Personality and Individual Differences 124 (2018) 8–11

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Men with more masculine digit ratios are partnered with more attractive women

Berenika Kuna*, Andrzej Galbarczyk

Department of Environmental Health, Faculty of Health Sciences, Jagiellonian University Medical College, 20 Grzegorzecka St., 31-351 Krakow, Poland

ARTICLE INFO

Keywords:
2D:4D
Mate choice
Mate value
Waist-to-hip ratio
Bust-under-bust ratio
Breast size

ABSTRACT

The low 2nd to 4th digit ratio (2D:4D) is thought to reflect higher prenatal exposure to testosterone and may be associated with higher testosterone levels in adulthood and higher reproductive success in males. However, there is little evidence that higher testosterone levels are directly responsible for higher male fertility. Here, we investigate if this phenomenon may be related to mate choice, and, in particular, if males with lower 2D:4D are partnered with more attractive and potentially more fertile women. We compared waist-to-hip ratio and breast size of 50 women from two groups, depending on the 2D:4D (more masculine, more feminine) of their actual partner. Moreover, we examined the relationship between men's digit ratio and their mate's body type. Men with more masculine 2D:4D were coupled with women with significantly lower waist-to-hip ratios. They were also four times more often partnered with women who had both relatively narrow waists and large breasts. These findings suggest that levels of sex steroids during fetal development in males may have long-lasting influences on their mating value. This is the first study to show relationships between men's intrauterine environment, reflected by 2D:4D, and their actual partners' anthropometric traits, linked to perceived attractiveness and potential fertility.

1. Introduction

The ratio of 2nd to 4th digit length (2D:4D) is a putative indicator of intrauterine hormonal environment, which may affect phenotype and health risks in individuals (Manning, Scutt, Wilson, & Lewis-Jones, 1998). Low 2D:4D (longer 4th finger) ratios is thought to reflect higher exposure to testosterone in utero (Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, & Manning, 2004; Manning & Fink, 2017). A low 2D:4D in men has also been linked with their higher reproductive success (Klimek, Galbarczyk, Nenko, Alvarado, & Jasienska, 2014; Manning & Fink, 2008), though the mechanisms driving this correlation still remain unclear. Although more masculine 2D:4D among men has been linked with higher testosterone levels in adulthood (García-Cruz, Huguet, Piqueras, Ribal, & Alcaraz, 2012; Klimek et al., 2014), there is no evidence for direct correlation between testosterone levels and male fertility (Gomendio, Malo, Garde, & Roldan, 2007).

The higher reproductive success of men with lower 2D:4D may be explained by their higher physical attractiveness (Bogaert, Fawcett, & Jamieson, 2009), which may increase their value as mates. Men with lower 2D:4D exhibit greater development of sexually dimorphic traits, such as facial masculinity (Fink et al., 2005; Weinberg, Parsons, Raffensperger, & Marazita, 2015) and height (Fink, Neave, & Manning, 2003), making them appear more masculine. They also demonstrate greater facial symmetry (Fink, Manning, Neave, & Grammer, 2004). All of these traits are considered indicators of biological quality and are perceived as attractive by women (Gangestad & Scheyd, 2005). Higher attractiveness of men with lower 2D:4D may explain why they have more sexual partners (Hönekopp, Voracek, & Manning, 2006).

For men, higher reproductive success may be also associated with the higher biological quality of their partners. If men with more masculine digit ratios have traits that signal their good quality as mates, then they may be more likely to attract women who also possess features that indicate they are high-quality mating partners.

In Western cultures, female attractiveness assessment includes mainly waist and breast size as cues of youthfulness, health status, and reproductive capability (Dixson, Duncan, & Dixson, 2015; Singh, 2002). These features also correlate to estrogen and progesterone levels, crucial for facilitating conception and maintaining a pregnancy (Gorkemli, Ak, Akyurek, Aktan, & Duman, 2004; Lipson & Ellison, 1996). Women who are characterized by both relatively narrow waists and large breasts have the highest reproductive potential (Jasienska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004).

Therefore, if men with more masculine 2D:4D are more likely to be in a relationship with women who have narrow waists and large

* Corresponding author at: Institute of Public Health, Jagiellonian University Medical College, Grzegorzecka 20, 31–351 Krakow, Poland.
E-mail address: berenika.kuna@gmail.com (B. Kuna).

https://doi.org/10.1016/j.paid.2017.11.040
Received 7 October 2017; Received in revised form 23 November 2017; Accepted 24 November 2017
Available online 28 November 2017
0191-8869/

breasts, this could explain the previously demonstrated correlation between men's digit ratio and their reproductive success. We hypothesized that men's fetal hormonal environments (reflected by 2D:4D), and their associated attractiveness, may enhance their chance of mating with more attractive and presumably more fertile women.

