Sexual Dimorphism in Stature as a Measure of Gender Inequality

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Abstract. Many human biologists argue that males and females have contrasting responses to deprivation during the period of human growth and development. Specifically, females are more resistant than males to adverse conditions, i.e. their physical growth is less likely to falter, or to falter less, if net nutritional conditions deteriorate. Conversely, the growth of males is more likely than that of females to respond vigorously to improving conditions (assuming conditions were less than ideal initially). Therefore the ratio of male to female stature is potentially a useful indicator of the way that nutritional resources were allocated across the sexes within a population or society. This paper measures this sex-specific sensitivity and develops procedures for applying the results to assessing the degree of gender inequality in the allocation of nutritional resources.

Within the social and biological sciences there is a well-established interest in inequality. Traditional measures of its extent include wages, income, life expectancy, and education. Much can be learned about the topic, however, by evaluating the contrasting responses of males and females to changing nutritional conditions.

The male sensitivity hypothesis expresses the essential idea. Males typically have higher mortality rates than females from conception onward [Retherford, 1975; Lancaster, 1990]. Although cultural influences are important causes of these sex differences in mortality rates, it is clear that biological factors are also important particularly in infancy and prenatal life. For example, male prenatal mortality appears to be linked to the exposure of recessive alleles on the X chromosome of males. Among adults, females are more metabolically conservative than males with lower average metabolic rates, higher proportions of body fat, and so on.

These biological differences have led to speculation about environmental influences on human sexual dimorphism. It has been hypothesized that owing to the energetic demands of their reproductive role, females are better buffered against stressors than males and as a result unfavorable environmental conditions such as food shortages are likely to have a greater impact on male than female growth and development [Ghesquiere, 1985; Hall, 1982]. It has been hypothesized that this would tend to result in reduced size sexual dimorphisms in populations experiencing food shortages because the body size of relatively well-buffered females would show less stress-induced reduction than that of males.

Accepting this line of argument, the next step is to measure the differential responses by sex. Fortunately a large body of evidence relevant to the question is available from Eveleth and Tanner, Worldwide Variation in Human Growth [1976, 1991]. The results of 131 growth studies across the world are applied to the task.

Consider the function $\ln y = \beta_0 + \beta_1 \ln x$, where y is male height and x is female height. By regressing ln y on ln x one obtains the elasticity of male height with respect to female height, β_1. The scatter diagram below shows the results.

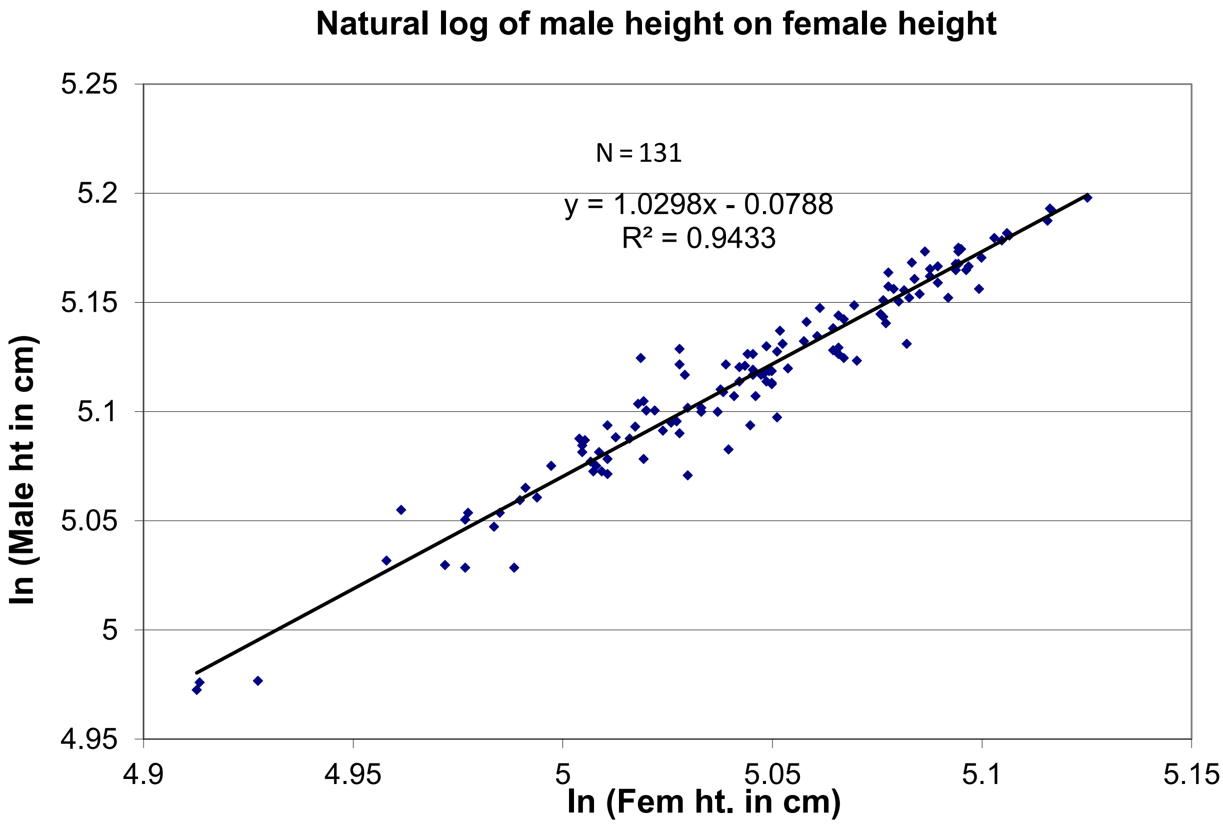

Figure 1: Regression of ln of male height on ln of female height

One can see that the elasticity is approximately 1.03 as estimated from a very tight relationship. The outliers then become the focus of interest. Outliers above the line show instances in which males are privileged, and those below indicate the opposite. The extreme values of these are of particular interest, which can be judged by a 95% confidence interval, shown below.

