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Original Article

Facial Width-to-Height Ratio in a Large Sample of Commonwealth Games Athletes

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Abstract: Evidence that facial width-to-height ratio (FWHR) is a sexually dimorphic morphological measure is mixed. Research has also linked FWHR with aggression and other behavioral tendencies, at least in men. Again, other research has found no such relationship. Here, I tested for both possible relationships using a sample of 2,075 male and 1,406 female athletes from the Glasgow 2014 Commonwealth Games. Men showed significantly greater FWHRs than women, but this difference could be attributed to differences in body size. In addition, I found greater FWHRs in men who competed in sports involving physical contact and those stereotyped as more masculine. Again, these results could be attributed to differences in body size between categories. For women, no differences in FWHR were found regarding the amount of contact involved in a sport and how that sport was stereotyped. Finally, the FWHRs of athletes showed no relationship with the amount of aggression and related traits that were judged as required for success in those sports, although FWHRs did correlate with perceived endurance demands in women. Therefore, in a large sample of athletes, the sex difference in FWHR could be attributed to body size, and little support was found for the predicted links between this facial measure and behavior.

Keywords: facial width-to-height ratio, sexual dimorphism, body size, aggression, testosterone

Introduction

The idea that stable facial characteristics are predictive of behavioral tendencies has received increasing attention in recent years. Several research groups have focused on one particular measure—relative facial width—and its links with aggression and other male dominant behaviors. Men with a greater facial width-to-height ratio (FWHR; defined as bizygomatic width divided by upper facial height, e.g., Carré and McCormick, 2008) are more aggressive (Carré and McCormick, 2008; Carré, McCormick, and Mondloch, 2009), more formidable fighters (Třebický et al., 2014; Ziliolo et al., 2014), more likely to exploit the trust of others (Stirrat and Perrett, 2010), and more likely to deceive and cheat (Haselhuhn and Wong, 2011). However, studies have also failed to find predicted relationships between FWHR and behaviors (Gómez-Valdés et al., 2013; Özener, 2011).

Explanations for these FWHR–behavior links are often based on the premise that FWHR is sexually dimorphic (i.e., differs between males and females). Indeed, the original finding of dimorphism, it was argued, was independent of body size differences between men and women (Weston, Friday, and Lio, 2007). The authors suggested that greater male FWHRs may have been favored by women (intersexual selection), resulting in an increase in this ratio in men and a difference between the sexes. This evolved distinction between men and women might also explain within-sex differences that correspond with increased male or female traits (e.g., men who appear more masculine also behave as such). Alternatively, within-sex differences may be the result of different mechanisms in men and women. For example, higher levels of testosterone in men are associated with increased FWHR (Lefevre, Lewis, Perrett, and Penke, 2013), whereas female facial development may be driven by levels of estrogen and growth hormone (both of which are higher in women; Frantz and Rabkin, 1965). Therefore, determining whether FWHR is sexually dimorphic, and cannot be explained in terms of body size differences, is important when considering potential explanatory mechanisms linking this measure with particular behaviors. Evidence to date on this question is summarized in Table 1.

Table 1. Previous evidence regarding sexual dimorphism in FWHR

First Author (Year)	Dimorphism	*Cohen's d*	Sample (m, f)	Description
Carré (2008)	Yes	0.50	37, 51	student (mixed ethnicity) photos
Gómez-Valdés (2013)	No	NA	2256, 1156	dry skulls (26 populations)
	No	NA	297, 143	dry skulls (23 populations)
	No	NA	302, 278	dry skulls (19 populations)
	No	NA	401, 381	dry skulls (13 populations)
	No	NA	111, 149	dry skulls (8 populations)
	Yes	NA	179, 117	dry skulls (1 population)
Kramer (2012)	No	-0.18	138, 277	White photos
	No	-0.36	66, 89	White 3D scans
	No	-0.42	75, 105	White anthropometry
Lefevre (2012)	No	-0.29	46, 99	Caucasian photos
	No	-0.18	137, 169	Caucasian photos
	No	-0.33	124, 131	Caucasian photos
	No	-0.18	108, 110	African photos
Mileva (2014)	No	0.01	50, 50	student (mixed ethnicity) photos
	No	0.15	31, 29	student (mixed ethnicity) photos
	No	0.05	21, 29	student (mixed ethnicity) photos
Özener (2011)	No	-0.17	230, 240	Turkish student photos
Stirrat (2012)	No	0.03	523, 339	dry skulls (mixed ethnicity)
Weston (2007)	Yes	0.85	30, 30*	native African dry skulls

