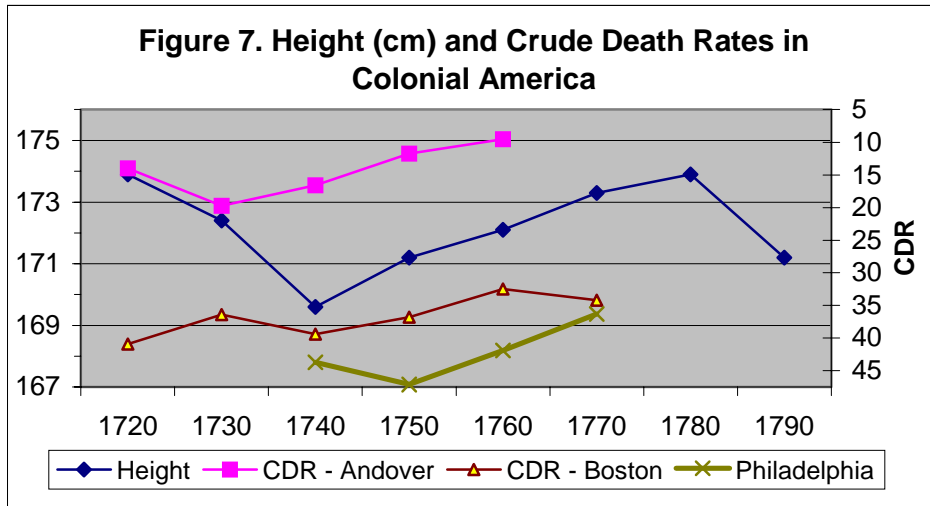
Sources: Table 1; Sokoloff and Villaflor, 1982, p. 457; Fogel, 1986, p. 511.



Source : Table 1.

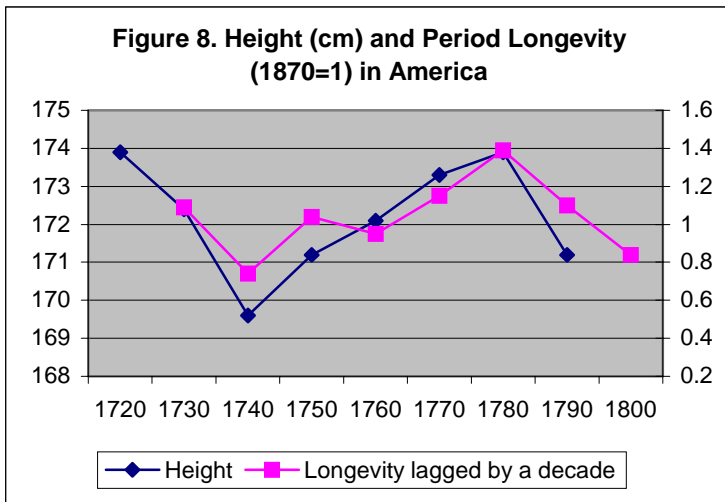


Sources: Table 1; McCusker, 2000, p. 156.



Source: Table 1; Gemery, 2000, p. 159.





Sources: Table 1; Kasakoff and Adams, 2000, p. 117.

Table 1. Characteristics of the Apprentice Sample - Number of Observations

Birthplace Unknown or America

Unknown	1017
American	<u>29</u>
Total	1046

Age		Decade of Birth		Residence	
14	17	1730	32	New England	99
15	31	1740	103	New York	165
16	73	1750	150	Pennsylvania	589
17	171	1760	47	Ohio	15
18	263	1770	207	Upper South	156
19	304	1780	220	Lower South	10
20	157	1790	223	Unknown	<u>12</u>
21	8	1800	<u>64</u>	Total	1046
22	13	Total	1046		
23	<u>9</u>				
Total	1046				

Decade of Advertisement

	Percent
1740	0.4
1750	3.3
1760	13.4
1770	13.7
1780	5.1
1790	22.3
1800	17.9
1810	21.5
1820	2.4
Total	100.0

Source: ICPSR. Data set no. 9721.

