Physical Characteristics and Performance of Starters and Non-Starters in Elite-Level Female Soccer Players in College: A Case Study of Japanese Athletes

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[Received February 19, 2021; Accepted March 1, 2022]

This research aimed to elucidate whether there were differences in physical characteristics and performance across starter and non-starter players in Japanese elite-level female soccer in college. Twenty-four college players (age: 19.8 ± 0.8 years, body height: 160.3 ± 4.0 cm, body mass: 55.2 ± 5.2 kg) participated in this study. We assessed the college players in the field and laboratory on two separate days. We found a significantly low value in the starter players' group than the non-starter players' group in the 10-m sprint and 5 × 10-m shuttle run. For the maximum isokinetic contraction, 300°/s of hip extensor as concentric in the starter players was significantly higher than that of the non-starter players, and we found no statistical differences in the other laboratory-based assessments. This study suggested that although there was no significant difference in maximal muscle strength between starter and non-starter players, non-starter players may be inferior in field tests.

Keywords: women's soccer, sprint, agility, jump, isokinetic strength

[Football Science Vol.19, 49-58, 2022]

1. Introduction

Modern soccer has turned into a sport that requires athletes with enhanced physical ability who can run at high speeds repeatedly. This is because parameters, such as sprint effort, high-speed running distance (Zhou et al., 2020), and the number of maximum sprints, are increasing with each passing year (Barnes et al., 2014; Wallace and Norton, 2014). Physical performance has become a means for monitoring and identifying young players at the national and international levels. A large majority of these high-intensity activities take place during offensive or defensive actions and goal-scoring opportunities, possibly having a huge impact on game outcomes (Faude et al., 2012). In fact, in the 2018 World Cup, midfielders in the winning team displayed a longer high-speed running (>25 km・h^{-1}) distance than those in the losing team. Moreover, the losing team's high-speed running distance was found to reduce strongly in the second half of the game, which suggested that continuous high-intensity movement is a factor that contributes to winning (Ugalde-Ramírez., 2020).

Female soccer players have been found to be at a greater risk of developing injuries, such as those associated with the anterior cruciate ligament, which force them to leave the game (Lin et al., 2018) and have 21% more absence caused by injury compared with male soccer players (Larruskain et al., 2018). In addition, the menstrual cycle reportedly results in injury occurrence and a decline in physical performance (Martin et al., 2021). These findings propose that there is a high possibility of female soccer players being replaced more frequently than male soccer players. Therefore, if a soccer team wishes to maintain its strength at a high level throughout the season, the physical strength level of the nonstarters should be maintained as high as that of the starters. A previous study on female soccer players from the National Collegiate Athletic Association (NCAA) Division I collegiate team (Risso et al., 2017) compared the physical ability of starters (n = 10) and nonstarters (n = 12) and evaluated their 30-m sprint time, pro-agility test, and Yo-Yo intermittent recovery test level 1 (YYIR1) scores. No statistical differences were observed between the nonstarters and starters. This finding suggests that the individual players on high-level teams, such as NCAA Division I, have similar levels of physical strength.

Alternatively, Scott et al. (2014) compared the duration of standing (<0.7 $km \cdot h^{-1}$), walking (0.7–7.2 $km \cdot h^{-1}$), jogging (7.2–14.4 $km \cdot h^{-1}$), running (14.4–19.8 $km \cdot h^{-1}$), fast running (19.8–25.2 $km \cdot h^{-1}$), and sprinting (>25.2 $km \cdot h^{-1}$) during training, including a full pitch simulation game, and the actual games for male soccer players. They reported that standing, walking, and jogging during training and the actual games occurred 48.0%, 34.0%, 13.0%, and 2.7%, 59.7%, 26.1%, respectively. Thus, because the physical intensity and load in training are lower than those in the actual game, the possibility of the physical performance level of nonstarters declining with few opportunities to participate in the actual game is a matter of concern. However, because only two previous studies (Manson et al., 2014; Risso et al., 2017) compared the features and performance of female starters and nonstarters, further investigation is required to understand the differences between these two groups.

