COMMENTARY | Genetics inMedicine

Prenatal technologies and the sex ratio

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In an important article in this issue of *Genetics in Medicine*, Kamlash Madan and Martijn Breuning[1] draw attention to the extent and social implications of sex selection in India. They point out that selection through infanticide and selective abortion of female fetuses are widespread and are used by all socioeconomic groups. Furthermore, sex selection appears to correlate with crimes against women, specifically rape, kidnap, trafficking of women, and even murder. The gender imbalance in India is not unique; it is clearly evident in many other countries, notably in China and other Southeast and Central Asian, Middle East, and North African countries.[2]

Although there is evidence that in some countries such as South Korea, there has been a decline in gender imbalance,[3] this is not the case for India. Moreover, the increasing availability of low-cost and easily performed noninvasive prenatal testing (NIPT) based on the analysis of cell-free fetal DNA in maternal plasma may further encourage prenatal sex determination. With increased media attention to horrific and illegal acts of infanticide, greater use of prenatal sex identification and selection can be anticipated in some locations where it will be considered a more acceptable, but often still illegal, alternative.

Of course, there is absolutely no genetic basis for assigning a lower economic or social value to females. On the contrary, the argument can be made that, at least by some genetic measures, females are actually the stronger sex, and they also have a more important biological role. However, to discriminate against males would also be unfair. The historical origins of discrimination against females lie in patrilineal societies that are substantially inconsistent with the contemporary social order.[4] Ethnic historical traditions should be valued, but these need to be placed in the context of modern societies that have evolved in their economic structure, emphasized education for all, and substantially equalized the roles of males and females. It seems paradoxical that today's Indian women can be the recipients of high levels of education and can attain the highest levels of success in science and politics but remain the target of lethal discrimination.

Sex selection for nonmedical reasons is of great importance to the entire clinical genetics community because it is the use of ultrasound and laboratory tests that were developed to identify fetal congenital malformations and genetic disorders that have been contributory to the selective abortion of female fetuses. Clinical geneticists may be called upon to provide counseling to parents seeking fetal sex selection for nonmedical reasons anywhere in the world. For example, there is evidence for the use of sex selection in minority populations in the United States.[5] Sabu George,[6] an active campaigner against sex selection in India, points out that in the United States and Europe, there is often a double moral standard that protects completely unrestricted abortion rights domestically but is critical of gender selection in India and China. He notes that for Asian minorities in multiracial Western societies, the unrestricted availability of gender testing and abortion is detrimental; in these settings, a girl should have the same chance of being born regardless of race or ethnicity. Even in homogeneous Western populations in which fetal sex selection for nonmedical purposes is rare, there is still an ethical difficulty; the staunchest defenders of unrestricted abortion must surely be morally challenged by occasional requests for pregnancy terminations that appear to be based on nothing more than gender discrimination. The American College of Obstetricians and Gynecologists' Committee on Ethics opposes sex selection except for the prevention of serious sex-linked genetic diseases.[7]

How can the international clinical genetics community respond to this problem? All clinical geneticists and other health professionals, but particularly those in those areas where there are major sex ratio distortions, need to be vocal in their opposition to both the underlying social injustices and the practice of gender selection. Many Asian doctors have trained outside their home country or are otherwise knowledgeable about societies where the gender bias is minimal, and they should therefore be particularly aware of the changes in practices that are needed in their home country. Asian professionals who have immigrated to Western countries can also be highly influential, and in this context, Dr Madan must be commended for highlighting this issue.

It is also crucial that prenatal testing everywhere remains focused on medically important disorders. Inclusion of fetal sex reporting has become part of NIPT under the guise that it is an essential part of the detection of sex chromosome aneuploidy. However, data to support the use of NIPT for all fetal sex chromosome abnormalities are lacking, and robust data showing the accuracy of the testing for normal fetal sex chromosome complements are also scant. In fact, the inclusion appears to

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be driven more by a commercial competition and pressure to demonstrate that the scope of NIPT can approach that of invasive testing. At a minimum, some NIPT promotional activities and news reporting that have emphasized prenatal gender detection[8] may have the effect of distracting patients and the public from the true purpose of prenatal screening and diagnosis. As with prenatal ultrasound, it is likely that some patients will elect to receive NIPT knowing it will reveal fetal gender and without considering the full consequences of the testing being offered. At least in countries such as the United States, public support for prenatal diagnosis is likely to wane if testing is perceived as a tool for selecting babies' preferred characteristics. In other words, the well-established individual patient and public health benefits of prenatal screening and diagnoses for major fetal abnormalities can be placed at risk by irresponsible use of the technology. For countries such as India, the consequences appear to be even more dire.

Advances in genomic sequencing now offer the opportunity to preconceptionally and prenatally access unprecedented amounts of genomic information. This potentially could substantially improve the chances of producing a healthy baby. But the example of prenatal gender identification illustrates that even the most basic genetic information can fundamentally affect societies in worrisome ways. Clearly, the desire to profit from genomic technology can potentially corrupt the altruistic goals of health care.

The moral challenges associated with new technologies are not new. The dangers in clinical genetics may seem relatively minor as compared with those posed by nuclear physics. Nevertheless, I believe we should pay attention to the counseling and advice of Nobel Prize winner and pacifist Joseph Rotblat:[9]

"At a time when science plays such a powerful role in the life of society, when the destiny of the whole of mankind may hinge on the results of scientific research, it is incumbent on all scientists to be fully conscious of that role, and conduct themselves accordingly. I appeal to my fellow scientists to remember their responsibility to humanity."

DISCLOSURE

The author declares no conflict of interest.

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