The Measure of a Man: Associations between Digit Ratio and Disordered Eating in Males

April R. Smith, MS*  
Sean E. Hawkeswood, BA  
Thomas E. Joiner, PhD

ABSTRACT
Objective: The current study sought to determine whether there is a relationship between prenatal testosterone exposure, as indicated by the digit ratios of the second to fourth fingers (2D:4D ratio), and disordered eating and drive for muscularity in men.
Method: Digit ratios were calculated by measuring photocopies of participants’ finger lengths. Self-reported body image and eating attitudes and behaviors were assessed.
Results: There were significant correlations between 2D:4D ratio and disordered eating and drive for leanness, indicating that greater prenatal testosterone exposure was associated with less disordered eating and increased drive for muscularity.
Discussion: This suggests that greater prenatal testosterone exposure may be protective factor against the development of eating disorders in men. Potential mechanisms are discussed.

Keywords: eating disorders; body image; human males; hormones; testosterone; gonads; prenatal development; postnatal period

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*Correspondence to: April R. Smith, MS, Department of Psychology, Florida State University, 1107 W. Call Street, Tallahassee, Florida 32306-4301. E-mail: asmith@psy.fsu.edu
Department of Psychology, Florida State University, Tallahassee, Florida
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Introduction
There are pronounced sex differences in eating disorders, such that ~9 of 10 people with an eating disorder are female. Explanations for this discrepancy are varied. Some researchers utilize sociocultural theories to explicate these differences and posit that they are the result of culture-driven factors, such as the glorification of an unrealistically thin body ideal for females in Western societies. Other theories highlight the role of biology, and hold that gonadal hormones may play an important role in influencing the sex differences. However, most agree that eating disorders develop from a complex interplay between cultural, environmental, and genetic and other biological factors. Although males account for 10–15% of all bulimic and anorexic patients, this rate appears to be increasing. Given this increase it is important to enhance our understanding of the development of eating disorders in men, especially because men are often neglected in eating disorders research. The purpose of the this study was to investigate potential biological correlates of attitudes about eating and body shape by utilizing a marker of prenatal testosterone exposure and measurement scales designed specifically for men.

Testosterone is an organizing hormone and is pivotal for the masculinization of the body; it is required for the development and organization of genitalia, the brain, and other organ systems in men. Moreover, prenatal testosterone exposure also influences cognition (e.g., mental rotation ability) and behavior (e.g., athletic ability). Importantly, multiple animal studies have found that prenatal testosterone exposure “masculinizes” eating, such that animals receiving testosterone neonatally tend to eat more and weigh more. A recent study conducted on human twins found that greater prenatal testosterone exposure led to less disordered eating in both men and women. Specifically, males from male–male twin pairs had less disordered eating than the male twin from a male–female twin pair, and the female from a female–male twin pair had less disordered eating than females from female–female twin pairs. Sharing a prenatal environment with a male cotwin is believed lead to increased levels of testosterone in the prenatal environment. Thus, the authors
hypothesized that male–male twin pairs are more protected from disordered eating than other twin pairs due to their greater prenatal testosterone exposure.

Because it is difficult and potentially hazardous to directly study prenatal testosterone levels in utero, researchers have found other ways to indirectly measure prenatal hormone levels. One promising marker is the ratio of the second to fourth digits of the hand (known as the 2D:4D ratio), as this ratio has been shown to be strongly correlated with prenatal levels of testosterone and is sexually dimorphic—that is, a lower 2D:4D ratio is found in men and a higher 2D:4D ratio is found in women. More specifically, research suggests that testosterone promotes the growth of the 4th digit, whereas estrogen increases the length of the 2nd digit. Thus, in order to produce the lower 2D:4D ratio seen in men, the uterine environment needs to be high in testosterone and low in estrogen.

The 2D:4D ratio has been found to be correlated with several mental disorders, including eating disorders. Klump et al. found that higher levels of prenatal testosterone exposure, as indicated by a lower 2D:4D ratio, were associated with less disordered eating in women. The authors propose that lower levels of prenatal testosterone exposure may make women more receptive to estrogens at puberty; this increased receptivity in turn may facilitate activation of genes related to the development of eating disorders.