To our knowledge, no study has investigated the physical features and performance of Japanese elite-level female soccer players in college. Therefore, this study verified whether differences existed in Japanese elite-level female soccer players (starters and nonstarters) in college in terms of physical features and performance. It was hypothesized that there would be no significant difference between the starter and nonstarter groups if the Japanese elite-level female soccer players were found to possess superior competitiveness, as observed in a previous study (Risso et al., 2017).

2. Methods

2.1. Participants

Twenty-four elite-level female soccer players of the Kanto female soccer Division 1 were recruited in 2017 (**Table 1**). This team won the All-Japan University Women's Soccer Championship three times consecutively. The participants in this study had no injuries in the muscles of their lower limbs for 6 months before the experiment. The competition history of starters and nonstarters was 15.2 ± 1.4 years and 14.9 ± 2.1 years, respectively, with no statistical difference between groups. This study targeted the starters and nonstarters who participated in the finals when they won the 2017 All-Japan University Women's Soccer Championship. They participated in this study in February after finishing the 2017 season. The official appearance number in games for the starters and nonstarters in the 2017 season was 37.0 ± 2.6 and 4.3 ± 1.5. Throughout the year, the starters in this study were found to be regular members and showed only few instances when they were absent in games due to injuries. After being thoroughly

Table 1 The number of people in each position and the morphological characteristics of all participants

Variable	All (n = 24)	Starter (n = 11)	Non-starter (n = 13)	*P* value (A-B)	Effect size (*d*)	Magnitude
Forward	5	2	3	–	–	–
Midfielder	10	5	5	–	–	–
Defense	9	4	5	–	–	–
Age (year)	19.8 ± 0.8	20.1 ± 0.8	19.6 ± 0.7	0.163	0.62	Moderate
Height (cm)	160.3 ± 4.0	161.5 ± 4.1	159.4 ± 3.7	0.231	0.53	Small
Body mass (kg)	55.2 ± 5.2	56.4 ± 4.4	54.2 ± 5.5	0.323	0.43	Small
Muscle mass (kg)	24.4 ± 2.1	25.1 ± 1.5	23.8 ± 2.3	0.113	0.69	Moderate
Body fat mass (kg)	11.5 ± 2.7	11.3 ± 2.8	11.6 ± 2.6	0.820	-0.10	Trivial
Percent of body fat (%)	20.6 ± 3.6	19.9 ± 3.5	21.1 ± 3.7	0.427	-0.35	Small

informed about the purpose of this study and the potential risks associated with it, written informed consent was obtained from participants. This study was conducted according to the guidelines of the Declaration of Helsinki.

2.2. Experimental procedure

This study was divided into field and laboratory-based assessments and conducted on different days. Field-based assessments included a 40-m sprint, zig-zag test, 5 × 10-m shuttle run, ball speed, vertical jump, 5-jump test, and YYIR1. The participants wore soccer shoes that they were accustomed to wearing daily, and field-based assessments were conducted after sufficient warm-up on artificial turf soccer grounds. The order of field-based evaluation was randomized to reduce the effect of fatigue bias.

Laboratory-based assessments included maximum voluntary isokinetic contraction and morphological measurements. Maximum voluntary isokinetic contraction, concentric and eccentric contraction of the knee joint's extension/flexion muscle group, and hip joint were adopted. Body mass, muscle mass, body fat mass, and body fat percentage of the players were measured using a multifrequency impedance body composition analyzer (InBody720, Inbody Japan Inc., Tokyo, Japan). Body height of the players was measured using a wall-mounted stadiometer (SECA213, Yagami Inc., Nagoya, Japan) (Yamaguchi et al., 2020b).

2.3. Forty-meter sprint test

The 40-m sprint test was assessed using a timing gate (Brower Timing Systems, Utah, USA). It was set approximately 1 m above the ground at a starting point of 0, 10, and 40-m. Participants stood 0.5 m behind the starting point and chose when they wanted to start. This test was performed twice, and participants were instructed to recover before starting again. The fastest of the two sprint times was used for further analyses (Steffen et al., 2008).

