John Komlos:

On English Pygmies and Giants: the Physical Stature of English Youth in the late-18th and early-19th Centuries

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Abstract:

The physical stature of lower- and upper-class English youth are compared to one another and to their European and North American counterparts. The height gap between the rich and poor was the greatest in England, reaching 22 cm at age 16. The poverty-stricken English children were shorter for their age than any other European or North American group so far discovered, while the English rich were the tallest in their time: only 2.5 cm shorter than today's US standards. Height of the poor declined in the late-18th century, and again in the 1830s and 1840s conforming to the general European pattern, while the height of the wealthy tended rather to increase until the 1840s and then levelled off.

A significant advantage of anthropometric history is the insight it affords into the living conditions of segments of a population for whom conventional economic indicators are frequently – or even generally - unavailable. Important such groups include children and youth, whose welfare depended, in the main, upon overall family socio-economic circumstances as well as upon resource allocation within the family. To what extent family income benefits the children of the household is not at all clear even in contemporary societies; in a historical context such evidence is even more tenuous to obtain. The standard economic assumptions pertaining to the relationship between income and welfare does not hold easily for dependent groups, i.e., for those who do not have a personal source of income. As a consequence, anthropometric records on children and youth are of considerable value, particularly since these can be often decomposed by social status, gender, and age.

We review the evidence on the height of British lower- and upper-class youth and compare them to their cohorts in other countries. The data originate in records of military schools, armies, prisons, orphanages, charities, and in the case of African-Americans, shipping documents, runaway newspaper advertisements and certificates of freedom.

The Height of the English well-to-do

We first turn to an analysis of the height of students at the prestigious Royal Military Academy at Sandhurst in the 19th century, who were primarily of middle and upper-class origin (Floud et al. 1990, 107).[1] The data were collected by Roderick Floud (1986a) and analysed in Floud et al. (1990, 174-178), without considering the effect of a minimum height requirement for being accepted into the institution. Floud et al. suggest that "it seems that upper-class boys could pass the standard with ease and the observed distributions are very close to normal" (Floud et al 1990, 174). Yet, their calculations did reveal some unexpected fluctuations in the estimated height of the youth, which could be due to changes in the height requirements.[2] They did not publish the height distributions themselves, but a re-examination of the Sandhurst data indicates that there were actually both minimum and maximum height

requirements for gaining entrance into the Academy, which were not enforced consistently over time. The height distributions, particularly those of the younger students, often depart quite obviously from the expected bell-shaped (or "normal") curve (Figures 1-4). This suggests that height requirements were enforced from time to time by the examiners perhaps on an ad-hoc basis, even if their actions might have followed informal procedure, rather than one mandated by law. It is also possible that parents failed to inscribe children who were well below or well above average height for their age. As a consequence, in such a truncated distribution the calculation of simple means is inaccurate, and the appropriate statistical procedure to estimate mean heights, and their correlates, is truncated regression (A'Hearn 2004, Komlos 2004). In addition, Floud et al. did not consider the effect of family income on the height of the students. Insofar as the fees paid by the student's families is available, it can be used as a proxy for family economic circumstances, and consequently, is used as an independent variable in the determinant of physical stature (Table 1). For these two shortcomings of the original analysis it is worth revisiting these data to estimate the trends taking these two factors into account.

INSERT FIGURES 1-4 AND TABLES 1 and 2 ABOUT HERE

The students were divided into two groups: those who paid fee category 1 and 2, and those who paid fee category 3, which was higher.[3] We examine the distributions for three time periods by recruitment years: during the Napoleonic Wars (1807-1816) (referred to as Period 1), between 1817-1836 (Period 2), and after 1836 (Period 3) in order to allow for changing truncation points which differed for different fee-category students (Figures 1-3). For example, in Period 2 there was a minimum height requirement imposed on 13-year-olds at 56 inches, whereas in Period 3 that requirement was raised to 57 inches but only on fee category 1 and 2 students, not on fee category 3 students (Table 2 and Figure 1). Similar patterns are found in Periods 1 and 3. After having determined the truncation points of the height

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distributions (Table 2), we estimate the height of the students by age and fee category using truncated regression program in STATA7.

There were substantial differences in height among the Sandhurst students by fees paid (Figure 5). Those who paid higher entrance fees were invariably taller by between 0.8 and 3.3 cm (Table 3). Our estimated trends are quite similar to those of Floud et al., although the new estimates fluctuate much less (Figure 6). The estimated heights of these upper-class youth did not decline in the late-18th century as did those of the average adult population (Komlos 1989, 1993, 1998). This is similar to the pattern found among aristocratic and middle-class German youth of the late-18th century (Komlos, 1990; Komlos et al. 1992). Sandhurst students tended to be taller in 1840 than in 1795, even if the trends were not uniform.[4] A regression of average heights on time and on the three ages between 1795-1840 yields an average annual increase of 0.7 mm per annum (with t=4.0). Thus, upper-class height trends departed substantially from those of the rest of the population in the late-18th century. This is plausible insofar as their income would have sufficed to compensate for the increased price of nutrients.

TABLE 3 AND FIGURES 5 AND 6 ABOUT HERE

Data on older students are available for ages 16 to 20 beginning with the birth cohorts of 1840, although the trend for those 20 and above cannot be estimated accurately due to the small number of observations. The height of 16 to 19-year olds tended to be constant during the first half of the 19th century (Figure 7).

