

# Does Facial Width-to-Height Ratio Predict Japanese Professional Football Players' Athletic Performance?

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A number of studies have shown that facial width-to-height ratio (fWHR)—the distance between the two zygomatic arches (width) compared with the distance from the top of the lip to the bottom of the eyebrows (height)—is related to aggression and is reflective of testosterone levels. The purpose of this study was to examine the association between fWHR and the athletic performance of Japanese professional football players. Photographs of 343 Japanese professional football players were measured for fWHR and compared with the number of goals scored and penalty cards (yellow and red) acquired in the 2012 season. The results showed that fWHR was not associated with the number of goals scored in any football position. However, the number of penalty cards acquired was positively associated with fWHR only in the forward offensive position. These findings showed that fWHR is not related to goals scored by Japanese football players, but is related to the penalty cards acquired in the offensive domain.

## Keywords

facial structure, facial width-to-height ratio, facial features, sports, aggression

## Introduction

Over the past decade, numerous studies have examined the relationship between physical characteristics and human aggression (Bailey & Hurd, 2005; Deane, Goetz, Shattuck, & Schnotala, 2012; Mileva, Cowan, Cobey, Knowles, & Little, 2014). Facial width-to-height ratio (fWHR), which refers to the comparison of the distance between the two zygomatic arches (width) and the distance from the top of the lip to the bottom of the eyebrows (height), has garnered particular attention in this regard, as secretion of testosterone is known to influence craniofacial growth (Carré, McCormick, & Mondloch, 2009; Haselhuhn & Wong, 2012; Stirrat & Perrett, 2010, 2012; Verdonck, Gaethofs, Carels, & de Zegher, 1999)

and salivary testosterone level is associated with fWHR (Lefevre, Lewis, Perrett, & Penke, 2013).

Recently, a large number of studies examined the association between fWHR and the performance of professional athletes (Carré & McCormick, 2008; Deane et al., 2012; Goetz et al., 2013; Mayew, 2013; Tsujimura & Banissy, 2013; Welker, Goetz, Galicia, Liphardt, & Carré, 2014). Welker et al. (2014) examined the relationship between fWHR in professional football players across 32 countries and their match performance. They found that fWHR was strongly associated with the number of fouls and goals scored in offensive positions (forward and midfielder), but not in defensive positions (defense). As the sample in their study included players of various countries and regions, they concluded that fWHR is universally associated with human aggression. However, as several studies have reported no association between fWHR and aggression (Gómez-Valdés et al., 2013; Özener, 2012), this association might be still culture-specific. Thus, it is necessary to investigate the association between aggression and fWHR within various countries.

The purpose of this study is to examine whether the association between fWHR and the performance of professional football players is observed Japanese athletes. Because the performance of Japanese professional baseball players is not associated with fWHR (Mayew, 2013), it is necessary to examine whether this lack of association is observed in professional athletes in other sports. To examine this, we focus on Japanese professional football players and examine the association between the number of goals and penalties (yellow/red cards) acquired and their fWHR by position in football (forward [FW]; offensive position, midfield [MF]; offensive/defensive position, defense [DF]; defensive position). If fWHR is associated with aggression, a higher fWHR will relate to more goals scored and yellow/red cards accrued.

## Methods

A total of 343 Japanese male professional football players from the Japan Professional Football League division 1 (J1) were measured for their fWHR. The players' mean age was 25.7 years ( $SD = 4.3$ ), ranging from 18 to 44 years (full demographic information is presented in Table 1). To measure fWHR, color photos of the players (6.3 cm  $\times$  4.1 cm) were printed from the player directory, which was published in February 2012 (BASEBALL MAGAZINE SHA Co., Ltd.). All players were facing forward in the photos, and all photos were taken from the chest up. These photos were scanned and enlarged using computer software (GIMP, free image editing software), and fWHR was measured in a manner similar to that used in the study by Carré et al. (2009) (Figure 1). Data about players' age, height, weight, and position were obtained from the player directory. Performance information from the 2012 J1 season, including the number of goals scored, penalty cards

(yellow/red cards) acquired, total playing time in minutes, and total number of matches played, was taken from the J. League's official website (<http://www.j-league.or.jp>). As done in the previous study (Welker et al., 2014), we excluded goalkeepers from this study because the number of goals scored and penalty cards acquired by goalkeepers was very low.



