

Does Facial Width-to-Height Ratio Predict Aggressive Behavior in Association Football?

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Abstract

A growing body of research has emphasized the role of facial structures in affecting human social behavior. In particular, the facial width-to-height ratio (fWHR) was found to predict aggressive behavior, most notably in men of low social status. The current study aimed at broadening the insights into the role of fWHR in sports regarding the indicators of aggressive behavior and performance. We questioned the impact of fWHR in association football by analyzing fouls committed by players, their (yellow and red) cards received, and their goals scored and assists in the German ($n = 278$) and Austrian ($n = 194$) first division in the 2016–2017 season (306/180 matches). The market values of players were used as a measure of social status. Generalized estimating equation models taking negative binomial distribution into account did not reveal any significant impact of fWHR on fouls committed, yellow and red cards received, or assists and goals scored. Even the consideration of players' field positions, players' body mass index (BMI), their market value, and the interactional term of players' fWHR and players' market value did not affect the results. The analyses refuted any impact of fWHR in association football both on parameters of aggressive behavior (fouls and cards received) and performance (goals and assists). Merely, players' market value was found to predict players' goals and assists. The current study adds to the empirical evidence encouraging a critical assessment and discussion of fWHR research in sports.

Keywords

aggression, facial structure, formidability, sport, performance, social perception, dominance

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Introduction

Human faces may serve as a crucial source of information for others, substantially contributing to the formation of initial impressions (Mason, Cloutier, & Macrae, 2006). Facial features are used to group others into social categories, having a huge impact on individual social interaction and behavior (Haselhuhn, Wong, Ormiston, Inesi, & Galinsky, 2014; Mason et al., 2006; Todorov & Porter, 2014). By classifying others into social categories, the associated knowledge of each category becomes accessible (Cloutier, Mason, & Macrae, 2005). Hence, Hehman, Leitner, Deegan, and Gaertner (2015, p. 51) stated that “facial cues can provide the initial seed from which perceptual and cognitive processes evolve to influence how an individual is perceived and treated.” However, still little is known about which specific facial cues and features social perceivers select when forming their initial impression. In this regard, a growing body of research has emphasized the role of the facial width-to-height ratio (fWHR), garnering a great deal of attention due to correlates with broad aspects of human

behavior (Geniole, Denson, Dixon, Carré, & McCormick, 2015; Haselhuhn, Ormiston, & Wong, 2015; Lewis, Lefevre, & Bates, 2012).

The fWHR is calculated by dividing the distance between the left and right zygion—the bizygomatic width—by the distance between the nasion and prosthion—the upper-face height (Weston, Friday, & Liò, 2007). Research has revealed that men with a high fWHR were judged to be physically stronger and more aggressive (Carré, McCormick, & Mondloch, 2009; Hehman et al., 2015; Sell et al., 2009). These results were substantiated by an association between fWHR and aggression or dominance, respectively (Haselhuhn et al., 2015; Lefevre,

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Etchells, Howell, Clark, & Penton-Voak, 2014; Lewis et al., 2012; Mileva, Cowan, Cobey, Knowles, & Little, 2014). However, research also revealed that men with a high fWHR were not only perceived to be more aggressive, dominant, or more ambitious for success by others (Carré et al., 2009; Geniole et al., 2015; Lefevre et al., 2014; Lewis et al., 2012; Wong, Ormiston, & Haselhuhn, 2011); several studies also suggested a direct link with self-reported aggressive and dominant behavior (Carré & McCormick, 2008; Carré, Murphy, & Hariri, 2013; Geniole, Keyes, Carré, & McCormick, 2014; Haselhuhn et al., 2014; Lefevre et al., 2014; Mileva et al., 2014; Wong et al., 2011), whereas others failed to detect significant correlations (Gómez-Valdés et al., 2013; Kosinski, 2017).

