Measuring Gender Well-being with Biological Welfare Indicators

Aravinda Guntupalli* and Joerg Baten**

*University of Tuebingen, Mohlstrasse 36, 72074 Tuebingen, Germany.
Email: aravinda-meera.guntupalli@uni-tuebingen.de  Corresponding author
** University of Tuebingen and CESifo, Mohlstrasse 36, 72074 Tuebingen, Germany, Email: joerg.baten@uni-tuebingen.de

Abstract

Measuring gender well-being for the period before the 20th century is a difficult task, given that quantitative information is often lacking. We review the literature that uses gender differences of height (as a proxy of net nutritional status, and health). Previous research has focused on the gender inequalities during (a) the Middle Ages and the early modern period that includes the “witch hunting” period (b) the early industrial revolution in Britain, as well as still agricultural societies in other countries such as Bavaria and Ireland in the 19th century (c) modern societies at the transition from socialism to market economy. However, the number of country studies should be extended, especially for the 19th century, for which a lot of treasures still slumber in the archives.

Keywords: Anthropometry, Gender, Well-being
Measuring gender differences in historical periods is a challenging task, as there is a dearth of information regarding the gender differences in incomes and well-being. Our review considers the quantitative evidence regarding gender-specific well-being. We first give an overview over anthropological and various views on gender distribution issues in history. We will then discuss the problems and advantages of these methods by reviewing the literature that applied them. We conclude with plans for future research.

1. Anthropological dimorphism


According to Eveleth and Tanner (1976), two genotypes that can produce the same adult height under optimal environmental circumstances, can produce on the contrary different heights under circumstances of deprivation. Thus children who would be taller in a well-off community would be shorter under poor economic conditions. We use these arguments for studying gender differences in adult stature. The ratio of female to male height can serve as an indicator for measuring gender discrimination.

At which ages is the influence on final adult heights strongest? The use of anthropometric indicators for measuring nutrition rested on a well-defined pattern of human growth between childhood and maturity that reflects the interaction of genetic, environmental, and socioeconomic factors. The average annual increase in height is greatest during infancy, falls sharply up to age three, and then falls more slowly during the remaining pre-adolescent years, except for the teenage growth spurt (Fogel et al. 1983). Baten (2000) found that
environmental conditions during the first three years plays an important role in determining adult height compared to later part of the growth period. In contrast, the height of still growing children and young adults is also strongly influenced in the one or two years before measurement. For those still growing persons, catch-up growth did not yet take place that normally wipes out temporary influences until final adult height is attained.

Biologically men and women have differences in the nature of growth, final adult size and behavior. Males have a larger stature, more robust cranial and facial features, along with greater musculature and strength (Frayer and Wolpoff 1985). However, apart from these biological differences between men and women, other determinants like nutrition, health care, and disease might play an important role in determining stature differences between men and women.

Many studies have found a decrease in male-female height differences under conditions of nutritional stress and an increase in dimorphism with improved diet. Based on this finding and biological theorizing, they hypothesized that women are more resilient during crisis periods (Brauer 1982, Gray and Wolfe 1980, Lieberman 1982, Stini 1985, Wolanski and Kasprzak 1976). They argued that males are more susceptible to fluctuations in nutritional quality and show greater impairment in long bone growth compared to females under the same food deficits (Clutton-Brock and Harvey 1984). So a long term nutritional shortage would not only mean a reduced adult height size in both sexes and but also more impact on men. Gender dimorphism (also known as Sexual Size Dimorphism by biologists and anthropologists) is calculated in most of the studies as the ratio between male and female stature whereas in some contemporary studies gender dimorphism is calculated as the difference between the mean heights of the genders expressed as a percentage of male height.

Gray and Wolfe (1982) compared mean heights of men and women in various population groups and supported increasing dimorphism with increasing height. Later Gaulin and Boster (1985) criticized the sample as the studies were based on too small sample sizes.
Gustafsson and Lindenfors (2004) tested if populations with larger stature were exhibiting more dimorphism using adult male and female data that are above 19 years from 124 population groups where most of the recordings were from the later part of the 20th century. They rejected the hypothesis of increasing dimorphism with increasing stature in humans using phylogenetic method to correct for errors arising as a consequence of populations sharing a common ancestry. Phylogeny is the evolutionary history of a group of organisms and the modern phylogenetic investigations are based on molecular data, primarily nucleotide sequences. Basically, the more closely related two organisms are the more genes they will have in common. Hence Gustafsson and Lindenfors controlled for genetic ancestry to compare evolutionary dimorphism.

