Height and the High Life – What Future for a Tall Story?*

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Ever better information on health and living standards will remove height from history's centre stage. This will be compounded by declining variation in adult heights both within countries and across nations, as populations approach their genetic potential. We suggest two cases where stature will retain its role because other data are poor or unavailable. Children's heights can capture the effects of changing public policy and social conditions on families even in western countries. As with many current historical studies, the absence of other data may also make adult heights a useful tool in understanding the transition from communism to capitalism.

Introduction: The Fading Usefulness of Stature

Height itself is not a "good". It provides precious few immediate benefits, and beyond a certain point height appears to be a "bad". [1] It is useful to economic historians not for what it is, but insofar as it serves as an indicator of health status and living standards in a wider sense. Three conditions need to be satisfied for historians to find height a useful measure. First, adult heights are only of interest at a more than anecdotal level if direct information on health status and living standards is unavailable or insufficient. Second, even then, height will only be useful if other indirect indicators do not show greater predictive power and/or greater data availability. Third, it must be the case that heights are a robust indicator of health and wellbeing, something that cannot be taken for granted in all periods.

The first two conditions have been broadly satisfied for a significant number of historically important periods. This has lead to the production of a number of useful anthropometric studies for various countries, covering different periods.[2] The evidence that height is a well behaved indicator in these periods is not, however, wholly convincing, with evidence that gains in height and well-being may be uncorrelated, or even in conflict.[3] We argue that, for future historians, these conditions will be reversed. For the vast majority of countries better direct and indirect data will undermine the popularity of stature as a proxy for either health or living standards more generally. In contrast, however, for those countries in which data remains poor or unavailable, height can be used as a relatively reliable indicator of health and

well-being. This is because the specific factors that can cause systematic divergence will decline in importance.

Future economic historians will have what are, by the standards of today's historians, quite remarkable data for all developed and many developing countries. We have high quality evidence on incomes, prices, working hours and conditions, consumption, mortality, morbidity, literacy, and so on and so forth. The single most important reason why we will become less concerned with adult heights in OECD countries is that we are able to directly observe just about everything that we might, as economic historians, be interested in.

It is worth remembering that historians today use height not because the medical evidence claims that it is the most reliable indicator of health status, but because it is frequently the only measure that was recorded by contemporaries. It is simply the case that the army and the prisons measured height, rather than weight or skinfold thickness. In recent years one of the largest gains in data quality and understanding has been in health. Around the world health information today is much better than at any other point in history. Health surveys and medical records generate data on an unprecedented scale. Mortality risk and various measures of morbidity are tracked closely over time and in cross-sections. Over the past 30 years, an average of 270,000 medical articles have been published each year, the vast majority of them based on original empirical research. Height itself is not used very often in modern-day medical studies as an indicator of mortality, and shows poor predictive power in many cases. There is some doubt, for example as to the correlation between height and mortality. Work on Union Army recruits by Costa and Fogel and Wimmer implies that the two are positively correlated.[4] Their results are in line with research by Waaler, who found a U-shaped relationship between stature on the one hand, and mortality risk on the other.[5] In contrast, a WHO study found that American veterans from the 20th century appear to live substantially longer if they are shorter.[6] The so-called Framingham Study, analysing data on 2,019 men and 2,585 women over a period of 36 years, failed to find any association between all-cause mortality and stature in general, and height and cardiovascular disease in particular.[7] A large random sample of the US population, containing 13,031 respondents, also showed that heart disease and height are not associated.[8] On the other hand, alternative measures of health status such as body mass index (BMI, defined as weight divided by the square of height), waste to hip ratio (WHR), and skinfold thickness (normally measured at

the triceps) consistently show high predictive power for mortality.[9] It therefore comes as no surprise that there are many more medical studies using weight measures as a predictor of mortality than those using stature – the main medical literature database, MEDLINE, lists 1,806 articles over the period 1966-99 linking mortality and height, while there 21,296 papers examining weight as a risk factor. As the medical community dedicates substantially more effort to collecting and analysing weight data than height data, future historians, insofar as they are concerned with anthropometric measures, are likely to redirect their attention from height to girth.

Third, whilst it is true that many populations are markedly taller than their ancestors, it is also true that height gains have slowed dramatically, and may have stopped altogether in some cases. Mainland China, arguably one of the largest economic success stories of the past 20 years, saw no gains in average stature in its urban population between the 1980s and the 1990s.[10] In Sweden, height gain for the 1943 cohort was still significant compared to the 1933 cohort while later cohorts show sharply lower rates of growth.[11] Height gains of Californian children of Japanese origin born between the 1950s and the 1970s have almost come to a standstill.[12]

Nor is this slowdown a passing phenomenon. Figure 1 plots mean heights by income, as well as the height gain per additional $1,000. The evidence is from a cross-country regression of adult heights on income, ancestry, inequality (measured by the Gini coefficient), and dummy variables for student populations and military samples.[13] While richer countries clearly have taller populations, it is evident that as incomes rise the gain in height becomes smaller and smaller for every additional unit of purchasing power. A population that sees incomes rise from $2,000 to $3,000 would normally expect to see the average height of the population rise by some 1.6 cm. To achieve the same gain in height, the US today would have to increase average incomes by more than $9,000.[14] The spectacular height gains of the past that left younger generations towering over their parents are therefore likely to come to an end, first in OECD countries, later in others. Further, to the extent to which country incomes converge, cross-country height differences will decline.[15] Even constant income gaps (in absolute terms) would reduce the international differentials, as the "height penalty" for being a few thousand dollars poorer declines with rising incomes. The same will be true for the gap between rich and poor within countries.