Studies focusing on fWHR and social outcomes showed that men with a high fWHR were found to show a stronger tendency to exploit the trust of others (Stirrat & Perrett, 2010, 2012) and to cheat for personal gain (Haselhuhn & Wong, 2012; Haselhuhn et al., 2014) than men with a low fWHR. Thus, participants with a high fWHR were found to be more likely to show unethical and socially undesirable behavior, even to the point of violating another's trust (Haselhuhn & Wong, 2012; Stirrat & Perrett, 2010). However, men with a high fWHR also showed an increased level of cooperation with the in-group when facing intergroup competition (Stirrat & Perrett, 2012). It seems that in general, a high fWHR in men is associated with a strong ambition to strive for success and high social status (dominance) even to the extent of making use of unethical behavior or riding roughshod over others (aggression). These findings were supported by studies conducted in sports: Here, a benefit for those with a higher fWHR was reported in mixed martial arts (Třebický et al., 2015; Zilioli et al., 2015), baseball (Tsujiura & Banissy, 2013), and association football (Welker, Goetz, Galicia, Liphardt, & Carré, 2015). Following the assumed link between fWHR and aggression, Carré and McCormick (2008) demonstrated an increased number of penalty minutes per game in ice hockey for male players showing a higher fWHR. Also, in association football positive correlations between fWHR and committed fouls and yellow/red cards were reported (Fujii, Goto, & Takagishi, 2016; Welker, Goetz, Galicia et al., 2015).

Despite the growing body of literature emphasizing a connection between fWHR and aggression and/or dominance, several limitations restricted the generalizability of the reported findings: Above all, the underlying mechanism forming the connection between fWHR and aggression has remained inconclusive (Bird et al., 2016; Eisenbruch, Lukaszewski, Simmons, Arai, & Roney, 2018; Hodges-Simeon, Hanson Sobraske, Samore, Gurven, & Gaulin, 2016; Lefevre, Lewis, Perrett, & Penke, 2013). In addition, many studies solely conducted correlational analyses, not permitting causal interpretations, and several findings are lacking in consistency and replicability (cf. Geniole et al., 2015; Haselhuhn et al., 2015). However, two meta-analyses proved a small but robust positive relationship between men's fWHR and aggression/dominance substantiating the validity of fWHR's impact (Geniole et al., 2015; Haselhuhn et al., 2015). Nonetheless, research failed to

comprehensively make clear why some of the studies failed to detect the assumed link between fWHR and aggression (Gómez-Valdés et al., 2013; Hodges-Simeon et al., 2016; Kosinski, 2017; Özener, 2012). Thus, there is a need for studies to cast light on potential moderators/mediators affecting fWHR's impact on human behavior (Haselhuhn et al., 2015).

In particular, studies conducted in the area of sport emphasized the role of mediating variables determining fWHR's impact: Mayew (2013) showed that by taking body mass index (BMI) as mediating variable into account, the impact of fWHR did not reveal any significance in predicting a player's performance in the sport of baseball. In ice hockey, the significant role of fWHR disappeared when body weight was included as additional variable (Deaner, Goetz, Shattuck, & Schnotala, 2012). Also, in association football, the significant effect of fWHR turned out to be limited to offensive players (Fujii et al., 2016; Welker, Goetz, Galicia et al., 2015). Furthermore, an individual's social status has received attention: Goetz et al. (2013) found that the assumed positive correlation between fWHR and aggressive behavior was only observed for men of low social status (measured as self-report and salary data). It has been argued that men of low social status may have less to lose but more to gain from aggressive behavior than men of high social status (Goetz et al., 2013; Wilson, Daly, & Pound, 2009). This finding was supported by Welker, Goetz, and Carré (2015) showing increased risk-taking behavior in men of low social status and high fWHR. Such risk-taking behavior was observed to be used often in order to enhance one's status in a social hierarchy (Mason et al., 2006).