Several studies for prehistoric periods covering North America (Hamilton 1982), Mexico (Nickens 1976), Europe (Frayer 1984), India (Kennedy 1984), China, and Southeast Asia (Brace et al. 1984) support the “female resiliency” hypothesis. These studies mostly focus on prehistoric time periods and have small sample sizes.

Holden and Mace (1999) tried to relate sexual division of labour and gender dimorphism by observing 76 aboriginal populations. They took sexual division of labour data from an “Ethnographic Atlas” and concluded that sexual dimorphism in stature is negatively correlated with women’s labour force participation. They conclude that this negative association stems from sex-biased parental investment.

Moradi and Guntupalli (2006) found that mean stature of both females and males are increasing with food supply generally at the same rate. Their research on the Indian population between the 1930s and 1970s does not support the hypothesis of more dimorphism with increasing stature. They also show that during the food crisis period in the states of Kerala and Orissa, an increase in gender dimorphism was observed pointing to a rise in gender discrimination.
In conclusion, due to the resiliency hypothesis we can assume that if women’s height declined somewhat, this might even imply a stronger downturn of food intake, because women’s resiliency compensate a part of it. However, for the more recent period, food consumption behaviour patterns cannot be neglected at higher income levels. For example, teenage girls in rich societies might consume less food in order to be slim, for culture and fashion reasons. But during most of history food and health resources were scarce goods, and there were gender-related conflicts about its distribution.

What are the views from economic theory on this? Apart from the fact that there is a biological stature difference between man and woman, some other determinants play a role. Other factors influencing the female-male height ratio were probably agricultural patterns. For example, women were more often specialized in cattle farming and garden work, increasing their “advantage of proximity” to milk and vegetables. In contrast, grain cultivation might require more male upper-body strength than herding cattle; hence a grain-oriented society might distribute more nutrition and health resources to male offspring. When agricultural patterns changed, for example from cattle farming towards grain-based agriculture, women’s height and health might have declined, as Klasen (1998) argued assessing relative mortality. But those “rational” distribution patterns should not be taken too easily at face value. Oglivie (2004) argued, for example, that while this sounds plausible, in early modern Germany almost all occupations in which males had seemingly rational brawn advantages, there were also women active. And they were actually actively excluded from those occupations not because they were unsuccessful, but because male competitors succeeded in creating institutions (guilds etc.) to exclude them and limit their activity.

Apart from agricultural specialization, the expected income of girls which might determine the relative parental investment in their female offspring could also be influenced by other labour market relations, such as the relative efficiency of female labour in factories, for example, of a labour market for female domestic services.
Another important issue is mobility. Boix and Rosenbluth (2004) have argued that male brawn that can be used for grain production is a relatively mobile factor, whereas female specialization in child-rearing is an immobile, family-specific investment. Given that most societies have the traditional division of labour with women performing more of child-rearing, males have a better bargaining position by threatening to run away. Boix and Rosenbluth illustrated this with the empirical fact that in hunter gatherer societies, dimorphism tends to be relatively small. With sedentary lifestyle and urbanization, male brawn becomes relative more important and their bargaining position increases, hence dimorphism grows.

There are some other factors that we can just mention briefly. The relative exposure of women to disease might also have played a role, although this is not always easy to measure. Culturally determined discrimination patterns could play a role. For example, Das Gupta (1993) argued that the relation between discrimination against girls and available resources has an inverse relation where acute scarcity results in gender bias. We can test this hypothesis with our data. In the very long run, military demand for upper-body strength might favour redistribution towards males.

We conclude that anthropological studies emphasize mostly the female resiliency hypothesis (taller heights in better periods means more dimorphism) whereas the economic views on dimorphism stress mobility-based bargaining patterns, as well as agricultural specializations and other labour market factors that influence the expected revenue from female labour.

2. Were the Middle Ages good for “wise women”, and the Early Modern “witch hunting period” a transition to a more male-dominated society?

A relative new area of study has focused on male and female heights using human bones from archaeological excavations. Koepke and Baten (2005) have employed almost 10,000 height estimates from more than 300 sites all over Europe to estimate human stature by century,
region, and gender. A large amount of their study focuses on strategies of minimizing measurement error, hence we repeat those issues not again, but refer the reader to the original study.

What can we learn from archaeological bones about gender distribution issues? The most important aspect is probably the strongly changing distribution of biological welfare between the Middle Ages and Renaissance (Figure 1). We find that the Dark Ages were really dark for women, whereas the Renaissance brought redistribution in favour of women. To be more specific, especially women in the 10th to 12th, and 14th centuries were particularly short in relation to men, whereas the 15th and 16th century women were actually quite tall. While the increase of female heights during the 15th century is supported by only 18 observations, the positive situation of the 16th century relies on 118 cases. Women might have benefited from a change in social roles during the Renaissance period. This stands clearly in contrast to the view in much of the historical gender literature that “wise women” could have had a stronger position during the Middle-ages, before the “witch hunting period” started in the 15th century in order to increase male dominance.