2. Material and methods

We analyzed data from a sample of 50 heterosexual couples ($N = 100$ individuals). The mean age of the men was 24.0 years ($SD = 3.19$) and the mean age of the women was 22.2 years ($SD = 2.30$). The average length of relationship was 27 months ($SD = 24.6$). All women were nulliparous and did not use hormonal contraception. Written informed consent was obtained from all individual participants included in the study.

Finger length in men was measured twice with a caliper, directly on the ventral surface of the both hands from basal crease to the fingertip, according to a standard protocol (Klimek et al., 2014; Manning et al., 1998), by the same researcher. The mean of the two measurements was used in analyses to minimize measurement errors. 2D:4D values obtained for left hand varied from 0.97 to 1.05 ($Me = 0.97$, $SD = 0.03$) and for right hand: 0.98 to 1.08 ($Me = 0.98$, $SD = 0.03$). Men were divided into two groups: those with more masculine, lower 2D:4D (< 1), and those with more feminine, higher 2D:4D (≥ 1), following previously published studies (Klimek et al., 2014; Manning et al., 1998). Respectively to differentiation in methodology accepted in study on 2D:4D, all analyses were re-ran with 2D:4D as continuous variable (Galis, Ten Broek, Van Dongen, & Wijnaendts, 2010).

Waist-to-hip ratio (WHR) in women was calculated as a proportion of waist circumference measured at the narrowest point (about 2 cm above navel) to hip circumference, measured at the widest point of the hips. Relative breast size was assessed by the bust-to-underbust ratio (BUR), calculated as proportion of bust circumference (the largest circumference around the chest) to the circumference obtained under bust. Since women who are characterized by both relatively narrow waists and large breasts have a higher potential fertility (Jasienska et al., 2004), using median values of WHR ($Me = 0.72$) and BUR ($Me = 1.15$) we divided women into two groups, according to their body type: “women with both relatively narrow waists and large breasts” and “other body types.”

The difference in partners WHR and BUR values between groups of men with low and high digit ratio was assessed with an unpaired *t*-test and with analyses of covariance (ANCOVA), with length of relationship as a potential confounder. Additionally, analyses were repeated with right- and left-hand 2D:4D as a continuous variable in simple linear regression analysis and in multiple linear regression, with length of relationship as a potential confounder. A chi-square test of independence was performed to examine the relation between men's 2D:4D and women body type.

3. Results

There was a statistically significant difference in partner's WHR between men with more masculine vs. more feminine 2D:4D ($t_{(48)} = 5.14$, $p < 0.001$ for right-hand and $t_{(48)} = 2.69$, $p < 0.01$ for left-hand 2D:4D) (Table 1). Women partnered with men with lower digit ratios had significantly narrower waists in relation to their hips (lower WHR). There was no statistically significant difference in BUR between the two groups of men with lower and higher digit ratios ($t_{(48)} = -1.27$, $p = 0.44$ for right-hand and $t_{(48)} = -0.77$, $p = 0.21$ for left-hand 2D:4D). After controlling for length of relationship the results remained unchanged; women partnered with men with more masculine 2D:4D had significantly lower WHR ($F_{(1,\ 47)} = 26.22$, $p < 0.001$, $\eta^2 = 0.36$ for right-hand and $F_{(1,\ 47)} = 7.15$, $p = 0.01$, $\eta^2 = 0.13$ for left-hand 2D:4D) but they did not differ in BUR ($F_{(1,\ 47)} = 1.81$, $p = 0.185$, $\eta^2 = 0.04$ for right-hand and $F_{(1,\ 47)} = 0.65$, $p = 0.424$, $\eta^2 = 0.01$ for left-hand 2D:4D).

When we re-ran all analyses with 2D:4D as a continuous variable we observed that male 2D:4D was positively related to their partner WHR ($r^2 = 0.28$, $p < 0.001$ for right-hand and $r^2 = 0.08$, $p = 0.04$ for left-hand 2D:4D). No statistically significant relationships were observed between male digit ratio and their partner BUR ($r^2 = 0.05$, $p = 0.13$ for right-hand and $r^2 = 0.01$, $p = 0.46$ for left-hand 2D:4D). After controlling for length of relationship, male 2D:4D was also positively related to their partner WHR ($p < 0.001$ for right-hand and $p = 0.04$ for left-hand 2D:4D), but not to their partner BUR ($p = 0.16$ for right-hand and $p = 0.65$ for left-hand 2D:4D).