Note. Dimorphism represents whether men showed significantly greater FWHR than women. Negative effect sizes represent greater FWHRs in women. NA = not available. * includes only fully grown specimens.

In the present study, I investigated the question of sexual dimorphism in FWHR using a large sample of international athletes. Findings of sexual dimorphism have tended to come from relatively small samples, and examination of a larger set is important if we are to be confident in our conclusions. In addition, by utilizing athletes from an international competition, demographic information was available that allowed for the consideration of potential effects due to ethnicity and body size.

Second, I investigated some predictions regarding the relationship between FWHR, aggression, and testosterone. If greater FWHRs correlate with increased aggression (Carré and McCormick, 2008), athletes who competed in more aggressive sports should have greater facial ratios. Similarly, if FWHR is related to fighting ability (Třebický et al., 2014), then athletes that compete in sports involving more contact or strength should have greater FWHRs. Lastly, testosterone may be associated with FWHR (Lefevre et al., 2013), and within sports research in particular, there is evidence linking testosterone with aggression (Salvador, Suay, Martinez-Sanchis, Simon, and Brain, 1999), endurance (Chennaoui et al., 2004; Izquierodo et al., 2004), and spatial ability (Gouchie and Kimura, 1991). Therefore, athletes that require these particular traits may, presumably through mechanisms involving testosterone, show associated differences in FWHR in comparison with those athletes for whom such traits play less of a role in their sport.

Materials and Methods

All available information on, and photographs of, Commonwealth Games athletes were obtained from the official website for the Glasgow 2014 event (glasgow2014.com). This full sample comprised 3,703 athletes (2,199 men and 1,504 women). Images were passport-style and were taken front-on. Athlete information of relevance included sex, age, weight, height, and the sport that they competed in. In addition, body mass index (BMI) was calculated and reflects an athlete's body weight scaled for height (specifically, the weight divided by the square of the height; Keys, Fidanza, Karvonen, Kimura, and Taylor, 1972). Some of the athlete profiles had incomplete information, so the sample sizes for analyses varied based on whether individual information was available or not, and these are reflected in the associated degrees of freedom reported below.

From this initial sample, I excluded individuals whose photographs did not permit accurate measurement of FWHR, e.g., images that featured glasses or sunglasses, head scarves, or a noticeable smile. Therefore, a total of 3,481 athletes (2,075 men and 1,406 women) were included in at least some analyses (see Table A1 for a complete description).

Although place of birth and the country that an athlete represented were reported online, these did not necessarily reflect facial ethnicity. Ethnicity was not listed on the website, so I divided athletes into categories based on their appearance, utilizing labels from the U.K. 2011 Census form: 1,697 White, 969 Black, 182 Asian–Oriental, 306 Asian–Indian, and 327 "Other," used for any image that did not fall clearly under one of the previous labels.

FWHR was measured using custom MATLAB software. Images were first rotated such that the pupils were horizontally aligned. Facial width was measured as the horizontal distance between the left and right zygions, and height as the vertical distance between the highest point of the upper lip and the highest point of the eyelids (Kramer, Jones, and Ward, 2012; Stirrat and Perrett, 2010). Measurements were carried out by the author, who was unfamiliar with the athletes but was not blind to the research hypotheses. The FWHR was calculated as width divided by height.