As many open questions remain regarding fWHR and its role in competitive sports, the necessity of studies analyzing the impact of fWHR by taking potential mediators and moderators into consideration is emphasized. Based on the varying findings dealing with fWHR and indicators of aggression and dominance in sport (Carré & McCormick, 2008; Deaner et al., 2012; Fujii et al., 2016; Goetz et al., 2013; Kramer, 2015; Mayew, 2013; Tsujimura & Banissy, 2013; Welker, Goetz, Galicia et al., 2015), we analyzed the impact of fWHR in association football on fouls committed, cards received, as well as assists and goals scored for every player of the German and Austrian Bundesliga in the season 2016–2017. Association football appeared to be beneficial for analyzing the impact of fWHR, since it provides objective performance data (e.g., goals) and explicit measures of aggression (e.g., penalties) in real-world situations. In addition, we aimed at taking care of potential moderators of the fWHR aggression/dominance relationship: We considered the moderating effects of social status, BMI, and player positions (Deaner et al., 2012; Fujii et al., 2016; Welker, Goetz, Galicia et al., 2015). Thus, the study attempted to replicate previous findings of moderators of fWHR in the specific context of football. As an indicator of social status, players' market value was included. The market value of footballers can be defined as "an estimate of the amount of money a club would be willing to pay in order to make an athlete sign a contract, independent of an actual transaction" (Herm, Callsen-Bracker, & Kreis, 2014, p. 484).

Taking into account that in European football, players are mainly traded for cash settlements instead of for other players or future draft picks as is the case in American football in the United States, the market value also provides an indication of a player's social status and was found to correlate closely with player salaries (Torgler & Schmidt, 2007; see also Müller, Simons, & Weinmann, 2017).

Method

Material

Player performance data were assessed by the sports analytics company Opta Sports. They gave permission to analyze the statistics of each player for the season and provided proof of high reliability (Liu, Hopkins, Ruano, & Molinuevo, 2013). For all matches in the German ($k = 306$ matches) and Austrian Bundesliga ($k = 180$), lineups, minutes of gameplay, assists, goals, fouls committed, and yellow and red cards received were analyzed. The maximum number of a player's matches was 34 in Germany (18 teams) and 36 in Austria (10 teams). In the German Bundesliga, each team plays twice against each other (home and away match), whereas in Austria each team plays against each other 4 times (2 home and 2 away matches). Thus, players' minutes of gameplay ranged between 0 and 3,060 min in Germany and between 0 to 3,240 min in Austria, respectively. The moderating variables of players' physical attributes (body weight and height), their field position (goalkeeper, defender, midfielder, forward), and their market value were obtained from the website *transfermarkt.de*. Past research was able to provide strong evidence on the accuracy and reliability of the reported market values given by *transfermarkt.de* (Herm et al., 2014).

Facial width-to-height ratios were measured using the software ImageJ Version 1.51f; (NIH open-source software) in accordance with the instructions made by Weston, Friday, and Liò (2007) as well as Carré and McCormick (2008). Goalkeepers were excluded due to their lower rate of committing fouls, receiving yellow/red cards and scoring goals (cf. Fujii et al., 2016; Welker, Goetz, Galicia et al., 2015). Photographs were obtained from the website *transfermarkt.de* (82%), *kicker.de* (15%), or via Google's image search (3%) for all players who played at least once in the 2016–2017 season. In order to measure fWHR as accurately as possible, photographs were, if necessary, horizontally aligned. Only forward-facing images were selected, precluding any noticeable effects of different head tilts, positions, and rotations (cf. Hehman, Leitner & Gaertner, 2013; Jenkins, White, Van Montfort, & Burton, 2011; Kramer, 2016; Třebický, Fialová, Kleisner, & Havlíček, 2016). The full sample comprised 751 players ($n_{AUT} = 281$, $n_{GER} = 470$). Four independent research assistants (two blind and two aware of the research's purpose) rated the photographs on neutral facial expressions (mouth closed, straight lips, eyes fully open) and visibility of both zygions dichotomously (0 = *restricted*, 1 = *perfectly present*). The ratings of each feature aimed at enabling even more accurate detections of

Table 1. Means and Standard Deviations of Players' fWHRs for all Positions in the Austrian and German Bundesliga.