The relationship between male right-hand digit ratio and partner's body type was significant ($\chi^2_{(1,\ N\ =\ 50)} = 4.77$, $p = 0.03$, $\varphi_c = 0.31$). Men with lower right-hand 2D:4D were more likely to be partnered with women with both relatively narrow waists and large breasts (41%) than men with higher 2D:4D (11%). This relationship was similar (37% vs. 13%), but was not statistically significant for left-hand digit ratio ($\chi^2_{(1,\ N\ =\ 50)} = 2.83$, $p = 0.09$, $\varphi_c = 0.24$). These results are compatible with a notion that right-hand 2D:4D is more sensitive to the effects of fetal testosterone levels (Hönekopp & Watson, 2010).

4. Discussion

To our knowledge, this is the first study to examine relationships between male's 2D:4D, a proxy of prenatal testosterone levels, and indicators of attractiveness of their actual mate. Previous studies have shown that men with more masculine digit ratios have more children (Klimek et al., 2014) and the reason for this phenomenon may be explained by our results.

The evolutionary psychology of human mating predicts that men with high mating value should be partnered, especially in long-term relationships, with women also characterized by high mating value (Buss & Schmitt, 1993). Men with more masculine digit ratios are perceived as more attractive (Bogaert et al., 2009). They also possess some observable indicators of higher biological quality, such as greater facial symmetry, and therefore higher mating value for women (Fink et al., 2004). That may explain the results presented here, that men with more masculine digit ratios are partnered with women characterized by more attractive body shape, such as a low WHR, and four times more often than men with more feminine digit ratio are partnered with women who have both relatively narrow waists and large breasts.

For men, one of the most important factors in assessing a mate is their reproductive value (Buss & Schmitt, 1993). Waist-to-hip ratio and breast size are both indicators of women's reproductive value. Women with low WHR and women who are characterized by both relatively narrow waists and large breasts have a higher potential fertility, as indicated by higher levels of reproductive hormones (Jasienska et al., 2004). Eye-tracking studies have shown that, during evaluation of female body attractiveness, men focus mainly on the waist and breast areas, which deliver honest signals about a woman's reproductive status (Dixson, Grimshaw, Linklater, & Dixson, 2011). A narrower waist in relation to wider hips is a visual sign of nulliparity, healthiness and youthfulness (Singh & Singh, 2011). Numerous historical and cross-cultural studies have shown that low WHR may be considered a universal indicator of women's attractiveness and their high mate value (for review see Singh, 2002). The significance of breast size is much more uncertain. Larger breasts may be a sign of age, sexual maturity, and nurturing ability; however, mainly in Western cultures they are considered a sign of attractiveness (Dixson et al., 2015; Galbarczyk, 2011). Therefore, larger breasts cannot be considered a universal indicator of a woman's mate value. WHR also seems to be a better predictor of reproductive potential than breast size (Jasienska et al., 2004). Considering these factors, it is not surprising that we failed to find a direct significant association between men's digit ratio and their partner's breast size.

Our results are consistent with some previous research on mate

Table 1
Comparison of WHR and BUR in women, due to their partner's 2D:4D.

	Low right 2D:4D (N = 32)	High right 2D:4D (N = 18)	t	df	p	Cohen's d	Low left 2D:4D (N = 35)	High left 2D:4D (N = 15)	t	df	p	Cohen's d
	Mean (*SD*)	Mean (*SD*)					Mean (*SD*)	Mean (*SD*)				
WHR	0.71 (0.03)	0.75 (0.03)	5.14	48	< 0.001	1.51	0.71 (0.04)	0.74 (0.04)	2.69	48	0.01	0.83
BUR	1.16 (0.04)	1.15 (0.03)	− 1.27	48	0.21	− 0.38	1.16 (0.04)	1.16 (0.03)	− 0.77	48	0.44	− 0.24

preferences. It has been shown that among men higher levels of testosterone are associated with stronger attraction to femininity in women (Welling et al., 2008). Therefore, if intrauterine testosterone levels (reflected in 2D:4D) predict adult testosterone levels (Klimek et al., 2014), men with more masculine digit ratios should have stronger preferences for women with more feminine women body shape. It has been also shown that women's WHR may predict their preferences for masculinity (Smith et al., 2009). Women with low WHR tend to have stronger preferences for more masculine male faces. Therefore, if men's digit ratio is related to facial masculinity (Fink et al., 2005), women with low WHR should prefer men with masculine digit ratios. Assuming that human mating systems are based on mutual mate choice, men with more masculine digit ratios should select more attractive women as their preferred mate, but also they should have higher chance to be selected by more attractive potential mates.