Perceptions of sports characteristics

Previous research has produced a classification of sports as masculine, feminine, or neutral based on raters' perceptions (Koivula, 1995). Of the current list of 17 sports, four are listed as masculine (boxing, judo, rugby, weightlifting) and two as feminine (artistic and rhythmic gymnastics). One might also usefully categorize sports according to the amount of contact they involve (Deaner and Smith, 2012). Here, sports were classified as "full contact" (boxing, judo, rugby) or "no contact" (badminton, artistic and rhythmic gymnastics, lawn bowls, shooting, swimming, table tennis, weightlifting). The remaining sports, which can involve some incidental contact as part of play (e.g., hockey), were not included in this categorization.

In addition, to produce a measure of the perceived characteristics associated with athletes competing in particular sports, I asked 22 volunteers (7 men; age M = 25.41, SD = 7.06) to rate, for each of the 17 sports (see Tables A1 and A3), the importance of six traits for a successful athlete (0 = not at all important, 4 = very important indeed). These traits were: strength, power, hostile aggression, instrumental aggression, endurance, and spatial ability. Definitions of these traits appeared on the questionnaire (see Table A2). In addition, descriptions of the sports were provided on the questionnaire where this was deemed necessary, e.g., "Athletics – includes track and field events." Ratings were averaged across raters for each sport and trait separately.

Results

Sexual dimorphism in FWHR

For the overall sample of athletes, male FWHR (M = 1.98) was greater than female FWHR (M = 1.92), $t(3479) = 9.01$, $p < .001$, $d = 0.31$. This finding of a sex difference is in line with previous results (Carré and McCormick, 2008; Weston et al., 2007). However, given the multiethnic nature of the sample and the possibility for differences between groups, athlete ethnicity was incorporated as a factor. A 5 (Ethnicity) x 2 (Sex) analysis of variance found significant effects of Ethnicity, $F(4, 3471) = 38.27$, $p < .001$, $\eta_p^2 = .04$; Sex, $F(1, 3471) = 10.58$, $p = .001$, $\eta_p^2 < .01$; and their interaction, $F(4, 3471) = 7.71$, $p < .001$, $\eta_p^2 = .01$. Independent samples t-tests (see Table 2) found significant sex differences in FWHR for the White and Black subsamples only.

Table 2. Sex differences in FWHR for each ethnicity

	FWHR				
Ethnicity	Men	Women	*t* (*df*)	*p*	*Cohen's d*
White	1.94 (0.17)	1.89 (0.14)	7.17 (1695)	< .001*	0.35
Black	2.01 (0.19)	1.93 (0.17)	6.13 (967)	< .001*	0.42
Asian – Oriental	2.00 (0.15)	1.98 (0.15)	0.72 (180)	.47	0.11
Asian – Indian	1.99 (0.14)	2.04 (0.17)	-2.30 (304)	.02	-0.27
Other	2.00 (0.15)	1.98 (0.18)	1.27 (325)	.21	0.14

Note. FWHR values are presented as *M* (*SD*). Reported *p*-values are uncorrected. * significant after correcting for multiple comparisons.

These results demonstrate the importance of controlling for ethnicity when considering FWHR differences. In addition, it may be that large samples are required to detect what appears to be a generally modest sex difference in FWHR (see also Table 1).

In addition to ethnicity, previous research suggests that body size may also play an important role when investigating sexual dimorphism in FWHR (Coetzee, Chen, Perrett, and Stephen, 2010; Kramer et al., 2012; Lefevre et al., 2012; Mayew, 2013). Here, across the whole sample of athletes (where values were available), FWHR was significantly correlated with weight, $r(1923) = 0.19$, $p < .001$; and BMI, $r(1813) = 0.27$, $p < .001$; but not height, $r(2047) = -0.03$, $p = .14$. Analyses of covariance (ANCOVA) were therefore carried out, testing for the effect of sex on FWHR while controlling for each factor and its interaction with sex (Lefevre et al., 2012). Table 3 summarizes these results for the White and Black subsamples, the two groups that showed evidence of sexual dimorphism.