Given previous findings indicating that prenatal testosterone exposure organizes the brain and physiology to be more “masculine,” we hypothesized that greater prenatal testosterone exposure would be associated with less disordered eating in men. Though greater prenatal testosterone exposure is associated with healthier eating in women, no studies have examined whether or not higher levels of testosterone exposure, as measured by the 2D:4D ratio, are associated with more “masculinized” eating behaviors (i.e., less disordered eating) in men. Thus the primary aim of the current study was to determine if, similar to women, men who are exposed to more prenatal testosterone report more body satisfaction and less disordered eating than men exposed to a lower amount.

Additionally, we sought to examine other potential correlates of increased testosterone exposure, such as increased drive for muscularity. Preliminary support for this latter hypothesis comes from studies examining the relationship between 2D:4D and sporting ability. Specifically, Manning et al. found that 2D:4D significantly predicted sporting rank such that a lower ratio (indicating increased prenatal testosterone exposure) was associated with being a more accomplished player, even after controlling for age, experience, and type of sport played. Furthermore, another study found that male physical fitness was negatively correlated with 2D:4D ratio. The authors suggest that increased prenatal testosterone exposure may influence improved fitness potential through mechanisms such as more efficient heart and vascular systems, and by promoting behaviors such as exercise. Given these findings, we hypothesized that increased prenatal testosterone exposure may be associated with a greater drive for muscle, as men with lower 2D:4D ratios are more likely to be involved in activities requiring developed musculature.

A final aim of the study was to enhance the validity of the findings by including a measure of eating attitudes and body dissatisfaction specifically designed for men. Earlier research on body dissatisfaction and eating attitudes in men has relied heavily on measures that were designed for use in women. These inventories do not place a strong emphasis on masculinity, and some items include descriptors such as “breasts” and “hips.” Aside from item irrelevance and/or a lack of items assessing issues pertinent to male body image, scales designed for women might suggest that body image concerns are obstacles only females face and thus lead men to underreport symptoms. Another factor to consider when using female-based measures is that they are designed to measure one facet of a body ideal—thinness. Thus, these measures fail to distinguish whether the male figure is larger because he is fat or muscular. Cafri and Thompson analyzed models used in male body image research and concluded that in order to appropriately assess men's body image, researchers must use a tool that contains items that focus on muscularity. As such, the current study utilizes the Male Body Attitudes Scale (MBAS), which has items that assess for desire for masculinity and leanness.

The current study extends upon a small but growing body of research examining body dissatisfaction and disordered eating in men. It was hoped that the measurement of 2D:4D ratios would provide insight into the relationship between prenatal testosterone exposure and susceptibility to disordered eating. We predicted that a lower 2D:4D ratio, which indicates more prenatal testosterone exposure, would be associated with a reduced drive for leanness and less disordered eating. Furthermore, it was predicted that men who were exposed
to more testosterone prenatally would desire a more muscular body figure.

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**Method**

**Participants**

Two hundred and four males were recruited from a large southeastern university. Seventy-five of the participants were gay. The ethnic/racial composition of this sample was generally representative of the university student body. The ethnic composition was: 83% Non Hispanic and 17% Hispanic. The racial composition was: 78% Caucasian, 7% Black, 8% Asian, 1% American Indian, 4% more than one race, and 2% did not report a race. The participants' ages ranged from 17 to 24 (M = 19.21, SD = 1.52).

**Measures**

**Male Body Attitudes Scale.** The male body attitude scale (MBAS) is a 29-item self-report measure of men's attitudes towards their bodies. The MBAS consists of the following subscales: Muscularity, Body Fat, and Height. The Muscularity subscale assesses desire for muscularity, and consists of items such as, "I think I have too little muscle on my body," and "I think my chest should be larger and more defined." The Body Fat subscale assesses body satisfaction and desire for leanness. Example items from this subscale are: "I think I have too much fat on my body," and "I am concerned that my stomach is too flabby." The following two items assess attitudes towards height: "I wish I was taller," and "I am satisfied with my height." The MBAS has demonstrated good construct validity and test-retest reliability. In the current study, we utilized only the Muscularity and Body Fat subscale, as we did not have reason to believe that dissatisfaction with height would be associated with prenatal testosterone exposure. The alpha coefficients for these subscales in the current sample were as follows: Muscularity (0.80) and Body Fat (0.86).