Figure 1 about here

Three possible reasons can be suggested for the apparent slowdown in height gains. First, it is possible that populations in today's affluent countries are approaching a genetically-determined maximum height. Evidence for such a "speed limit" for the human body is paltry, but it cannot be ruled out. Second, additional income is spent to an ever decreasing extent on increasing nutrient availability once the most blatant nutritional shortcomings have been remedied. While food expenditure may be a normal good, nutrients appear to be an inferior good even in today's Third World.[16] As Adam Smith observed:[17]

> The rich man consumes no more food than his poor neighbour. In quality it may be very different, and to select and prepare it may require more labour and art; but in quantity it is very nearly the same...

Some goods with high income-elasticities, such as healthcare and better housing, may also facilitate height gains. Others, such as most consumer durables, have no obvious health benefit. Indeed, affluence beyond a certain limit may lead to behavioural and dietary changes that reduce the human body's likelihood of attaining its genetic potential. High levels of net nutritional status, that is the body's energy balance after accounting for the needs of basic hygiene, work, and keeping warm, may owe more to inactivity than to healthy diets. Lower levels of physical activity, typical in industrialized countries, may inhibit the production of growth hormones in adolescents. Finally, a taste for unhealthy dietary habits is often associated with high incomes. There is some evidence, for example, that vegetarians grow more slowly than their peers.[18] The argument that affluence reduces growth should not be taken too far: we know that people in developed countries today stop growing at an earlier age than in previous centuries, suggesting that final attained height is not ultimately constrained by insults, whether from lack of exercise or too much junk food. [19]

The attraction of adult heights alone as a research topic seems likely to fade in the future. Amongst historians of our own age, there will be "catch-up" growth in research on other health measures such as weight, waste-to-hip ratios, and BMI. Not only are data on these being collected on a greater scale than in the case of height, but they are also more useful in

predicting health outcomes. International differences, as well as height gains over time, are bound to fall to low levels in the future, offering less scope for research. In short, a combination of better direct data, better availability of more meaningful health measures and lower levels of variance in attained adult heights in rich countries will reduce future historians' interest in using adult attained heights to write the histories of rich nations.

The Future Uses of Heights

We noted at the outset that the mapping from height to other measures of well-being has recently attracted the attention of economic historians. Crafts has shown that stature in industrializing Britain was less correlated with other measures of the standard of living, such as life expectancy, infant mortality, literacy, or real wages, than any one of these measures was with all others.[20] In the US, for example, there appears to be a puzzling decline in average stature during the middle of the 19th century, at a time when all other indicators of living standards are pointing upwards.[21] There are two main reasons why trends in height may systematically diverge, at certain points in time, from overall trends in the standard of living. First, exposure to disease may change in such a way as to reduce height, but improve well-being. The transition of many infectious diseases from deadly epidemics to benign childhood illnesses probably reduced heights, but clearly improved living standards.[22] Second, changes in the availability of consumer goods – through improved transport and goods innovation, for example – may lead to changes in consumer behaviour that impair height, even if the standard of living, broadly defined, has not suffered.[23]

The causes of such divergence are unlikely to operate in the post-war era. 'L'unification microbienne', the unification of the globe by disease, has been achieved long ago. Similarly it seems unlikely that there are any communities left where food consumption is running at extremely high levels simply because there are no consumer goods available to purchase. There is therefore little reason to expect that future changes in heights will move in a "perverse" fashion with changes in living standards.

We foresee two areas in which conventional data will either be unavailable or unreliable. In both cases there is at least a reasonable chance that the history of heights will prove to a useful means by which economic historians are better able to explain the past. The first area

is social history, and in particular family history, in the developed world. The second is the economic history of those countries or areas in which other data are either scarce or unbelievable.

Analysing social policy: the heights of children

We have already noted that gains in adult heights have slowed dramatically in most developed countries. Furthermore, given that many people reach their final heights substantially earlier than before, it appears that they have a long 'reserve' growth period that is no longer needed. The process of growing earlier, and more quickly, does not appear to be over – the rise in child heights by age in both England and Scotland continues.[24] It is noticeable that children's growth patterns are not perfectly smooth, but exhibit periods in which growth is checked and later catches up. So long as age specific data – rather than just final height data – are collected, the variation in height gain offers future generations of social historians a potentially valuable source of information.