Table 3. The effect of sex on FWHR, controlling for body size factors and their interactions with sex, separately for the White and Black subsamples

			Model	Sex	Factor	Sex*Factor
Factor	Ethnicity	*n*	*F*	*F*	*F*	*F*
BMI	White	969	46.33** (.13)	0.35	75.66** (.07)	0.04
	Black	357	6.32** (.05)	0.05	11.31** (.03)	0.06
Height	White	1100	16.36** (.04)	0.96	2.21	1.81
	Black	415	6.15** (.04)	0.05	7.33* (.02)	0.00
Weight	White	997	38.08** (.10)	0.15	47.11** (.05)	0.20
	Black	409	2.51	0.15	2.69	0.01

Note. * $p \leq 0.01$; ** $p \leq 0.001$. All results are from ANCOVA models with body size factors as continuous covariates. Partial eta-squared effect sizes are reported in parentheses for significant effects.

In all cases, sex differences became nonsignificant after controlling for body size measures, in agreement with previous findings (Lefevre et al., 2012). Therefore, FWHR is sexually dimorphic in large samples of White and Black athletes, but this can be attributed to sex differences in body size.

Finally, recent research has suggested a link between FWHR and age, specifically that an increase in age is associated with a decrease in FWHR in men (Hehman, Leitner, and Freeman, 2014). For each sex and ethnicity, I correlated these two measures. Of the 10 analyses, two were significant: White women, $r(753) = -0.09$, $p = .02$; and Asian–Oriental women, $r(78) = 0.28$, $p = .01$. However, the likelihood of chance findings appearing significant with this many correlations is high, and the two relationships that were significant are in opposite directions. Note that no correlations for men were significant (all *p*s > .158). Therefore, there is little evidence to suggest a link between FWHR and age in the current sample of athletes.

FWHR and sports

Are there FWHR differences between athletes competing in different sports due to the differing demands or requirements placed on athletes for each sport? As outlined above, if FWHR is linked with testosterone levels then I would expect differences between athletes who competed in high versus low testosterone sports (i.e., those sports where athletes may benefit from higher testosterone levels). As such, I explored several methods of sports classification in order to test this idea.

For the analyses that follow, I included only the White athletes. As the largest subsample, this allowed investigation of particular sports while maintaining substantial athlete numbers and avoiding potential ethnicity effects.

Six of the sports featured here were classified as either masculine (boxing, judo, rugby, weightlifting) or feminine (artistic and rhythmic gymnastics), in line with previous research investigating perceptions of gender appropriateness (Koivula, 1995). Comparison of athletes across these two groups of sports showed that men who competed in masculine sports (M = 1.99) have a greater FWHR than those who competed in feminine sports (M = 1.91), $t(222) = 2.78$, $p = .006$, $d = 0.56$. However, women who competed in masculine sports (M = 1.89) showed no difference in FWHR compared with women who competed in feminine sports (M = 1.90), $t(127) = 0.43$, $p = .67$, $d = 0.08$. For athletes who competed in masculine sports, there is a significant sexual dimorphism in FWHR, $t(251) = 4.16$, $p < .001$, $d = 0.61$, while there is no difference for feminine sports competitors, $t(98) = 0.21$, $p = .84$, $d = 0.04$.

Sports were also classified as "full contact" or "no contact" (Deaner and Smith, 2012). Comparison of athletes across these two groups of sports showed that men who competed in "full contact" sports (M = 2.00) have a greater FWHR than those who competed in "no contact" sports (M = 1.95), $t(613) = 2.84$, $p = .005$, $d = 0.25$. However, women who competed in "full contact" sports (M = 1.90) showed no difference in FWHR compared with women who competed in "no contact" sports (M = 1.91), $t(423) = 0.19$, $p = .85$, $d = 0.03$. In addition, there was a significant sexual dimorphism in FWHR for athletes who competed in "full contact" sports, $t(218) = 3.36$, $p < .001$, $d = 0.58$, and for those who competed in "no contact" sports, $t(818) = 4.24$, $p < .001$, $d = 0.30$.