	German Bundesliga			Austrian Bundesliga		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
Defenders	101	2.05	.14	66	2.00	.12
Midfielders	122	2.04	.13	86	2.03	.13
Forwards	55	2.04	.15	42	2.05	.15
Total	278	2.04	.14	194	2.03	.13

Note. fWHR = facial width-to-height ratio.

irregularities in the photographs in order to take more care of the noise in fWHR measurements due to facial expressions and camera/head positions (Kramer, 2016; Noyes & Jenkins, 2017). Fleiss's κ turned out satisfactory (mouth closed: $\kappa = .89$, straight lips: $\kappa = .83$, eyes fully open: $\kappa = .86$, clear visibility of both zygions: $\kappa = .96$). Photographs that did not permit accurate measurements of fWHR (sum of ratings < 4) were excluded from further analyses. In total, the final sample consisted of 472 players: 278 players from the German and 194 players from the Austrian Bundesliga. FWHR's measurement reliability was determined using an intraclass correlation coefficient (ICC) of the four raters. ICC turned out high (.94) and comparable with the interrater agreements achieved in previous studies (e.g., Kramer, 2015; Kosinski, 2017). Table 1 displays the means and standard deviations of players' fWHR for all positions in the German and Austrian Bundesliga. All photographs and player data were obtained between May 26, 2017, and July 18, 2017.

Statistical Analyses

Due to the highly skewed variables of fouls committed, cards received, and assists and goals scored, generalized estimating equation models were calculated considering a negative binomial distribution (cf. Welker, Goetz, Galicia et al., 2015). For the variable of cards received, yellow and red cards were totaled. Assists and goals scored were also totaled, representing a single parameter of offensive power. At first, generalized estimating equation models were calculated considering minutes of play and players' fWHR as covariates solely (Model 1). At second, also players' BMI, players' market value, and the interaction term of fWHR and market value were considered as covariates (Deaner et al., 2012; Mayew, 2013). We mean-centered fWHR and market value prior to computing the interaction term and included them in the estimated model. BMI was calculated and considered as predictor instead of including the highly correlated and confounding variables of body weight and height ($r = .82$, $r_{ger} = .80$, $r_{aut} = .84$; each $p < .001$; the separate consideration of a player's weight/height instead of a player's BMI in the statistical models would not have changed the results of the study). By taking into consideration previous research that emphasized the role of fWHR in attacking but not in defending players (cf. Fujii et al., 2016; Welker, Goetz, Galicia et al., 2015), separate analyses for player positions

(defender, midfielder, forwards) were conducted after calculating the models for all player positions. Due to multiple statistical testing and the inflated risk of error 1, α level was set at .01.

Results

At first, generalized estimating equation models for fouls committed and cards received were calculated for players from the German and Austrian Bundesliga. Table 2 shows the results for all included predictors of Model 1 and Model 2. As expected, minutes of play showed a significant impact throughout the estimated models: More minutes of play corresponded to a higher number of fouls committed and cards received. However, the effect of players' fWHR did not turn out significant in both models. Most notably, in the Austrian Bundesliga, fWHR's impact on yellow and red cards revealed the tendency of players with a high fWHR to receive less cards and vice versa. This tendency contradicts the expectancy of an inflated rate of cards received for those having a higher fWHR. The analysis of players' BMI, market value, and the interaction of fWHR and market value did not reveal significant results.