An extreme example demonstrates that the timing of growth may continue to be of interest even if final attained heights are not. During the Dutch Hunger Winter of 1944-5 the retreating German forces essentially starved the population of western Holland, a society already lacking food and fuel and under heavy psychological stress. As a result there was a cessation of growth among children. In the period after 1945 Dutch standards of living were sufficiently high that most children were able to entirely make up for their lost winter of growth.[25] It would be wrong to conclude that because the final attained height of children of this generation recovered from their early insult, their standard of living was not affected by the events of 1944-5. Rather, the pause in growth in 1944-5 is historically interesting and demonstrates severe problems in that society, problems that are not negated by the later height catch up. The same is true for an individual's growth patterns. There is, for example, increasing evidence that reversible growth hormone deficiency (GHD) can have psychosocial causes. Children from disadvantaged family backgrounds are more likely to suffer reduced production of insulin-like growth factor 1 (IGF-1) without organic cause. Once placed in better care, they quickly return to normal levels of IGF-1 and growth hormone production, and experience catch-up growth with other children.[26] A similar case of severe stunting involving a 6.4 year old boy who suffered from psychosocial GHD recently occurred in

Britain.[27] In some cases, extreme stunting (sometimes termed "psychosocial dwarfism") indicated extreme forms of psychosocial deprivation. Albanese et al. found that of 11 prepubertal children treated for growth failure without apparent organic cause, six had been sexually abused.[28] In all of these cases, later periods of above average height gain do not alter the fact that the earlier periods of height shortfalls indicate that something is wrong.

In contemporary life, welfare workers use large growth shortfalls as an indicator of severe problems at an individual level. It is unlikely that economic and social historians of the future will do likewise. Rather, they are likely to use larger samples to detect smaller but more widespread height shortfalls that indicate more widespread social problems. Although smaller, these differences are not tiny: at the start of the 1960s, the Government's Chief Medical Officer for Education found that children in the poorer districts of Liverpool and Sheffield were between 1.5 and 6.6 cm shorter than children from more affluent parts of the same cities.[29] A substantial 'social gradient in height' among pre-school children continues to exist into the modern era.[30] A widespread programme of height measurement – or, for that matter, of weight, or skinfold thickness – would allow social policymakers today, and social historians tomorrow, to analyse policies that are otherwise hard to assess.

It is easy to think of family-oriented policies whose effects are hard to gauge. One example would be the current UK government's plan that, for low-wage families, child-related benefits should not be paid to the mother, as at present, but to the wage-earner, usually the father, via the wage packet. This is part of their programme to 'make work pay'. The move has, however, been strongly opposed by groups such as the Child Poverty Action Group, who argue that money is more likely to reach the child if paid to the mother. Direct evidence on this question is hard to come by. We cannot use aggregate income measures, or market based data, because the whole question resolves around the allocation of resources within the family. Using age specific height data before and after such changes may allow us to better understand the internal dynamics of family income distribution, and, if done contemporaneously, might allow policy makers to better design public policy to achieve the objectives set for it. An early attempt was made to analyse the withdrawal of free school milk using this methodology. Indeed, it was for this purpose that the *National Study of Health and Growth* was created. Unfortunately it began data collection after the cessation of free milk, severely limiting its ability to create data to answer this question.[31] This approach has been

used more successfully in South Africa. In the early 1990s pension coverage for blacks was increased dramatically.[32] One third of black South African children live with an elderly person. Research showed that pensions received by women had a statistically significant effect on the height of female children in their households. This effect was large – sufficient to bridge more than half the gap between South African and US girls of the same age. The effect was smaller and insignificant for boys in such households, and the pension rise had no effect on stature of children of either gender when it was received by men. Notice that it does not matter that any height shortfall will be made up later, nor that child height shortfalls have no long-term health consequences. All that is needed is the basic inference, accepted by all medical and public health authorities, that if a child is not getting taller, something is wrong.

Height can also be used to assess the efficacy of public policy in a wider sense. We know, for example, that in the eighteenth century, members of the upper class were on average some 9 cm taller than the poor. In the 1980s, the difference between men in class I/II and IV/V was 3 cm, substantially less than in the eighteenth century, but by no means a trivial height difference.[33] Since even the lower classes in England nowadays are well-fed by historical standards, the persistence of such differences is something of a puzzle.[34] This is especially true since the economy today is characterised neither by extensive heavy manual labour nor child labour. It therefore appears that neither nutrient intake nor (work-related) energy expenditure are directly responsible. There are a number of potential theories that may explain this finding. First, claims on energy intake, such as keeping warm, may have responded less flexibly to increased incomes than nutrient consumption itself – Britain still has a well known problem of 'fuel poverty', the extreme manifestation of which is the early death of old-age pensioners as a result of inadequately heated homes. Second, there is a host of other environmental factors that are known to impact terminal heights. Medical research has shown that high concentrations of lead in drinking water leads to stunting in children – every increase by 10 micrograms/dL reduces the height of 7-year old children by 1.57 cm.[35] High nitrate concentration have also been hypothesized to produce similar effects, but the evidence is not always convincing.[36] To the extent to which the replacement of lead pipes has taken longer in poorer parts of Britain, for example, the continuing sensitivity of height with respect to class can be explained.

