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# Big and tall parents do not have more sons

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Recently Kanazawa (2005) proposed a generalization of the Trivers-Willard hypothesis namely that parents who possess any heritable trait that increase male reproductive success at a greater rate than female reproductive success will have more male offspring. He proposed that size (height and weight) of the parent is one such trait and presented evidence apparently consistent with the hypothesis, heavier parents have more boys and taller parents have fewer girls controlling for a number of variables. This note shows that analysing the same data somewhat differently leads to very different conclusions. A number of statistical criticisms of the paper and related work by the same author have also been raised by Gelman (2007) and Gelman and Weakliem (2007).

As dependent variables Kanazawa uses, separately, the number of sons and daughters born to cohort members. The independent variables of interest are the cohort member's height and weight. Controls include their years of education, income, sex, whether married and the number of children of the opposite sex.

A more direct test of the theory is to examine the relationship between the sex of the cohort member and the size of each parent (as opposed to the size of the cohort member and the number of sons and daughters that each has). Hence I estimate a model Probability(sex=male) = F(parents' size + controls + $\varepsilon$) using a subset of the data he uses, the British National Child Development Survey. I use the probit estimator, that is it is assumed that the F(.) function above follows a Normal distribution (see, for example, Verbeek (2006). Table 1 presents three models. The means of the independent variables are in the final column. The dependent variable is a binary variable indicating whether the cohort member is male (1) or female (0), 51.2% of the sample are male. In the first column father's and mother's height and Body Mass Index (BMI) only are included as regressors. Not one of these coefficients is individually statistically significant nor can one reject the hypothesis that they are jointly insignificant (p value=0.99). To test the theory directly one sided tests (i.e. that the coefficients are positive) could be used however clearly in this case this will lead to the same conclusion as will Bonferroni-type adjustments to the critical p-values as suggested by Gelman (2007).

In column 2, parents' age at birth is included and in column 3 the age at which each parent left full-time education is added. In both cases the result from the first model is unchanged: both parents' height and BMI have no statistically significant effect on the probability of being born male. Note that even if the estimated coefficients were estimated more precisely (i.e. were "statistically significant") they are tiny in magnitude and hence would be of doubtful scientific significance.

It is clear from the data that there is no evidence of any relationship between the size of either parent (measured by height and by BMI) and the sex of their offspring. It is not credible that an evolutionary explanation could hold for one generation but not for the one immediately preceding it hence the suggested generalization of Trivers and Willard is not supported. Given the statistical flaws in Kanazawa's papers already shown by Gelman, there is no good evidence for it. Further mining of the data is unlikely to change to change this conclusion.

**Table 1 : Probit estimates of the probability of being male**

| | (1) | (2) | (3) | Mean |
|---|---|---|---|---|
| Father's height (in cm) | 0.000 | -0.001 | 0.000 | 174.6 |
| | (0.100) | (0.310) | (0.080) | |
| Father's BMI | 0.002 | 0.002 | 0.001 | 24.7 |
| | (0.400) | (0.340) | (0.320) | |
| Mother's height (in cm) | 0.000 | 0.000 | 0.001 | 162.1 |
| | (0.010) | (0.140) | (0.230) | |
| Mother's BMI | 0.001 | 0.002 | 0.001 | 23.8 |
| | (0.230) | (0.440) | (0.300) | |
| Father's age | | -0.004 | -0.004 | 30.3 |
| | | (1.120) | (1.050) | |
| Mother's age | | -0.001 | -0.001 | 27.4 |
| | | (0.130) | (0.002) | |
| Age father left education | | | 0.002 | 15.0 |
| | | | (0.190) | |
| Age mother left education | | | -0.019 | 15.0 |
| | | | (1.770) | |
| Constant | 0.002 | 0.149 | 0.328 | |
| | (0.000) | (0.310) | (0.670) | |
| $\chi^2$ | 0.27 | 0.50 | 0.26 | |
| | (p=.99) | (p=.974) | (p=.992) | |
| Pseudo R-squared | 0.000 | 0.004 | 0.007 | |

**Note:** Z statistics (in parentheses) reported. Father's and mother's height, BMI and age are at the time of the birth of the cohort member. Dependent variable =1 if male, =0 if female, n=8249. Data is from the National Child Development Survey, see Kanazawa (2005) for more details. $\chi^2$ is a test for the joint statistical significance of the first four coefficients, d.f.=4.

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