Second, separate analyses for each field position (defender, midfielder, forward) were conducted. In the German Bundesliga, generalized estimating equation models did not reveal differing results for defenders, midfielders, and forwards. Again, the minutes of gameplay turned out significant in defenders, $B = .001$, $\chi^2(1) = 23.71$, $p < .001$, midfielders, $B = .001$, $\chi^2(1) = 41.75$, $p < .001$, and forwards, $B = .001$, $\chi^2(1) = 9.23$, $p = .002$, whereas fWHR did not, defenders: $B = .10$, $\chi^2(1) = .02$, $p = .90$; midfielders: $B = -.14$, $\chi^2(1) = .03$, $p = .87$; forwards: $B = -.859$, $\chi^2(1) = .56$, $p = .46$. By taking players' BMI, players' market value, and the interaction of fWHR and market value into consideration (Model 2), the results did not change: Minutes of play turned out significant in defenders, $B = .001$, $\chi^2(1) = 23.37$, $p < .001$, midfielders, $B = .001$, $\chi^2(1) = 39.17$, $p < .001$, and forwards, $B = .001$, $\chi^2(1) = 7.72$, $p = .005$. Players' fWHR, defenders: $B = .150$, $\chi^2(1) = .03$, $p = .87$; midfielders: $B = -.203$, $\chi^2(1) = .05$, $p = .82$; forwards: $B = -1.12$, $\chi^2(1) = .88$, $p = .35$, players' BMI, defenders: $B = -.018$, $\chi^2(1) = .03$, $p = .86$; midfielders: $B = -.051$, $\chi^2(1) = .29$, $p = .59$; forwards: $B = -.120$, $\chi^2(1) = .74$, $p = .39$, players' market value, defenders: $B = -.007$, $\chi^2(1) = .09$, $p = .76$; midfielders: $B = -.002$, $\chi^2(1) = .024$, $p = .88$; forwards: $B = -.001$, $\chi^2(1) = .01$, $p = .95$, and the interaction of fWHR and market value did not turn out significant, defenders: $B = .063$, $\chi^2(1) = .131$, $p = .72$; midfielders: $B = .043$, $\chi^2(1) = .18$, $p = .67$; forwards: $B = .063$, $\chi^2(1) = .38$, $p = .54$.

These results were corroborated for all positions in the Austrian Bundesliga: Again the impact of minutes of play turned out significant, defenders: $B = .001$, $\chi^2(1) = 21.81$, $p < .001$; midfielders: $B = .001$, $\chi^2(1) = 37.00$, $p < .001$; forwards: $B = .001$, $\chi^2(1) = 13.68$, $p < .001$, whereas fWHR did not, defenders: $B = -2.41$, $\chi^2(1) = 3.86$, $p = .05$; midfielders: $B = -1.14$, $\chi^2(1) = 37.00$, $p = .26$; forwards: $B = -1.00$, $\chi^2(1) = .52$, $p = .47$. Also by taking players'

Table 2. Results of the Negative Binomial Regression Models for all Predictors on Fouls Committed and Cards (Yellow and Red) Received for Players from the German and Austrian Bundesliga.

	Fouls Committed						Cards Received					
	German Bundesliga			Austrian Bundesliga			German Bundesliga			Austrian Bundesliga		
	B	95% CI	$\chi^2(1)$	p	B	95% CI	$\chi^2(1)$	p	B	95% CI	$\chi^2(1)$	p
Model 1												
MoP	.001	[.001, .001]	112.17	<.001	.001	[.001, .001]	96.17	<.001	.001	[.001, .001]	73.87	<.001
fWHR	-.052	[-.969, .865]	.01	.91	.033	[-1.024, 1.091]	.01	.95	-.152	[-1.187, .882]	.08	.77
Model 2												
MoP	.001	[.001, .001]	100.33	<.001	.001	[.001, .001]	81.98	<.001	.001	[.001, .001]	64.86	<.001
BMI	-.026	[-.127, .075]	.026	.61	.047	[-.079, .173]	.54	.46	-.058	[-.176, .059]	.95	.33
MV	.002	[-.017, .020]	.004	.85	.016	[-.131, .162]	.04	.83	-.005	[-.026, .016]	.23	.63
fWHR	-.062	[-.996, .872]	.002	.90	.057	[-1.029, 1.143]	.01	.92	-.075	[-1.260, .840]	.15	.70
MV * fWHR	.055	[-.044, .155]	1.18	.28	-.229	[-1.407, .948]	.15	.70	.007	[-.069, .153]	.55	.46

Note. fWHR = facial width-to-height ratio; MoP = minutes of play; MV = player's market value.