Age-specific height data can be used to assess the effects of long run social changes. Two examples include the rising number of lone parent households and rising inequality in work patterns, with the growth of both no worker and dual worker households in many western countries. We know, for example, that at the whole nation level, the secular rise in child heights ceased temporarily in the period 1979-86 in both England and Scotland.[37] During this period positive height gains continued to be recorded within social groups, but these within group rises were negated by the redistribution of the population from taller to shorter groups. This was particularly important in England, where many of the newly unemployed had previously been skilled manual workers.[38]

Collecting data on the height of children should allow us to understand the link between inequality and height shortfalls more fully. At present there is a debate as to whether inequality per se causes height shortfalls, through some sort of psychosocial mechanism, or whether inequality is only correlated with such shortfalls because it indicates the presence of (absolute) poverty.[39] If it is the former, we would expect that, ceteris paribus, for any given income level, areas with lower inequality would have taller children. We have in Britain very good data on income inequality by area. The Inland Revenue publishes annual figures giving the mean and median income of taxpayers for each of the UK's 407 local councils.[40] These show much variation: some areas are poor but equal, others poor and unequal, a third group are rich and equal while the remainder are both rich and unequal.[41] We have even more locationally specific data for unemployment, with most local council employment services recording unemployment at ward level, where each ward contains between 6 and 12 thousand adults.[42] In addition, the Index of Local Conditions, a measure of deprivation, is available at the level of local council enumeration districts.[43] With an average of just 300 adults each, these enumeration districts are tiny, and mean that we have remarkably good evidence for the location of both the most deprived areas, and the most unequal areas in Britain.[44] Furthermore, since almost all primary school children attend their closest school, we are able to map these measures of deprivation into school based data with remarkable precision. This should allow us to assess whether, through psychosocial mechanisms, children's development is slowed by inequality at the local, regional or national level.

In the light of these suggested uses for child height data we regret both the ending of universal height measurement in the UK, and that nationwide data was not properly kept

when the policy was in force. We correspondingly endorse the recommendation of the UK Joint Working Party of Child Health Surveillance that all children be measured at ages five, seven and nine, and argue that the data should be available to researchers at school level. Of the three ages, the most important is five, on entry to school. At this point height more closely reflects the realities of home life than at later ages, where height is also affected by the stresses of interacting, perhaps for the first time, with non-family members on a regular basis.

It would, of course, be possible to use biological indicators other than height to assess both the effects of changing social conditions and policies, and the links between poverty, inequality and children's development. The choice of height, weight, weight for height, skinfold thickness etc. is essentially a pragmatic one. Historians will use which ever has been collected previously; governments should collect the data in a cost-effective manner. In this decision height retains some advantages. Compared with weight based measures it does not suffer from reversal, and the cessation of height gain is easier to interpret.[45] Weight loss, unlike height loss, can be a positive choice on the part of the child, and excessive weights for some can make average weights misleading. Height is also relatively quick and easy to measure, and needs less specialised equipment or training that, say, measures such as skinfold thickness. We note that the UK Joint Working Party of Child Health Surveillance recommended that children's heights, rather than other auxological measures, should be recorded, but historians will be able to make use of any such data to answer important questions about the conditions under which families exist and thrive.

Analysing political change: heights in transition economies

The second instance where height data will continue to interest future economic historians is where it is the only reliable data available. One unambiguous advantage of using heights is that even when bureaucrats choose not to record the data at the time, the data can be recorded with a reasonable degree of accuracy some years later. Once a person has attained their final height, they remain at that height until at least middle age; furthermore their peak height can be gauged reasonably accurately even when they are old.[46] Self-evidently this is not true for income data, but furthermore it is not true for other auxological measures, including those that involve weight data, such as the waist to hip ratio, and those that measure subcutaneous

fat levels, such as skin-fold thickness. This ability to collect data that was not recorded contemporaneously is useful for historians of societies that do not record more traditional standard of living data accurately, either because of omission or deliberate error.

Subsistence based economies are one example where both individual and national income data may rest on heroic assumptions. In addition, cash economies with large black markets, or economies with very weak governments may suffer from very poor data collection. More generally in many countries both individuals and – sometimes – the state have an incentive to lie about GDP. If individuals are self-certifying income that may later be used for tax assessment purposes they have a clear incentive to understate their income. More generally the relationship between the state and its citizens will affect the quality of statistical data. For example Atkinson and Micklewright report a fall in the response rates to the Polish Household Survey following the imposition of Martial Law.[47] If the state itself is a recipient or potential recipient of overseas assistance, they too may have an incentive to underreport the level of national income. In contrast we know that, for political reasons, the East European communist bloc substantially overstated the standard of living prior to the fall of the Berlin Wall, and many western experts are sceptical about the income and growth figures produced by the remaining communist countries, China, Cuba and North Korea.[48]

The ability to collect height data long after the historical events whose effects we wish to understand may be especially useful in understanding the economic history of economies that have undergone a transition from communism to capitalism, especially if new countries are born in the process. National income data will almost certainly be available for the communist period, but may be unusable for three reasons. First, under communism it may have been falsified for political purposes. Second, the prices used to construct the GDP estimates may be far from market prices. Third, data for the new nation itself may simply not be available for the period prior to independence, when it was part of a larger political unit. National income figures for the transition period, in contrast, may well suffer from underreporting – the black economy is more likely to flourish – and from different methods of accounting for the production of large industrial companies whose survival is based on the continuance of soft credit. In these circumstances economic historians retain the ability, half a century or so after the beginning of transition, to collect the heights of the current adult population of different ages, and so construct a consistent measure of the standard of living in

the communist, transition and post-transition economy. The income levels of these countries suggest that heights may prove responsive to changes in economic conditions. At the end of the communist period, the official figure for GDP per head in the USSR was $2,055.[49] Figure 1 makes it clear that typical countries with an income of around $2,000 still have 6-8 cm of growth to gain to reach 'western' levels, and that relatively slight falls in income at these levels can be expected to yield quite substantial falls in attained heights.

