SEX RATIOS AT SEXUAL MATURITY AND LONGEVITY: THE EVIDENCE FROM SWEDEN

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INTRODUCTION

Past research has indicated that imbalances in the human sex ratio can influence behaviour, including patterns of marriage and divorce, fertility behaviour, and also less immediately obvious outcomes, such as labour supply (Svarer, 2007; Lloyd and South, 1996; Angrist, 2002). However, very little research has addressed the relationship between sex ratios and health. A small handful of studies have examined whether gender imbalances in the workplace are associated with morbidity and differences in sickness absenteeism rates for males and females, but the evidence is mixed (Bryngelson et al., 2011; Mastekaasa, 2005; Hensing and Alexanderson, 2004; Svedberg et al., 2009). Even less research has been conducted on the relationship between sex ratios and mortality risk. A study published recently by Jin, Elwert, Freese and Christakis (2010) was the first to propose the hypothesis that imbalances in the contextual sex ratio at sexual maturity may be related to longevity.

The authors of this study proposed three potential mechanisms by which such a relationship might be operating. The first was that imbalances in the sex ratio may lead to delays in marriage, and that individuals would thus be less likely to gain from the cumulative health benefits associated with marriage. Secondly, imbalances in the sex ratio might mean that individuals have to settle for a partner of a lower-quality, meaning that even conditional upon entry into a long-term partnership, the cumulative benefits would be lower for members of the supernumerary sex. Finally, imbalances in the sex ratio should be related to higher levels of competition for sexual partners, and the psychosocial stress associated with this elevated level of competition at a relatively sensitive age might have a long-term impact upon health.

The study performed by Jin et al. (2010) used two different datasets. The current study will attempt to replicate these analyses as closely as possible within the Swedish context. The first dataset used was derived from the Wisconsin Longitudinal Study (WLS). The WLS collected data on one-third of all high school graduates in Wisconsin in 1957. Jin et al. (2010) were able to compute the sex ratio for the graduating class of each high school that the individuals within their sample attended. They subsequently estimated a Cox proportional hazards model, specifying shared frailty for schools, and followed the members of their sample until 2004. The sex ratio was operationalized as a linear term for the the proportion of males within the graduating class of each high school. The results indicated that a 1% increase in the proportion of males was significantly associated with a 1% increase in the hazard of dying before 65 for males, but not for females.

The second dataset used allowed the authors to examine whether sex ratios at sexual maturity might be related to an increased risk of mortality in old age. The data used was a register containing all elderly men in the United States who were registered in 1993 for Medicare, America's old-age health insurance programme, and the final sample used for analysis totalled approximately 7.7 million males. All these men were aged over 65, with the average age being 71. The sex ratios at sexual maturity for these males were calculated at the U.S. State level, using census data from 1930, 1940 and 1950, and exponential interpolation to estimate the sex ratios for when each male in the sample was aged 20. They used a Cox proportional hazards model to examine whether the sex ratio at sexual maturity was associated with mortality risk, with the follow-up period being from 1993 to 2002. They found that the relative risk of mortality was approximately 1.5% higher for males who were sexually mature in States where the proportion of sexually mature adults was 53% male relative to States where the proportion of sexually mature adults was 47% male.

Data and Methods

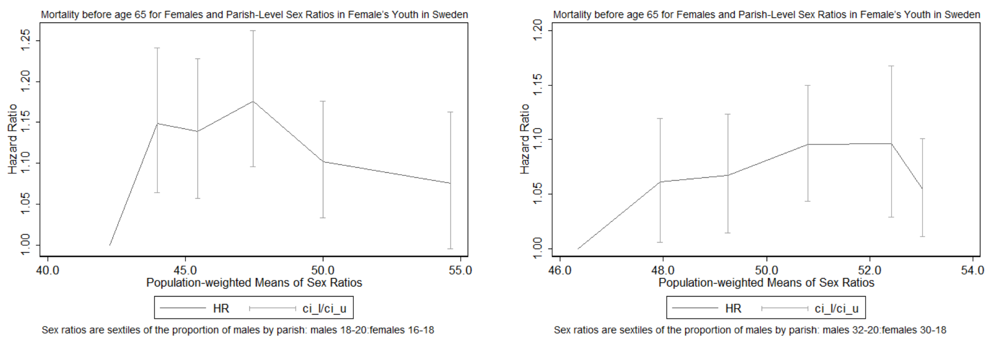
The data used is individual level population data for Sweden from the administrative registers. The sex ratios at sexual maturity were calculated using the 1960 census data. Males and females were followed from 1960 to 2007, the latest point for which data is currently available. I have used piece-wise constant survival models to estimate the impact of the proportion of males upon mortality risk, where:

$$\lambda_i(t \mid x_i) = \lambda_0(t) exp\{x_i' \beta\}$$

Preliminary Results

Sex ratios were calculated at the population level, at the three levels of geographical aggregation available in the register data: parishes (församling: average population - 3,700); municipalities (kommun: average population - 32,256), and counties (län: average population - 445,450). No statistically significant associations were found for the larger geographical units, municipalities and counties, and the rest of this section refers to results from the parish-level analyses. In the preliminary results available from analyses conducted thus far, the findings from Jin et al. (2010) were not replicated, both when calculating the sex-ratio based on all individuals within these age ranges, as well as when only including unmarried individuals within these age ranges.

Sex ratios were calculated using males aged 18 to 27, and females aged 15 to 24. Using population-weighted means, sex ratios were split into sextiles. Using these specifications, no statistically significant results associations were found between the sex ratio at sexually maturity and longevity for either males or females. It seemed reasonable, however, that norms regarding cohabitation and different patterns of marriage and fertility in Sweden might mean that a different specification of the sex ratio at sexual maturity might be more valid for the Swedish context. Two further analyses were run, for both males and females. The first calculated sex ratios within a narrow age range, using all males aged 18 to 20, and all females aged 16 to 18. The second age band specified was much wider, and calculated the sex ratio for all males and females within the age range: males aged 20 to 32, and females aged 18 to 30.



(a) Sex Ratio Calculated: Males 18-20:Female 16-18

(b) Sex Ratio Calculated: Males 20-32:Female 18-30

FIGURE 1. Relative Risks of Mortality by Sex Ratio at Sexual Maturity for Females.

Using these two different specifications, there were again no statistically significant results for males. However, the results for females for both specifications showed a statistically significant assocation. The results illustrated in figures 1(a) and 1(b) show the relative risk of mortality before the age of 65 for females by a population-weighted mean of the sex ratio in 1960, for all women within the age bands described above.

DISCUSSION AND FURTHER WORK

These preliminary results suggest that there is support in Sweden for the hypothesis proposed by Jin et al. (2010). However, in Sweden the sex ratio at sexual maturity is associated with increased mortality risk for females, but not for males, in contrast to the original finding. The final version of this study for presentation at the EPC will involve further analysis, including an analysis of males and females over the age of 65. However, to focus upon the results already obtained for the moment, there are a number of potential reasons why these results differ from that of the original analyses. To begin with, data is not currently available that would allow a replication of the analysis where the sex ratio was calculated in the graduating class of high schools. The earliest date for which school identification is available at present is the mid-1980s.

That is not sufficiently early enough to make a mortality study comparable to that performed by the Jin et al. (2010), as the sample in the Swedish data would currently be aged around 45 to 50. Nevertheless, it will be possible to include an analysis using this school data in the version of this paper to be presented at the EPC. Calculating sex ratios within geographical units is more problematic than calculating sex ratios within schools or workplaces, as the former, unlike the latter, does not necessarily reflect the conditions within the environment in which these individuals are actually interacting on a day-to-day basis. Parishes are relatively small geographical units, and it is likely that individuals will work or socialize outside of the parish in which they are registered as living, meaning that they may not be experiencing the sex ratio that geographical calculations indicate they should.

Given this, it may be reasonable to calculate sex ratios using larger geographical units, as they may capture the entire area in which an individual interacts. However, this approach is also very vulnerable to the criticisms outlined above. If the proportion of males within a county is 53%, and the county contains 500,000 people, this calculated sex ratio is potentially completely irrelevant to a very large proportion of the sample. They may be employed within a workplace that is heavily male- or female-dominated, and spend 40-50 hours a week in that workplace. The sex ratio at the county level would therefore not reflect the sex ratio within their own interaction environment at all. While the analyses that will be conducted for the later versions of this study may provide support for the original results obtained by Jin et al. (2010), it is quite possible that the null results, and results indicating that female mortality risk is affected by sex ratios at sexual maturity, are spuriously obtained because sex ratios calculated within geographical units may not reflect the actual interaction environment of the individuals in the sample.

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