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Sex Differences in Early-Age Mortality: The Preconception Origins Hypothesis

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Abstract

The preconception origins hypothesis holds that some of the preconception and prenatal environmental factors that have been shown to determine the offspring sex ratio also explain sex differences in early-age mortality (Pongou 2013). It extends and complements the biological hypothesis, which affirms that the mortality sex gap originates in biological and genetic differences between the sexes. As such, it offers a broad framework for understanding changes in male–female differences in early-age mortality across space and over time. I argue that this hypothesis is consistent with the concurrent increase in the proportion of female births and in the relative mortality of female to male infants in the United States since World War II.

Key words: *Sex differences in early-age mortality; preconception origins hypothesis; biological hypothesis.*

JEL Classification: J10, I10.

Résumé

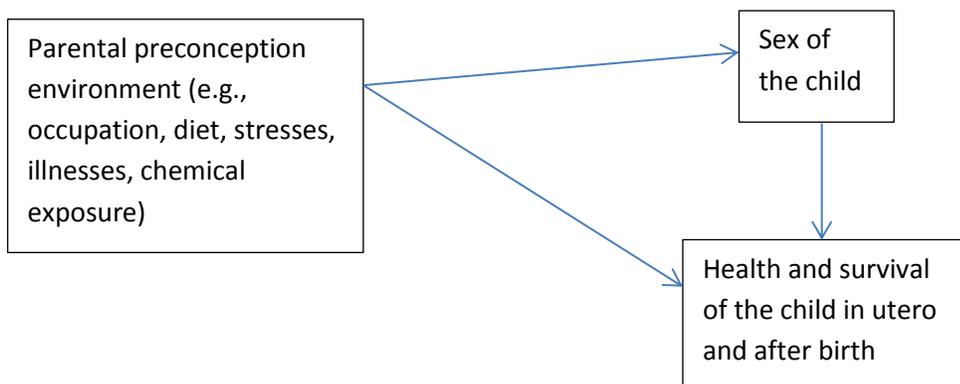
L'hypothèse des origines préconceptionnelles affirme que certains facteurs auxquels les parents sont soumis pendant la période préconceptionnelle et prénatale et qui déterminent le sexe de l'enfant expliquent partiellement les différences de mortalité entre les garçons et les filles en bas âge (Pongou 2013). Cette hypothèse généralise et complète l'hypothèse biologique selon laquelle l'écart de mortalité entre les garçons et les filles provient des différences biologiques et génétiques entre les sexes. Ainsi, cette hypothèse offre un cadre général qui permet de mieux comprendre les changements dans la différence de mortalité entre les sexes dans le temps et l'espace. Je montre que cette hypothèse est cohérente avec l'augmentation parallèle de la proportion des naissances féminines et de la mortalité infantile des filles relativement à celle des garçons aux États-Unis depuis la fin de la deuxième guerre mondiale.

Mots clés : *Mortalité entre les garçons et les filles en bas âge, hypothèse des origines préconceptionnelles, hypothèse biologique.*

Classification JEL : J10, I10.

Questions about the causes of sex differences in mortality have occupied statisticians, biologists, and social scientists since pioneer demographer John Graunt (1662) discovered, through his analysis of the vital statistics of the citizens of London, that more boys than girls are born but boys are more likely to die. Until recently, excess male mortality was thought to be caused by biological and genetic differences between the sexes, with boys being biologically weaker and therefore more susceptible to premature death (Naeye et al. 1971; Waldron 1998). In previously published research (Pongou 2013), I showed some limitations of this biological hypothesis and proposed the “preconception origins” hypothesis, which holds that some of the preconception and prenatal environmental factors that have been shown to determine the offspring sex ratio also explain the male–female difference in early-age mortality (see Figure 1 for a graphical presentation of this hypothesis). Analyzing a large sample of twins from sub-Saharan Africa, I found broad empirical support for this hypothesis: preconception factors, on average, account for 40 % to 52 % of the male–female difference in infant mortality.

Figure 1: The preconception origins hypothesis



I did not, however, identify the specific preconception environmental factors responsible for the male survival disadvantage. The comment by James (2015) compellingly argues, based on earlier works (James 1996, 2015), that high levels of maternal testosterone are one such factor. This is an important scientific hypothesis that also has the merit to prompt crucial public policy questions. For instance, what proportion of the male–female difference in infant mortality is explained by high levels of maternal