The quality of conventional GDP data for the countries of Eastern Europe is sufficiently high to allow economic history to be written based on conventional measures. This is, however, less true for the former Soviet Union, where the problems of general under-reporting, and non-market prices are much more pervasive. In addition, the Russian Federation is today made up of 89 constituent parts. It is at least plausible that, at some stage, some of these constituent parts will successfully establish themselves as independent nations. Whether that process is painless or bloody, it seems unlikely that historians will find it easy to assemble accurate series for living standards for such new nations prior to their independence. Even without historians measuring people in middle age, the widespread use of conscription may, as for so many countries historically, offer relatively good quality height data for such nations. Changes in genetic composition as a result of Russians leaving the far-flung provinces of the former Soviet Empire should be relatively easy to overcome – last names alone should provide a robust indicator of ethnic origin. In summary, the absence of reliable conventional data combined with the potential availability of height statistics, means that a height based history of the former Soviet Union will surely prove as attractive as measuring the heights of individuals during the British industrial revolution.

The 'height history' of the transition from communism to capitalism may also interest social and economic historians for another reason, its link to the different values of communist countries. The claim of many such countries was not that their growth rates were the highest in the world, but that they had 'developed country' health indicators despite 'less-developed country' levels of income. Today the most vigorous defender of the second way is Cuba, which is able to boast infant mortality rates just 18% worse than OECD levels, even though its level of GDP per head is 85% below OECD levels. Similar comparisons can be made in Asia, where the East Asian market economies have infant mortality rates 65% higher than their planned neighbours, despite having income levels that are four times as high.[50] We

would correspondingly expect planned economies to have substantially better height profiles than their income levels would suggest.[51] The causes of this performance seem to be two fold. First, planned economies have broadly similar relative poverty profiles to richer OECD nations; that is, they are far more equal than capitalist nations at similar levels of development.[52] Second, they have made the conscious choice to spend substantially more on healthcare than capitalist nations: a case of public affluence and private squalor. Thus we find that Eastern Europe had 60% more doctors per head of population in 1988 than did OECD nations, while the planned Asian economies had more than three times as many doctors than their capitalist Asian neighbours. In each case, the capitalist half of the comparison is at least five times richer than the communist half.[53]

Both of these aspects of communist countries, relatively low inequality and relatively high spending on healthcare, are likely to decline at least in the transition stage. This means that writing the history of transition in terms of height will give a very different story from writing the story in terms of GDP per head. In particular, if under communism most people have a sufficiently healthy start to life that they are able to closer approach their full height potential than would be expected from their income alone, then heights will be vulnerable to the introduction of a market economy. In the early stages of transition we might expect both income and heights to fall, as the demolition phase of transition occurs. But even in the medium term, as average GDP per head rises above the communist level, the rise in inequality might lead us to expect average height to remain at less than its communist level for a considerable period of time. This is an example of where we might expect the height and income stories to systematically diverge, but it is at least arguable that both will offer meaningful stories. A history in GDP will mirror capitalist values and capitalist expectations, while a history in height will place much greater weight on those things with communist regimes emphasised, equality and public services.

A multi-country height history of the former communist states would have a further advantage. By looking at those nations for whom we have good data, we may be able to better calibrate the effect of known changes in income levels, growth rates, unemployment and inequality on heights. By better understanding what causes height changes, we will be better placed to interpret changes in heights in conditions where we have only limited amounts of other data.

Conclusion

As the average height of an adult population ceases to rise, the history of adult heights must cease with it. We believe that we are fast reaching such a point for most OECD countries. In those countries the tall story will turn towards the shortest, and use the height of children to answer a different, but by no means less important, set of questions. Average adult heights will, in contrast, remain potentially interesting in countries whose income levels have not reached those of the West. Just as for the history of Britain in the industrial revolution, our interest in height inevitably increases as the availability of other data declines. Wherever possible historians will follow the medical experts in deciding which anthropometric indicators are most worthwhile, and in all cases they will be forced to work with whatever form of data is left by one generation for the next. That much, at least, will never change.

References

Albanese, A., G. Hamill, J. Jones, D. Skuse, D. Matthews, and R. Stanhope, "Reversibility of Physiological Hormone Secretion in Children with Psychosocial Dwarfism", *Clinical Endocrinology* 40 (1994)

Atkinson, A.B. and J. Micklewright, "Economic Transformation in Eastern Europe and the Distribution of Income", EUI Working Paper in Economics No. 91/33, Florence, 1991

Bailey, D. (ed.) *Inland Revenue Statistics* London: The Stationery Office, 1998

Ballew, C., L. Khan, R. Kaufmann, A. Mokdad, D. Miller, and E. Gunter, "Blood Lead Concentration and Childrens Anthropometric Dimensions in the Third National Health and Nutrition Examination Survey", *Journal of Pediatrics* 134, (1999).

