

THE SCIENTIFIC ABUSE OF GENETICS AND SEX CLASSIFICATIONS

By Prof. M. Italiano, Advisor on Biosex Variations,
Organisation Intersex International
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It is a common misconception amongst many professionals and non-professionals alike, that the so-called “sex chromosomes” determine one’s sex. Typically in humans, there are 23 pairs of chromosomes with a total number of 46 chromosomes. Twenty two pairs are called autosomes and one pair is called sex chromosomes. They were designated as such because the pair found in males and females typically differed. Males usually had one X and one Y chromosome and females usually had two X chromosomes. Thus, it was believed that X and Y chromosomes determined sex, and that the autosomes (all the other “chromosomes”) determined non-sex physical characteristics.

However, correlation does not equal causation. There are actually more genes on the autosomes, and not the so called “sex chromosomes”, which are involved in sex determination (and sex differentiation and development), than there are on the so-called sex chromosomes. In fact, a gene on the Y chromosome (SRY) is one of the few genes on this chromosome which even has a role in sex determination, and its role in sex determination is indirect. It turns on genes on other chromosomes which more directly determine sex. The X chromosome also contains only a few genes which have a role in sex determination, but again, often in a very indirect way,

through regulating autosomal sex genes (not on the “sex chromosomes”) which directly determine sex. In fact, almost all of the X chromosome genes are inactivated on the second X chromosome in XX individuals, making XX and XY individuals roughly equal in X chromosome gene expression. As the X chromosome is necessary for survival, it becomes clear that the X chromosome is not a female chromosome. Furthermore, the X and Y chromosomes pair during gametogenesis and exchange chromosomal material with each other in a process called crossing over. As a result, part of an individual’s X chromosome was part of a Y chromosome, and part of an individual’s Y chromosome is part of an X chromosome. These areas are known as pseudoautosomal, mainly because the “sex chromosomes” are labeled as such.

There are in fact sex determining genes on many of the chromosomes, making the term “sex chromosomes” as such a misnomer. In the presence of an XX chromosome type with no Y specific chromosomal genes, an embryo still can become a male with testes, a penis, prostate, with no female organs, and the testes can initiate spermatogenesis (1). Likewise, in the presence of an XY chromosome pattern, with totally normal X and Y chromosomes, an individual can still become a female, with ovaries, a uterus, Fallopian tubes and a vagina, with no male organs (2, 3). These XY females can deliver a normal baby, both with or even without assisted reproductive technologies (2, 3). This is because genes on the autosomes may still be altered, or even switched on or off in both XX and XY embryos. This can result from environmental stimuli. “Sex chromosomes”, as a label, is neither scientific nor accurate as a term for either or both the X and Y chromosomes.

Thus, referring to either the XX or XY karyotype of an individual as the person's "genetic sex" is also a misnomer since most genes involved in sex determination are on the autosomes and not the so called "sex chromosomes". Furthermore, to refer to an XY person as a genetic male or genetically male, or an XX individual as a genetic female or genetically female, is errant and is a rare example of how scientific terminology is misused when compared to other relevant examples. For instance, sex is a phenotype, just as hair color, height, and eye color. Just as it is unscientific to refer to someone as a "genetic tall person" or a "genetically blonde haired person", it is not scientific to use expressions such as "genetic male", "genetically female", or "chromosomally a male" to define an individual's sex. When speaking about traits which affect individuals who are XY to a far greater degree than those who are XX, it is also unscientific to refer to them as "male limited". They may be XY limited, but not "male limited".

Because most sex determining genes are on autosomes, most intersexed individuals have a typical XX or XY karyotype. Thus, to divide intersexed individuals into categories such as XX intersex (now 46, XX DSD) or XY intersex (now 46, XY DSD) is counterproductive and problematic (4). An XX male with unambiguous testes and only male sex organs has virtually nothing in common with an XX female who lacks a uterus. Yet, both would be classified as having a 46, XX DSD. Likewise, an XY female with a uterus, and no male sex organs and who can deliver a baby, has virtually nothing in common with an XY male born with cloacal bladder exstrophy. Yet, again, both of them would be classified as having a 46, XY

DSD. To further compound the problem, if someone who has both XX and XY chromosomes (known as XX/XY chimerism or XX/XY mosaicism), were also what was formerly called a "true hermaphrodite" (a case of both ovarian and testicular tissue co-existing in the same individual), that same person would now not only have an "ovotesticular DSD" but also a "chromosomal DSD". Yet again, this intersexed person would have virtually nothing in common with an anatomically typical and even fertile male or female, who may also be XX/XY (5, 6). Yet this anatomically typical and fertile male or female would now have a "chromosomal DSD". It doesn't stop there. There are numerous examples of how this bad science leads to erroneous categorization. For instance, someone can be XY in the blood karyotype, yet be XX in the skin and ovaries and be a fertile female, simply due to blood chimerism caused by a twin fetus brother (6). This person would ostensibly have a "chromosome DSD", would be misdiagnosed in amniocentesis, or chromosome screening, and although DSD is supposed to represent congenital conditions, this would be an "acquired DSD", which likewise would be misdiagnosed even in later life.

Forensic science has now realized the error in using "male DNA" or "male genetics" at crime scenes (7). Legal systems are now realizing the same for trying to find "correct" sex for marriage (when actually they would promote same sex marriage by using "sex chromosomes" as decisive, since an XY female who can give birth could be viewed as the opposite sex of an XX female who could also give birth) by using outdated and incorrect "science". That an XX true hermaphrodite was declared female due to karyotype (8) has

been criticized (9) and not followed in subsequent legal practice. Even sports medicine is realizing that “sex chromosomes” or indeed any given “sex gene” is inadequate for “determining” the sex of an athlete (10).

It is time to dismiss mythology as a substitute for scientific knowledge and evidence, and if this requires social and political acquiescence, then so must it be.

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