Quality of life in late Chosŏn Korea: a view from anthropometric data

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Abstract
Any study of late Chosŏn economic history (prices, wages, markets) must address larger systemic concerns (environment, epidemiology, demography, nutrition, and others) that directly reveal the quality of life. Specific indicators for quality of life would also include infant mortality, life expectancy, sanitation, and water quality. These are far-ranging and difficult to find in historical records. In this paper, we have turned to Chosŏn-period military rosters for what they offer as baseline information on the health and fitness of able-bodied males. The data can provide objective and comparable data to consider general health. Anthropometric studies of military rosters are common in Europe and the United States. By offering what is available for pre-1900 Korea, Korean data can be incorporated into global considerations of pre-modern or early modern health. Comparisons will be attempted wherever possible.

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> Queen Chindŏk was enthroned [in 647]. Her personal name was Sŭngman...[her] appearance was portly and beautiful. She was 7 *ch'ŏk* tall and her hands went past her knees.[1]
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> *Samguk sagi*, Silla Annals, book 5.

The problem

From the late 1990s and early 2000s, R. Bin Wong, Kenneth Pomeranz, James Lee, Li Bozhong, and others associated with the so-called 'California School' of economic history opened a debate usually referred to as the 'Great Divergence' debate, which is still on-going. Their argument is that, while England and northwest Europe had pulled ahead of the rest of the world in trade and industry, there were very few, if any, differences between the standard of living in northwest Europe and in the Yangzi River Valley until sometime in the early to mid-1800s. Angus Maddison disagreed and argued that the gap had appeared as early as the fourteenth century and continued into the present (Ma, p. 262).[2] In 2007, Allen and colleagues pursued the question of global comparisons by publishing their conclusions on comparative real wages and found that workers in London and Amsterdam were significantly better paid than workers in China from even before the early eighteenth century, when their data begin. The surprising conclusion of their study, however, is that Southern Europe, China, India, and Japan were generally at the same level until the nineteenth century, pointing to the conclusion that only London and Amsterdam were the global exceptions, not 'Europe' in general (Allen et al., 'Wages', p. 32).[3]

In an attempt to first determine and then to test whether Korean early-modern living standards were comparable to Europe, Jun and Lewis (Jun and Lewis, 'Wages', 2006) assessed real wages and showed that Korean skilled labour were paid rather well coming out of the eighteenth century. Because productivity is difficult to determine in a pre-industrial society, Jun, Lewis, and Kang (Jun et al., 'Korean expansion and decline,' 2008) shifted the question from supply to demand and looked for evidence of consumption of non-food goods. Apparently, sufficient surplus allowed for the expansion of non-food consumables (e.g., cotton cloth), and this was seen in the high relative prices of cottage manufactured goods versus lower and stable prices for basic foodstuffs. Again, coming out of the eighteenth century and into the middle of the nineteenth century, the prices of manufactured goods easily eclipsed food prices, but the two converged by the middle of the nineteenth century. Jun et alia argued that the change in relative importance of goods and foods, as indicated by prices, suggests general stability, if not prosperity, in the eighteenth century but systemic and structural decline in the nineteenth century (Jun et al., 'Korean expansion and decline,' 2008). They were criticized for trying to determine prosperity by not using a government-derived wage series and for trying to determine productivity via relative price changes and not from the decline in land rents (Cha, 'Productivity,' 2009). Jun et alia replied that their use of non-government wages was more reflective of the market and that, while they had also found declining land rents, these could be interpreted as indicating an expansion of land by the conversion of dry fields to paddy for speculative purposes. Rather than working from supply, it might be useful to work from demand (as suggested by de Vries, 1994 and 2008)—the higher prices of goods over food may well show the availability of a food surplus that supported goods consumption. That surplus indirectly indicates higher agricultural productivity. In

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[1] Kim Pusik. *The Silla Annals of the Samguk Sagi*. Translated by Edward J. Shultz and Hugh H.W. Kang, with Daniel C. Kane. Sŏngnam: The Academy of Korean Studies Press, 2012, pp. 157-158.

[2] For a concise and insightful outline of the revision proposed by the 'California School' and its opponents, see Ma, 'Growth,' pp. 261-264.