Table 2. The Age-by-Height Profile of American Youth (cm)

Age	Eighteenth Century					Nineteenth Century			
	Apprentices <sup>1</sup>		Runaway Slaves		Soldiers <sup>2</sup>	Transported Slaves		West Point Cadets	
	Height	Vel. <sup>3</sup>	Height	Vel. <sup>3</sup>		Height	Vel. <sup>3</sup>	Height	Vel. <sup>3</sup>
14	145.3					146.6			
15	154.4	9.1				152.1	5.5		
16	159.5	5.1	156.0			158.8	6.6	166.1	
17	163.8	4.3	165.4	9.4	164.7	162.8	4.1	169.2	3.0
18	166.6	2.8	168.4	3.0	167.1	166.1	3.3	170.7	1.5
19	169.7	3.0	169.2	0.8	167.2	168.4	2.3	171.2	0.5
20	171.5	1.8	168.4	--	169.3	168.9	0.5	171.7	0.5

Sources: Table 1; Komlos, 1994, p. 111; Steckel, 1979; Komlos, 1987.

<sup>1</sup> American or Unknown Birthplaces

<sup>2</sup> Standardized on those born in the 1780s.

<sup>3</sup> Growth Velocity

Table 3. Characteristics of the Military Sample - Number of Observations

Army Deserters	3307	Birthplace		Birthdecade <sup>1</sup>	
Navy Deserters	<u>609</u>	CT	56	1710	99
Total	3916	MA	47	1720	309
Age		RI	27	1730	729
16	18	New England (other)	39	1740	442
17	42	MD	54	1750	1219
18	87	VA	83	1760	244
19	128	NJ	55	1770	331
20	184	NY	84	1780	333
21	226	PA	127	1790	<u>210</u>
22	252	Lower South	30	Total	3916
23	243	America (other)	218		
>23	1678	America Sub-total	820		
unknown	<u>1058</u>	England	344		
Total	3916	Ireland	619		
		Scotland	63		
		Wales	18		
		Germany	163		
		Holland	26		
		France	28		
		Europe Sub-total	1261		
		Unknown	<u>1835</u>		
		Total	3916		

Source: See Table 1.

<sup>1</sup> For those of unknown ages the birthdecade was estimated by imputing the average age of 26. The 1710s includes those born earlier, and the 1790s includes those born thereafter.

Table 4. Comparison of American and English Adult Male Heights, 1720-1780

	Decade of Birth		
	1720	1750	1790
American	171.9 to 173.9	171.2 to 172.1	173.2 to 173.9
English	172.2	170.9	168.4
Difference	-0.2 to 1.7	1.2 to 2.2	4.8 to 5.5

Sources: The American ranges are from this study and from Fogel, 1986, p. 511;

Nicholas and Steckel, 1993; Komlos, 1993.

## Endnotes

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<sup>1</sup> The population increased from about 200,000 to some 3.2 million in the course of the 18<sup>th</sup> century. (Gemery 2000, p. 178.)

<sup>2</sup> For an excellent recent survey of this literature, see McCusker (2000).

<sup>3</sup> These results were confirmed in Steegmann and Haseley (1988). They report a mean height of 172.2 cm for those born in the 1730s. In contrast, 20-year-old German aristocrats were 169 cm tall. (Komlos, 1990).

<sup>4</sup> „The demand for labor in the colonies forestalled the creation of a depressed economic class, and thereby promoted general health.“ (Duffy, 1953, p. 244).

<sup>5</sup> Gemery suggests that the crude death rate in New England was in the range of 15-25 and in the 30s and 40s in the cities. (2000, Table 5). In contrast, in 18<sup>th</sup> century England, the CDR was in the high twenties. (Wrigley and Schofield, 1981, p. 533; Wrigley, Davies, Oeppen, and Schofield, 1997, p. 295).

<sup>6</sup> Surprisingly, not only did free Americans benefit from the easy access to nutrients. Unexpectedly, the nutritional and epidemiological advantages accrued to some degree, to even the most unfortunate members of society, namely, to those of African ancestry. Studies have consistently shown that American-born slaves were taller, and lived longer than the brethren they were forced to leave behind in Africa. Already in the eighteenth century American adult slaves were almost as tall as the most privileged classes in Europe (Steckel, 1979; Eltis, 1982).

<sup>7</sup> That the free settlers were better off in material terms than most of their contemporaries in Europe is widely recognized (McCusker and Menard, 1985, pp. 54, 213.) Americans

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lost their height advantage permanently only in the 1960s, to West-Europeans and Scandinavians, whom they now trail behind by as much as seven centimeters.