**Figure 1.** Measurement method of facial width-to-height ratio. The distance between the two zygomatic arches (width) and the distance from the top of the lip to the bottom of the eyebrows (height) were calculated.

**Results**

The mean level of fWHR for each position is shown in Table 1 and the number of goals scored and yellow/red cards acquired for each position is shown in Table 2. A one-way ANOVA revealed that there was no significant

difference in fWHR between positions,  $F(1, 384) = 0.03, p = 0.856$ . In the following analysis, we excluded twelve players (FW = 1, MF = 3, DF = 8) whose total playing time was zero.

*The Effect of fWHR on Goals Scored*

Because the number of goal scored is not normally distributed, we conducted a poisson regression analysis with fWHR, BMI, as independent variables and the number of goals scored as the dependent variable. We used total playing time as an offset term and the two independent variables were standardized. Regression analysis revealed that there was no significant effect of fWHR on the number of goals scored by players in each position (FW:  $b = 0.007, p = 0.927$ ; MF:  $b = -0.05, p = 0.384$ ; DF:  $b = 0.066, p = 0.572$ ) (Table 3).

*The Effect of fWHR on Yellow/Red Cards Acquired*

Due to the low number of red cards acquired in each position, we analyzed the data by adding together the number of yellow and red cards. Because the number of yellow/red cards acquired is not normally distributed, we used same model described above. Regression analysis revealed that while the effect of fWHR on the number of yellow/red cards acquired in the FW position was significant (FW:  $b = 0.29, p = 0.013$ ), it was not significant for the MF and DF positions (MF:  $b = 0.043, p = 0.417$ ; DF:  $b = -0.01, p = 0.873$ ) (Table 3).

**Table 1.** Participants' demographic information by each football position

|             | FW (n = 75) |      | MF (n = 152) |      | DF (n = 116) |      |
|-------------|-------------|------|--------------|------|--------------|------|
|             | M           | SD   | M            | SD   | M            | SD   |
| Age (years) | 24.9        | 4.74 | 25.1         | 4.21 | 26.3         | 4.07 |
| Height (cm) | 177.7       | 6.07 | 174.5        | 4.65 | 178.7        | 4.99 |
| Weight (kg) | 71.6        | 5.55 | 68.2         | 4.57 | 72.9         | 5.07 |
| BMI         | 22.7        | 1.12 | 22.4         | 1.02 | 22.8         | 1.13 |
| fWHR        | 2.04        | 0.14 | 2.01         | 0.15 | 2.02         | 0.15 |

Note. FW = forward; MF = midfield; DF = defense; BMI = body mass index; fWHR = facial width-to-height ratio.

**Table 2.** Participants' performance in football match by each position

|                      | FW (n = 75) |     |      | MF (n = 152) |      |      | DF (n = 116) |      |      |
|----------------------|-------------|-----|------|--------------|------|------|--------------|------|------|
|                      | Q1          | Q2  | Q3   | Q1           | Q2   | Q3   | Q1           | Q2   | Q3   |
| Goal Scored          | 0           | 1   | 6    | 0            | 1    | 3    | 0            | 0    | 1    |
| Yellow Card Acquired | 0           | 0   | 2    | 0            | 2    | 3    | 1            | 2    | 4    |
| Red Card Acquired    | 0           | 0   | 0    | 0            | 0    | 0    | 0            | 0    | 0    |
| Total Playing Time   | 95          | 527 | 1619 | 362          | 1237 | 2161 | 397          | 1528 | 2560 |

Note. FW = forward; MF = midfield; DF = defense; Q1 = first quartile (25%); Q2 = median (50%); Q3 = third quartile (75%)

