As we reported late in 1997 (REHW #576), the male proportion of live births has been declining in the U.S. and Canada for at least 20 years. Normally there are 106 males born for every 100 females, for a male proportion of 106/206 = 0.5145. This proportion is often called the "live birth sex ratio" or simply the "sex ratio." Several studies -- some very recent [1,2] and others dating back to the late 1980s and early 1990s -- reveal similar 20-year declines in the male proportion of live births in England and Wales, [3] Denmark, Sweden, Finland, the Netherlands, Germany, Chile, Argentina, Brazil, Bolivia, Peru, Paraguay, Ecuador, Venezuela, Colombia, and Costa Rica. [4]

The declines in the male proportion of births are not large, and by themselves they have no practical importance. Often the shift has been from 0.515 to 0.513 or 0.512. Nevertheless, even small shifts in the sex ratio can add up. In Canada during the last 20 years, approximately 8600 males have not been born and in their place we have females; in the U.S. during the same period, 38,000 baby boys were replaced by baby girls. (From an environmental perspective this is arguably beneficial because environmentally destructive organizations tend to be dominated by men, while the effective wing of the environmental movement is largely led by women.)

Nevertheless, there is a very serious side to these small shifts in sex ratio. It is extremely unlikely that similar trends in so many different countries are due to chance. Therefore, the altered sex ratio raises a grave public health question: what is causing consistent biological changes in the human populations of so many industrialized and industrializing countries? Does this pattern signal some general change in exposures to environmental toxicants? Now two teams of researchers -- in the U.S. [1] and in Denmark [2] -- are asking whether the pattern of declining male proportion of births is linked to a similar pattern of increasing birth defects of the penis and testicles, increasing testicular cancer, and declining quality and quantity of sperm.

Both groups of scientists are hypothesizing that all of these patterns are linked to exposures to hormone-disrupting chemicals including dioxin, pesticides, lead, solvents and smoke stack emissions from smelters, steel foundries and incinerators. [5] And both groups are hypothesizing that the relevant exposures are most likely taking place before birth, in the mother's womb.

Devra Lee Davis of the World Resources Institute (Washington, D.C.), writing in the JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, [1] acknowledges that any change in a complex biological process, such as sex determination, probably has several causes. She then goes on to argue, offering evidence from many different areas of research, that the male proportion of live births can be affected by environmental exposures:

** At the moment of conception, all embryos are destined to be female unless something changes them into males. We all start out female by default. For the first six to 9 weeks of life, we all have unisex gonads. Between the 6th and 9th week, the gonads of those with a Y chromosome specialize into testicles and begin producing hormones that continue the process of creating a male. If anything interferes at this stage, a female may result. Thus sex is determined by tiny amounts of hormones circulating in the blood of the embryo. This situation provides opportunities for chemicals entering the mother's body ("xenobiotics") to disrupt normal processes. And there is some evidence that chemicals entering the mother's body do just that:

** In Seveso, Italy, in 1976, a group of people were heavily exposed to dioxin after an explosion at a pesticide factory. Dioxin is a potent poison, an unwanted byproduct of metal smelters, the manufacture of paper and pesticides, and incinerators. Between April 1977 and December 1984, 74 children were born to parents in the zone of greatest dioxin exposure. Of these, 48 were female and 26 male, for a male proportion of 0.351. After 1985, the male proportion of live births began to return to normal.

** Among a group of workers applying the pesticide dibromochloropropane (DBCP), several men became sterile. Importantly, those able to have children produced 3 times as many daughters as expected. [6]

** A study of pesticide-exposed workers in the Netherlands revealed a male proportion of 0.248, less than half the normal proportion of male births.

** Five studies of heavily polluted residential areas in Scotland revealed significantly diminished sex ratios. The pollutants were emitted by metal smelters, steel foundries, and incinerators.

** In rural Minnesota, increased rates of birth defects are reported to occur among the male children of workers who apply pesticides, suggesting that the male fetus may be especially vulnerable to hormone-disrupting substances. In an area with high usage of chlorophenox herbicides and/or fungicides, the male proportion among children born with defects to workers who apply pesticides was 0.735, compared to a male proportion of 0.607 for births with defects among the general population.