[3] Moreover, comparisons have to be handled with thorough consideration given to the cultural context. For example, Allen et alia found high caloric consumption by Englishmen, implying more than adequate food consumption. One wonders, though, what else is comparable when one calculates a caloric and protein equivalency for beer and rice wine? An important function of beer in England was to provide a sanitized potable liquid to slake thirst, whereas East Asians probably achieved a higher level of sanitation (if not productivity) by boiling water for teas.

short, agricultural productivity is still quite difficult to measure for pre-modern Korea and original approaches are needed, both from consideration of supply and demand.

But, to pursue productivity and the standard of living in a pre-industrial agricultural setting through supply-side indicators developed to assess productivity growth for industrial societies may ultimately be impossible. Rather than looking backwards from the twentieth century, it would be better to look forward from the fifteenth or sixteenth centuries. Even the assumption that industrialization brings on a rise in the standard of living is flawed, because the advantages have often taken decades to become noticeable while populations are subjected to more intensive work (including child labor) with less food, in lower-quality housing, in dense population concentrations, which become disease vectors. Moreover, there are periods under industrialization when living standards rise and periods when they fall (Choi and Schwekendiek, 'Biological Standard,' pp. 262-263; Fogel and Grotte, 'Overview,' p. 4).[4] For industrial societies, even the use of GDP as an indicator of the standard of living is now questioned, and the United Nations has developed a Human Development Index (HDI) that combines 'GDP per capita, life expectancy at birth, and a composite measure of education based on literacy and school enrolment' (Easterlin, p. 8). For an industrial or a pre-industrial, agricultural society, wages compared to food costs can only show the quantity of goods that an individual can buy. The HDI acknowledges that this is not the sum total of a good life for industrial societies, and the same probably holds for pre-industrial societies. Length of life and health are also important (Easterlin, p. 12). Fertility rates, school enrolment and literacy, and even political democracy have also been proposed as indicators (Easterlin, p. 16-22). While life-spans, fertility, and literacy could possibly be determined for pre-industrial or pre-twentieth-century societies in East Asia, democracy would have little meaning. We would also add environmental factors that could be examined in terms of deforestation, water quality, and sanitation. These are the types of indicators that try to encompass a person's life in the round but are hard to quantify. Health is one indicator that has become tractable in recent decades and one approach to that has been through stature.

Human stature offers an indicator that can contribute to the debate on the Great Divergence, as has been convincingly argued by Baten and Hira (2008). It can also reflect real wages and food and nutrient intake (Easterlin, p. 16). Stature is strongly affected by disease, particularly gastrointestinal diseases (Easterlin, p. 16), as well as by strenuous work. For these reasons, it has been increasingly used in recent decades as a 'proxy for health' (Tanner, *Foetus*, p. 163). Particularly since the mid 1990s, studies of stature have greatly expanded in number and 'heights are now widely accepted as useful measure of human welfare' (Steckel, 2009, p. 1). Steckel has offered us far-ranging surveys of the literature on stature (1994 and 2009) and has mapped out a number of current and future issues for consideration.

Indicators of health before the twentieth century were not often recorded in government or private records. In European and American studies, we can now easily locate information on mortality, birth-rates, body-mass indices, caloric intake, and height for many European countries and the United States stretching back to 1750 (Fogel, 'Overview,' Table 1, p. 4). There is some data for East Asia (Shin et al., p. 438), but generally, we have very little information.[5] Attempts have been made to

[4] For example, Englishmen born between 1820 and 1850 were 4.8 centimeters shorter than their ancestors (Fogel and Grotte, 'Overview,' p. 5), and '...it is possible that a significant proportion of the British population had diets below levels necessary to maintain weight' (Fogel and Grotte, 'Overview,' p. 7). Koreans born in the 1920s under Japanese colonial rule experienced stature growth but height deteriorated from 1930 to 1945 (Choi and Schwekendiek, 2009). These were periods when England and Korea were undergoing rapid industrialization. See also Olds, 'Biological Standard,' 2003, who notes stature growth for Taiwanese under Japanese rule but a stagnation of body mass index. See also Morgan and Liu (2007) who discuss a rise in Taiwanese stature until the 1930s, similar to the Korean case. Height deterioration in both the Korean and Taiwanese cases were primarily attributable to the pressures of the Japanese mobilization for and conduct of war in East Asia in the 1930s. An extensive discussion for many national cases of the effects of industrialization can be found in Steckel and Floud, *Health*, 1997.