2.4. Agility tests

The agility of participants was determined using the zig-zag test and 5 × 10-m shuttle run test.

The zig-zag test consisted of four 5-m sections marked with a stick set at 100°. Participants were instructed to decelerate and accelerate as fast as possible around each stick. The timing gates were installed at the starting point and both goal points, and participants stood 0.5 m behind the starting point and chose when they wanted to start (Aquino et al., 2018).

The 5 × 10-m shuttle run was required to be performed alternately using the left and right feet and repeated 180° turn four times, using the timing gates (Brouwer Timing Systems, Utah, USA). Participants ran 2.5 times between lines drawn 10 m apart and then sprinted for 10 m in a straight line. Participants stood 0.5 m behind the starting point and chose when they wanted to start. These tests were conducted twice and participants were instructed to recover before starting again. The fastest of the two sprint times was used for further analyses (Hirose and Seki, 2016).

2.5. Shooting speed test

Following their decision regarding the angle and distance to kick the ball, participants kicked the stationary ball toward the target (width 3.00 m, height 2.00 m), which was located at 15 m,. The pressure of the ball was adjusted to 11 psi using a pressure measurement device. Participants were asked to kick the ball with maximal velocity in order to strike the target. The ball speed was evaluated using a radar speed gun (Bushnell, Overland Park, KS, USA), having an accuracy of ±2 kph. The radar recorded the highest speed between the participants kicking the ball and the ball reaching the goal. The highest speed rate among the three measurements was used for further analyses (Cerrah et al., 2011).

2.6. Power outputs in vertical jump and 5-jump test

The vertical jump and 5-jump tests were used for the indirect measurement of leg power.

The vertical jump was evaluated thrice using a jump meter (Jump MD, Takei Scientific Instruments Co., Niigata, Japan). First, participants were instructed to swing their arms during the jump because their arms would generally be used while jumping during a game. Next, participants were asked to bend their knees in a standing posture until their thighs were parallel to the ground and then perform a vertical jump. They were asked to jump vertically without moving backward or forward or to the left or right. The greatest height achieved during this test among the three measurements was used for further analyses (Lockie et al., 2018).

For the 5-jump test, participants positioned themselves at the starting line with their feet apart at shoulder width. Then, they jumped four times with no running start, alternating between their left and right foot. A tape measure was used to evaluate the shortest distance from the starting line to the heel of the rearmost landing foot. When participants lost their balance and fell backward, either landing on their buttocks or with their hand on the landing point, the distance from the starting line to their hand or buttocks was measured. The most extended length among the two measurements was used for further analyses (Baklouti et al., 2017).

2.7. Yo-yo intermittent recovery test level 1

The YYIR1 test was used to evaluate the speed endurance of the players. First, participants teamed up in pairs. While one repeated a 20-m round trip according to a sound signal, the other recorded the number of runs. They were required to continually notice the false start and make a strict judgment of success or failure. The measurement was performed only once, and participants ended the test when they could not make it on time for the sound signal twice (Hasegawa and Kuzuhara, 2015).

2.8. Maximum voluntary isokinetic contraction

The player's knee and hip extensor/flexor maximum voluntary isokinetic concentric and eccentric contraction on their dominant side (MVICC and MVIEC) was assessed using an isokinetic dynamometer (BIODEX System 3, Biodex Medical Systems, Shirley, NY, USA). Before the measurements, the participants were briefed on the MVICC/MVIEC measurement safety and were asked to put in maximum effort in each trial. The angular velocity of the dynamometer was 30°/s and 300°/s during MVICC and 30°/s and 180°/s during MVIEC in each joint. The number of contractions was noted to be 30 and 300°/s at MVICC and 30 and 180°/s at MVIEC thrice for the players, considering that fast MVICC, such as 300°/s, was performed five times.

