

# The Race to the Egg

Laura Soul

In 2008, 221 out of 223 nations surveyed reported a greater proportion of male than female births [1]. However, Sen et al have shown that female foetuses are more likely to survive from conception to birth [2], and significant decreases in the proportion of male births have been observed following stressful situations. This leads to a conundrum; known biological factors lead us to expect a greater proportion of female births, and yet the very opposite is true. The life expectancy of males is, on average, shorter than that of females.

“ **Sperm carrying Y chromosomes win the race to the egg more often** ”

So what is behind this consistently skewed sex ratio? Are male foetuses more successfully-conceived? Can the condition of the mother influence the gender of the child? Or are the sperm carrying male genes simply winning the race to the egg?

The sex ratio at birth varies through time without an obvious pattern and many theories have been suggested in order to explain it. These include health of the father [3], time of conception within the menstrual cycle [4], and the level of stress on the mother [5].

One of the most well known cases of a high sex ratio is that of China [6]. The ‘one-child’ policy introduced for many residents in urban China in 1979 and has been linked to

mainland China’s 11% higher birth rate for males than females [1]. In Lianyungang City, Jiangsu Province, the difference has become as high as 63% [6]. In this particular case the factors affecting the sex ratio are social rather than biological; sons are seen as more useful to the family, they carry on the family name and can get a job and earn money. With a one-child policy in place, many parents would prefer a male child and some even go as far as to perform sex-selective abortion or infanticide. A similarly high sex ratio can be seen in countries where there are no such restrictions but where having a son is still seen as more useful, for example in India; though it is harder to show a significant correlation between the sex ratio and social factors in these cases. However, the case of China sheds little light on the globally male-biased sex-ratio since countries such as Portugal and Canada, where sex-selective abortion and infanticide are not a known problem, also have a ratio significantly biased towards more males [1].

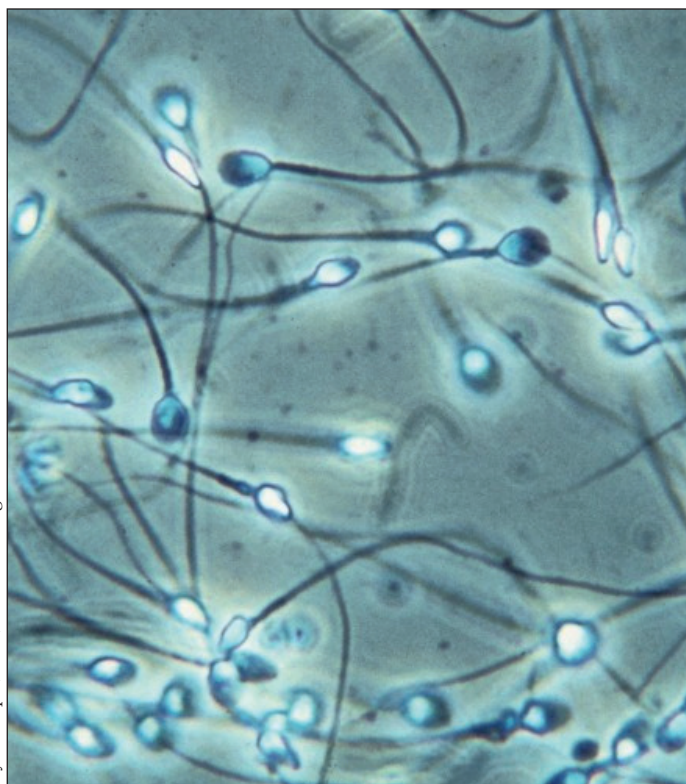
It seems that social factors do not explain the phenomenon fully; there are several biological factors involved as well.

“ **Most biological factors seem to support a higher incidence of female births** ”

For example, Grant et al hypothesise that the day during a woman’s menstrual cycle on which the egg is fertilised has an influence on the gender of her child [4]. One study showed that conception during a woman’s most fertile days results in more female births, while conceptions on other days are more likely to be male. If true, this could have great implications, as it will be possible for couples to control the sex of their child. The results however are of low statistical significance and the findings are still under debate [7].