Figures 7 and 8 ABOUT HERE

Sandhurst students were exceptionally tall for their time in international comparison. Their height at age 20, which can be considered their adult height, was 174 cm (68.5 inches), just 3 cm less than the average height of current British male youth (Table 3). High-fee students were 1.6 cm shorter than today's US standard (Figure 8).[5] Even low-fee-paying Sandhurst students were taller than most other students attending elite schools in Germany, France, and the United States (Figure 9). Although the reference to the German youth (of the

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lower-aristocracy) is to the birth cohorts of the 18th century, the 10 cm advantage of the low-fee-paying Sandhurst students at age 16, is nonetheless, very substantial. It is also quite extraordinary that the Sandhurst students – even the low-fee-paying ones, - were taller than the cadets attending the West Point Military Academy as well as The Citadel, the Military Academy of Charleston, South Carolina (Figure 9). This is unexpected, because the more propitious disease environment and the greater availability of nutrients meant that the average American adult male was at least 5-6 cm taller than its European, including British, counterparts in the 19th century (Komlos and Baur 2004). In fact, average Americans were the tallest in the world, but no segment of the population was as privileged as the European elite.[6] The European elite was clearly capable of overcoming the disadvantages brought about by a higher level of urbanisation, higher population density, a more virulent disease environment, and higher nutrient prices. In fact, the high-nobility in Germany was the only group who was as tall as, and at younger ages were even taller, than of the high-fee paying Sandhurst students (Figure 10). Hence, only the sons of the hereditary princes and barons on the Continent were as tall as the descendants of the British gentry attending the Sandhurst Academy.

<div align="center">Figures 9 and 10 about here</div>

The Height of the English Ultra-Poor

The records of the Marine Society provides important evidence on the height of lower-class English boys in the late-18th and first half of the 19th centuries, first reported in Floud and Wachter (1982). Floud collected more than 50,000 observations of "poor children" "of the London slums" who entered this institution between the 1770s and 1870s (Floud et al. 1990, 55, 105, 196) (Table 4). The initial analysis of these data (Floud, et al. 1990) also showed implausibly large variations in the height estimates[7] (Figure 11). The fluctuations were caused by Floud et al.'s complete disregard of the fact that both tails of the height distributions were truncated in some cases, not just the lower tail (Floud et al., 1990, 164, Komlos 1993, 2004). This was often the case because very tall men were not suitable to

become sailors, as life at sea required a low centre of gravity (Figure 12). The use of truncated regression alleviates this problem mostly, and identifies the following secular trends in the height of these poverty-stricken children: heights declined between the birth cohorts of circa 1770 and 1795, increased thereafter, and then decreased again in the 1830s and 1840s, as in most other parts of the Atlantic community (Figure 13) (Komlos 1993, 1998, 2004). The height profiles were shifting practically parallel to one another over time, with heights ending up in the mid-19th century at the level of circa 1795, the probable 18th century nadir (Figure 14).

Table 4 and Figures 11-14 about here.

These English data reveal an extremely deep divide that separated the social classes to an extent that is no longer imaginable today. The average difference between Sandhurst and Marine Society boys was 16.3 cm at age 13, rising to 22 cm at age 16, indicating that the wealthy experienced an adolescent growth spurt earlier and their peak growth velocity was greater than those of the poor (Figures 15). The difference between the two groups traces a "U"-shaped curve: the elite students enjoyed a 20.8 cm height advantage at the beginning of the period, declining to about 15 cm for most of the period under consideration, and rising again in the late 1830s to reach 22.6 in 1840[8] (Figure 16). It appears that harder times of the late 18th century and again in the 1830s and 1840s affected the nutritional well-being of the lower classes more adversely than those of the upper classes. Most authors report an increasing inequality during the classical phase of the Industrial Revolution (Lindert 1994, Williamson 1965). While these data do not confirm this pattern, as the difference in height between the two groups was the same at the end of the period as at the beginning, the intensity of income inequality during the early industrial era is illustrated more vividly by the differences in physical stature of the children of the two social groups than possibly by any other measure.

Figures 15 and 16 about here

The poor Marine Society boys, many of them from London, were the among the

shortest children in Europe and North America ever recorded. Only Dutch orphans recorded

in 1865 were slightly shorter (Figure 17) (Fredriks 2004, 174), implying that the physical

stature of Marine Society boys could well have been standard among the very bottom of the

European social classes of the 19th century, such as orphans. At age 16 the Marine Society

boys were 1.4-2.6 cm shorter than German servants (Komlos 1990) and 5-8 cm shorter than

US slaves (Engerman 1976, Steckel 1979). The tallest 16-year old Marine Society boys, born

in the 1820s, were on average 155 cm tall, shorter than the 3rd centile of the modern US height

distribution of 160 cm.

Figure 17 about here

The more egalitarian nature of the American society prevented such European-size

hiatus from emerging among the classes in North America. American apprentices, for

example, were 8.2 cm and American Slaves were 6.6 cm taller than German servants or the

boys attending Habsburg military schools (Figure 17). Among lower-class Americans, the

Georgia convicts were the tallest and the slaves the shortest, with the difference between them

at age 17 of about 5.2 cm, but northern white apprentices were only 1.6 cm taller than slaves,

while free blacks were merely 1.1 cm taller than slaves (Komlos and Coclanis 1997). Freed

slaves were but 3.5 cm shorter than the average northern soldier.