<sup>8</sup> Previous estimates underestimated the height of Americans on account of the fact that they included soldiers of unknown provenance in the sample, but overestimated it on account of disregarding the minimum height requirement. As it turns out, the two biases tend to cancel each other for the most part, except for the middle of the century.

<sup>9</sup> See appendix for a list of the newspapers consulted. We chose the newspapers simply on the basis of availability either locally or through interlibrary loan. We did not attempt to obtain a random sample, since the universe of all newspaper advertisements was not known to us. Those advertisements which did not mention height were not sampled. Data with height records were not excluded on any grounds except as specified below.

<sup>10</sup> The trade in which the apprentices were engaged was not given in the advertisements.

<sup>11</sup> Because most of the advertisements were placed after the 1750s, when most Americans were numerate, there were only a handful of advertisements that mentioned a descriptor, such as tall or short, for the size of the apprentice. Rather, numbers were used predominantly to describe the physical stature of the youth in question. The percentage of the advertisements that mentioned heights was not counted.

<sup>12</sup> This is the case even though there was considerable rounding on even numbers and on half foot intervals. However, these were largely self-canceling random errors. That is to say, some of those who were 63 inches tall were as likely to have been advertised as 62 as 64 inches. This is evidenced by the fact that the growth profiles of the adolescents are quite smooth over the various ages, and not markedly different from growth profiles obtained from other populations (Figure 1). Systematic biases are not apparent. For example, though the histogram of the 18- and 19-year-olds appear quite different from one another, the difference in the mean height of the two age groups is quite plausible

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(the distributions are not reported here, but are available from the author upon request).

The growth velocity of 3 cm is reasonable, insofar as they are similar to those experienced by transported slaves (Table 2).

<sup>13</sup> As a consequence, the height distributions of the soldiers do not show excessive heaping on even numbers except in the period before 1740 (Figure 5).

<sup>14</sup> The average height of the deserters including those of unknown provenance and not adjusting for the existence of the mhr, is quite similar to those reported by Sokoloff and Villaflor and by Fogel with the single exception of the decade of the 1740s (Appendix Figure 9).

<sup>15</sup> Height records on youth are rare even in the nineteenth century, with the exception of those of slaves on account of the extant shipping manifests. The records of West Point Cadets and Amherst students begin at age 16, which is too late to estimate the adolescent growth spurt.

<sup>16</sup> Many eighteenth-century apprentices came from middling sort families; their parents wanted them to learn additional or more lucrative skills. But some pauper apprentices, for example propertyless orphans, are probably also included in the sample (Hamilton 2000, Herndon, 2000, Murray, 1997, Towner, 1998).

<sup>17</sup> The regression is not reported here in its entirety, because all variables except age were insignificant, with the only exception being the residents of New England, who tended to be taller than the means reported in Table 2 by some 1.7 cm (0.7 inches). ). The level is standardized on height of 20-year-old apprentices advertised in Pennsylvania.

Pennsylvanian youth were equal to the average height across the sample.

<sup>18</sup> Insofar as birthplaces were not mentioned in 97 % of the advertisements, the presumption is that it was considered common knowledge of the time that apprentices were predominantly American born. Nonetheless, a handful of European boys might well



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be included in the analysis. Hence, the estimated height profile should be considered as a lower bound for Americans. However, the fact that the apprentices were much taller than German lower-class boys suggests that only a negligible number of Europeans could be in the sample (Figure 3) (Komlos, 1990).

<sup>19</sup> It is also equivalent to the sample average height.

<sup>20</sup> On account of the small number of observations at age 14, the estimate of the size of the adolescent growth spurt should be considered tentative. The number of apprentices known to have been born in Europe is 76. Because of the small number of observations for each age cohort, their height is not reported. Their heights were not systematically different from those apprentices with unknown birthplaces.

<sup>21</sup> Evidence for a later period suggests that American parents were not acting altruistically toward their children: „The evidence implies a willingness on the part of working class parents to sell cheaply the future income streams of their offspring for current consumption purposes.“ (Parsons and Goldin, 1989, p. 657).

<sup>22</sup> The apprentices at age 14 were at the 0.8<sup>th</sup> percentile of the modern height distribution, at age 15 they were at the 1.5<sup>th</sup> percentile, but by age 20 they moved up to the 20<sup>th</sup> centile (Steckel, 1996, p. 160).

<sup>23</sup> In the late-nineteenth century, many adolescents entered the labor force around age 14. (Parsons and Goldin, 1989, p. 639).

