SOCIAL PSYCHOLOGY | RESEARCH ARTICLE

Facial width-to-height ratio association with performances of cadets at the Korea Military Academy

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Abstract: Studies suggest that facial width-to-height ratio (fWHR) is positively correlated with performances, especially in males. However, the relationship between fWHR and performance in the military context is relatively unexplored. This study examines whether and how fWHR is associated with objective performances in the military, using a novel and large sample of cadets (n = 912) at the Korea Military Academy. The results indicate that, for male cadets, fWHR is negatively correlated with academic, military, physical, social, and overall performances, whereas for female cadets, fWHR was not significantly correlated with performances, except for physical performance. This study suggests that fWHR correlates with performances, but the direction of the relationship is negative in a sample of male military cadets.

Subjects: Psychological Science; Social Psychology; Non-verbal Communication

Keywords: Facial width-to-height ratio; objective performance; military cadet; Korea Military Academy

1. Introduction

Recent studies suggest that facial width-to-height ratio (fWHR), a putatively sexually dimorphic trait (Weston et al., 2007), is positively associated with various facets of performance, especially in males. Such areas include academic performance (Kausel et al., 2018), financial performance (Wong et al., 2011), negotiation performance (Haselhuhn et al., 2014), and athletic performance (Třebický et al., 2015; Tsujimura & Banissy, 2013; Zilioli et al., 2015).

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PUBLIC INTEREST STATEMENT

In the psychological literature, facial width-to-height ratio (fWHR) has been proposed to be predictive of various facets of performance, especially in males. Despite this, little attention has been paid to the relationship between fWHR and performance in the context of the military. To fill this gap, this study examined a sample of cadets at the Korea Military Academy. Inconsistent with previous studies, the present research suggests that for male cadet, fWHR is significantly and negatively associated with cadet performances. The findings highlight the potentially important role of the domain within which fWHR correlates with critical outcomes.
Despite a growing body of research linking fWHR with various performances, this relationship in the context of the military is relatively unexplored. Given that physical prowess and dominance are esteemed in the military, it is possible that fWHR could be associated with military performance. Few studies have revealed an fWHR correlation with military performance (i.e., military rank), but the results were inconsistent. Specifically, fWHR was negatively associated with military rank in Finnish soldiers who fought in the Winter War (Loehr & O'Hara, 2013), whereas facial dominance associated with fWHR (Mileva et al., 2014) was positively related to military rank in U. S. Military Academy (USMA) cadets (Mazur et al., 1984; Mueller & Mazur, 1996).

This lack and inconsistent pattern of findings suggests that further research is necessary to investigate the association of fWHR with military performance. Therefore, this study examines a set of cadets at the Korea Military Academy (KMA), evaluating them on objective performance of four measures: academic, military, physical, and social. Particularly, cadets are motivated to achieve good grades in all domains, as they are ranked (given a military number) based on an overall performance composite score of these four areas when they graduate. Thus, we investigate whether and how fWHR is associated with objective performances by examining recent former cadets at the KMA.

2. Methods

2.1. Sample
The sample for this study included native cadets (male cadets: 924; female cadets: 81) who graduated from the KMA in the recent four years, excluding 15 foreign cadets (e.g., Vietnamese, Thai).
2.2. Stimuli
We obtained photos of the former cadets from their yearbook graduation portraits. All images were standardized in size, direction of the eye gaze, and head tilt. Specifically, the yearbook included three types of images for each cadet, including a photo in a service uniform, mess uniform, and graduation caps and gowns, all of which were used in this study (Figure 1). Notably, we removed the photos with cadets exhibiting a broad smile displaying teeth, as this could influence the fWHR estimates. If a cadet showed a broad smile in all three types of photos, we excluded the cadet (male cadet: 82, female cadet: 12) from the sample.

2.3. Estimating fWHR
To estimate fWHR, we used facial landmarks produced by dlib, which is a face detector based on the Python open-source package. We computed fWHR as facial width (distance between the right and left zygion) divided by facial height (distance between the highest point of the eyelids and upper lip) (Figure 1), a method that follows previous research (Lewis et al., 2012). If more than one of the three images was available after eliminating the images showing a broad smile, the fWHR estimates for that cadet were averaged. Consequently, we were able to obtain averaged fWHRs for 842 male cadets and 69 female cadets. The mean fWHR was 1.83 (SD = 0.09) for male cadets and 1.87 (SD = 0.09) for female cadets.

2.4. Cadet performance
As illustrated above, we focus on five objective performances: academic, military, physical, social, and overall performance. All grades (marks) in each domain range from 0.7 (D –) to 4.3 (A +).

2.4.1. Academic performance
Academic performance represents the cumulative grade point average for all academic courses at the KMA, except for military science and physical education courses. Grades (marks) in each course range from 0.7 (D –) to 4.3 (A +), and the credit weighting is based on the credit hour (two-hour classes or three-hour classes). Thus, higher scores mean better academic performance.