Behrman, J. and A. Deolalikar, "Is Variety the Spice of Life? Implications for Nutrient Responses to Income", Harvard Institute of Economic Research Discussion Paper No. 1371, Cambridge, MA, 1988.

Bielicki, T., and A. Szklarska, "Secular Trends in Stature in Poland: National and Social Class-specific" *Annals of Human Biology*, Vol 26, No 3, (1999), pp. 251-258.

Cernerud, L. and G. Lindgren, "Secular Changes in Height and Weight of Stockholm Schoolchildren Born in 1933, 1943, 1953, and 1963", *Annals of Human Biology* 18, (1991)

Clark, G., M. Huberman, and P. Lindert, "A British Food Puzzle, 1770-1850", *Economic History Review* 48 No 2, (1995): 215-37.

Costa, D., "Height, Weight, Wartime Stress, and Older Age Mortality: evidence from Union Army Records," *Explorations in Economic History* 30, (1993)

Crafts, N.F.R., "Some Dimensions of the Quality of Life in Britain during the Industrial Revolution", *Economic History Review* 50 No 4, (1997): 617-639.

Duflo, E., "Child Health and Household Resources in South Africa: Evidence from the Old Age Pension Program" *American Economic Association Papers and Proceedings, American Economic Review*, (2000), forthcoming.

The Economist Book of Vital World Statistics: A Complete Guide to the World in Figures London: Hutchinson, 1990.

Eveleth, P. B., and J. M. Tanner *Worldwide Variation in Human Growth* Cambridge: Cambridge University Press, 1990

Floud, R. C., K. W. Wachter, and A. Gregory, *Height, Health and History: Nutritional Status in the United Kingdom, 1750-1980* Cambridge: Cambridge University Press, 1990.

Fogel, R. and L. Wimmer. "Early Indicators of Later Work Levels, Disease, and Death." NBER Working Paper on Historical Factors in Long Run Growth 38, Cambridge, MA, 1992

Gatseva, P., A. Aleksandrova, N. Ivanova, and K. Sapundzhiev, "The Physical Development of Children Living in a Settlement with a High Nitrate Content in the Drinking Water", *Problema Khig* 22, (1997)

Gregory, P. R., and R. C. Stuart. *Soviet and post-Soviet Economic Structure and Performance*. (fifth edition) New York: HarperCollins, 1994

Greulich, W., "Some Secular Changes in the Growth of American-born and Native Japanese Children", *American Journal of Physical Anthropology* 45 (1976)

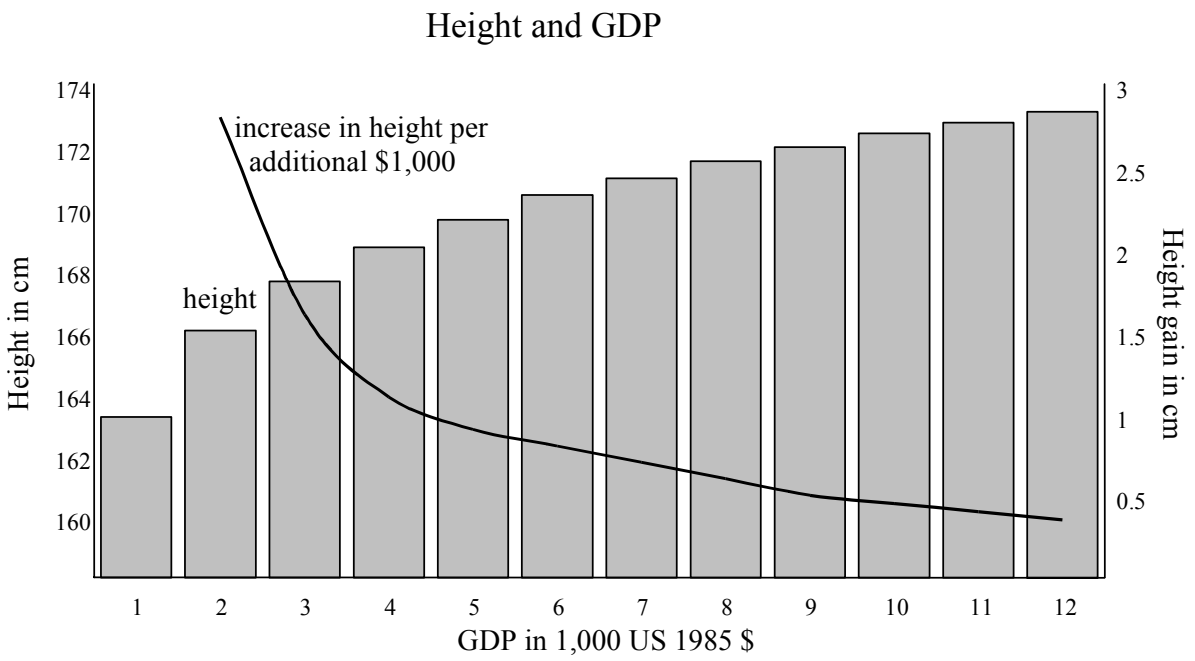
Harris, B. *Height of the Schoolchild* Buckingham: Open University Press, 1991

Kalmijn, S., J. Curb, B. Rodriguez, K. Yano, and Abbott, R., "The Association of Body Weight and Anthropometry with Mortality in Elderly Men", *International Journal of Obesity and Related Metabolic Disorders* 23 (1999)

