Why men's ring fingers are longer than their index fingers

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Biologists at the University of Florida have found a reason why men's ring fingers are generally longer than their index fingers — and why the reverse usually holds true for women.

The finding could help medical professionals understand the origin of behavior and disease, which may be useful for customizing treatments or assessing risks in context with specific medical conditions.

Writing this week in the Proceedings of the National Academy of Sciences, developmental biologists Martin Cohn, Ph.D., and Zhengui Zheng, Ph.D., of the Howard Hughes Medical Institute and the department of molecular genetics and microbiology at the UF College of Medicine, show that male and female digit proportions are determined by the balance of sex hormones during early embryonic development. Differences in how these hormones activate receptors in males and females affect the growth of specific digits.

The discovery provides a genetic explanation for a raft of studies that link finger proportions with traits ranging from sperm counts, aggression, musical ability, sexual orientation and sports prowess, to health problems such as autism, depression, heart attack and breast cancer.

It has long been suspected that the digit ratio is influenced by sex hormones, but until now direct experimental evidence was lacking.

"The discovery that growth of the developing digits is controlled directly by androgen and estrogen receptor activity confirms that finger proportions are a lifelong signature of our early hormonal milieu," Cohn said. "In addition to understanding the basis of one of the more bizarre differences between the sexes, it's exciting to think that our fingers can tell us something about the signals that we were exposed to during a short period of our time in the womb. There is growing evidence that a number of adult diseases have fetal origins. With the new data, we've shown that that the digit ratio reflects one's prenatal androgen and estrogen activity, and that could have some explanatory power."

Cohn and Zheng, also members of the UF Genetics Institute, found that the developing digits of male and female mouse embryos are packed with receptors for sex hormones. By following the prenatal development of the limb buds of mice, which have a digit length ratio similar to humans, the scientists controlled the gene signaling effects of androgen — also known as testosterone — and estrogen.

Essentially, more androgen equated to a proportionally longer fourth digit. More estrogen resulted in a feminized appearance. The study uncovered how these hormonal signals govern the rate at which skeletal precursor cells divide, and showed that different finger bones have different levels of sensitivity to androgen and estrogen.

Since Roman times, people have associated the hand's fourth digit with the wearing of rings. In many cultures, a proportionally longer ring finger in men has been taken as a sign of fertility.

"I've been struggling to understand this trait since 1998," said John T. Manning, Ph.D., a professor at Swansea University in the United Kingdom, who was not involved in the current research. "When I read this study, I thought, thank goodness, we've attracted the attention of a developmental biologist with all the sophisticated techniques of

molecular genetics and biology."

In dozens of papers and two books, including the seminal "Digit Ratio" in 2002, Manning has studied the meaning of the relative lengths of second and fourth digits in humans, known to scientists as the 2D:4D ratio.

"When Zheng and Cohn blocked testosterone receptors, they got a female digit ratio," Manning said. "When they added testosterone they got super male ratios, and when they added estrogen, super female ratios. And they've provided us with a list of 19 genes that are sensitive to prenatal testosterone and prenatal estrogen.

"I find this completely convincing and very useful," Manning said. "We can now be more focused in our examination of the links between digit ratio and sex-dependent behaviors, diseases of the immune system, cardiovascular disorders and a number of cancers."

Cohn, whose uses the tools of genetics, genomics and molecular biology to study limb development, said his lab began studying the digit ratios after Zheng became determined to find an explanation.

"He suggested that the 2D:4D ratio would be an interesting question, and I have to admit to being skeptical," Cohn said. "When he came back with the initial results, I was blown away. We looked at each others hands, then got busy planning the next experiment."

Provided by University of Florida