The knee extensor/flexor measurements were taken while sitting, wherein participants sat in chairs with the knee and hip joint at 90°. Participants extended the knee joint from flexion (90°, starting position) to extension (180°, end position), during which the investigator cheered them to do their best (Lee et al., 2009).

The players then performed the hip extension/flexion while standing and grasping a firmly secured pole during the stability test. Participants extended the hip joint from extension (15°, end position) to flexion (60°, starting position), during which the investigator cheered them to do their best (Dean et al., 2004).

2.9. Statistical analyses

The values were expressed as mean ± SD. The Shapiro–Wilk test was used for normal distribution analysis. The Mann–Whitney U test was used for different assessments because both groups' non-normal distribution in all measurements was confirmed (Yamaguchi et al., 2020a). The Mann–Whitney U test was conducted using the predictive analytics software version 25.0 for Windows (SPSS Japan Inc., Tokyo, Japan), and the statistical significance was set at a p value of <0.05. For the difference between the two groups, the effect size was calculated using Cohen's d in addition to the Mann–Whitney U test, and $|d|$, ≦ 0.2 was considered a trivial effect, $0.2 < |d| ≦ 0.6$ a small effect, $0.6 < |d| ≦ 1.2$ a moderate effect, and $2.0 < |d|$ a large effect (Hopkins, 2010).

3. Results

Table 1 presents the individual physical qualities of both groups. No significant differences were observed in any of the physical qualities measured.

Figure 1 indicates the field-based assessment values in both groups. The 10-m sprint time and the 5 × 10-m shuttle run time were significantly lower with moderate effects in the starters than in the nonstarters (p = 0.046, d = −0.924 and p = 0.039, d = 0.828, respectively).

Figure 2 presents the laboratory-based assessment values of both groups. Considering 300°/s of hip extensor as the MVICC, the value obtained by the starters was significantly higher (p = 0.032, d = 0.989) than that obtained by nonstarters. No statistical differences were found in the other laboratory-based assessments.