Kannam, J., D. Levy, M. Larson, and P. Wilson, "Short Stature and Risk for Mortality and Cardiovascular Events. The Framington Heart Study", *Circulation* 90 (1994)

Komlos, J., *Nutrition and Economic Development in the Eighteenth-Century Habsburg Monarchy: An Anthropometric History* Princeton: Princeton University Press, 1989.
Komlos, J., "Anomalies in Economic History: Towards a Resolution of the 'Antebellum Puzzle'." *Journal of Economic History* 56, (1996)
Liao, Y., D. McGee, G. Cao, and R. Cooper, "Short Stature and Risk of Mortality and Cardiovascular Disease: Negative Findings from the NHANES I epidemiologic follow-up study", *Journal of the American College of Cardiology* 27 (1996)
Maddison, A., *Monitoring the World Economy.* Paris: OECD, 1995
Meyer, H.E., and R. Selmer "Income, educational level and body height" *Annals of Human Biology* Vol 26, No 3, (1999): 219-27.
Nieves-Rivera, F., L. Gonzalez de Pijem, and B. Mirabal, "Reversible Growth Failure among Hispanic Children: Instances of Psychosocial Short Stature", *Puerto Rican Health Science Journal* 17 (1998)
O'Connell, J., M. Dibley, J. Sierra, B. Wallace, J. Marks, and R. Yip, "Growth of Vegetarian Children: The Farm Study", *Pediatrics* 84 (1989)
Pritchett, L., "Divergence, Big Time", *Journal of Economic Perspectives* (1997).
Rona, R.J. and S. Chinn, *The National Study of Health and Growth* Oxford: Oxford University Press, 1999.
Samaras, T., and L. Storms, "Impact of Height and Weight on Life Span", *Bulletin of the World Health Organisation* 70. (1992)
Seckler, D., "Malnutrition: An Intellectual Odyssey", *Western Journal of Agricultural Economics* (1980)
Srinivasan, T., "Undernutrition: Concepts, Measurements, and Policy Implications." In *Nutrition and Poverty,* edited by S. Osmani Oxford: Clarendon Press, 1992
Stanhope, R., P. Adlard, G. Hamill, J. Jones, D. Skuse, and M. Preece, "Physiological Growth Hormone (GH) Secretion during Recovery from Psychosocial Dwarfism", *Clinical Endocrinology* 28 (1988)
Steckel, R., "Stature and the Standard of Living", *Journal of Economic Literature* 33, no 4 (1995): 1903-40
Steckel, R., "Height and Per Capita Income", *Historical Methods* 16, no. 1 (1983): 1-7
United Kingdom, Department of Health and Social Security "Second Report by the Sub-Committee on Nutritional Surveillance (Committee on Medical Aspects of Food Policy)", *Reports on Health and Social Subjects*, no. 21.
United Kingdom, Ministry of Education *Health of the Schoolchild 190-1. Report of the Chief Medical Officer of the Ministry of Education for 1960-1*, London: HMSO 1962
Voth, H.-J., and T. Leunig (1997), "Did Smallpox Reduce Height?", *Economic History Review* 49, no 3 (1996): 541-60.
Waaler, H., "Height, Weight and Mortality: The Norwegian Experience," *Acta Medica Scandinavica* 1984, Supplementum 679
Wolfe, B. and J. Behrman, "Is Income Overrated in Determining Adequate Nutrition?", *Economic Development and Cultural Change* 31 (1983)
Xu, Y., Liang, S. and D. Liu, "Comparison of Stature Growth Curves in Children and Adolescents", *Chung Hua Yu Fang I Hsueh Tsa Chih* 31. (1997)
Yuan, J., R. Ross, Y. Gao, and M. Yu, "Body Weight and Mortality: A Prospective Evaluation in a Cohort of middle-aged men in Shanghai, China", *International Journal of Epidemiology* 27. (1998)

Figure 1


Height and GDP
increase in height per additional $1,000
height
Height in cm
Height gain in cm
174
172
170
168
166
164
162
160
3
2.5
2
1.5
1
0.5
1
2
3
4
5
6
7
8
9
10
11
12
GDP in 1,000 US 1985 $