Our findings show a long-lasting impact of the prenatal hormonal environment in a real mating context. It is worth noting that our study was conducted among couples in relatively long-term relationships. This allowed us to investigate biological factors influencing not preferences, but real mate choices, which are much more relevant from an evolutionary perspective. Our results may bring a new approach to exploring biological factors influencing actual mating decisions, and begin to address gaps in the literature observed between mate preferences and actual choices (Conroy-Beam & Buss, 2016). Further studies should seek to investigate not just putative indicators of hormone levels but also actual hormone levels or hormone-related habitual patterns of behavior (such as aggression or dominance) in relation to mating decisions.

In conclusion, our results suggest that men's prenatal environment, indicated by 2D:4D, has an impact on the likelihood of being in relationship with more attractive and presumably more fertile women, and may influence male's reproductive success.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interests

None.

Acknowledgements

We are very grateful to all study participants. We are also grateful for helpful comments from Grazyna Jasienska, Laura Klein, Magdalena Klimek and Amelia Sancillio.

References

Bogaert, A. F., Fawcett, C. C., & Jamieson, L. K. (2009). Attractiveness, body size, masculine sex roles and 2D:4D ratios in men. *Personality and Individual Differences, 47*(4), 273–278. http://dx.doi.org/10.1016/j.paid.2009.03.011.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*(2), 204–232. http://dx.doi.org/10.1037/0033-295X.100.2.204.

Conroy-Beam, D., & Buss, D. M. (2016). Do mate preferences influence actual mating decisions? Evidence from computer simulations and three studies of mated couples. *Journal of Personality and Social Psychology, 111*(1), 53–66. http://dx.doi.org/10.1037/pspi0000054.

Dixson, B. J., Duncan, M., & Dixson, A. F. (2015). The role of breast size and areolar pigmentation in perceptions of women's sexual attractiveness, reproductive health, sexual maturity, maternal nurturing abilities, and age. *Archives of Sexual Behavior, 44*(6), 1685–1695. http://dx.doi.org/10.1007/s10508-015-0516-2.

Dixson, B. J., Grimshaw, G. M., Linklater, W. L., & Dixson, A. F. (2011). Eye-tracking of men's preferences for waist-to-hip ratio and breast size of women. *Archives of Sexual Behavior, 40*(1), 43–50. http://dx.doi.org/10.1007/s10508-009-9523-5.

Fink, B., Grammer, K., Mitteroecker, P., Gunz, P., Schaefer, K., Bookstein, F. L., & Manning, J. T. (2005). Second to fourth digit ratio and face shape. *Proceedings. Biological Sciences/The Royal Society, 272*(1576), 1995–2001. http://dx.doi.org/10.1098/rspb.2005.3179.

Fink, B., Manning, J. T., Neave, N., & Grammer, K. (2004). Second to fourth digit ratio and facial asymmetry. *Evolution and Human Behavior, 25*(2), 125–132. http://dx.doi.org/10.1016/S1090-5138(03)00084-9.

Fink, B., Neave, N., & Manning, J. T. (2003). Second to fourth digit ratio, body mass index, waist-to-hip ratio, and waist-to-chest ratio: Their relationships in heterosexual men and women. *Annals of Human Biology, 30*(6), 728–738. http://dx.doi.org/10.1080/0301446031000162015 3.

Galbarczyk, A. (2011). Unexpected changes in maternal breast size during pregnancy in relation to infant sex: An evolutionary interpretation. *American Journal of Human Biology, 23*(4), 560–562. http://dx.doi.org/10.1002/ajhb.21177.

Galis, F., Ten Broek, C. M. A., Van Dongen, S., & Wijnaendts, L. C. D. (2010). Sexual dimorphism in the prenatal digit ratio (2D:4D). *Archives of Sexual Behavior, 39*(1), 57–62. http://dx.doi.org/10.1007/s10508-009-9485-7.

Gangestad, S. W., & Scheyd, G. J. (2005). The evolution of human physical attractiveness. *Annual Review of Anthropology, 34*(1), 523–548. http://doi.org/doi. https://doi.org/10.1146/annurev.anthro.33.070203.143733.

García-Cruz, E., Huguet, J., Piqueras, M., Ribal, M. J., & Alcaraz, A. (2012). Second to fourth digit ratio, adult testosterone level and testosterone deficiency. *BJU International, 109*(2), 266–271. http://dx.doi.org/10.1111/j.1464-410X.2011.10249.x.

Gomendio, M., Malo, A. F., Garde, J., & Roldan, E. R. S. (2007). Sperm traits and male fertility in natural populations. *Reproduction, 134*(1), 19–29. http://dx.doi.org/10.1530/REP-07-0143.