To complicate matters further, most biological factors seem to support a higher incidence of female births than male ones. One such factor is stress for the mother. Multiple cases of a significantly low (female-biased) sex ratio have been recorded following periods of stress. These include natural disasters, war and economic crises, such as the Kobe earthquake in Japan [8] or the 1991 economic crisis in East Germany [9]. Another such case was in New York City; four months after the September 11th terrorist attack, the sex ratio fell to 1:1, the lowest observed in the test period from January 1996 to June 2002 [5]. This evidence was used to suggest that the drop in the sex ratio could be explained by increased male foetal loss rather than reduced conception of males, as otherwise a low sex ratio should have been seen nine to eleven months after the attacks.

The biological mechanism for this is thought to be the effect of the hormone cortisol which is produced as a response to stress. There is strong evidence supporting the



Joyce Harper, UCL, Wellcome Images undr CC-BY-NC-ND



effect of cortisol in the maturation of foetal organs. However, overexposure to cortisol can lead to premature delivery or foetal death [10]. If the mother becomes stressed during pregnancy, she will produce a higher than normal amount of cortisol which may then endanger her child. It has been found that a female foetus is more likely to survive these stress-induced cortisol increases, although the exact reason behind this is not yet understood.

A further factor favouring females is the condition of the father. Periods of exposure to chemical toxins such as industrial waste can disrupt the male endocrine gland and cause toxicity in the testes. It is thought that this results in a reduced number of sperm carrying Y chromosomes, although again the mechanism for this reduction is unknown [3].

Intuitively, with less genetic material to carry you would expect sperm carrying Y chromosomes (male) to be lighter and thus to swim faster. This is potentially why they are more likely to reach the egg before a double X chromosome (female) carrying sperm. This would lead to a higher proportion of males being conceived and thus despite all

the other biological factors a higher male:female birth ratio would result. However, no research has been conducted to investigate this.

Biological factors affecting the sex ratio consistently favour females. Evolutionary theory predicts that the sex ratio should equilibrate at 1:1 as this is the only stable strategy [11]. One would expect from this to see an equal number of male and female births. Biological evidence demonstrates that female foetuses are more likely to survive to term and that the number of Y-chromosome (male) sperm is more likely to decline when chemical toxins are introduced, but data shows that there are consistently more male births worldwide. Taking all our available evidence into consideration, it appears that sperm carrying Y chromosomes win the race to the egg more often - the reason for which is yet to be discovered. ■

*Laura Soul is a fourth year Geology student at Murray Edwards College.*

#### References:

- [1] People statistics > sex ratio > at birth (most recent) by country. [Online] 2009 [Cited 2009 Jul 19]; Available from: URL: [http://www.nationmaster.com/graph/peo\\_sex\\_rat\\_at\\_bir-people-sex-ratio-at-birth](http://www.nationmaster.com/graph/peo_sex_rat_at_bir-people-sex-ratio-at-birth)
- [2] Sen A. More than 100 Million women are missing. *The New York review of books* 1990 Dec 20, 37:20
- [3] Mackenzie CA, Lockridge A, Keith M. Declining sex ratio in a First Nation Community. *Environmental Health Perspectives* 2005 Oct 113;10:1295-1298
- [4] Grant VJ. *Maternal Personality, Evolution and the Sex Ratio*. 1st ed. London (England): Routledge; 1998.
- [5] Catalano R, Bruckner T, Marks AR, Eskenazi B. Exogenous shocks to the human sex ratio: the case of September 11, 2001 in New York City. *Human Reproduction* 2006 21;12:3127-3131.

- [6] China warned of risks of imbalanced sex ratio. [Online]. 2007 [Cited 2009 Jul 19]; Available from: URL: [http://news.xinhuanet.com/english/2007-08/24/content\\_6599083.htm](http://news.xinhuanet.com/english/2007-08/24/content_6599083.htm)
- [7] James WH. The status of the hypothesis that the human sex ratio at birth is associated with the cycle day of conception. *Human Reproduction* 1999 14;8:2177-2178
- [8] Fukuda M, Fukuda K, Shimizu T, Moller H. Decline in sex ratio at birth after Kobe earthquake. *Human Reproduction* 1998 13;8:2321-2322
- [9] Catalano RA. Sex ratios in the two Germanys; a test of the economic stress hypothesis. *Human reproduction* 2003 18;9:1972-1975.
- [10] Challis JRG, Sloboda D, Matthews SG, Holloway A, Alfaidy N, Patel FA et al. The fetal placental hypothalamic-pituitary-adrenal (HPA) axis, parturition and post natal health. *Molecular and Cellular Endocrin* 2001 185:135-144.
- [11] Hamilton W.D. Extraordinary sex ratios. *Science* 1967 156:477-488.