<sup>24</sup> On the theoretical derivation of a discontinuous increase in slave food allotments upon entrance into the labor force see, Rees, Komlos, Lang, and Woitek (2001).

<sup>25</sup> Because the height of the soldiers was measured and recorded at mustering, the advertisements invariably included a numeric value of physical stature. No descriptors, such as „tall“ or „short“ were used.

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<sup>26</sup> The analysis of the height distribution of the runaway sailors reveals right hand truncation. They were not subject to a minimum height requirement, but to a maximum one: 70 inches for Americans and 69 inches for Europeans. As a consequence, they were shorter than the infantry. The number of observations is much too small, however, to attempt to extract meaningful information on the trend in the sailors' height. Subsequent samples of the height of sailors also show that there were both minimum and maximum height requirements (Dye, 1995). The height of the British and Irish soldiers in our sample are not comparable to their American-born counterparts, because, as for sailors, their height distribution reveals the presence of not only a left-hand, but also of a right-hand truncation. This should not be surprising, because that was also the case among the Royal Marines. Having a physical stature much above the average was a disadvantage aboard ships, and a maximum height limit was obviously applied to those soldiers who were shipped across the ocean to fight in America (Komlos, 1993).

<sup>27</sup> Those born in the Lower South were not included, because they were too few in number to ascertain the trend in their height independently from that of Northerners. The trend we report is very robust: the inclusion of these data has only a marginal impact on the results. Similarly, if we include in the analysis the height of ages 16 to 19 known to have been born in America, the basic trends reported here remain unaffected. State in which the advertisement appeared was not included in this regression.

<sup>28</sup> Of the adults, 13 from 381 were excluded from the regression on this ground (Komlos and Kim, 1990).

<sup>29</sup> (Adjusted)  $R^2 = 0.03$ ,  $F = 2.5$  (significant at the 1 percent level)  $N = 516$ . Truncated regression analysis (TOLS) has been found in simulation exercises to yield the most robust and accurate estimates of trends (Heintel, 1996; Cheung and Goldberger, 1984). TOLS is based on ordinary least squares regression after eliminating all observations below the

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minimum height requirement (mhr); the distribution of heights is unbiased to the right of this point. Though the conditional coefficient estimates obtained by TOLS are not accurate, they are biased by a *constant* factor of proportionality. That is to say, both the signs of the coefficients, and their relative ordering are unbiased. This is crucial, because after we obtain our estimates of the height of the soldiers from the truncated regressions, we convert the coefficients to the true population means of all Northern free men as follows: assume that the standard deviation of 6.858 cm for modern populations also held in 18<sup>th</sup> century America; assume, furthermore, that the truncation point was at the mhr of 65 inches (165.1 cm); take a normal distribution with mean 170.0 cm and s.d. 6.858 cm and discard all observations below 165.1 cm; then calculate the mean of the truncated distribution and obtain 172.78 cm. That is, if the mean of the soldiers' height above the mhr in the sample was 172.78 cm, then the mean height of the population of men from which the soldiers were drawn was 170.0 cm. In this manner the following schedule was obtained:

Mean of Truncated Distribution(cm)	Mean of true Distribution (cm)
169.0	172.25
170.0	172.78
171.0	173.34
172.0	173.95
173.0	174.60
174.0	175.29

This schedule was used to obtain the estimates of the height of the American male population from the calculated truncated means. We assume that the standard deviation of the height of the underlying population remained unchanged throughout the period at 6.858 cm, inasmuch as research on modern population has shown that the standard deviation remains essentially constant even if the mean of the distribution changes substantially over time.

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<sup>30</sup> The trend of the height of young soldiers (17-20 years old) cannot be estimated accurately on account of the small number of observations (N = 96)

<sup>31</sup> The growth profiles of the young soldiers is also inaccurate, but at some ages, the estimates are similar to those of apprentices (Table 2).

<sup>32</sup> Height is standardized on age 20.

-1739 18 174.7

1740-1769 30 169.3

1770-1799 48 173.7

<sup>33</sup> Nonetheless, the decline in height in the 1740s and 1750s relative to the 1720s and 1730s is significant at the 0.03 level. Put another way, the likelihood that they originated from a population of the same average height is 3 out of a 1000. Similarly, the increase in height between the 1740s and 1750s and the 1770s and 1780s is significant at the 0.04 level.