[5] Shin et al., p. 438, provide a table of male stature from various countries, including Korea and Japan for the fourteenth to nineteenth centuries. All sources are archaeological. The data for Japan come from Suzuki, 1996.

determine Chinese stature using Chinese records from the 1930s and 1940s to assess those born from the 1890s to the 1920s (Morgan 2004). Attempts to find earlier data have been less successful. Baten and Hira (2008) used records on Chinese immigrants to Indonesia, and Morgan (2009) has studied records on Chinese immigrants to Australia. The slightly taller Chinese immigrants to Australia seem to show a socio-economic difference (those to Australia were more affluent and therefore taller), and Baten and Hira have contributed to the Great Divergence debate by noting that 'economic development in China probably began to deviate from that of Europe, between the 1830s and the 1860s. This was a period of declining real wages in China...' (p. 223). The claim is based on the finding that the average southern Chinese heights (161 to 164 cm.) were the same as southern Europe in the mid nineteenth century, but shorter than heights in northwestern Europe, confirming findings by Allen et alia on differences in real wages (p. 223) in Europe and Asia.

The significant points from these studies on China are two: the heights (161-164 cm.) recorded and the lack of direct data for the Chinese case (and, it seems, for the Japanese case under Tokugawa). Heights will be addressed below, but the relative abundance of data from the Korean record marks Korea out for special consideration, and Korean data deserve close examination and the development of comparisons with Chinese and European data. While Morgan wants to push the time frame back to the mid eighteenth century to 'establish a base-line estimate of average height during the mid-Qing economic boom' (2009, p. 67), he cannot find any height data from inside China. There seems to be no data for the Imperial Chinese armies, none from the Imperial household; none for those in government service; and none from the judicial system: 'none have come to light so far' (2009, p. 67). We are beginning a study of the available Korean data, which is especially rich for the seventeenth and early eighteenth centuries and hope to report further in the future.

While indicators of mortality and birth rates can be found in such Korean documents as *hojŏk*, other indicators for nutrition and human development are harder to find. Caloric intake has been estimated for China and India by Allen et alia, but the research is still in its infancy, and body-mass indices outside Europe and the United States are rare (Olds, 'Biological Standard,' 2003 for Taiwan). Height, however, has drawn attention as an indicator, not of the supply-side question of what available food existed but of the demand-side question of the results obtained from available nutrition. Human stature is generally seen as the result of three factors: genetic input, nutrition, and general health (Shin, p. 433). If working with a sufficiently large enough sample within the same, general ethnic group, such as we have, then genetic variations within the group can be statistically controlled.

That leaves us with human height as a general indicator of nutrition and general health. The questions pursued in this paper are simple: can we see a secular change in Korean heights over the Chosŏn period? If we can, does this indicate that the period from the mid-sixteenth century to the mid nineteenth century was a period of health decline or was it a relatively stable period, particularly after recovery from the Japanese invasion of the 1590s?

The methods: Tomb measurements

There are two main ways to determine average heights: measurement of the dead and measurement of the living. There are many possible reasons why heights might be recorded, and those reasons produced data sources. We will limit this discussion to two data sources: data from tombs that offer measurements on the dead and data from military records that note the physical attributes of soldiers and offer measurements on the then living. Acquiring the data requires very different expertise. For example, tomb measurements focus on osteometric measurements of the lengths of long bones (e.g., femur, tibia, humerus, and radius) and equations that derive human stature from those measurements. A particular problem with this method is the choice of the equation to calculate from a single bone to the stature of the living person (Shin et al., p. 435-436) and, of course, the size of the sample, since wholesale tomb excavation of recent populations is socially unacceptable in Korea. Shin and colleagues collected 116 samples (67 males and 49 females) from excavations of lime-soil-mixture-barrier tombs in Korea for the period from 1400 to 1900. The lime-soil-mixture-barrier tomb was introduced by elites in the late fifteenth century and adopted by all social groups by the eighteenth century (Shin et al., p. 434). The building style of the tombs preserved bones, which ordinarily decayed in the acid-rich soils of Korea.

A particular weakness of Shin et alia's study is that the data sample is very small. They have data for only 116 individuals (67 males and 49 females) for a 500-year period. That is only about one

person for every four years or 23 per century. If we limit ourselves to men only, that is only one person for every seven years or 13 per century. A sample of at least 20 individuals is considered the bare minimum to prevent the data being skewed by genetic factors or an unusual disease environment.