Table 3. Results of the Negative Binomial Regression Models for all Predictors on the Sum of Assists and Goals Scored for Players From the German and Austrian Bundesliga.

	German Bundesliga				Austrian Bundesliga			
	<i>B</i>	95% CI	$\chi^2(1)$	<i>p</i>	<i>B</i>	95% CI	$\chi^2(1)$	<i>p</i>
Model 1								
MoP	.001	[.001, .001]	102.60	<.001	0.001	[.001, .001]	55.54	<.001
fWHR	-.510	[-1.501, .480]	1.02	.31	0.158	[-1.009, 1.326]	.07	.79
Model 2								
MoP	.001	[.001, .001]	56.09	<.001	0.001	[.001, .001]	48.39	<.001
BMI	-.006	[-.120, .107]	.01	.91	0.012	[-.144, .168]	.02	.88
MV	.046	[.024, .068]	16.53	<.001	0.247	[.069, .426]	7.37	.01
fWHR	-.406	[-1.481, .670]	.55	.46	-.0137	[-1.329, 1.054]	.05	.82
MV * fWHR	.094	[-.001, .188]	3.79	.05	1.638	[.040, 3.235]	4.04	.04

Note. fWHR = facial width-to-height ratio; MoP = minutes of play; MV = player's market value.

BMI, players' market value, and the interaction of fWHR and market value into consideration (Model 2), the results did not differ: The effect of minutes of play turned out significant again, defenders: $B = .001$, $\chi^2(1) = 19.72$, $p < .001$; midfielders: $B = .001$, $\chi^2(1) = 32.15$, $p < .001$; forwards: $B = .001$, $\chi^2(1) = 8.48$, $p = .004$, whereas neither players' fWHR, defenders: $B = -2.231$, $\chi^2(1) = 2.92$, $p = .08$; midfielders: $B = -.878$, $\chi^2(1) = .65$, $p = .42$; forwards: $B = -1.47$, $\chi^2(1) = 1.08$, $p = .30$, players' BMI, defenders: $B = .155$, $\chi^2(1) = 1.28$, $p = .26$; midfielders: $B = .02$, $\chi^2(1) = .02$, $p = .88$; forwards: $B = .186$, $\chi^2(1) = .98$, $p = .32$, players' market value, defenders: $B = .056$, $\chi^2(1) = .119$, $p = .73$; midfielders: $B = -.066$, $\chi^2(1) = .104$, $p = .75$; forwards: $B = -.10$, $\chi^2(1) = .33$, $p = .57$, nor the interaction of players' fWHR and market value, defenders: $B = -.314$, $\chi^2(1) = .04$, $p = .85$; midfielders: $B = .96$, $\chi^2(1) = .38$, $p = .54$; forwards: $B = -.752$, $\chi^2(1) = .27$, $p = .61$, revealed any significance.

In the final step, the impact of fWHR on the sum of goals and assists was analyzed, signifying a variable that might be more related to a player's power and success than to the more aggression-related parameters of breaking of the rules (fouls and cards). At first, the two variables of minutes of play and players' fWHR were included in the generalized estimating equation models. Table 3 shows the results for players from the German and Austrian Bundesliga. As expected, minutes of play showed a significant positive impact on assists and goals: The more minutes played, the higher the number of goals and assists and vice versa. However, players' fWHR did not turn out significant in predicting their assists and goals. Secondly, the variables of players' BMI, players' market value, and the interaction of fWHR and market value were included in the generalized estimating equation models (Model 2). Here, players' market value was found to significantly predict the number of assists and goals: The higher a player's market value, the more goals/assists were scored and vice versa. Again, players' fWHR did not detect any significant impact, even in interaction with players' market value. Also, the separate analyses for each field position—defenders, midfielders, forwards—did not reveal any differing results. Players' fWHR did not turn out