2.4.2. Military performance
Military performance captures the scores of military training (weighted 80%) and military science courses (weighted 20%). Military training is executed every summer and the training contents vary with cadets’ rank (freshman, sophomore, junior, and senior). Grades in military science courses are calculated as same with academic courses.

2.4.3. Physical performance
Physical performance includes physical education courses (weighted 40%) and fitness testing (weighted 40%). Cadets in the physical education courses are mainly assessed based on a practical technique (e.g., Taekwondo). Grades in the courses are also calculated on a scale of 0.7 to 4.3. Although instructors can evaluate cadets with a written exam on their discretion, the evaluation based on a practical technique is considered as a principle at the KMA, which means that grades in physical education courses substantially capture physical ability. Fitness testing including push-ups, sit-ups, and three-kilometer runs is graded on a pass/fail basis.

2.4.4. Social performance
Social performance comprises the composite score of merit and demerit points (weighted 40%), cadet core capabilities (weighted 40%), and self-development effort (weighted 20%). The composite score of merit/demerit points is calculated by subtracting demerit points from merit points in each term. Cadets can be given merit or demerit points based on their model behaviors or acts of breaking the rules, by superior cadets, tactical officers, and faculty members. Cadet core capabilities represent an overall judgment in each term by colleague cadets, tactical officers, and faculty
members on the basis of several capabilities (e.g., loyalty, courage, honor, sincerity, external position), on a scale of 1 (not at all) to 5 (very much). Self-development efforts capture extra-curricular activities such as volunteer work and prize for a contest (e.g., marathon, triathlon). In each term, tactical officer gives cadets the scores based on established standards.

2.4.5. Overall performance
Overall performance is a weighted composite score of academic (weighted 50%), military (weighted 25%), physical (weighted 15%), and social performance (weighted 10%).

3. Results
All correlations between variables are shown in Table 1. We found that for male cadets, fWHR was inversely correlated with all cadet performances. Specifically, male cadets’ fWHRs were negatively associated with academic performance \(r = -0.110, p = 0.001\), military performance \(r = -0.091, p = 0.009\), physical, \(r = -0.153, p < 0.001\), social, \(r = -0.068, p = 0.047\), and overall performance \(r = -0.130, p < 0.001\). All relationships maintained to be significant, when controlling for multiple comparisons using Holm-Bonferroni correction (adjusted significance levels: \(\alpha_{\text{academic}} = 0.017, \alpha_{\text{military}} = 0.025, \alpha_{\text{physical}} = 0.001, \alpha_{\text{social}} = 0.05\), and \(\alpha_{\text{overall}} = 0.013\)). Furthermore, post-hoc power analyses revealed that we had 89% power with a small effect size of 0.11 (i.e., average \(r\)), an alpha of 0.05, and sample size of 843.

Conversely, the results indicated that for female cadets, no cadet performance measures were significantly correlated with fWHR (all ps >0.27), except for physical performance \(r = 0.262, p = 0.030\). The relationship between fWHR and physical performance however ceased to be significant, when controlling for multiple comparisons as above (adjusted significance levels: \(\alpha_{\text{physical}} = 0.01\)).

We further examined the relationship between fWHR and performances by conducting two additional subsample analyses. First, we conducted a subsample analysis using a sample of cadets whose fWHR values fell either 1 SD above or 1 SD below the mean values, following previous research (Wang et al., 2019). The results indicated that all performances were negatively correlated with fWHR for male cadets \((n = 265)\): academic \(r = -0.165, p = 0.007\), military \(r = -0.143, p = 0.020\), physical \(r = -0.281, p < 0.001\), social \(r = -0.133, p = 0.030\), and overall performance

| Table 1. Correlations between facial width-to-height ratio and cadet performances \((n = 912)\) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
|                                | Male cadets \((n = 843)\) | Female cadets \((n = 69)\) |
|                                | \(r\) | \(p\) | 95% CI | \(r\) | \(p\) | 95% CI |
| AP                              | \(-0.110\) | \(0.001\) | \([-0.177, -0.043]\) | \(-0.042\) | \(0.730\) | \([-0.276, 0.196]\) |
| MP                              | \(-0.091\) | \(0.009\) | \([-0.157, -0.023]\) | \(0.132\) | \(0.278\) | \([-0.108, 0.358]\) |
| PP                              | \(-0.153\) | \(<0.001\) | \([-0.218, -0.086]\) | \(0.262\) | \(0.030\) | \([0.026, 0.469]\) |
| SP                              | \(-0.068\) | \(0.047\) | \([-0.135, -0.001]\) | \(0.008\) | \(0.949\) | \([-0.229, 0.244]\) |
| OP                              | \(-0.130\) | \(<0.001\) | \([-0.196, -0.063]\) | \(0.069\) | \(0.571\) | \([-0.170, 0.301]\) |

\(AP = \) academic performance; \(MP = \) military performance; \(PP = \) physical performance; \(SP = \) social performance; \(OP = \) overall performance (composite of AP, MP, PP, and SP).
(r = −0.211, p = 0.001). However, no significant correlations were found for female cadets (n = 25; all ps > 0.06).