Conclusion

The re-examination of the evidence using truncated regression analysis enables us to

estimate the height trends and height profiles both of the wealthy and of the ultra-poor English

youth from the late-18th to mid-19th century more accurately than has been done previously.

The results point to the very deep divide in English society between the gentry students of the

Royal Military Academy at Sandhurst and the slum boys who were taken in by the Marine

Society.[9] This has been less obvious from previous work, though Floud et al. did note that

"the [Sandhurst] cadets were very tall by the standards of the Marine Society," and that the

"contrast between them is dramatic", i.e., "20 cm" at age 14 (1990, 174, 196, 225). Indeed, the differences were substantial. In fact, the "Oliver Twists" of England were shorter than any other group hitherto examined in Europe or North America including even American slaves. Moreover, those who were further disadvantaged in this group, such as orphans, or those coming from female-headed households were even shorter (Horrell, Humphries and Voth, 1998). The hidden costs of industrialization are thus vividly revealed. At the same time, the wealthy English youth were among the tallest in the late-18th and early-19th centuries, equalled only by the German upper aristocracy. Thus, the difference between them, some 22 cm at age 16 is the largest difference in height between social groups ever recorded. Hence, anthropometric history once again provides valuable insights into the socio-economic processes accompanying the Industrial Revolution.

Table 1. Characteristics of the Sandhurst Sample

Age	N
13	1,235
14	1,687
15	544
16	513
17	1,086
18	2,213
19	2,240
20	820
>20	494
Total	10,832

Fees Paid

Before 1858		After 1858	
Fee Category	N	Fees (Pounds)	N
1	645	0	756
2	1,027	>50	700
3	1,808	50-99	1,706
Total	3,480	100-	3,677
		unknown	513
		Total	7,352

Table 2. Height Requirements of Sandhurst Students

Age	Period	Fee	Lower	Upper
13	1807-16	1, 2, 3	-	65
	1817-36	1, 2, 3	56	-
	1837-57	1, 2	57	-
	1837-57	3	-	-
14	1807-16	1, 2	58	-
	1807-16	3	57	-
	1817-36	1, 2, 3	58	-
	1837-57	1, 2, 3	58	65
15	1807-16	1, 2, 3	-	-
	1817-36	1, 2	-	70
	1817-36	3	-	70
	1837-57	1, 2, 3	-	69
16	1855-70	1, 2	-	-
	1855-70	3	65	-
17	1839-43	1, 2, 3	-	71
	1844-53	1, 2	63	72
	1844-53	3	-	72
	1854-76	1, 2, 3	64	72

Table 3. Height of Sandhurst Students by Fees Paid

| | Fees Paid | | Difference in Height | | Average | | Growth |
| | 1&2 | 3 | Fees 1&2 and 3 | | | | Velocity |
Age	inches	inches	inches	cm	inches	cm	cm
13	59.1	60.4	1.3	3.3	59.6	151.5	
14	61.4	62.4	1.0	2.5	62.0	157.5	6.0
15	64.2	64.5	0.3	0.8	64.4	163.5	6.0
16	67.0	67.8	0.8	2.1	67.4	171.1	7.6
17	67.9	68.3	0.4	1.1	68.1	173.1	2.0
18	68.2	68.5	0.3	0.8	68.4	173.8	0.7
19	68.4	68.9	0.5	1.3	68.7	174.4	0.6
>19	68.0	68.9	0.9	2.4	68.5	174.1	-

Table 4. Characteristics of the Marine Society Sample

Age	Number of Observations
10	17
11	93
12	600
13	9,527
14	12,392
15	15,150
16	10,435
17	2,103
18	655
19	213
20	38
21	11
other	42
Total	51,276

Date of Recruitment	Number of Observations
1770s	4228
1780s	4467
1790s	7289
1800s	6091
1810s	4327
1820s	5103
1830s	5851
1840s	4847
1850s	4344
1860s	3331
1870s	1398

