Short Report

Grip Strength and Digit Ratios Are Not Correlated in Women

SARI M. VAN ANDERS*
Department of Psychology, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6

ABSTRACT Fink et al. (2006) have reported that men with higher grip strength (GS) have lower digit ratios (2D:4D), interpreting this as evidence for organizational effects of prenatal androgens on strength. In this study, I attempted to replicate their finding with 99 women. I found no evidence that digit ratios were associated with GS, suggesting that 2D:4D is not associated with GS in women. The null findings are discussed in light of gender and statistical considerations. Am. J. Hum. Biol. 19:437–439, 2007. © 2007 Wiley-Liss, Inc.

The most common digit ratio measure is 2D:4D (second/fourth digit), which is lower in males (Malas et al., 2006). This is somewhat stable over life (McIntyre et al., 2005). Lower 2D:4D is putated to be influenced by higher prenatal testosterone (*T*), and there is evidence to support this (see, e.g., Fink et al., 2006; van Anders et al., 2006).

Researchers have thus used 2D:4D as a potential proxy for prenatal *T*. Fink et al. (2006) recently reported that men with higher grip strength (GS) had lower 2D:4D, and concluded that higher prenatal *T* exerts an organizational influence on strength. The evidence for an association between endogenous circulating *T* and strength is inconsistent (e.g., Elliot et al., 2003; Schaap et al., 2005), and Fink et al. suggest that this may result from hitherto unexamined organizational influences.

If lower digit ratios are associated with increased adult GS, then an association between the two should be apparent in women as well as men, since the association between prenatal *T* and digit ratios is at least as well substantiated in women as it is in men. To test this, I examined data collected from women for another study (van Anders and Hampson, 2005).

MATERIALS AND METHODS

Participants

Participants ($N = 99$; mean age = 23.76 years, SD = 5.66) were recruited through advertisements at the University of Western Ontario (UWO). No participants were using hormonal contraceptives or were pregnant or breastfeeding. Data on ethnicity were not collected.

Materials

Grip strength (GS) (kgf) was measured via dynamometer on the left (L) and right (R) hands; analyses are conducted on averages of two grips. For more details of the following, see van Anders and Hampson, 2005. Questionnaires were given to assess demographics. 2D:4D was measured via photocopies by two raters (average values were analyzed), with interrater reliabilities (intraclass coefficients; r_1) above 0.90.

Procedure

This study received prior approval from the UWO Research Ethics Board. Participants were tested in 1.5 h long morning sessions (0800–0930) during the menstrual phase, and received CAD$20.

RESULTS

Statistical analyses are conducted using SPSS v. 13.0. One L2D:4D was over three standard deviations from the mean and was excluded from analyses, and five digit ratios could not be calculated because of the difficulties with identification of landmarks for measurement.

2D:4D and GS are continuous measures, so I conducted Pearson-product moment correlations to assess interassociations. There were

Grant sponsor: NSERC; Grant sponsor: UWO.

*Correspondence to: Sari M. van Anders, SFU Psychology, 8888 University Drive, Burnaby, BC, Canada V5A 1S6. E-mail: saria@sfu.ca

Received 14 November 2006; Revision received 15 December 2006; Accepted 16 December 2006

Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/ajhb.20634

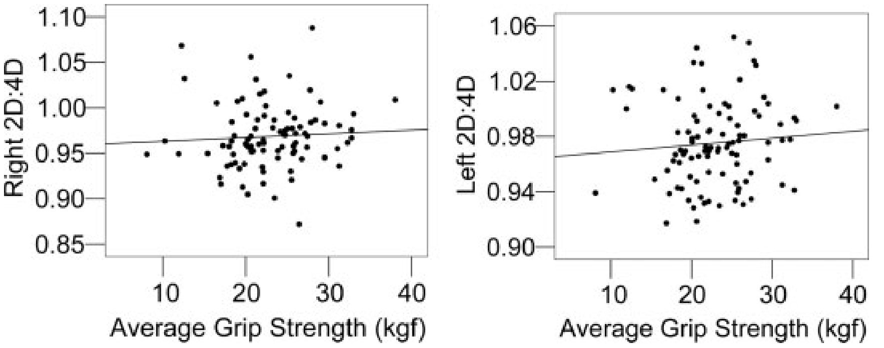

Fig. 1. 2D:4D values and average grip strength for the (a) right hand and (b) left hand.

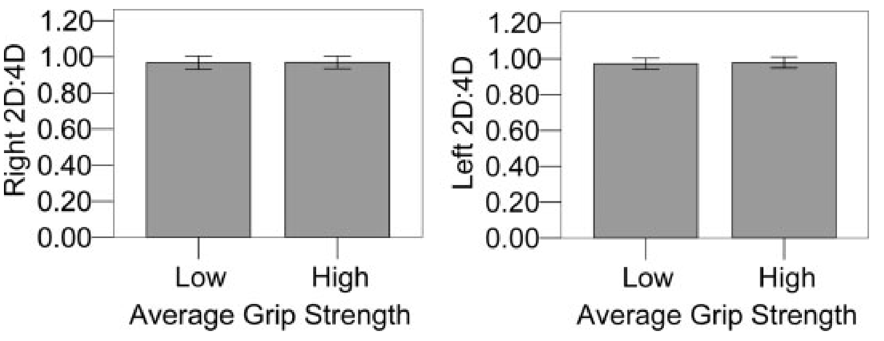

Fig. 2. Means and standard deviations for high and low grip strength for 2D:4D on the (a) right hand and (b) left hand.

no significant correlations (Fig. 1) between R2D:4D and RGS, $r(92) = 0.10$, $P = 0.34$, or L2D:4D and GS, $r(94) = 0.06$, $P = 0.59$. The pattern of results did not change when I controlled for weight, height, age, handedness, or BMI in partial correlations (Fink et al., 2006 sometimes included these as covariates).