Given these FWHR differences between men competing in masculine vs. feminine and full vs. no contact sports, the next step is to test whether such differences can be explained by body size measures (Mayew, 2013). The results are summarized in Table 4.

Table 4. The effect of category on FWHR, controlling for body size factors and their interactions with category, for men in the White subsample only

			Model	Category	Factor	Interaction
Category	Factor	*n*	*F*	*F*	*F*	*F*
Contact	BMI	360	7.74*** (.06)	1.74	7.47** (.02)	0.89
	Height	394	4.56** (.03)	5.10* (.01)	0.68	5.76* (.02)
	Weight	365	6.19*** (.05)	1.24	9.75** (.03)	0.46
Gender	Weight	139	4.37** (.09)	0.88	0.05	0.99

Note. All results are from ANCOVA models with body size factors as continuous covariates. Contact = full vs. no contact sports. Gender = masculine vs. feminine sports. * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$. Partial eta-squared effect sizes are reported in parentheses for significant effects.

Unfortunately, the necessary body size measures were not available for athletes in some of these categories, and comparisons could not be made for the "gender" classification controlling for weight and BMI. For those where the information was available, Table 4 provides evidence suggesting that group differences ("category") can be attributed to body size differences. In three of the four cases, the category of sport no longer predicts FWHR once body size has been taken into account. For instance, men who compete in full contact sports have greater FWHRs compared with men competing in non-contact sports, but this may simply be because the former group has greater BMIs than the latter group.

Finally, the ratings collected for each sport and trait were averaged across raters, providing a measure of people's perceptions of the importance of each trait for athletes competing in these sports (see Table A3). Previous research has suggested links between these traits and testosterone. Therefore, if sports differ in their requirements (the importance of aggression, etc.), then this may be reflected in differences in the levels of testosterone in the athletes, potentially resulting in FWHR differences (Lefevre et al., 2013). I correlated the ratings with the average FWHR for athletes competing in each sport, separately for each sex (see Table 5). Positive correlations would suggest that athletes with greater FWHRs competed in sports that were seen as more aggressive, for example.

Table 5. Correlations between mean FWHRs and trait ratings across sports, separately for male and female athletes

Trait	Men	Women
Strength	0.10	-0.36
Power	0.10	-0.40
Hostile aggression	0.24	-0.14
Instrumental aggression	0.04	-0.27
Endurance	-0.49*	-0.72**
Spatial ability	0.15	0.44*

Note. * $p \leq 0.1$; ** $p \leq 0.005$.

Given that these analyses produced 12 correlations, the likelihood of finding significant results by chance was high. However, as Table 5 illustrates, the only trait that showed a significant relationship with FWHR was endurance. Women who competed in sports judged as requiring high endurance levels showed smaller FWHRs, and this same tendency was also evident, to a lesser extent, for men. There may also be a tendency for women who competed in sports judged as requiring high levels of spatial ability to show greater FWHRs, although this pattern contradicts previous research (Gouchie and Kimura, 1991).

Discussion

The current work demonstrates that FWHR is sexually dimorphic in a large sample of international athletes, with greater ratios found in men. For the most part, these differences were found within groups of sports (e.g., full contact sports) as well as across the whole sample, suggesting that such differences were not due to an over- or underrepresentation of particular types of athletes. When ethnicities were analyzed separately, this sex difference remained for Black and White athletes (the largest subsamples). However, no effect of sex was found after controlling for body size measures. Therefore, although FWHR can be considered sexually dimorphic in athletes, this difference is explicable in terms of body size differences (cf. Weston et al., 2007). As such, FWHR may simply be one of many measures that show sex differences as a result of men being larger than women (e.g., left ventricular mass is greater in men, but not after controlling for height; Hammond, Devereux, Alderman, and Laragh, 1988).