Fig 1 . Height Distribution of 13-Year-Old Boys, Sandhurst Military Academy
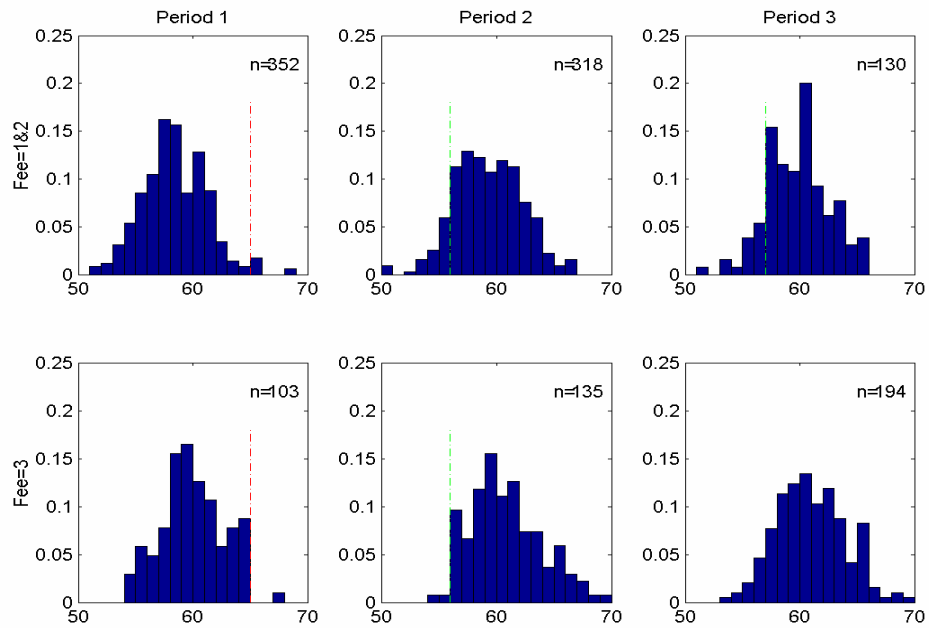
Fig 2 . Height Distribution of 14-Year-Old Boys, Sandhurst Military Academy
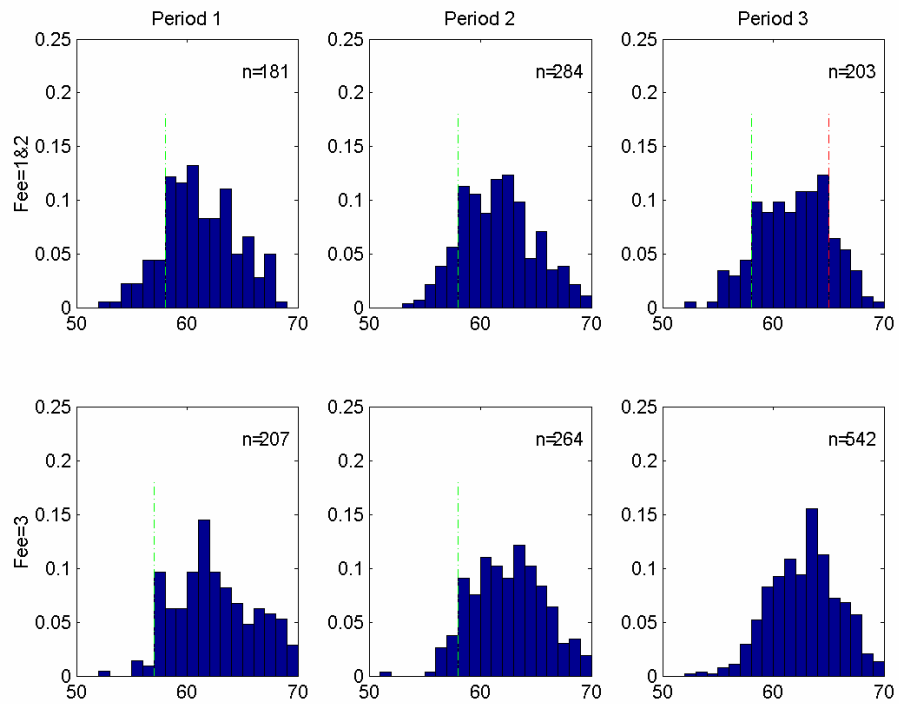
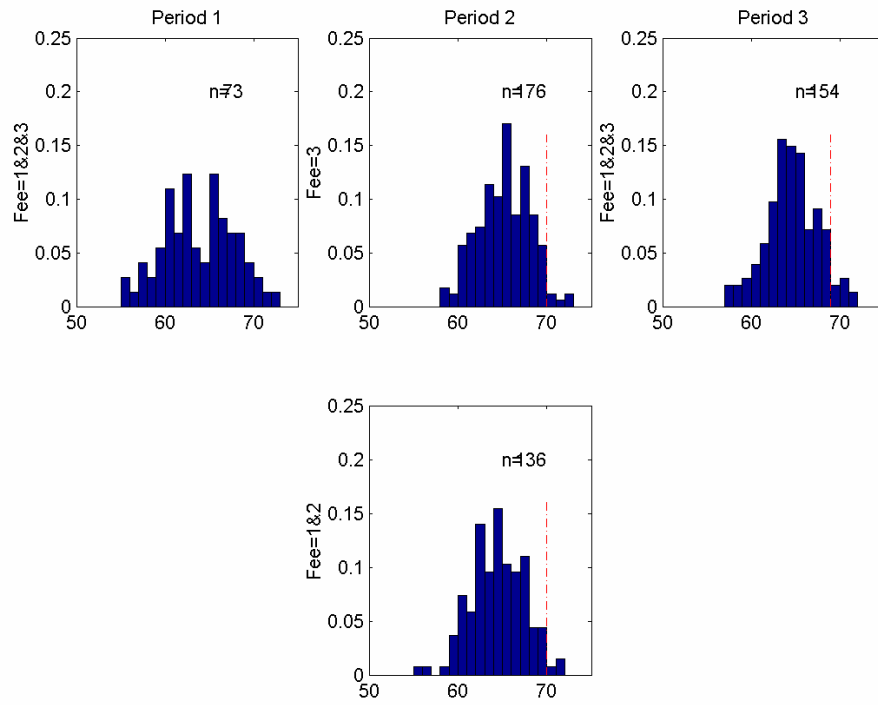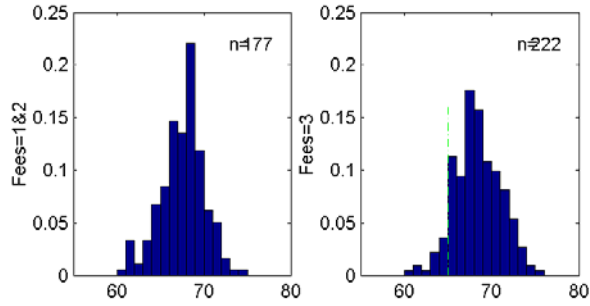Fig 3 . Height Distribution of 15-Year-Old Boys, Sandhurst Military Academy