Gorkemli, H., Ak, D., Akyurek, C., Aktan, M., & Duman, S. (2004). Comparison of pregnancy outcomes of progesterone or progesterone + estradiol for luteal phase support in ICSI-ET cycles. *Gynecologic and Obstetric Investigation, 58*(3), 140–144. http://dx.doi.org/10.1159/000079115.

Hönekopp, J., Voracek, M., & Manning, J. T. (2006). 2nd to 4th digit ratio (2D:4D) and number of sex partners: Evidence for effects of prenatal testosterone in men. *Psychoneuroendocrinology, 31*(1), 30–37. http://dx.doi.org/10.1016/j.psyneuen.2005.05.009.

Hönekopp, J., & Watson, S. (2010). Meta-analysis of digit ratio 2D:4D shows greater sex difference in the right hand. *American Journal of Human Biology, 22*(5), 619–630. http://dx.doi.org/10.1002/ajhb.21054.

Jasienska, G., Ziomkiewicz, A., Ellison, P. T., Lipson, S. F., & Thune, I. (2004). Large breasts and narrow waists indicate high reproductive potential in women. *Proceedings. Biological Sciences/The Royal Society, 271*(1545), 1213–1217. http://dx.doi.org/10.1098/rspb.2004.2712.

Klimek, M., Galbarczyk, A., Nenko, I., Alvarado, L. C., & Jasienska, G. (2014). Digit ratio (2D:4D) as an indicator of body size, testosterone concentration and number of children in human males. *Annals of Human Biology, 41*(6), 518–523. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/24766144.

Lipson, S. F., & Ellison, P. T. (1996). Comparison of salivary steroid profiles in naturally occurring conception and non-conception cycles. *Human Reproduction, 11*(10), 2090–2096. http://dx.doi.org/10.1093/oxfordjournals.humrep.a019055.

Lutchmaya, S., Baron-Cohen, S., Raggatt, P., Knickmeyer, R., & Manning, J. T. (2004). 2nd to 4th digit ratios, fetal testosterone and estradiol. *Early Human Development, 77*(1–2), 23–28. http://dx.doi.org/10.1016/j.earlhumdev.2003.12.002.

Manning, J., & Fink, B. (2017). Are there any "direct" human studies of digit ratio (2D:4D) and measures of prenatal sex hormones? *Early Human Development.* http://dx.doi.org/10.1016/J.EARLHUMDEV.2017.09.003.

Manning, J. T., & Fink, B. (2008). Digit ratio (2D:4D), dominance, reproductive success, asymmetry, and sociosexuality in the BBC internet study. *American Journal of Human*

Biology, 20(4), 451–461. http://dx.doi.org/10.1002/ajhb.20767.
Manning, J. T., Scutt, D., Wilson, J., & Lewis-Jones, D. I. (1998). The ratio of 2nd to 4th digit length: A predictor of sperm numbers and concentrations of testosterone, luteinizing hormone and oestrogen. *Human Reproduction (Oxford, England), 13*(11), 3000–3004. http://dx.doi.org/10.1093/humrep/13.11.3000.
Singh, D. (2002). Female mate value at a glance: Relationship of waist-to-hip ratio to health, fecundity and attractiveness. *Neuro Endocrinology Letters, 23*(Suppl. 4), 81–91.
Singh, D., & Singh, D. (2011). Shape and significance of feminine beauty: An evolutionary perspective. *Sex Roles, 64*(9), 723–731. http://dx.doi.org/10.1007/s11199-011-9938-z.
Smith, F. G., Jones, B. C., Welling, L. L. W., Little, A. C., Vukovic, J., Main, J. C., & DeBruine, L. M. (2009). Waist-hip ratio predicts women's preferences for masculine male faces, but not perceptions of men's trustworthiness. *Personality and Individual Differences, 47*(5), 476–480. http://dx.doi.org/10.1016/j.paid.2009.04.022.
Weinberg, S. M., Parsons, T. E., Raffensperger, Z. D., & Marazita, M. L. (2015). Prenatal sex hormones, digit ratio, and face shape in adult males. *Orthodontics and Craniofacial Research, 18*(1), 21–26. http://dx.doi.org/10.1111/ocr.12055.
Welling, L. L. M., Jones, B. C., DeBruine, L. M., Smith, F. G., Feinberg, D. R., Little, A. C., & Al-Dujaili, E. A. S. (2008). Men report stronger attraction to femininity in women's faces when their testosterone levels are high. *Hormones and Behavior, 54*(5), 703–708. http://dx.doi.org/10.1016/j.yhbeh.2008.07.012.