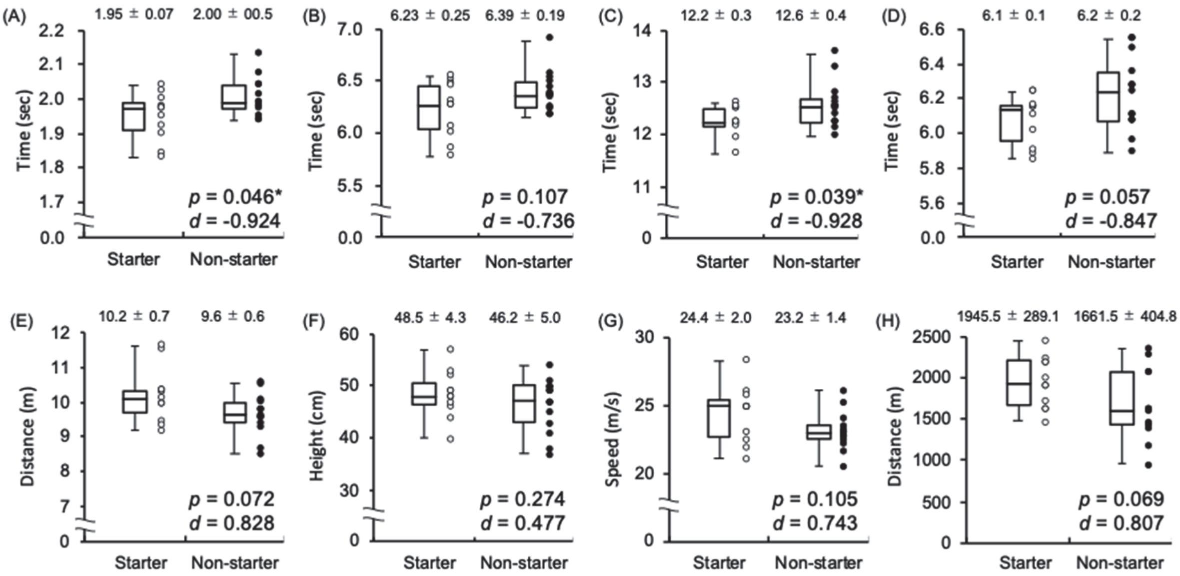
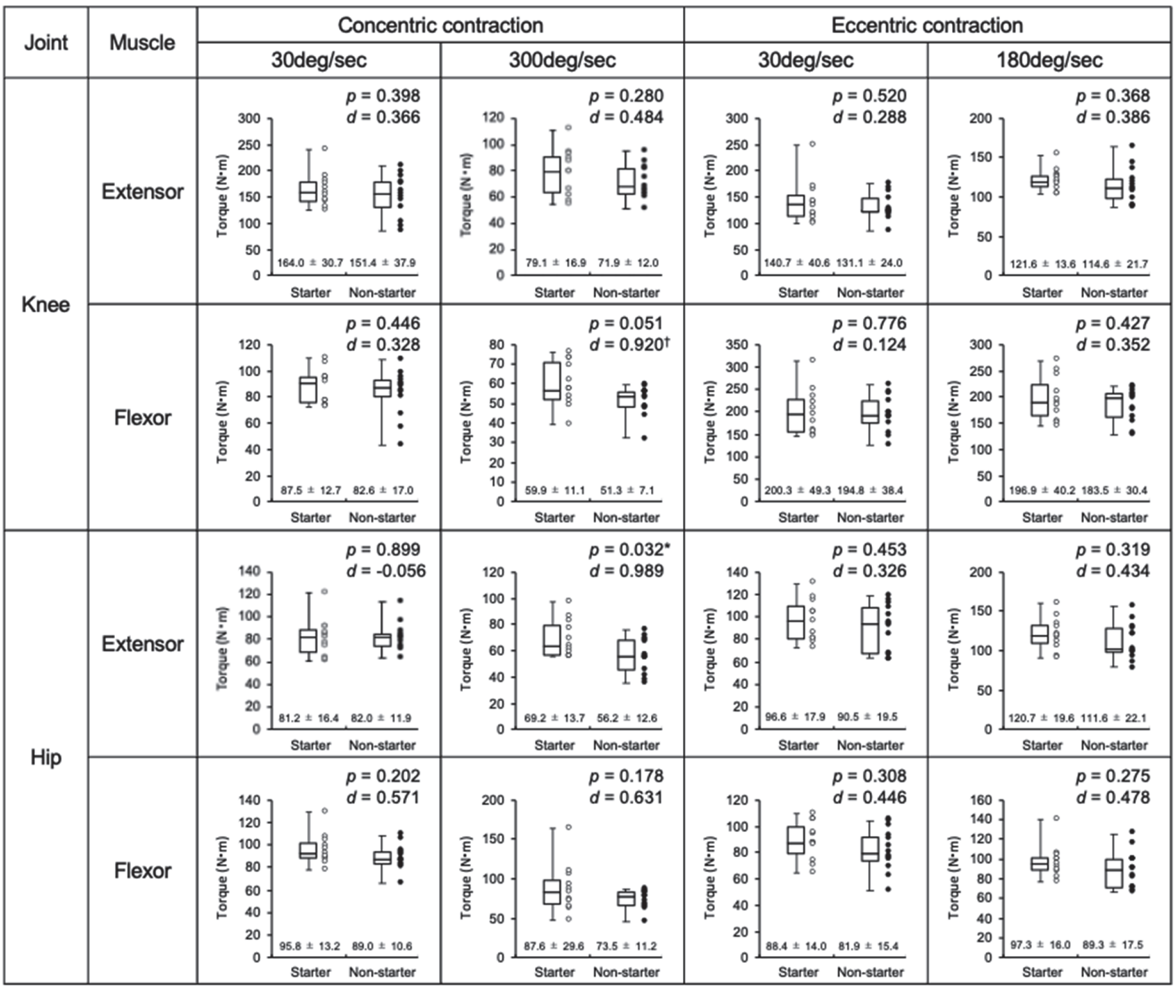


Figure 1 The difference in the values of the field-based assessment between starter and non-starter players

The consequences of the field test were shown. A: 10-m sprint, B: 40-m sprint, C: 5 × 10-m shuttle run, D: Zig-Zag test, E: 5-jump test, F: vertical jump, G: ball speed, H: Yo-Yo intermittent recovery test level 1. *p < 0.05.