Footnotes

[1] Note, however, that the number of sexual partners is correlated with an individual's height – though many other factors may be involved. Furthermore, an individual's height does positively affect their adult income, even correcting for education levels. Meyer and Selmer, "Income Inequality," pp. 222-3
[2] Steckel, "Stature"
[3] Crafts "Some Dimensions"
[4] Costa, "Height", Fogel and Wimmer "Early Indicators"
[5] Waaler "Height"
[6] Those 175.3 cm or shorter live 4.95 years longer than veterans that are taller than 175.3 cm. Samaras and Storms "Impact," pp. 259-67
[7] Kannam et al., "Short Stature," pp. 2241-7.
[8] Liao et al., "Short Stature," pp. 678-82.
[9] Kalmijn et al., "Association" pp. 395-402. Yuan et al., "Body Weight," pp. 824-32.
[10] Xu at al., "Comparison"
[11] Cernerud and Lindgren, "Secular changes"
[12] Greulich, "Some Secular Changes"
[13] The data is from Steckel "Stature", table 4, interpolated on the basis of his regressions in table 3. Steckel "Stature", see also Steckel "Height"
[14] Maddison gives per capita GDP of 18,317 US-$ in 1989, Maddison, 'Monitoring the World Economy"
[15] The empirical evidence in favour of convergence is ambiguous. Pritchett "Divergence"
[16] Wolfe and Behrman "Is income?"; Behrman and Deolalikar "Is Variety?". This lends further support to the revisionist literature associated with the work of Seckler "Malnutrition" and Srinivasan "Undernutrition".
[17] Cited by Clark et al., "British Food," p. 221.
[18] Vegetarian children (of different age groups) were 0.2 to 2.1 cm shorter than their peers. O'Connell et al. "Growth"
[19] Floud, Wachter and Gregory, *Height*, p. 22
[20] Crafts, "Some Dimensions"
[21] Komlos, "Anomalies"
[22] Voth and Leunig, "Did Smallpox?"
[23] Komlos, *Nutrition*.
[24] Rona and Chinn, *National Study*, p. 32
[25] Floud, Wachter and Gregory, *Height*, p. 19.
[26] Nieves-Rivera et al., "Reversible Growth Failure," pp. 107-12.
[27] Stanhope et al., "Physiological Growth Hormone Secretion," pp. 335-9.
[28] Albanese et al., "Reversibility," pp. 687-92.
[29] Ministry of Education *Health*, p. 11
[30] Department of Health and Social Security *Second Report on Nutritional Surveillance*, pp. 75-81, 95-7
[31] On the basis of smaller trials, no evidence was found that free school milk raised child heights. Rona and Chinn *National Study*, chapter 13
[32] Duflo, "Child Health"
[33] Floud, Wachter and Gregory, *Height*, p. 199
[34] Note also that the group of men, aged 16 to 64 in 1980, would not yet have been affected by differences in access to health care – the rise in private health care as a result of NHS inadequacies occurred later.
[35] Ballew et al., "Blood," pp. 623-30.
[36] Gatseva et al. "Physical Development," pp. 108-14.
[37] Rona and Chinn, *National Study*, p. 31
[38] Rona and Chinn, *National Study*, p. 33
[39] see Harris, *Height of the Schoolchild* for a fuller discussion
[40] Borough, District or Unitary Authorities, Bailey, ed, *Inland Revenue Statistics*, p. 32 and table 3.14, pp. 48-52
[41] For example, respectively, Sedgefield, County Durham (median income £10,900, mean to median income ratio 1.14), Craven, Yorkshire (£9,350/2.17), Spelthorne, Surrey (£16,400/1.15) and the City of London (£29,800/2.87), Bailey, ed, *Inland Revenue Statistics*, table 3.14, pp. 48-52
[42] The data are compiled and released by most council employment services on a regular basis.
[43] The data are collected by the Department of the Environment, Transport and the Regions.
[44] Based on the London Borough of Hammersmith and Fulham.

[45] In contrast weight can be lost through a conscious decision by parents or children, perhaps for fashion or health, or inadvertently, especially if warmer weather leads children to forsake the television in favour of more physical outdoor activities. Such weight losses are harder to interpret, both in health and social terms.
[46] Evidence exists that the turning point for height is around the ages of 35-40, with people growing trivial amounts in the previous decade, and shrinking trivial amounts in the following decade. By the age of 70, people are on average one inch shorter than when they were 25. Floud, Wachter and Gregory, *Height,* p. 163.
[47] Atkinson and Micklewright, "Economic Transformation," p. 16
[48] Such scepticism proved well founded for the USSR. Official Soviet figures give growth, 1928-84, at 9.7% per annum, whereas US estimates – now accepted as much more reliable – give a figure of 4.8%. The power of compound interest is such that Soviet estimates suggest national income grew by a factor of 178 over this period, while US estimates suggest a factor of such 14. Gregory and Stuart, *Soviet and post-Soviet Economic Structure*, p. 235
[49] All figures are for 1988. *Economist Vital World Statistics*, p. 34
[50] The market economies consist of Hong Kong, Indonesia, South Korea, Malaysia, Papua New Guinea, the Philippines, Singapore and Thailand, while the planned economies consist of Burma, Cambodia, China, N Korea, Laos and Vietnam. *Economist Vital World Statistics.*
[51] We find, for example, that in 1965, 8-year-old Moscovite boys were the tallest of eight European nations for which we have comparable data. Boys from Naples were shortest. By 1980 Dutch boys were tallest, with Moscovites slipping to fifth place, albeit still ahead of boys from Brussels, Athens and Naples. Boys were taller in 1980 than in 1965 for all groups except Moscovites. In a study of 16-year-old boys, Czechs were as tall or taller than Danes in both 1965 and 1980, while boys from Warsaw were taller than those of Brussels. In all cases the communist countries had substantially lower levels of national income than the non-communist countries. Eveleth and Tanner, *Worldwide Variation,* pp. 30-32. A more detailed height history of Poland is given in Bielicki and Szklarska "Secular Trends".
[52] Atkinson and Micklewright, "Economic Transformation"
[53] *Economist Vital World Statistics*, pp. 34, 216