Why is FWHR sexually dimorphic in the current study (although the effect size might be considered small) despite a growing body of evidence (see Table 1) suggesting a lack of any difference between men and women? Likely, this difference is due to the highly selective nature of the sample used here. Athletes who are successful enough to represent their countries at the Commonwealth Games should be considered some of the best sportsmen and women in the world, and therefore may not be representative of the general population. As such, the FWHRs of athletes may differ from those of the typical populations investigated in studies on this topic. Similarly, if FWHR differences are the result of body size differences, the current result might be explained by a larger sexual dimorphism in body size in international athletes. For example, preliminary analyses show that English athletes in this study's sample show a sex difference of 12cm in height and 19.4kg in weight (men show higher values for both). For comparison, English 16–24 year olds in the general population (the age range incorporating university students, the sample most often used in studies) show a sex difference of 12.5cm in height but only 9.9kg in weight (Moody, 2013). As such, this larger sex difference in weight (and resulting BMI) for athletes may explain why FWHR is dimorphic in the current sample but not in several previous studies. However, further research is needed before any conclusions can be made.

This study also yielded notable results regarding variation in FWHR across sports. One is that men who competed in stereotypically masculine sports had greater FWHRs than men who competed in stereotypically feminine sports. Similarly, men competing in sports with physical contact had greater FWHRs than men competing in sports without physical contact. These findings support the idea that masculine or contact sports involve more behaviors associated with testosterone (e.g., aggression or combat). If this were the case, such athletes may have higher levels of testosterone, which may be reflected in their greater FWHRs (Lefevre et al., 2013). However, follow up analyses suggest that FWHR differences can be attributed to differences in body size. Of course, it may be that testosterone could still play a role in these sports category differences through influences on body size and/or preferences for competing in more aggressive and physical sports.

Unlike the case for stereotypes and physical contact, there was little evidence that FWHR was related to sport demands as judged by raters. For example, although some sports were judged as requiring more aggression than others (e.g., rugby versus gymnastics), there was no link between this judged aggression and the FWHR of sport participants. One exception is that high endurance women had smaller FWHRs, which might be due to these athletes having lower testosterone levels (e.g., Izquierodo et al., 2004).

The results presented here find no support for a relationship between FWHR and testosterone, in contrast with recent evidence suggesting otherwise (Lefevre et al., 2013). However, it must be acknowledged that testosterone was not measured in this sample of athletes, and the assumption that particular sports (e.g., aggressive ones) are associated with higher testosterone apparently has not been tested. Alternatively, testosterone and FWHR may be associated in the general population, but this relationship is absent (or dwarfed by body size influences or other factors) in elite athletes. Targeted research is required in order to shed some light on these questions.

The current research may be limited by the measure of the requirements associated with each sport. Here, trait levels were measured indirectly through averaged judges' ratings, in comparison with previous research where individual differences in specific behaviors were correlated with FWHR (e.g., the point subtraction aggression paradigm – Carré et al., 2009). However, given the restrictive nature of the current sample, it seems justifiable to hypothesize differences across sports (controlling for sex and ethnicity) related with several traits, and these were not present.

Although the current work investigates the possibility of differences in FWHR between sports, it may be that differences within sports are associated with athletic performance and success (e.g., Tsujimura, and Banissy, 2013; Welker, Goetz, Galicia, Liphardt, and Carré, 2015; Ziliolo et al., 2014). For example, more successful boxers may show greater FWHRs. However, this exploration goes beyond the scope of the current work, and I invite future studies to address this question.

Overall, the present study provides additional evidence in the ongoing debate regarding the sexual dimorphism of relative facial width and its relationship with behavior. Using a large sample of athletes of multiple ethnicities, I found that sexual dimorphism in FWHR could be attributed to differences in body size. In addition, there was limited support for the idea that greater FWHRs correspond with increased aggression and other associated traits.