$^{*}p < 0.05$. † : Moderate

Figure 2 The difference in the values of the laboratory-based assessment between starter and non-starter players

4. Discussion

This study compared the physical features and performances of Japanese elite-level female soccer players (starters and nonstarters) in college. No significant difference was noted in any of the physical characteristic measurements. In terms of physical performance, the 10-m sprint and the 5 × 10-m shuttle run values of the starters were lower than those of the nonstarters. In laboratory-based assessments, the hip extensor as MVICC was higher at 300°/s for the starters.

4.1. Anthropometric

In this study, no significant differences were found between ages and muscle volume. A previous study comparing the physical features and performance within each age group (U17/U20/senior) of female soccer players from New Zealand that categorized players as starters and nonstarters found no difference in terms of age between these players in all categories (Manson et al., 2014). Thus, within the category of 3–4 years, age may not affect competitiveness. Alternatively, this cannot be applied to puberty, wherein growth is more rapid. The older and early maturation group of U15 athletes reportedly had superior values in the 50-m sprint and 5-jump tests compared with the younger and later maturation groups of U15 (Itoh and Hirose, 2020). Therefore, the effect of age is expected to be strongly felt until adolescence; however, this does not mean that the age difference in starters and nonstarters would have a considerable impact. The fact that the subjects in this study were athletes who had post-adolescence supports the above results.

In terms of muscle volume, according to Konarski et al. (2020), a comparison of the muscle mass of the selected group and the non-selected group of U15 male soccer players showed that the muscle mass of the selected group was 45.5 ± 5.0 kg and the muscle mass of the non-selected group was 40.9 ± 6.8 kg, which showed a statistically significant difference. Meanwhile, in a study examining the lean body mass of the select group and the non-select group of U15 male soccer players, no statistical difference was found. The lean body mass of the selected and non-selected groups was 53.4 ± 5.9 kg and 50.0 ± 6.9 kg, respectively (Tsukoshi and Asai, 2010). The muscle mass inferred from the lack of a specific finding on the relationship between muscle mass and competitiveness may not be the only factor determining competitiveness. However, soccer is a contact sport with frequent collisions between players. To gain an advantage over their opponent during contact, it is vital for players to increase their body mass. The same can be said for other contact sports. A study comparing the physical features and performances of American football players in the National Football League (NFL) and the Japanese national team practically reported that the NFL players with better performance had higher body weights (Yamashita et al., 2017). Although soccer is a contact sport, it is also an endurance sport where a player runs for approximately 9–12 km in a single game (Sausaman et al., 2019; Bradley et al., 2014). Therefore, rather than building up the body, which is inadequate, optimum weight and muscle mass need to be achieved based on competitive qualities. A 16-year study of the height, weight, and body mass index of the top 100 annual record holders in the 100, 200, 400, 800, 1500, 3000, 10,000-m, and full marathon in track and field reported that there was a decline in weight with an increase in running distance in the competition (Sedeaud et al., 2014). Therefore, in order to play soccer, which includes the element of endurance, players should increase their muscle mass to increase their resistance to contact and to obtain a physique suitable for running long distances.

4.2. Physical performance

In this study, starters performed better in field tests except for the vertical jump than nonstarters. Besides, the time taken by starters to complete the 10-m sprint and 5 × 10-m shuttle run was significantly low (**Figure 1**). Tsukoshi and Asai (2010) assigned junior youth, youth, and professional level athletes to select and non-select groups and investigated the differences in the 10, 30, 50-m sprint, 5 × 10-m shuttle run, vertical jump, and 5-jump test between these groups. The results indicated that the values obtained for 10, 30, 50-m sprint, and 5 × 10-m shuttle run were significantly lower in the selected groups in all categories. Moreover, to examine the discriminant factors between selected and non-selected players, a discriminant analysis was performed to calculate the reverse discrimination rate of each measured item. This analysis exhibited high discriminant variability in the 5 × 10-m shuttle run and the 10, 30, and 50-m sprint in all categories (Tsukoshi and Asai, 2010). These results indicate that the sprint and 5 × 10-m shuttle run are the tests that reflect the differences in performance levels. Thus, a significant difference in the 10-m sprint and 5 × 10-m shuttle run was found in this study because these measurements could detect the performance level of players rapidly.

