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Review

The use of digit ratios as markers for perinatal androgen action

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Abstract

Since the ratio of the second-to-fourth finger length was first proposed as a marker for prenatal androgen action in 1998, over 100 studies have been published that have either further tested the association between the digit ratio and prenatal androgens, or employed digit ratios as a marker to investigate the association between prenatal androgens and a variety of outcomes, including behavior, fertility, and disease risks. Despite the clear demand for an adult marker of prenatal androgen action and increased use of digit ratios as such a marker, its validity remains controversial. This review (1) evaluates current evidence for the relationship between digit ratios and prenatal androgens (using experimentation with animal models, amniotic testosterone, and congenital adrenal hyperplasia case-control studies), (2) describes opportunities for future validation tests, and (3) compares the potential advantages and disadvantages of digit ratio measures with more established methods for studying the effects of prenatal androgens.

Background

Many researchers are pursuing research programmes aimed at elucidating the effects of early testosterone exposure on later development outcomes, especially behavior. These include both experimental work with animal models and a large body of work in human psychology that have focused on the role of early testosterone action on behavioral sex differentiation [1]. In addition to the long-standing work on behavioral outcomes, interest has arisen more recently in the effects of early testosterone exposure on health-related outcomes in adulthood, including polycystic ovary syndrome [2,3] and reproductive cancers [4,5].

The concept of "early testosterone action" is broadly meaningful in mammals because a period of high testosterone production in males during the prenatal (and possibly postnatal) periods drives the differentiation of primary reproductive tissues, and is then followed by a long period of relative testicular quiescence before the onset of puberty. Nevertheless, the particular pattern and timing of early testosterone production varies among species, and, more importantly, the pattern and timing of potential target tissue development varies substantially both between species and among tissue types. Rodents, for example, might be expected to show greater potential effects of postnatal, relative to prenatal, testosterone exposure because of their altricial pattern of development, whereas primate males (including humans) might be expected to show greater postnatal effects because they produce more testosterone in infancy [6]. This review will focus on the pattern and effects of testosterone production in human males, with comparisons to animal models where relevant.

Human male perinatal testosterone production

The mid-gestational peak in human male testosterone production occurs between the 10th and 18th weeks of ges-