Davis considers many other factors that can reduce the male proportion of live births -- age differences between the parents, older age of father, mother under stress, multiple sclerosis, less-frequent intercourse, and test-tube fertilizations. None of these factors appears likely to have operated consistently in so many countries for 20 years or more. Therefore, Davis proposes that altered male proportion of live births should be considered a "sentinel health event that may be linked to environmental factors." A sentinel health event is defined as "an unusual pattern of health in a population that signals changes in avoidable factors." Thus, Davis writes, "changes in either a relatively common health occurrence, such as childhood asthma, or a relatively rare disease, such as pulmonary hypertension, can reflect changes in avoidable exposures."

The sex ratio is not static. In many countries, the ratio increased between 1900 and 1950 as better prenatal care reduced the number of stillbirths, which tend to affect males disproportionately. Thus, modern medicine has been able to avoid stillbirths, thereby keeping more baby boys alive. But some time between 1950 and 1970 the male proportion of live births began to decline. Henrik Moller of the Danish National Research Foundation [2] offers arguments similar to those of Davis, but based on somewhat different evidence. Moller restricts his discussion to men in Denmark, Finland, Norway, and Sweden. He argues that the declining male proportion of live births in these countries is closely linked to testicular cancer, and to declining sperm quality and quantity. He suggests that all of these effects may be caused by prenatal exposures to chemicals that act like dioxin and the pesticide DBCP, mentioned above.

Between 1960 and 1990, the incidence of testicular cancer doubled or more-than-doubled in each of the four Nordic countries. During the same period, testicular cancer also increased in England and Wales, Scotland, Australia, New Zealand, Slovenia [former Yugoslavia], Poland, Spain, Colombia, Japan, India, and the U.S. [7] Some of these increases may be due to better diagnosis, but the increases were consistent in all populations, were of similar size, and were reported by long-established cancer registries. Testicular cancer is a well-defined entity, and it inevitably becomes apparent, so it is unlikely to be missed.

Moller and others argue that, because testicular cancer tends to occur young in life, whatever causes it must become effective early, perhaps even before birth. [8] The causes of testicular cancer are poorly understood. One recent study has found that occupational exposure to polyvinyl chloride (PVC) increases the likelihood of getting testicular cancer. [9]

In the four Nordic countries that Moller discusses, during the period
that testicular cancer has been increasing, the quality of sperm has declined.[10] Sperm quality and quantity have also declined (on average) in the U.S. and in other European countries.[11] Moller argues that all these trends are related.

Moller conducted a case-control study of 514 Danish men with testicular cancer, comparing them to a control group of 720 men without cancer.[2] In both groups Moller interviewed the men and their mothers. Among the cancer cases, he recorded the sex of their children born up until 2 years before their cancers were diagnosed. He found a male proportion of 0.470. Among children born to the 720 controls, Moller found a male proportion of 0.520. Thus there was a significant reduction in the male proportion of live births among men who would later develop testicular cancer. Moller says his study does not close the book on the subject -- there are two other studies on record which found different results.

In recent years the world's scientific community has been expressing concerns about male reproductive health -- increasing birth defects of the penis and testicles, declining sperm quantity and quality, and increasing testicular cancer -- and asking whether these phenomena all have common origins in some sort of chemical exposures. (See REHW #438, #514.) This new information about altered sex ratios in more than a dozen countries simply makes the case more compelling and more urgent.

--Peter Montague (National Writers Union, UAW Local 1981/AFL-CIO)


Descriptor terms: sex ratio; male reproductive health; testicular cancer; cancer; carcinogens; pvc; semen; birth defects; cryptorchidism; undescented testicles; devra davis; england; denmark; sweden; finland; netherlands; germany; chile; argentina; brazil; bolivia; peru; paraguay; ecuador; venezuela; colombia; costa rica; canada; u.s.; hormone-disrupters; wri; jama; dibromochloropropane; dbcp; pesticides; kenrik moller; norway; wales; scotland; incineration; australia; new zealand; slovenia; poland; spain; japan; india;