meaningful in predicting their goals and assists, German Bundesliga: defenders: $B = -.164$, $\chi^2(1) = .03$, $p = .87$; midfielders: $B = -1.315$, $\chi^2(1) = 2.54$, $p = .11$; forwards: $B = .732$, $\chi^2(1) = .45$, $p = .50$; Austrian Bundesliga: defenders: $B = -.170$, $\chi^2(1) = .01$, $p = .91$; midfielders: $B = -.577$, $\chi^2(1) = .345$, $p = .56$; forwards: $B = -.996$, $\chi^2(1) = .75$, $p = .39$, nor in interaction with players' market value, German Bundesliga: defenders: $B = .199$, $\chi^2(1) = 1.56$, $p = .21$; midfielders: $B = .074$, $\chi^2(1) = .55$, $p = .45$; forwards: $B = .003$, $\chi^2(1) = .01$, $p = .97$; Austrian Bundesliga: defenders: $B = .368$, $\chi^2(1) = .04$, $p = .85$; midfielders: $B = .874$, $\chi^2(1) = .22$, $p = .64$; forwards: $B = 2.574$, $\chi^2(1) = 4.39$, $p = .04$.

Discussion

The current study aimed at analyzing the impact of fWHR on parameters of aggression and performance in association football by taking a player's position, social status, and BMI into consideration. We revealed three principle findings: First, we did not find any impact of fWHR on fouls committed and (yellow and red) cards received. According to previous studies (Carré & McCormick, 2008; Fujii et al., 2016; Třebický et al., 2015; Welker, Goetz, Galicia et al., 2015), we expected men with a higher fWHR to commit more fouls and thus receive more penalties. In contrast with this assumption, fWHR did not turn out meaningful in predicting fouls and cards received in the German and Austrian Bundesliga. However, even in the Austrian sample, the tendency for men with smaller fWHR to receive more yellow and red cards was observed. This non-significant finding seems in line with the studies of Deaner et al. (2012), Kramer (2015), and Mayew (2013), who also did not find any impact of fWHR in sports. It has to be considered that—in contrast to previous studies emphasizing the role of fWHR in sports (Carré & McCormick, 2008; Fujii et al., 2016; Goetz et al., 2013; Tsujimura & Banissy, 2013; Welker, Goetz, Galicia et al., 2015)—we analyzed the impact of fWHR by controlling for minutes of play for each player, which seems to be a more accurate variable than the number of matches/games played, as was considered in previous studies. A player

in association football might merely be substituted at the end of a match, which increases the number of games played even though minutes of play still remain low. A player's performance data will therefore have a higher risk of not being representative as only the number of games, disregarding minutes of play, is considered. Thus, future research has to take this into account more comprehensively in order to broaden insights into the differences made by the numbers of games played and effective playing time.

In addition, the current study did not detect differing effects of fWHR for defenders, midfielders, and forwards. Past research suggested a more prominent role of fWHR in forwards or midfielders than in defenders (Fujii et al., 2016; Welker, Goetz, Galicia et al., 2015). However, these studies already reported low consistent results in predicting players' fouls committed, cards received, or goals scored and revealed rather small effect sizes. In comparison to these studies, both the sample size and the number of matches analyzed exceeded those of previous research, indicating a higher validity and generalizability with our findings. However, it has to be noted that players' positions were assessed as stable characteristics of the players over the season. Taking the tactical decisions of coaches into consideration, it might have been the case that players did not always play in their regular field position, instead playing in a different one (e.g., midfielder playing as outside defender). This might also have affected their performance data (e.g., a higher probability of scoring a goal when playing as a forward). To control for this, the tactical lineups for each match should have been analyzed separately, which was not possible within this study. However, by increasing the number of matches played, the representativeness of a player's data should also be improved and the potential impact of this situation should be diminished. Nonetheless, future studies have to address this limitation.