**Eating Disorders Examination Questionnaire 4.** The eating disorders examination questionnaire 4 (EDEQ-4) is a 36-item self-report measure adapted from the EDE interview that measures symptoms of eating disorders (e.g., self-induced vomiting, binging), weight concerns, shape concerns, eating concerns, and restraint. Numerous studies have reported on the excellent internal consistency and test-retest reliabilities for the subscales of the EDEQ-4, as well as its validity. Cronbach's alpha in the current sample for the total score was 0.80.

**Digit Ratios.** Digit ratios were calculated by measuring photocopies of participants’ finger lengths. Two trained research assistants independently measured each finger length. Their inter-rater reliability was excellent (all intra-class r's > .91). Next, differences in participants' digit ratios from the left and right hand were examined. There was a significant difference in 2D:4D between the left and right hands (t = 2.18, p = .03), such that the left hand was "more masculinized" (i.e., lower ratio). Other studies have found significantly lower digit ratios in the left hand as well. This raises the possibility that left hand 2D:4D represents the truer signal. In fact, our findings support this possibility, as the results using the right hand were generally in the same direction as those using the left, though they are clearer in the left hand. Moreover, we also computed an average of the right and left hand 2D:4D ratio and found that the patterns of significance for the composite were more similar to the left than right hand. The results for both hands, as well as the composite, are reported separately.

**Procedure**

Participants were told that they were participating in an experiment on body image. They were then instructed to fill out demographic information, and complete the questionnaire packet, which contained the EDEQ-4 and MBAS. Participants then had their hands photocopied so that their digit ratios could be measured. Klump et al. have demonstrated that this is a reliable way to obtain digit ratios.

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**Results**

Associations between digit ratios and drive for leanness (as measured by the MBAS Body Fat subscale), disordered eating (as measured by the EDEQ-4 total score), and drive for muscularity (as measured by the MBAS Muscularity subscale) were examined using Pearson correlations. Because a visual inspection of some of the scatter plots suggested the presence of a quadratic relationship we tested for this relationship as well, with regard to
each factor of interest (drive for leanness, disordered eating, and drive for muscularity), by entering the square of the digit ratio term along with the unsquared term into a regression equation. The quadratic term was not significant in any of the analyses, and thus all relationships appeared to be linear.

2D:4D and Drive for Leanness

Associations between drive for leanness (as measured by the MBAS Body Fat subscale) and 2D:4D digit ratios were examined using Pearson correlations. The relationship was significant \((r = .18, p = .04)\) and in the predicted direction, indicating that more prenatal testosterone exposure was associated with a diminished drive for leanness (see Fig. 1). When gay men were included in the analysis, the relationship remained significant \((r = .16, p = .02)\). The results for the right hand were not significant \((r = .09, p = .19)\), but the results for the composite were \((r = .15, p = .04)\).

2D:4D and Disordered Eating

The Pearson correlations between digit ratio and disordered eating (as measured by the EDE total score) were also significant \((r = .19, p = .04)\) and in the predicted direction (see Fig. 2). These findings indicate that more prenatal testosterone exposure is associated with less disordered eating.\(^b\) When gay men were included in the analysis, the relationship approached significance \((r = .12, p = .09)\).\(^c\) The results for the right hand \((r = .06, p = .41)\) and composite \((r = .105, p = .14)\) were not significant.

2D:4D and Drive for Muscularity

Pearson correlations examining the association between drive for muscularity (as measured by the MBAS Muscularity subscale) and 2D:4D digit ratios were significant \((r = -.24, p < .01)\) and in the predicted direction (see Fig. 3). This suggests that more prenatal testosterone exposure is associated with a greater drive for muscularity. When gay men were included in the analysis, the relationship remained significant \((r = -.16, p = .02)\). The results for the right hand \((r = -.18, p = .01)\) and composite \((r = -.20, p \leq .01)\) were also significant.