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Appendix A

Table A1. Frequencies of men and women of each ethnicity competing in each sport

Sport	Ethnicity				
	White	Black	Asian (Oriental)	Asian (Indian)	Other
Athletics	110/83	203/125	6/1	14/7	17/9
Badminton	39/38	17/12	14/14	18/12	6/8
Boxing	53/13	107/15	6/0	16/5	26/5
Cycling – Track	41/13	6/1	3/3	4/2	3/1
Gymnastics – Artistic	35/44	2/0	7/4	11/6	5/6
Gymnastics – Rhythmic*	0/21	0/1	0/3	0/1	0/3
Hockey	95/103	17/12	8/8	15/11	13/14
Judo	49/31	52/16	0/3	7/3	10/6
Lawn Bowls	74/54	15/12	3/4	8/8	11/12
Netball*	0/67	0/68	0/0	0/0	0/2
Rugby Sevens*	74/0	56/0	6/0	22/0	24/0
Shooting	114/67	25/13	15/4	29/21	23/12
Squash	33/21	16/4	2/1	9/8	6/4
Swimming	146/121	30/17	8/6	12/7	17/23
Table Tennis	18/16	42/27	19/21	15/9	7/8
Triathlon	34/24	5/0	0/1	0/1	2/3
Weightlifting	13/20	34/16	4/7	14/5	28/10

Note. Sex frequencies are listed as men/women. No sport was reported for 46 athletes and so these individuals were not included here. * indicates a single-sex sport.

Table A2. The traits that each sport was rated on, along with the definitions provided to raters

Trait	Definition
Strength	Able to exert large amounts of force
Power	Able to exert large amounts of force instantly (explosive strength)
Hostile aggression	Aggression with the aim of causing harm or injury to an opponent (impulsive)
Instrumental aggression	Able to play within the rules at a very high intensity but with no intention to harm an opponent (premeditated)
Endurance	Able to handle sustained competition over longer periods of time without becoming tired
Spatial ability	Able to judge the relations of objects in space, to judge shapes and sizes, to mentally manipulate objects

Table A3. FWHRs for the White subsample, together with raters' perceptions of each sport

	FWHR							
Sport	Men	Women	Str	Pow	HA	IA	End	SA
Athletics	1.95 (0.21)	1.86 (0.15)	2.86	3.27	0.41	2.00	3.55	2.68
Badminton	1.93 (0.15)	1.89 (0.14)	2.36	2.91	0.64	2.95	3.27	3.82
Boxing	1.98 (0.14)	1.86 (0.13)	3.82	3.91	3.77	3.05	3.36	2.86
Cycling – Track	1.88 (0.16)	1.84 (0.12)	2.86	2.86	0.50	1.64	3.73	2.27
Gymnastics – Artistic	1.91 (0.13)	1.90 (0.13)	3.55	3.27	0.09	1.05	2.82	3.45
Gymnastics – Rhythmic		1.90 (0.14)	2.55	2.50	0.09	0.91	2.64	3.68
Hockey	1.91 (0.14)	1.90 (0.13)	2.73	2.91	2.18	3.41	3.45	3.23
Judo	1.96 (0.15)	1.92 (0.16)	3.59	3.64	2.55	3.55	3.05	2.45
Lawn Bowls	2.00 (0.18)	1.94 (0.13)	1.57	1.67	0.19	1.00	1.24	3.57
Netball		1.86 (0.12)	2.41	2.45	1.09	2.71	2.91	3.27
Rugby Sevens	2.03 (0.18)		3.59	3.68	2.86	3.41	3.32	3.05
Shooting	2.01 (0.15)	1.94 (0.17)	0.86	1.09	0.77	1.18	1.18	3.82
Squash	1.86 (0.15)	1.82 (0.17)	2.73	3.27	1.09	2.41	3.45	3.50
Swimming	1.91 (0.16)	1.89 (0.13)	3.27	2.91	0.23	1.23	3.86	1.55
Table Tennis	1.87 (0.12)	1.91 (0.11)	1.73	2.50	0.64	2.05	2.32	3.59
Triathlon	1.83 (0.13)	1.82 (0.14)	3.55	3.41	0.55	1.86	3.95	1.73
Weightlifting	1.94 (0.20)	1.87 (0.17)	3.95	3.95	0.55	1.68	2.50	0.91

Note. FWHR values are presented as *M* (*SD*). Str = strength, Pow = power, HA = hostile aggression, IA = instrumental aggression, End = endurance, SA = spatial ability.