<sup>34</sup> Sokoloff and Villaflor report a constant trend until the 1740s and a slightly increasing one in the 1750s, while Fogel reports a constant trend throughout the first half of the century (Figure 4). However, our procedure for analysis is not comparable. While we confine our analysis to soldiers known to have been born in America, Sokoloff and Villaflor included in their regressions also the height of European-born soldiers as well as those of unknown provenance. As a consequence, the trend in the height of Americans is unavailable by themselves in their study. Fogel, on the other hand, does not report the method of his analysis, and it is left to the reader to surmise that his data are probably based on those reported by Sokoloff and Villaflor.

<sup>35</sup> Steegman and Haseley's (1988) study does analyze American-born men separately, but their study is confined, in the main, to the birth-cohorts of the 1730s, and hence not suitable for determining a trend.

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<sup>36</sup> Sokoloff and Villaflor and Fogel also report that heights increased between 1750 and the 1780s only to decline in the 1790s (Figure 4). The diminution in heights in the 1790s is perhaps an indication that the distribution of wealth became more unequal at the turn of the century. One local study finds that to have been the case in Maryland between 1800 and 1820. (Sarson, 2000). Another possibility is that the physical stature of the 1790s birth cohort is a reflection of the disruptions of associated with the War of 1812 – which many of them would have lived through as teenagers.

<sup>37</sup> Food consumption today among adolescents increases substantially during their growth spurt: in Britain calorie intake increases from circa 1500 to about 2000 kcalories between the ages of 10 and 15 (Chesher, 1997).

<sup>38</sup> During the second half of the eighteenth century American apprentices at age 20 were - at 171.5 inches - fully 7.5 cm taller than French youth of the same age (Weir, 1997, p. 191; Komlos, 1990).

<sup>39</sup> In addition, a recent study finds that the colonial economy was probably not growing (Mancall and Weiss, 1999). However, another study emphasizes the increase in living standards (Egnal, 1998).

<sup>40</sup> While this economic downturn would not have affected the birth cohorts of the 1740s, it could well have had an impact on the nutritional status of those born in the 1750s.

<sup>41</sup> A genealogical study indicates that among northern white males period life expectancy at age 10 seems to have declined slightly between 1725 and 1739, and then stagnated thereafter until 1760 (Fogel, 1986 p. 465).

<sup>42</sup> There is a bit of evidence that climatic conditions may not have been propitious in the 1750s. This was much colder than average decade with many thunderstorms, but the 1760s and 1780s were also cold when heights increased (Baron, 1995, pp. 83, 88).

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<sup>43</sup> Though, during the first half of the century the meat-consumption trend does not correlate positively with the height trend reported here. Meat allowances for widows increased steadily during the course of the 18<sup>th</sup> century from about 120 pounds to 180 pounds, and peaked in the early 19<sup>th</sup> century at 200 pounds. Most noticeable were the increases among the least well-to-do widows. While only 20 percent of them received any meat allowance at the beginning of the century, this share doubled by 1800. Fresh meat allowances were not mentioned in wills at all until 1800, but then increased quickly until fully 20 percent of all wills mentioned them (McMahon, 1981, pp. 17-18).

<sup>44</sup> Initial research underestimated the height of Englishmen, because it was not known that the recruiters of the Royal Marines systematically discriminated against tall men. Thus, the average height reported of 164.3 cm for the birth cohort c. 1740-1750 is downwardly biased and not representative of the English male population. Sokoloff and Villaflor, 1982 , pp. 457-58). The heights reported by Floud, Wachter and Gregory (1990, p. 148) fluctuate too randomly to be considered reliable for international comparisons.

<sup>45</sup> “The eighteenth century brought a definite improvement in colonial health. The rising standards of living... and the development of a colonial-born population were primarily responsible for this change., For example, because of improved drainage, New England was free of malaria by the outbreak of the Revolution, and the introduction of inoculation by the second half of the century brought an end to epidemics of smallpox (Duffy, 1953, pp. 242-243).

<sup>46</sup> Compared to a population density of 157 persons per square mile in England, in the United States there were merely 13 inhabitants per square mile around 1800, even though population size had doubled during the quarter century after the Revolution from 3.1 to 6.6 millions. Even in densely populated Connecticut average farm size was 60

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acres with 13 head of cattle and 7 swine in stock. European peasants and farmers only dreamt of such prosperity (Purvis, 1995, pp. 11, 38).