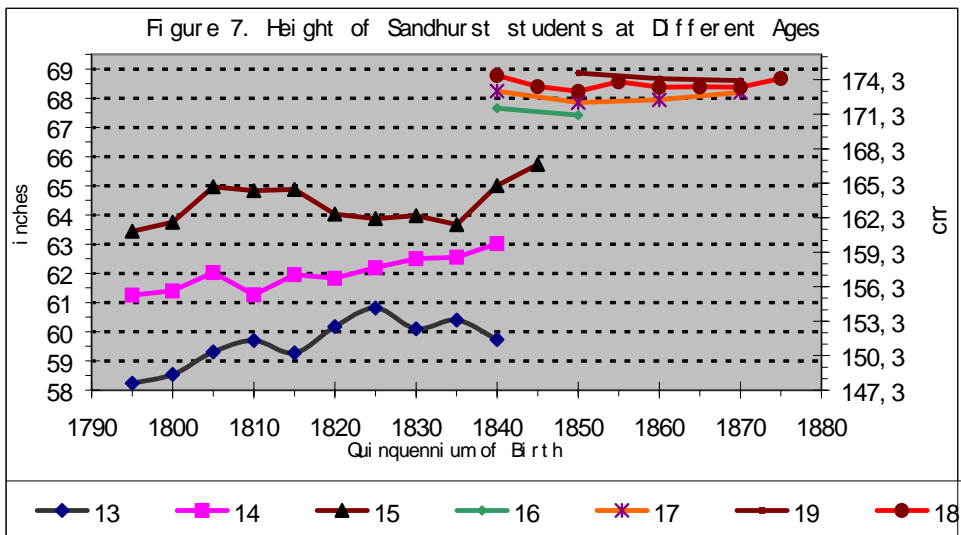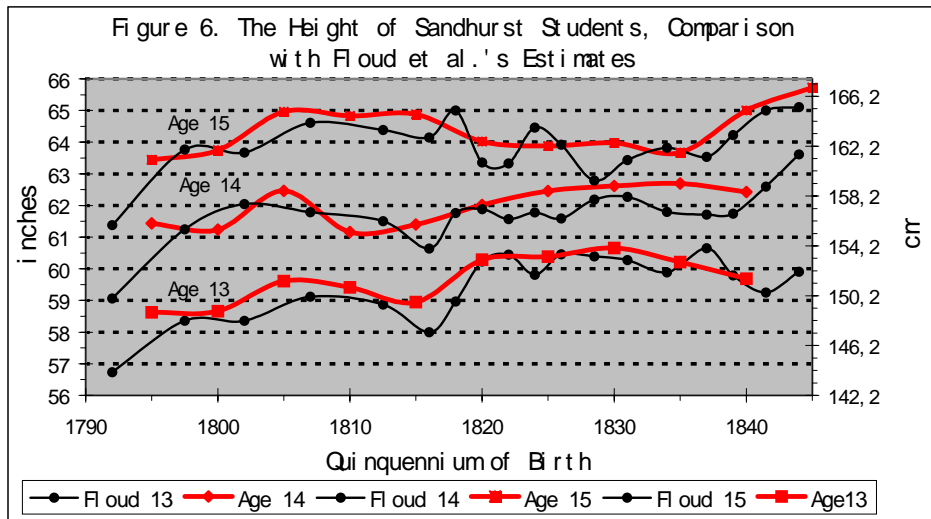Fig 4 . Height Distribution of 16-Year-Old Boys, Sandhurst Military Academy