![Figure 1: Male and Female Height from 1 Century to 18th century](image)
3. Gender dimorphism during the 18th and 19th centuries

The economic historiography of relative heights mainly relies on prisoner records of female heights. The gender histories of England, Scotland and Ireland were the first studied with this type of source (Johnson and Nicholas 1995, Nicholas and Oxley 1993, Oxley 2004). A similar data set could be mobilized for Southern Germany (Baten 2000B, Baten and Murray 2000). The British studies found a similar height decline for both genders in the 1830s and 1840s. However, surveying all studies in combination, Komlos and Coll (1998) found a slightly earlier decline of female heights. This is the case in Southern Germany in particular (Baten and Murray 2000). In Germany, heights of man and women were less correlated than in the British Isles. The height dimorphism was relatively high in the early period right until the famine years of mid-century (Figure 2). In the late 1850s and 1860s it decreased, which might be caused by the improving general situation: “better times are even better for women”, quite opposed to the resiliency hypothesis. During the 1870s, dimorphism increased again.

According to Horrell and Oxley (1999), gender bias in the treatment of children is expected to occur in the regions where there are few opportunities for women to work, especially at low income levels. They found that greater availability of work for children of one sex does not show in their well-being. For example, in the textile industry was there was much more female labour, whereas in metal manufacturing male labour dominated. In both industries, boys received more food than girls. They conclude though - based on other evidence - that a child’s well-being is decided by the expected economic return -both likelihood of child being employed and the length of time for which parents might expect to be the recipients of the earning- evaluated by the parents. The removal of employment opportunities for girls had deleterious consequences on the welfare of females.

Johnson and Nicholas (1995) argued that both males and females born between the early 1820s and the mid 1850s in the UK suffered from nutritional stress. Moreover, they
stated that female stature decline in the stressful period is higher compared to the male stature decline reflecting differential impact of disease, work, and inter-household allocation.

Using data on heights of English and Irish women and men transported to New South Wales Stephen Nicholas and Deborah Oxley (1993) found that English rural women suffered the most – depicted by decline in stature - compared to urban and rural men, and urban women during 1800-1815 confirming the differential impact of industrialization on English women’s living standard. Declining labor market opportunities for women was one of the reasons for the differential welfare. Interestingly, during the same period height of Irish women increased – along with the height of men - suggesting that pre-famine Irish living standards were not that declining. We could imagine that the increasing specialisation of some Irish regions on butter production for the English market could have caused this relatively positive development – after the butter fat had been removed, the remaining low-fat milk was a high quality food that could not be transported to urban or English consumers with high purchasing power. Hence it could be consumed by the locals at very low costs. This increased also the relative quality of female nutrition. This “equality effect” of local low-fat milk abundance is also visible in the more favourable mortality statistics of the English West Coast and North England (Klasen et al. 2005).
4. Gender differences in the transition period from socialism to market economy in the 20th century

For the early 20th century, Bernard Harris will give a much more detailed and well-informed review than we could do here (see also Harris 1994, 1998). For the later 20th century in contrast, anthropometric dimorphism has not yet been studied very well, partly because food habits could play a role in this period. However, one promising area of research is the transition period from socialism to market economies between the 1980s and 1990s.

Komlos and Kriwy (2003) found, that gender differences were slightly smaller in the GDR compared both with Western Germany, and with East Germany after reunification. After reunification, the heights of male children and even military conscripts in the East converged rapidly towards the higher Western level (Hermanussen 1995, 1997, Komlos and Kriwy 2003), although the exact dimension of the previous gap is still debated (Greil 1998).
Female heights appear to have converged less than male heights (Komlos and Kriwy 2003). Komlos and Kriwy (2003) note that male heights in Brandenburg improved more during and after reunification, as was the case in other areas of Eastern Germany (see also Schilitz 2001, Kromeyer, Hauspie and Susanne 1997). Zellner et al. (2004) postulate that the height of 7-year-old girls in Jena was 124.5 cm in 2001, whereas boys were 126.4 cm tall (Jena is situated in the Land of Thueringen, south-west of Brandenburg). Heights in Kazakhstan - one of the former Soviet republics in Central Asia – have been stagnating or declining, with the height of girls developing even worse than boys’ height due to religiously-induced discrimination in the labour market (Dangour 2003).

The divergent development in the heights of adolescent males and females in socialist countries after unification might be explained by differences in labour market policies and child care provision between East and West. In the former German Democratic Republic, the socialist policy of putting women to work and taking special care of children might have resulted in relatively more and better resources being allocated to these groups. In capitalist market economies, young males might have a higher income expectation, so that the allocation of resources within households could have shifted in their favour.