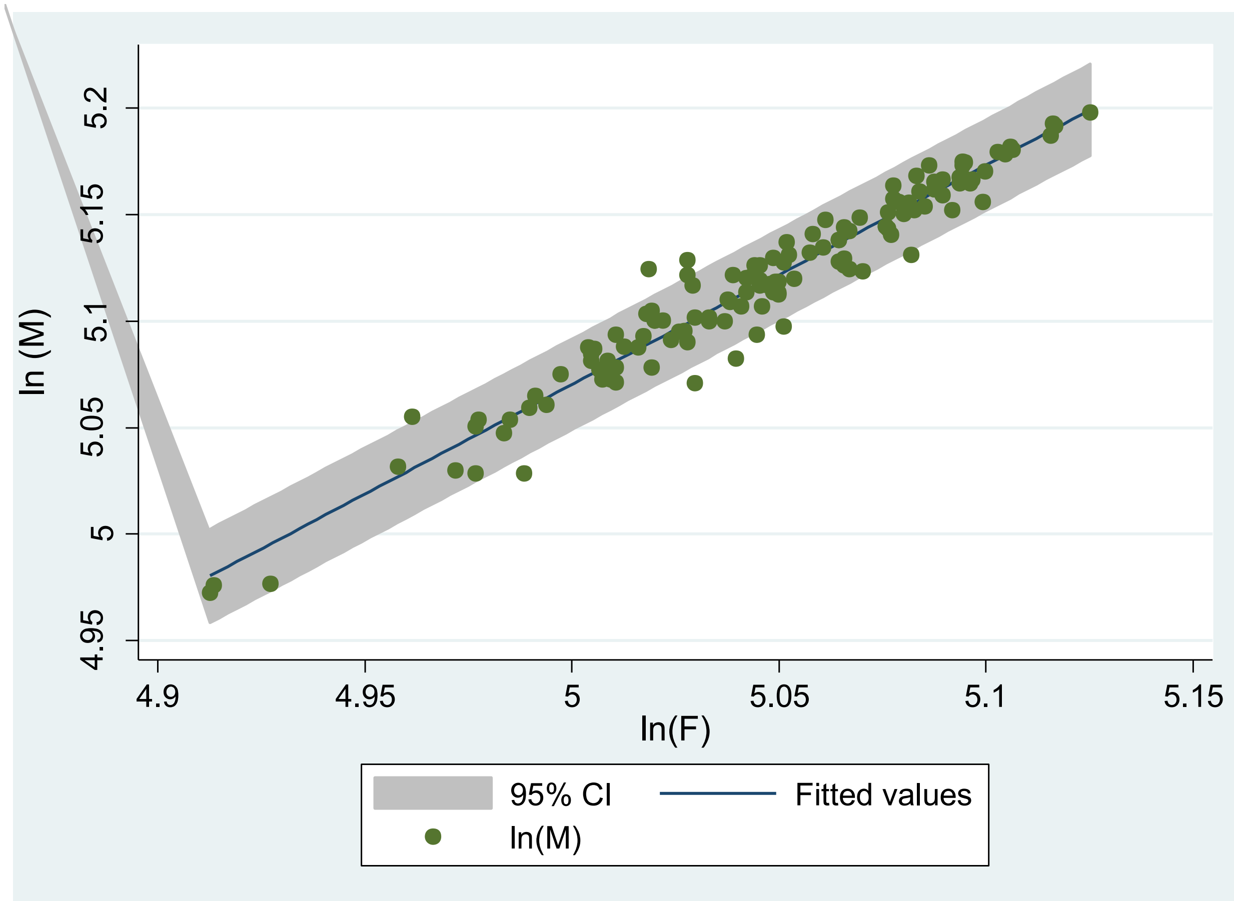

Figure 2: 95% Confidence Interval

The next step is to identify the specific outliers, and thereafter to investigate what might be the sources of the gender inequality. One can see from Table 1 the cases in which males or females can be identified as privileged by the criterion of two or more standard residuals from the regression line. At the top of the table are 6 populations from South America, Africa, New Guinea, and India, in which females are excessively privileged relative to males. The bottom part of the table shows extremes of the opposite type, in which males of the Punjab are the most extreme case.

Solid explanations for these outcomes are beyond the scope of this paper, which is primarily methodological. One cane sense, however, that the approach has considerable promise and can be applied in historical settings where height by sex is available. Promising examples include American slaves, Native American tribes whose data were collected by Franz Boas, convicts transported to Australia, and prison populations of the United States. Examples of this analysis will be given at the ASSA meetings.

Table 1: Outliers in Sexual Dimorphism

Ancestry	Country	group	male	female	Std resid
Asiatic	Argentina	Chaco Indians	164.3	152.9	-2.841
Aus Abor, P.I.	Papua New G	Mountain Ok	152.7	146.7	-2.812
Afr	Cen Afr Rep	Bagandu & Issongo	161.2	154.4	-2.672
Afr	Tanzania	Bantu	168.6	156.2	-2.405
Asiatic	Bhutan	?	169.2	161.1	-2.231
Indo-Med	India	Assam	163	155.2	-2.128
Indo-Med	Ethiopia	Adi-Arkai	168.8	152.6	2.124
Asiatic	Guatemala	Maya	156.8	142.8	2.288
Indo-Med	Israel	Kurdish jews	167.6	152.6	2.795
Indo-Med	India	Punjab	168.1	151.2	3.297