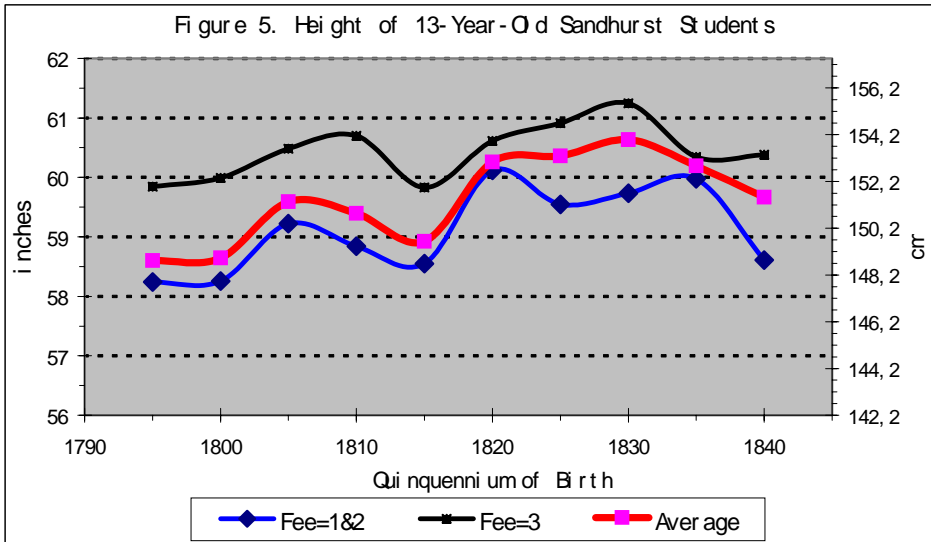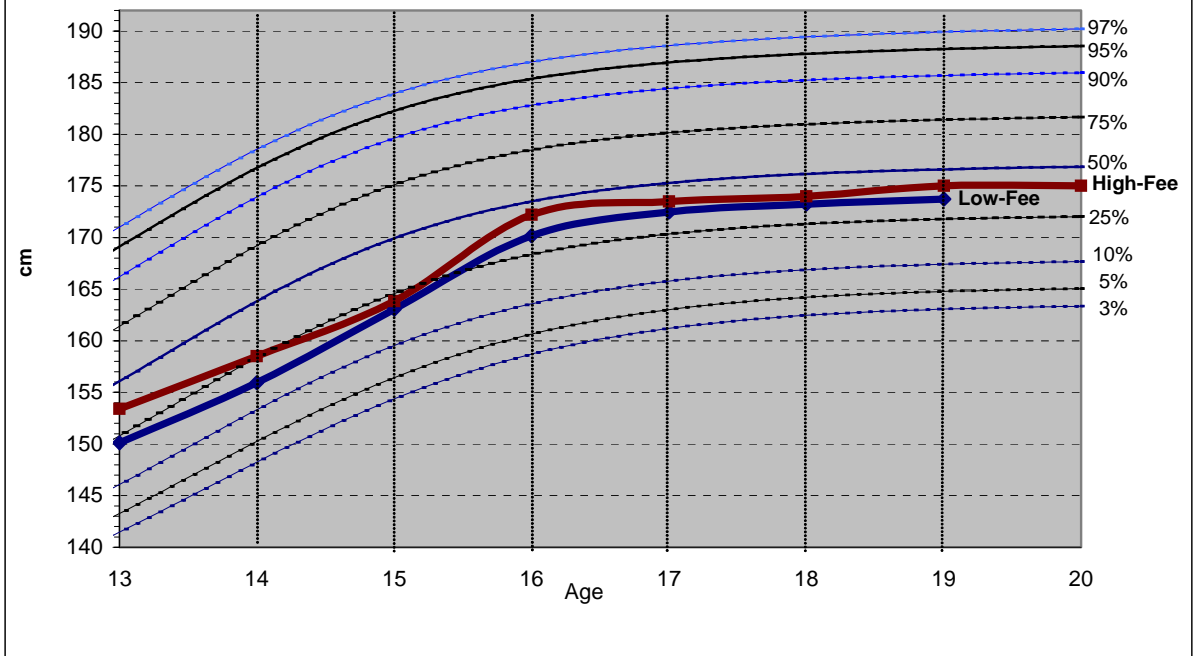Figure 5. Height of 13-Year-Old Sandhurst Students

Figure 6. The Height of Sandhurst Students, Comparison with Floud et al.'s Estimates

Figure 7. Height of Sandhurst students at Different Ages

Figure 8. Growth Profile of Sandhurst Students Compared to Contemporary US Standards

Figure 9. Growth Profiles of Elite Youth, International Comparison

English

French

German

U.S.

West Point Cadets · Sandhurst Low Fee Students · Lower Aristocrats · École Polytechnique

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Fig. 10. Growth Profiles of Elite Youth, International Comparison

German

English

U.S.

U.S.

West Point Cadets · Sandhurst High Fee Students · German Upper Aristocrats · South Carolina Students

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Figure 11. Height of Poor English Boys: Floud and Wachter Estimates

Age 13 · Age 14 · Age 15 · Age 16

Source: Floud, Wachter and Gregory, 1990, p. 166.

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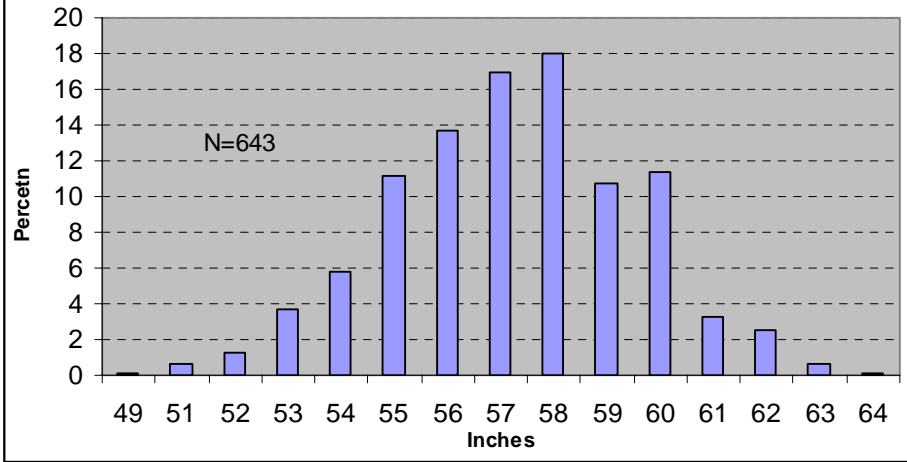Figure 12. Height Distribution of 16-Year Old Boys Born in the 1760s