Another weakness of Shin et alia's study is the adjustment formula used to calculate an individual's height from the length of long bones. From seven possible equations, they chose A. Fujii's equation developed to analyze Japanese skeletons. Their criteria for choice was the following: low Delta of Gini level, 'genetic similarities' between 'the Japanese and Korean peoples' (p. 436), and similarities between the mean statures of Fujii's reference population and Shin et alia's Korean skeletons. The actual range for males across all seven equations is from 160.9 (± 5.1) to 166.5 (± 5.5) or from 155.8 to 172 cm., a spread of 16.2 cm. We are unable to criticize the choice of equation, but we would note that, given the small size of the sample and the variety of results obtainable depending on the adjustment equation used, the results have to be taken with some reservation.

Another weakness is that they have no demographic data for their specimens. In other words, they do not know when these people lived, so they cannot distribute the data over the fifteenth to nineteenth centuries. They have to take their samples as representing the entire five-hundred year period. This means that they cannot incorporate information of known famines or epidemics as variables.[6] The lack of demographic data also means that they do not know who these people were, so they cannot control the data for socio-economic status and thus cannot be sure whether their data are mostly drawn from elites or from a mixture of more ordinary people and elites.

Furthermore, the acquisition of the sample is not fully explained. Tombs were ordinarily established with markers and tended by families over time. Shin et alia do not explain how they obtained their samples, so we can only speculate. The tombs seem to have been lost and then re-discovered from rescue archaeology, that is, they were uncovered by accident at building sites and then quickly surveyed before construction continued. Whether there were any markers or not goes unmentioned. Shin et alia conjecture that the data are mostly from social elites and elites would have tended to be taller (Shin et al., p. 438).

Aside from the data gathered on their 116 instances from 1400 to 1900, Shin et alia have incorporated information from the few other reports available on skeletons excavated from ancient tombs from 410 BCE to the seventh century CE and from more detailed twentieth-century records. Their findings must be rather rough because of the methodological problems mentioned above, but they conclude that Korean stature remained fairly stable from antiquity to the early twentieth century, when it rose dramatically.[7] The ancient samples for males range from 169.3 to 161.9 (± 1.1) cm. and the samples for 1400 to 1900 average 161.1 (± 5.6) cm. For females, the findings range from 148.8 (± 5.3) to 153.0 (± 4.3) for the ancient period and average 148.9 (± 4.6) for the period 1400 to 1900. Again, though, the size of the ancient samples is extremely small, and it is difficult, if not impossible, to take those samples as representative of the population at large. Many of the reports are for a single individual and the largest report is for no more than 10 males, or 25 people, if females are included (1st cent. BCE). Shin et alia point out that by 2004, average Korean male height reached 173.2 cm and females reached 160.1 cm. (p. 436). The historical average for Chosŏn put Korean males at approximately 5 cm. taller than Edo period Japanese and as much as 10 cm. shorter than Europeans at that time. Shin et alia's central conclusion is that Korean heights remained 'largely unchanged' (p. 438) from antiquity to the twentieth century, and this is generally attributed to genetics. However, the authors also argue that the low height as compared to Europeans was probably attributable to a Korean diet low in protein (Shin et al., p. 438).

Because Shin et alia do not know the death dates of their samples, they cannot actually discuss secular trends within the period from 1400 to 1900. Nevertheless, the spread of ± 5.6 cm. for their data suggests fluctuations, up and down, as appeared in European data. For example, European populations shrank between 1450 and 1750 and then became taller again with the onset of industrialization from the early nineteenth century, only to shrink again as the adverse effects of industrialization were felt, and then it rose again into our contemporary times. Shin et alia list three factors affecting the European data and speculate that the Korean case did not see the same factors at

[6] The authors fail to take into consideration the cholera epidemic of the early 1820s and its introduction from China, but they do note the population drop that resulted from the Imjin War.
[7] See Choi and Schwekendiek (2009) for an analysis of early twentieth-century data.

work so that would account for Korean heights remaining fairly stable over the 500-year period: a radical increase in population, unplanned urbanization, and the development of long-distance trade (Shin et al., p. 439). A spike in population would have put unusual pressure on the food supply and reduced nutrition. Unplanned urbanization and extensive long-distance trade would have created disease vectors in new cities or introduced epidemics (Shin et al., p. 439). While Shin et alia offer a completely different method to assess height, by not incorporating historical documents, they are unable to offer a more finely-grained view of secular trends, which is the chief advantage of the present study.