Second, the current study did not corroborate the role of social status in moderating the impact of fWHR on measures of aggression. As shown in ice hockey (Goetz et al., 2013), players having a high fWHR and low social status were expected to commit more fouls. It was argued that men having a high fWHR but lacking in social status will increase their aggressive and/or risk-taking behavior to reach their subjectively desired (higher) status (Goetz et al., 2013; Welker, Goetz, & Carré, 2015). However, this tendency was not found to apply to football in the German and Austrian Bundesliga. Further studies need to show whether the reported effect of fWHR in men with low social status is limited to sports like ice hockey or combat sports, where aggressive behavior may seem to be more socially accepted and common than in association football. In addition, it has to be noted that the rate of players excluded from our data analyses—due to nonneutral facial expression—turned out much higher than in previous studies (Fujii et al., 2016; Goetz et al., 2013; Welker, Goetz, Galicia et al., 2015). Although some studies documented the dependency of reliable judgments and measurements of facial features on camera position, camera-to-subject distance, and most notably the neutrality of facial expressions (Jenkins

et al., 2011; Kramer, 2016; Noyes & Jenkins, 2017; Todorov & Porter, 2014; Třebický et al., 2016), research failed to establish clear and valid rules for judging and documenting the suitability of archival photographs to assure valid fWHR measurements. Above all, Kramer (2016) pointed out that particularly faces displaying happiness or joy tended to produce biased fWHRs. However, many previous studies merely stated that they controlled for neutral facial expressions but did not report how this was done. As a consequence, we at least tried to document our efforts to control for neutrality of facial expressions in the current study. According to the judgments of four raters, we exclusively analyzed photographs that showed players with their mouths closed and straight lips, as well as with their eyes fully open and both zygions perfectly visible. On detecting any doubts in the raters' judgments of these features, the pictures were excluded from further analysis. We find it noteworthy to say that in light of the resulting high rate of rejection, this procedure seems to be more conservative than the procedures of previous studies. However, as a consequence to this conservative approach, the potential noise in fWHR measurements, which reduces the validity of potential fWHR effects, should also have declined (Haselhuhn et al., 2015; Geniole et al., 2015; Kramer, 2016). Future studies are obliged to address this question and establish criteria for neutral facial expressions in fWHR research.

Third, the current study did not find any significant effect of fWHR on players' goals and assists. It was solely the minutes of game play and players' market value that predicted their goals and assists. As expected, the more minutes a player played and the higher his market value was, the more goals and assists were scored. This result emphasizes the strong impact of players' scored goals and assists on their market value and their expected transfer fees (Torgler & Schmidt, 2007). In our study, players' market value was considered as a measure of social status. However, Goetz et al. (2013) used their estimated salaries instead. As a consequence, our results are limited to not including a direct measure of social status (e.g., questionnaires) or players' salaries. Nonetheless, we expect a high correlation between a player's market value and his salary (cf. Torgler & Schmidt, 2007): A player with a high market value should also earn more money and should have more options to boost his salary. However, future research has to consider this possible divergence and challenge the assumption concerning a potential interaction of fWHR and social status in sports.

The current study has added to the empirical evidence refuting an impact of fWHR—even in interaction with social status—on aggressive behavior in sports. It has broadened the insights by analyzing male players in association football. Taking the previously published findings on fWHR into consideration, there seems to be small but significant association between fWHR and aggressive behavior (Carré & McCormick, 2008; Goetz et al., 2013; Třebický et al., 2015; Welker, Goetz, Galicia et al., 2015; Zilioli et al., 2015). Nonetheless, research has remained incomplete in clarifying why some studies did not detect such an impact of fWHR (Deaner et al., 2012;

Kramer, 2015; Mayew, 2013). Therefore, research is needed to understand more comprehensively how facial structures like fWHR may generate an impact on human behavior, particularly in order to build up a theoretical framework predicting the effects of differing facial cues on human social behavior.

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