Figure 13. Height of Marine Society Boys, Truncated Regression Estimates
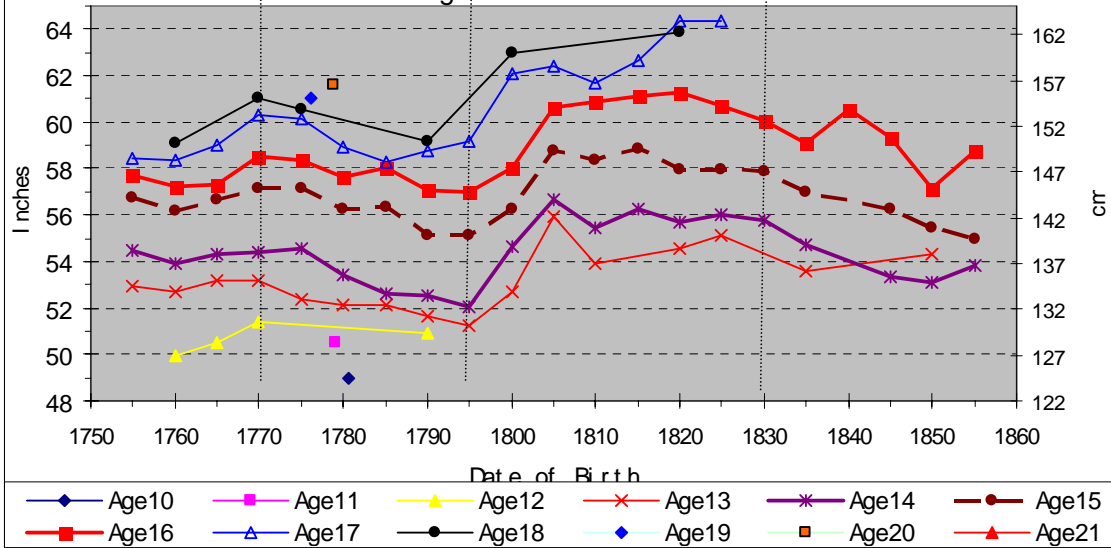
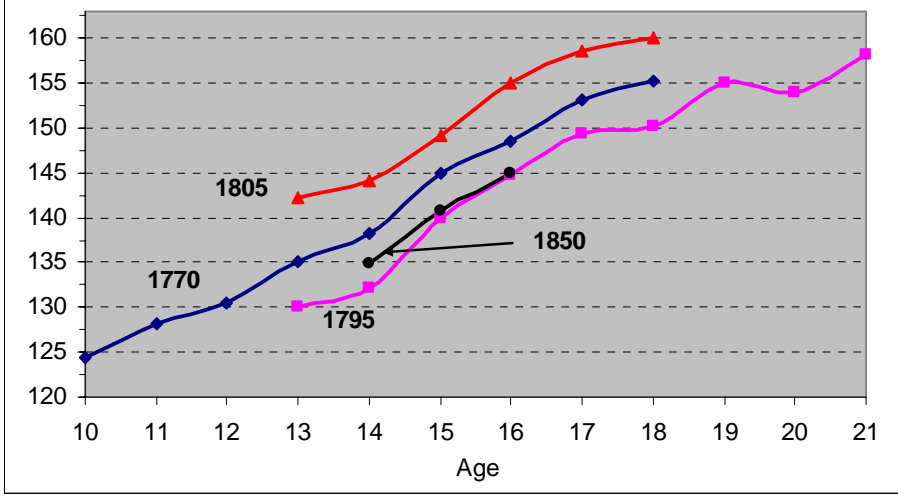Figure 14. Height Profiles of Marine Society Boys (cm)

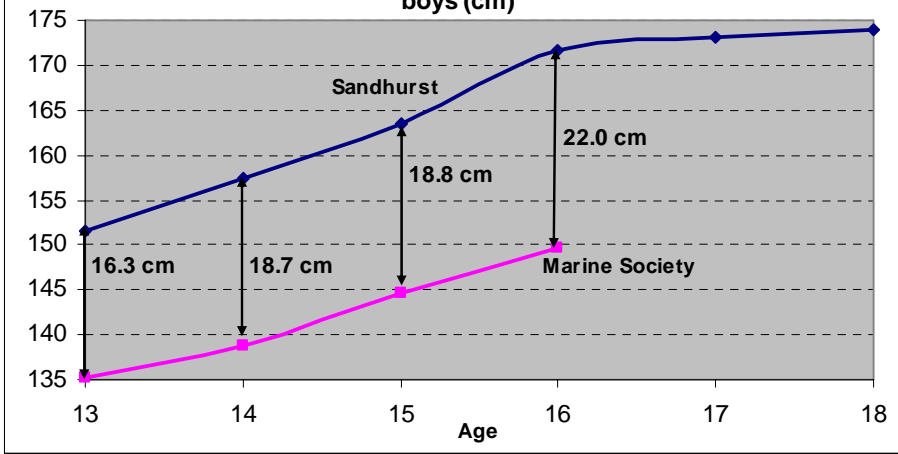Figure 15. Height Profile of Sandhurst and Marine Society boys (cm)