In addition, the difference between the groups in this study was not only apparent during the vertical jump, rather the vertical jump had already matured in the nonstarter player's group. A previous study that investigated vertical jump height with arm swing in top and reserve players from a club in the Northern Premier League in England indicated that 12 weeks of speed, agility and quickness training, including power improvement training, improved the vertical jump height from 39.9 ± 3.32 cm to 46.6 ± 3.23 cm (Polman et al., 2014). These findings were similar to those observed in case of the starters and nonstarters in our study. Therefore, it is possible that the participants from the study's groups were already at their highest physical level, near the female athletes' upper jumping limit. Nonetheless, such a level is not directly associated with their athletic performance, which was contrary to the observation made in case of sports directly associated with jumping, including volleyball and triple jump. Compared with other previous studies on measurements other than vertical jump, the values obtained via YYIR1 were reported to be 780–1379 m (Hammami et al., 2020; Mujika et al., 2009; Martínez-Lagunas et al., 2014), whereas those obtained via YYIR for participants in this study were a minimum of 1000 m and 2500 m at the highest. Therefore, the target teams in this study outperformed the university female soccer players not performing at the national level in other countries. Besides, a study that measured the physical performance of NCAA Division 1 female soccer players reported a 10-m sprint of 1.974 ± 6 s and YYIR1 of 1700 ± 800 m (Lockie et al., 2018). This result is higher than that for nonstarters and similar to that of starters in this study. Furthermore, it was reported that Japanese U13 male soccer players had a 40-m sprint of 6.14 ± 0.33 s, a 5-jump test of 10.57 ± 0.54 m, and a 5 × 10-m shuttle run of 12.44 ± 0.54 s (Hirose and Seki, 2016), and this result is also similar to that of starters in this study. Based on these previous studies, the physical performance of starters in this study appears to be similar to that of NCAA Division 1 female soccer players and partially similar to that of Japanese U13 male soccer players.

4.3. Muscle strength

In this study, a statistically higher value was observed in starters in terms of the maximum isokinetic concentric strength performed by fast contractions such as an angular velocity of 300°/s. (**Figure 2**). Studies investigating the duration of movements performed in many sports, such as vertical jumps and sprints, indicated that most movements are completed within 0.3 s (Taber et al., 2016). Therefore, movements in many sports are assumed to exert a large and strong force in a limited time. Work per unit time is called "power," and the amount of power output is a factor that contributes to the improvement of competitive performance because there is a limit to the operating time in many sports. Based on these findings, the effectiveness of training that emphasizes fast speed, called velocity-based training, has also been clarified recently (Gonzalez-Badillo et al., 2015; Mann et al., 2015). Therefore, why starters showed a significantly higher isokinetic maximal strength than nonstarters only in fast contraction in this study may be because fast contraction, a factor of power output, is required for high athletic performance.