Discussion

Though research on the effects of prenatal testosterone exposure is burgeoning, few studies have examined the relationship between 2D:4D digit ratio and known risk factors for eating disorders, such as body dissatisfaction and disordered eating attitudes. Thus, the purpose of the present study was to examine the association between these risk factors and prenatal testosterone exposure in men, as males tend to be an understudied population in the field of eating disorders.

\(^b\)To explore whether men’s drive for leanness lead to their engagement in disordered eating behaviors, we examined drive for leanness as a potential mediator of the relationship between digit ratio and disordered eating. This meditational analysis was supported \((z = 2.05, p = .04)\); however, the meditational analysis was not specific to drive for leanness, as disordered eating also mediated the relationship between digit ratio and drive for leanness \((z = 2.04, p = .04)\). This is likely due to the high correlation between these variables, \(r = .79, p < .01\). Future meditational work with a longitudinal component is needed to clarify these relationships.

\(^c\)We also examined the correlations between the weight and shape concern subscales of the EDEQ-4 and 2D:4D ratios. Though not statistically significant, the magnitudes of the correlations were similar to that of the global score: weight concern, \(r = .13, p = .15\); shape concern, \(r = .17, p = .07\).
Our prediction that participants with lower 2D:4D ratios would report a reduced drive for lean-ness and less disordered eating was supported. Thus, it appears that for men, greater prenatal tes-tosterone exposure may be a protective factor against the development of eating disorders and problematic weight loss behaviors. This is in keeping with previous studies in women, which have also found that greater prenatal testosterone exposure is protective against disordered eating.22,2 This association may in part be due to the masculiniza-tion of the brain and later behaviors (e.g., eating) that result from prenatal testosterone exposure. Our prediction regarding the effect of prenatal testoster-one exposure on men’s drive for muscularity was also supported. Specifically, men with a lower 2D:4D ratio reported an increased drive for muscularity. This suggests that men who have higher lev-els of prenatal testosterone exposure also desire a more muscular physique and are overall less dissat-isfied with their current figures. It may be that males’ preferences for different body compositions vary partly as a function of the amount of testosterone they were exposed to prenatally.

The current study possesses several notable strengths. This is the first study to examine the rela-tionship between prenatal testosterone exposure, as indexed by the 2D:4D ratio, and eating and body attitudes in men. Furthermore, this is one of few studies utilizing measures that are appropriate for the assessment of disordered eating and body dissatisfaction in men. This allowed for a more accurate assessment of these constructs, as well as an examination of drive for muscularity, which appears to be a concern more characteristic of men.

A few limitations of the study are also important to note. First, the sample consisted of nonclinical, college-aged men, so we cannot be sure that the observed results can be generalized to other samples. Another limitation of the current study is that data were acquired through self-report and, as such, must be interpreted with caution. Moreover, although participants’ feelings about their bodies and shape were assessed, their actual weights and BMI were not recorded. Finally, the effect sizes were not robust, which means the possibility of Type I error must be considered. However, the magnitude of the effects was similar to those observed in females. This indicates that despite modest effect sizes, the associations appear to be consistent and replicable.

The mechanism by which prenatal androgen exposure may affect later eating and weight loss behaviors is not yet clear, though it has been hypothesized that in women, low prenatal testoster-one exposure influences later receptivity to circulating levels of ovarian hormones, which may serve to activate genes that affect disordered eating.2 Future studies should examine the relationship between prenatal androgen exposure and circulating levels of androgens in the development of disordered eating in men. Researchers should also examine whether low versus high levels of prenatal testosterone exposure may be related to different types of body dissatisfac-tion and/or pathology. For example, because men with reduced prenatal testosterone exposure appear to prefer a leaner ideal they may be more likely to utilize inappropriate compensatory mechanisms and/or strict dieting in order to achieve this ideal. However, because men with higher prenatal testosterone exposure seem to desire more muscular ideals they may be more likely to abuse steroids or other body mass enhancing agents. Moreover, given findings that gay men appear to be at risk for developing eating disorders,23,24 as well as findings sug-gest that gay men tend to have higher 2D:4D ratios,25,22,12 future studies should more closely examine the role of biological factors, such as prena-tal testosterone exposure, in the development of eating disorders in this group.

References


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