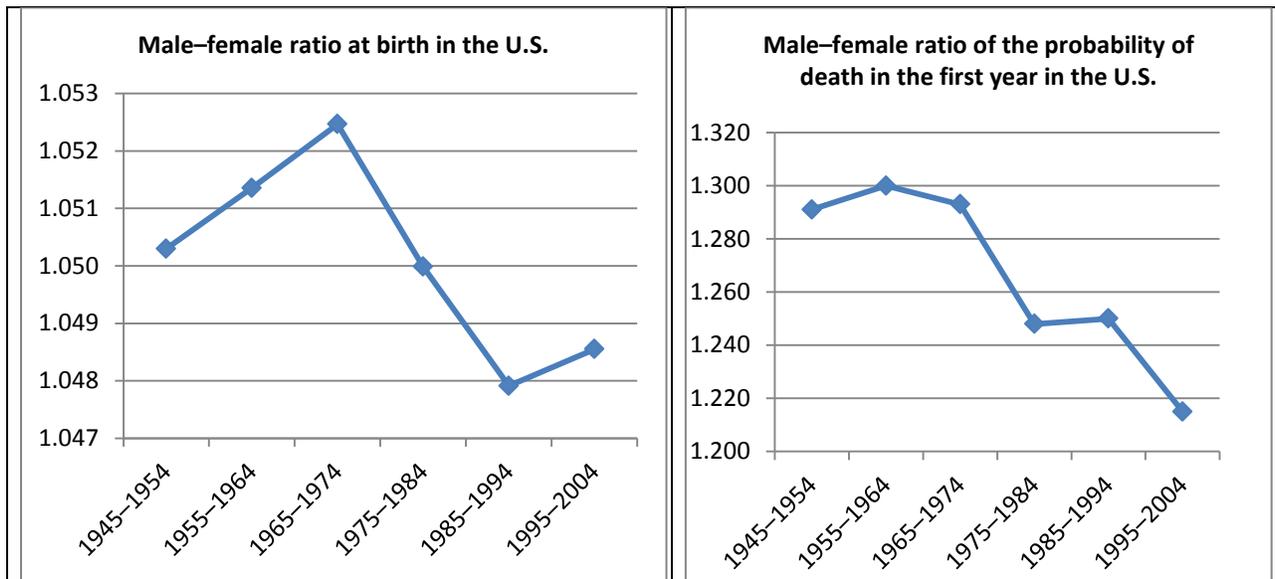
testosterone? What are the more distal preconception factors—including social, economic, and political factors—that cause high levels of maternal testosterone? Answering these questions will allow researchers to assess the relative importance of maternal testosterone among the different potential environmental causes of sex ratio and sex differences in early-age mortality surveyed in my earlier study (Pongou 2013); it will also inspire evidence-based policies that can be implemented to address this crucial problem.

The preconception origins hypothesis is formulated on the basis of a growing literature on the environmental determinants of offspring sex ratio, including parental occupational exposure, diet, illnesses and stresses, chemicals, and other environmental hazards (Pongou 2013). As such, this hypothesis offers a broad framework for understanding male–female differences in early-age mortality across space and over time. Among the preconception factors that increase the probability of a male (female) conception, some have been found to increase child survival, whereas others have been found to decrease it. It follows that the magnitude of the male–female difference in mortality may be large or small depending on which of these preconception factors predominate in a given time and area.

Although the available evidence showing a male survival disadvantage in most regions of the world implies that boys are more likely than girls to be conceived in poorer environmental conditions, it is important to note that the conditions that favor the conception of a specific sex vary across space and may change over time as a result of both natural and human-made causes. An example of such a change was recorded in Seveso, Italy, in July 1976, after one of the most toxic human-made pollutants (2,3,7,8-Tetrachlorodibenzo-pdioxin (TCDD)) was released following a plant explosion. Mocarelli and colleagues (1996) have shown that parents who were exposed to high concentrations of this pollutant when they were younger than 19 years were significantly more likely to have girls than boys, with a male-to-female ratio of 0.38. If environmental hazards such as TCDD become more prevalent, the exposure will not only increase the proportion of female births but also decrease their survival advantage, shrinking the male–female early-age mortality gap. This hypothesis is consistent with the concurrent increase of female births

and their relative mortality in several developed societies (see Figure 2 below for the United States for the period 1945–2004). It has been argued by scientists that environmental hazards that cause endocrine disruption have become more prevalent in these countries, resulting in more females being conceived (Møller 1998, Davis et al. 1998, Van Larebeke et al. 2008). In addition, I argue that the greater level of exposure of females to these chemicals might have also decreased their survival advantage. This explanation is consistent with my previous study (Pongou 2013), which empirically shows that the preconception factors responsible for the male–female difference in mortality are primarily those that vary over time within parents.

Figure 2: Sex ratio at birth and sex ratio in infant mortality in the United States, 1945–2004



Sources: Data for the calculation of the male-female ratio at birth are obtained from Mathews and Hamilton (2005), Martin et al. (2005, 2006). Data on the male–female ratio of the probability of death in the first year are taken from Drenstedt et al. (2008).

The identification of the preconception environmental factors responsible for the male–female difference in early-age mortality is an important area of research that has just started. Progress in this area will not only satisfy a pure scientific curiosity but also inspire evidence-based policies aimed at closing the gap between the sexes.

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