Moreover, when we compared the maximum isokinetic strength values observed in this study with those observed in studies conducted in other countries, a higher value was observed in the field test. A study that measured isokinetic maximal muscle strength in 17 international level female soccer players in Brazil reported that 60°/s of the knee flexor was 91 ± 18 N•m, 60°/s of the knee extensor was 169 ± 27 N•m, 300°/s of the knee flexor was 60 ± 9 N•m, and 300°/s of the knee extensor was 83 ± 12 N•m (Andrade Mdos et al., 2012). Besides, a study measuring 60°/s of the knee extensor/flexor among female soccer players in each category (U17/U20/senior) from New Zealand indicated that flexion was 89.3 ± 20.0 N•m and extension was 119 ± 24.5 N•m in U17, flexion was 104 ± 13.2 N•m and extension was 114 ± 24.7 N•m in U20, and flexion was 101 ± 18.7 N•m and extension was 135 ± 36.3 N•m in seniors (Manson et al., 2014). Based on these reports, it was understood that the isokinetic muscular strength of female soccer players at the international level compared with that of female players from other countries is not that different in terms of the values confirmed in this study. Therefore, the starters and nonstarters in our study had equivalent muscle strength levels compared with players from other countries. Alternatively, to our knowledge, there has been no research on the constant velocity of muscle strength of the hip joint in a standing posture for female soccer players. Sprint and agility, which are essential for the physical performance of soccer players, require the development of horizontal force (Brughelli et al., 2011), and this is necessary to improve hip extensor strength (Williams et al., 2021). In the same way that force production during sprinting cannot be adequately measured using ground reaction force measurements during vertical jumping movements, assessing physical performance measurements using a method similar to the assumed competitive movements is desirable (Morin et al., 2011). Therefore, improving our knowledge of hip muscle strength measurements, as performed in this study, in the standing position, which is similar to soccer movements, rather than in the supine or lateral lying positions, would be essential.

While there was no difference between the performance levels of female soccer players at elite universities in and those in other countries, there was a clear difference between the starters and nonstarters in this study. A previous study examining the performance of starters and nonstarters in NCAA Division 1 female soccer players reported no difference in performance levels between the two groups (Risso et al., 2017). Based on this knowledge, it was suggested that Japanese female soccer organizations should be aware of the shallow bench problem even at the top level of Japanese universities. In Japanese female university soccer, a clear distinction exists between the tournaments of A and B teams. Generally, the A team plays 50–60 games per year, whereas the B team plays only six times per year (Japan University Woman Football Aassociation official website, 2017). The difference in game frequency between the teams was suggested to be a factor that contributes to lowers the competition and performance level in the nonstarter players.

This study contributes to the literature by providing normative data for coaches, trainers, and clinicians working with elite and international level female soccer players. Particularly, comparing the results of this study with those of other studies may aid in understanding the weak and strong points of in-team performance. It may determine training content that the team should prioritize. Nonstarters were found to have fewer opportunities of exposure to the actual game than the Japanese starters. The training, including a full pitch simulation game held within practices, was reportedly not considered a part of the work volume, including running and the number of sub-maximum sprints (Scott et al., 2014). Therefore, actively providing nonstarters with opportunities to participate in actual games so as to raise their level within the team is essential. Besides, the quality performance levels of a few nonstarters in this study were similar to those of starters (see **Figure 1**, nonstarters). Particularly, the values obtained by some nonstarters for zig-zag test, vertical jump, and YYIR1 were similar to those obtained by the top-level starters, whereas the sprint did not show any such tendency. This result indicates that there may be strengths and weaknesses in each physical performance parameter among the nonstarters. Therefore, it would be desirable for the physical coach of each team to develop a training strategy that prioritizes the weak points of each player based on their test results in order to boost their performance.

5. Conclusion

This study elucidated whether differences existed in Japanese elite-level female soccer players (starters and nonstarters) in college. In terms of physical performance, the 10-m sprint and the 5 × 10-m shuttle run values of the starters were lower than those for the nonstarters. Considering 300°/s of hip extensor as the MVICC in terms of the maximum isokinetic contraction, the values shown by starters was significantly higher than those shown by nonstarters, and no statistical differences were found in other laboratory-based assessments. This study revealed that physical qualities and performance in Japanese elite female soccer players are not substantially different from those of soccer players in other countries; however, remarkable results were observed in YYIR1 and vertical jump tests. The fact that there was a difference between the starters and nonstarters should be seen as a problem. Therefore, it may be necessary to actively increase the number of opportunities for nonstarters in order to improve the level of physical strength of each team and that of the country as a whole.

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- Japan Society of Physical Education, Health and Sport Sciences
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