Second, most studies on facial traits and performances have focused on individuals in positions of power (e.g., politicians, CEOs) (Re & Rule, 2017). Given that commander cadets (i.e., company, battalion, and regiment commander) and staff cadets who take charge of cadet discipline (i.e., personnel manager) are regarded as the most powerful cadets at the KMA; we further examined these cadets. As the number of female cadets in the power positions was low (n = 6), we examined only male cadets (n = 163). The results indicated that the correlation between fWHR and cadet performances was still negative: academic (r = −0.192, p = 0.014), military (r = −0.200, p = 0.010), physical (r = −0.155, p = 0.049), social (r = −0.070, p = 0.376), and overall performance (r = −0.219, p = 0.005).

4. Discussion
The purpose of the present study was to investigate whether and how fWHR correlates with objective performances among cadets at the KMA. The results indicated that, for male cadets, fWHR was inversely correlated with objective performances, whereas for female cadets, fWHR was not significantly correlated with performances, except for physical performance.

The current findings are inconsistent with previous research that found a positive relationship between fWHR and performances in males. Although it is unclear why male cadets’ fWHRs was negatively associated with performances, we speculate several possible reasons. First, one notable study found that facial appearances of social skill (likability, trustworthiness, and social competence), but not power (dominance and facial maturity), predicted rank in the mafia group, where traits of power are normative (Re & Rule, 2017). However, those of power, but not of social skill, predicted rank among executives in law firms, where the traits of social skill are highly valued (Re & Rule, 2017). Likewise, the facial appearance of dominance (i.e., wider faces), assumed to be normative in the military, might be ineffective for performances in male cadets.

Second, the KMA emphasizes cohesion, commitment to group, and organizational identification, so cadets work collaboratively in academic courses, military training, and physical education courses. A high portion of performance scores thus represents cadets’ collaborative teamwork. In this respect, trustworthiness rather than dominance might be valued higher. Hence, raters at the KMA (e.g., professors, discipline officers, peer cadets) would perceive cadets with higher fWHRs as less trustworthy (Stirrat & Perrett, 2010), resulting in lower grades.

Furthermore, the current results among the KMA cadets did not correspond with the positive association between facial dominance and military rank among the USMA cadets (Mazur et al., 1984; Mueller & Mazur, 1996). The difference in cultural of the KMA and USMA (i.e., Eastern culture and Western culture) might result in this discrepancy. For example, Rule et al. (2010) found that perceived facial warmth (trustworthiness and likability) predicted the preferences for Japanese politicians, whereas perceived facial power (dominance and facial maturity) predicted the endorsement of U. S. politicians. The findings of Rule et al. (2010) suggest that trustworthiness-related traits are preferred in Eastern culture whereas dominance-related traits are endorsed in Western culture. Given this, higher fWHR might negatively influence their performances among the current sample in Eastern culture.

It is noteworthy that this study addresses some deficiencies in the fWHR literature illustrated by Kosinski (2017) and Wang et al. (2019), including a reliance on self-reported data and small sample size. This study examines the relationship between fWHR and objective performances with a large sample (n = 912) and high power (i.e., 89%). Furthermore, we use photos that are strictly standardized in size, direction of eye gaze, and head tilt, which could influence fWHR estimates (Kramer, 2016;
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Witkower & Tracy, 2019). Finally, this study extends fWHR research by using a rare sample of military cadets that have not been examined in the fWHR literature to the best of our knowledge.

Despite this contribution, it should be noted that participants were cadets at the KMA, which raises concerns regarding the generalizability of the results to the military. Thus, it would be interesting to examine how fWHR associates with performances among active-duty officers in a future study. Furthermore, null correlational effects among female cadets in this study should be interpreted with caution, given that the sample size of female cadets was small (i.e., \( n = 69 \)). Future research would therefore benefit from a larger sample of female cadets for clarifying the relationship between fWHR and performances. Finally, prior studies suggest that higher BMI (Body Mass Index) is associated with larger fWHR (e.g., Geniole, Denson, Dixson, Carré, & McCormick, 2015). Future work should examine the association between fWHR and performances among cadets, controlling for BMI.

5. Conclusion

This work suggests that fWHR is negatively associated with performances, especially in male cadets across several objective facets. The findings highlight the potentially important role of the domain within which fWHR correlates with critical outcomes. Future studies should consider the effect of individual facial structure on performance and how it interacts with the culture and characteristics of the respective organizations.

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