Further light is shed on this unresolved puzzle by the development of mortality rates in the years following German unification. Available data suggest that mortality rates deteriorated in Eastern Germany during this period, although mainly for those in the middle age groups around age 40. Eberstadt and Riphahn/Zimmermann studied the determinants of this surprising demographic development (Eberstadt 1993, Riphahn and Zimmermann, 1997). They found that certain gender-specific age groups were most at risk. In general, female mortality decreased in Eastern Germany after unification; only women in the age-group 35-45 experienced some increase in mortality between 1989 and 1991. Eastern German men in this 35-45 age-group also saw an increase in mortality. In the first few years after unification, younger Eastern German males also experienced increased mortality, but their death rates
moved back to normal values relatively fast. By contrast, as late as 1994 Eastern German males around age 40 still had mortality rates 10-20 per cent higher than before unification.

One may speculate that younger people adjusted more easily to the new situation, while men of 35-45 years are typically in a life phase in which they want to apply the knowledge they have obtained up to that point. Not being able to do so and instead being faced with uncertainty and often unemployment, it seems likely that they experienced strong psycho-social stress. Riphahn and Zimmermann conclude that the increased mortality rates among Eastern German men of this age-group were mostly caused by over-consumption of alcohol and by circulatory and cardio-vascular problems which were also related to psycho-social stress (Riphahn and Zimmermann 1997).

It is interesting that women were much less sensitive to this development, even though they were the main victims of the high unemployment which emerged in Eastern Germany after unification. Only middle-aged women in Eastern Germany saw some increase in their mortality rates after unification. For Eastern German women as a whole, by contrast, life expectancy improved considerably, mostly because of falling mortality risks for elderly women and, to a lesser extent, for very young females. Interviews of Eastern German individuals after unification suggested that men suffered more than women from the psycho-social stress of unemployment, because – in accordance with traditional gender roles – males felt more loss in social status from losing their jobs.

For the period after 1995 Boehm and Baten (2006) argued also for the land of Brandenburg (East Germany) that boys were taller than girls, which is not normally the case in this age range. In fact, none of the available growth reference charts for the U.S. and European countries suggests a height advantage for boys of this age (see http://www.cdc.gov/growthcharts/).

For the late 20th century, there are also some studies on Less Developed Countries and middle income countries. Conducting a worldwide comparison, Guntupalli and Schkekendieck
(2006) investigate male and female malnutrition rates of children living in 117 countries at the end of the millennium (1995-2001). They found that decrease in fertility rates and an increase in GDP, decreases malnutrition rates significantly in both males and females. The Asian continent shows the highest female discrimination compared to the rest of the world.

5. Measuring gender differences in well-being: discussion

In all populations, mean male stature is greater than female stature. However, the interesting observation is variation in the degree of stature difference among populations. We would argue that gender differences in stature can be used to answer some important questions: Which societies discriminate females more than others? Which influence do relative female labour participation rates have? Which role has relative mobility? Does the dimorphism increase or decrease during famine and crisis periods? However, the data available is not yet sufficient for a more systematic treatment of those questions with anthropometric data, which is perhaps the most important disadvantage. Much more countries need to be documented, for example for the 19th and perhaps early 20th centuries: all of Eastern, Southern, and Northern Europe is missing, within central Europe only data Bavaria is available. For Western Europe, the situation is a bit better with existing studies on England, Scotland, and Ireland being studied, and studies on the Netherlands and Switzerland is in preparation. However, even here France and Belgium are missing. The data are most likely available, as prison records of female and male convicts have typically survived. Even for countries such as Mexiko, Brazil, Argentina etc. prison records have survived in the archives, hence he can expect the same from the “white spot on the map” countries in Europe mentioned above.

References


Brennan L et al. 1977. Sex Differences in Indian Height at Home and Abroad. Man in India 77: 105-118.


Modern Germany, American Historical Review, 109. 325-359.

Oxley, Deborah (2004). “Living Standards of Women in Prefamine Ireland”, Social Science
History 28-2, pp. 271-296.


Riphahn and Klaus F. Zimmermann 1997. The Transition’s Mortality Crisis in East Germany,
UNU/WIDER - Research for Action 42.

Brandenburger Schulkindern im Geschlechter-und Altersgruppenvergleich, Aachen:

1903-40.

Industrialization. Chicago: The University of Chicago Press.

Stini WA. 1985. Growth Rates and Sexual Dimorphism in Evolutionary Perspectives. In. The

WHO Working Group 1986. Use and Interpretation of Anthropometric Indicators of

Anthropology 17: 548-552.