The methods: military records

Shin et alia assert that their study is the first to report on secular changes in Korean stature using osteometric data 'as well as historical documents' (p. 434), and that 'the first reliable document pertaining to Korean stature was written as recently as the beginning of the 20th century' (p. 436). They apparently took no notice of Chosŏn-period military records as a source of data. Military records have been used extensively in Europe and the US, because those states engaged in extensive warfare and routinely recruited troops. Because the effectiveness of military planning relied on an accurate assessment of the strengths and weaknesses of recruits, those records have a high degree of authority and are presumed accurate, although we will discuss below what 'accuracy' meant for the Korean documents as time passed.

We have located data from military rosters prepared by the Korean government from the late sixteenth to the late eighteenth centuries. Heretofore, about half of our sources that detail anthropometric data have been known, while the others have not been analyzed. All these military rosters are considered here, and they enable us to provide a finer grain of analysis to complement Shin et alia and consider secular trends from the sixteenth to the eighteenth centuries. Because this is an initial assessment of the data sources, in this paper we will discuss only the quality of entries and offer a rough estimate of secular trends in height.

For two reasons, the quality of the military rosters is probably high. The first reason relates to recruitment. Military service was an aspect of taxation and resulted from conscription. There were no mercenary armies in the Chosŏn period. Society was divided into three gross divisions: elite (*yangban*), commoners, and un-free labour (*nobi*, often translated as 'slave') in descending order. The size of each class is still a matter of debate, but the number of elites in the seventeenth and eighteenth centuries may not have been more than 20% of the entire population (probably much less), and they were not conscripted. The soldiers in the rosters examined here were commoners and un-free labour. The size of the un-free labour class has been estimated at 30% of the population at the upper end, but this is controversial. The remainder of the population were commoners. Recruits were drawn from commoners and from un-free labour. Because they were conscripted (with some payments made to 'stand-ins'), and because they were taken from among commoners and un-free labour, the recruits in our rosters can be said to be representative of the majority of the population.

The second reason supporting the quality of the rosters is deduced from the type of data recorded—highly militarily relevant—and the clear digression of entries away from militarily relevant information as the Japanese invasion of the 1590s recedes into the past. Beginning with the Imjin War, and over the seventeenth century, the data sources offer actual assessments of body height and general health. It is clear that, by the early 1700s, the focus of the records had shifted from a concern with physical prowess to social status. The eighteenth-century data offer little information on height, but the heights are recorded with some precision. More importantly, the data fastidiously record fathers' names for nearly all entries, but records of heights are less than about 10% of the entries. Father's names refer to local social status. By the late eighteenth century, the data show no variation in height measurements—all are exactly the same at 4 *ch'ŏk* (尺), and the average age is in the upper 40s, far away from the early 30s seen in other sources.

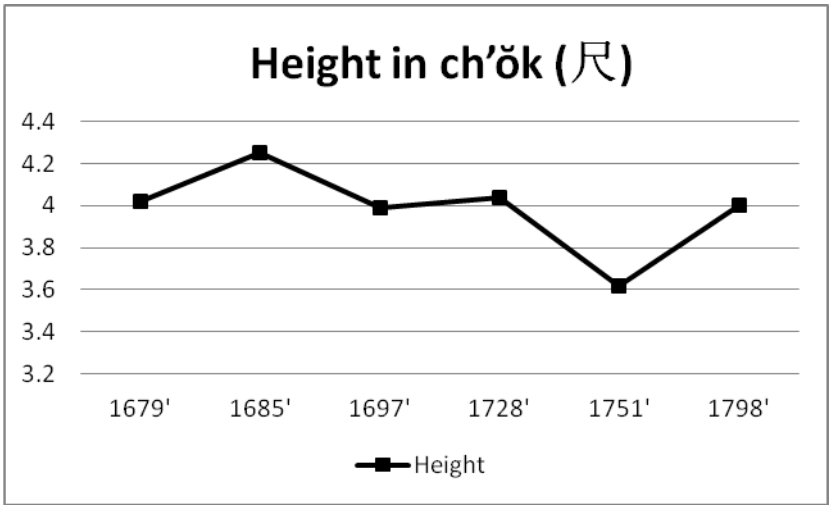
The late sixteenth-century and seventeenth-century records show a concern with actual military preparedness. The disappearance of this usable military information must reflect the general peace that had been maintained from the 1640s onwards. In other words, by the eighteenth century, the major concern of the records had shifted from the soldier's body to his social status.