**Table 3.** Poisson regression analysis of the performance of football games

|                      | Goal Scored |           |          |          | Yellow/red Card Acquired |           |          |          |
|----------------------|-------------|-----------|----------|----------|--------------------------|-----------|----------|----------|
|                      | <i>b</i>    | <i>SE</i> | <i>t</i> | <i>p</i> | <i>b</i>                 | <i>SE</i> | <i>t</i> | <i>p</i> |
| FW ( <i>n</i> = 74)  |             |           |          |          |                          |           |          |          |
| Intercept            | -5.596      | 0.066     | 84.82    | 0.000    | 6.548                    | 0.109     | 59.81    | 0.000    |
| fWHR                 | 0.007       | 0.074     | 0.092    | 0.927    | 0.290                    | 0.117     | 2.487    | 0.013    |
| BMI                  | 0.051       | 0.059     | 0.870    | 0.385    | -0.019                   | 0.087     | 0.221    | 0.826    |
| MF ( <i>n</i> = 149) |             |           |          |          |                          |           |          |          |
| Intercept            | -6.648      | 0.062     | 106.67   | 0.000    | 6.429                    | 0.056     | 115.47   | 0.000    |
| fWHR                 | -0.050      | 0.058     | 0.872    | 0.384    | 0.043                    | 0.053     | 0.812    | 0.417    |
| BMI                  | 0.030       | 0.070     | 0.433    | 0.666    | 0.019                    | 0.063     | 0.297    | 0.767    |
| DF ( <i>n</i> = 108) |             |           |          |          |                          |           |          |          |
| Intercept            | -7.594      | 0.111     | 68.48    | 0.000    | 6.284                    | 0.057     | 109.62   | 0.000    |
| fWHR                 | 0.066       | 0.116     | 0.566    | 0.572    | -0.010                   | 0.060     | 0.161    | 0.873    |
| BMI                  | 0.072       | 0.096     | 0.747    | 0.456    | 0.051                    | 0.050     | 1.010    | 0.313    |

Note. FW = forward; MF = midfield; DF = defense; BMI = body mass index; fWHR = facial width-to-height ratio.

## Discussion

This study has two important implications for research into athletic performance and aggression. First, no association was observed between players' fWHR and the number of goals scored in any of the positions. This result fails to replicate the results of the previous study (Welker et al., 2014) and indicates that there is no association between fWHR and the number of goals scored in Japanese football players. The association of the number of goals scored and aggression might be weakened because various other factors (e.g., leadership of manager and cooperation with allies), and not just the players' aggression, affect the number of goals scored in football. Alternatively, the relationship between the number of goals scored and aggression disappears due to cultural-specific factors, such as tactics that are favored by Japanese managers.

Second, the higher a player's fWHR, the more penalty cards they acquired in the FW position. This result partially supports the previous study (Welker et al., 2014) and indicates that unlike the number of goals scored, the number of penalty cards acquired is strongly associated with aggression. Interestingly, the association between fWHR and the number of penalty cards was found only in the offensive position, suggesting that fWHR may be related to aggression only in an offensive domain. One possible explanation for these findings is that offensive players with high fWHR may attack the opposing team more powerfully, taking more risks when they play and, as a result, receive more penalty cards. In support, another study recently demonstrated that social status moderates the relation between fWHR and aggression (Goetz et al., 2013), and that fWHR does not reflect aggression generally. Thus, the association between fWHR and aggression appears to be particularly strong for offensive roles, but fWHR is not related to defensive aggression,

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such as for self-defense or protection.

The findings in this study primarily report that the number of penalty cards acquired, but not the number of goals scored, is associated with fWHR in Japanese professional football players. However, a methodological problem remains. In this study, we obtained data for each player's height and weight from the player directory. Because almost all professional athletes try to show themselves as being strong to others, they might exaggerate reports of their height and weight. In order to more accurately examine the association between players' athletic performance and fWHR, actual measurements of each player's height and weight should be examined. Moreover, further research is needed to examine whether the results of this study would also be observed in other professional sports or female professional sports players.

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