In contrast, Fink et al. (2006) conducted analyses on associations between GS and 2D:4D by creating a median split with mean GS in their data, apparently using GS averaged over both hands, and I divided my participants accordingly, who then differed significantly in average GS, $t(94) = 12.20$, $P < 0.001$. An analysis of variance (ANOVA) was then conducted with R2D:4D and L2D:4D as dependent variables, and average GS (high vs. low) as the independent variable, and I followed this (Fig. 2). No significant differences were found between women with high and low GS on R2D:4D, $F(1,93) = 0.05$, $P = 0.82$, partial $\eta^2 = 0.001$, power $= 0.056$, or L2D:4D, $F(1,94) = 1.09$, $P = 0.30$, partial $\eta^2 = 0.011$, power $= 0.178$. This pattern did not change when age, weight, height, handedness, or BMI were entered as covariates into ANOVA.

DISCUSSION

Fink et al. (2006) reported lower 2D:4D in men with high GS. In this study, I found no evidence of such an association in women. My sample of women was larger ($N = 99$) than the samples of men from Fink et al. (i.e. $N = 52$; $N = 88$), and exhibited either less or comparable variation in GS and 2D:4D. Notably, the estimated effect sizes (partial η^2) from my data were very low (0.001–0.011) relative to those from Fink et al.'s samples men (0.024–0.073). Similarly, my power estimates were very low (0.056–0.178). The effect sizes suggest null, or at best negligible, associations that might only be apparent with exceedingly large samples of women.

There are some differences between this study and Fink et al.'s (2006) study. For example, their study controlled for ethnicity, which contributes to variation in 2D:4D. I could not control for ethnicity since I had not originally collected these data, but previous studies that have been used as foundational evidence for prenatal androgen influences (e.g. Brown et al., 2002; McIntyre et al., 2005; van Anders et al., 2006) also have not controlled for ethnicity. Additionally, the means from my data were not in the expected direction, as they would likely be if variation from ethnicity was only adding noise that precluded significance. One additional difference is that I used photocopy measures and Fink et al. (1998) used direct hand measures. Photocopy measures have been widely used and correlate highly with direct measures (Manning et al., 2005), and though Manning et al. report that photocopies yield lower 2D:4D than hand measures, this consistent pattern would not have confounded our findings.

The most notable difference, of course, is that the present study reported on women and Fink et al. reported on men, leaving the possibility open that 2D:4D is differentially associated with strength in men and women or is a less accurate marker of organizational effects of androgens on strength in women than in men. Although possible, these seem unlikely since there is little evidence that the value of 2D:4D as a possible marker of prenatal androgens differs by sex. Even if 2D:4D is associated with strength because of sexual selection for male competition as per Fink et al.'s suggestion, it is not immediately apparent why this same proximate mechanism would fail to occur in women. This point is underscored by associations between better athletic performance and lower 2D:4D in men (Honekopp et al., 2006), which is predicated on the same logic, but which are also apparent in women (Honekopp et al., 2006). Other than that a possibly falsely rejected null hypothesis by Fink et al., one remaining possibility, therefore, is that the lower strength in women is leading to some floor effect or restriction of range precluding statistically significant associations with 2D:4D.

ACKNOWLEDGMENTS

These data were collected while SMvA was at the Department of Psychology, UWO.

LITERATURE CITED

Brown WM, Finn CJ, Cooke BM, Breedlove SM. 2002. Differences in finger-length ratios between self-identified "butch" and "femme" lesbians. Arch Sex Behav 31:123–127.

Elliott KJ, Cable NT, Reilly T, Diver MJ. 2003. Effect of menstrual cycle phase on the concentration of bioavailable 17-β oestradiol and testosterone and muscle strength. Clin Sci (Lond) 105:663–669.

Fink B, Thanzami V, Seyde H, Manning JT. 2006. Digit ratio and hand-grip strength in German and Mizos men: Cross-cultural evidence for an organizing effect of prenatal testosterone on strength. Am J Hum Biol 18:776–782.

Honekopp J, Manning JT, Muller C. 2006. Digit ratio (2D:4D) and physical fitness in males and females: evidence for effects of prenatal androgens on sexually selected traits. Horm Behav 49:545–549.

Malas MA, Dogan S, Evcil EH, Desdicioglu K. 2006. Fetal development of the hand, digits and digit ratio. Early Hum Dev 82:469–475.

Manning JT, Fink B, Neave N, Caswell N. 2005. Photocopies yield lower digit ratios (2D:4D) than direct finger measurements. Arch Sex Behav 34:329–333.

McIntyre MH, Ellison PT, Lieberman DE, Demerath E, Towne B. 2005. The development of sex differences in digital formula from infancy in the Fels Longitudinal Study. Proc Biol Sci 272:1473–1479.

Schaap LA, Pluijm SM, Smit JH, van Schoor NM, Visser M, Gooren LJ, Lips P. 2005. The association of sex hormone levels with poor mobility, low muscle strength and incidence of falls among older men and women. Clin Endocrinol (Oxf) 63:152–160.

van Anders SM, Hampson E. 2005. Testing the prenatal androgen hypothesis: Measuring digit ratios, sexual orientation, and spatial abilities in adult women. Horm Behav 47:92–98.

van Anders SM, Wilbur CJ, Vernon PA. 2006. Finger-length ratios show evidence of prenatal hormone-transfer between opposite-sex twins. Horm Behav 49:315–319.