Secular trends in height have been widely used in European and American historical studies to assess improvements or declines in general health. If we can track changes in height over at least

the late Chosŏn period, then we can make comments about the improving or declining quality of nutrition. One complication in assessing the data contained in these military rosters is in the measure used. The measures are *ch'ŏk* (尺) and *ch'on* (寸). There were ten *ch'on* in one *ch'ŏk*, but there were various *ch'ŏk* and there were various measures used for the same *ch'ŏk*. It is possible that one standard measure was used in the late sixteenth century and another thereafter. Kim U-ch'ŏl has suggested that we should apply one *ch'ŏk* for 1596 (*chuch'ŏk* 周尺) and another (*hwangchong ch'ŏk* 黃鐘尺) for the period of the seventeenth century and later (Kim U-ch'ŏl, '17 segi', 2006, p. 100). This is possible, but we do not have any corroborating evidence to determine the use of one *ch'ŏk* or the other. Moreover, there were various measures in various regions, and a national standard was difficult to re-establish after the devastation of the Imjin War. We will eventually compile a range of possible measures and compute our *ch'ŏk* along that range, but it is probably more enlightening at this point to consider the secular trend purely in terms of *ch'ŏk*, without trying to convert to metrics and bearing in mind that the *ch'ŏk* may not have been exactly comparable.

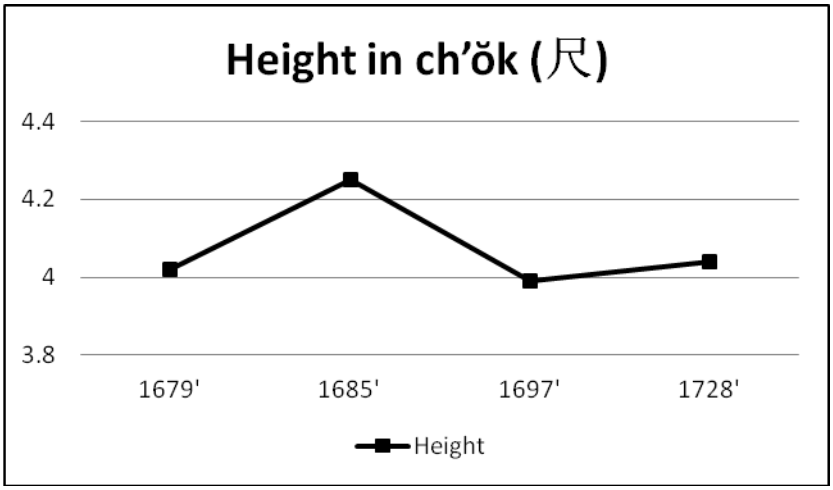
From all of our data sources, we have culled an initial total sample of over 4,500 cases that offer information on both heights and age. All the information applies only to men, and all years mentioned refer only to the year of measurement and have not been adjusted. Comparing the crude averages, there appears to have been a slight downward trend. The variation in average heights ranges from 4.25 to 3.62 for a range of 0.63 of a *ch'ŏk*. This range is beyond the standard deviations but within the minimum and maximum ranges. Figure 1 shows a rough secular trend of Korean heights from 1679 to 1798.

Figure 1: Height in *ch'ŏk* for 1679 to 1798



There is a significant problem in including data from the mid and late eighteenth century, because the focus of the data shifted from the condition of the body to the social position of the body. If we take out data for the mid and late eighteenth century, then we probably have a more accurate picture of heights as depicted in Figure 2.

Figure 2: Height in *ch'ŏk* for 1679 to 1728



Conclusion

We cannot yet convert our *ch'ŏk* to metrics, but we can offer a finer grained picture to complement the long, secular trend offered by Shin et alia that stretches from antiquity to the twentieth century by reporting here on assessments of the living made during the Chosŏn period. Contrary to expectations, nutrition appears to have been better for those born in the early to mid seventeenth century, just when the country was recovering from the Imjin War, but it appears to have declined somewhat towards the end of the seventeenth century. There may have been further declines in the early decades of the eighteenth century with improvement thereafter, but these conclusions are very sketchy and require much more analysis of the data base.

The work ahead is quite extensive. We have not yet adjusted our data for age, disease, or a number of other variables included in the data that indicate health. We have yet to control our sample for social status, but it is likely that the military rosters recorded the heights of individuals who were not high in social status, while the tombs may show the heights of social elites. If we combine the two, we may have an upper range in heights from the tombs and a lower range in heights from the military rosters.[8]

[8] A gap between upper and lower classes is not unusual in world history. For example, Pre-Conquest Latin American heights had a gap of 7 to 8 cm. and the heights of the English peerage began to diverge from the general populace from the middle of the eighteenth century (Shin et al. p. 438).

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