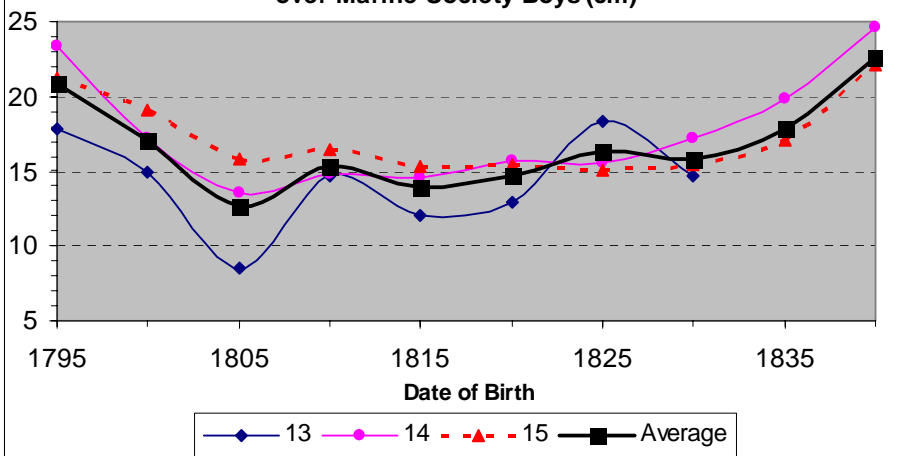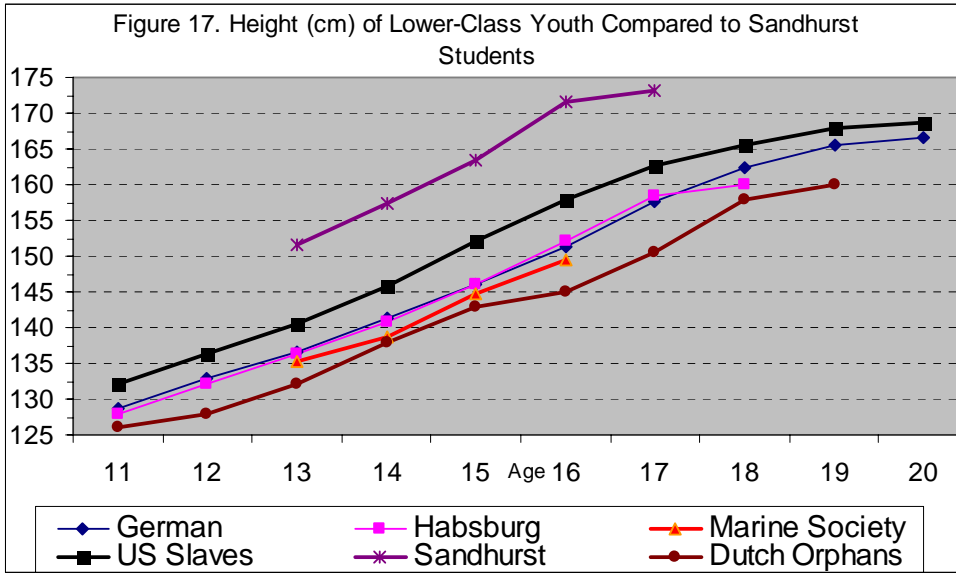Figure 16. The Height Advantage of Sandhurst Students over Marine Society Boys (cm)

Figure 17. Height (cm) of Lower-Class Youth Compared to Sandhurst Students

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Endnotes

[1] The data were extracted from the records of the academy by Roderick Floud (1986) and deposited at the University of Essex's data archive. There are about 10,000 data deposited in

the archive even though Floud et al. (1990, p. 133) mention that there were twice as many

extracted from the archive. Unfortunately the occupation of the parents was not recorded,

even though the information is apparently available in the archive.

[2] They do report "substantial movements in the heights of the recruits over time", without,

however, considering that these fluctuations could be due to height requirements. (Floud et al.

1990, 174).

[3] After 1858 three fee categories were built: >50, 50-99, 100< (Table 1).

[4] Some of the fluctuations is possibly due to omitted variables, such as the regional

provenance of the boys and the occupation of the parents. Coupled with the uncertainties

associated with the determination of the height requirements, the missing variables prohibit a

precise estimate of the trends.

[5] High-fee paying students were 2.4 cm (0.9 in.) taller as adults than low-fee paying students.

[6] The students at the École Polytechnique, whose admission policies were more meritorious,

were as tall as the cadets of the West Point Military Academy (Figure 9).

[7] Height of a population tends to change minimally from year to year (on the order of a

millimetre). Whenever estimates change by more than 2 cm per decade, they should be

considered suspect. Floud et al.'s estimates vary as much as 2.5 cm per year – which is above

a reasonable order of magnitude.

[8] In contrast, Floud et al. (1990, 198) suggest that the "gap between them was narrowin

towards the middle of the nineteenth century,…"

[9] If one considers that the shorter children among the lower classes probably had a higher than

average mortality rate than the estimated hiatus between the classes could be considered as an

lower bound of the true value.