Materials : Football (Soccer)

Anthropometric and physical ability in youth soccer players in Japan, Korea, China, and Germany

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We compared the physical and motor ability of youth soccer players in Japan, Korea, China, and Germany. Then, we clarified the physical characteristics of young Japanese players. We examined the physique, level of physical fitness, and motor ability of top-level young players from these countries using the following relatively common field test items in accordance with the Japan Football Association (JFA) Physical Measurement Guidelines (2006): body height, body weight, percent body fat, 10-m sprint, 30-m sprint, 50-m sprint, shuttle run (10 m × 5), vertical jump, standing 5-step jump, and Yo-Yo intermittent recovery test. Our main results were as follows: 1) Regarding physique (height, weight, and lean body mass), Japanese players showed the lowest values. 2) Japanese players achieved the fastest times in the 10-m sprint. Japanese players with lower height tended to perform better in 10-m sprints than in the other sprints. 3) Japanese players were the fastest in 10 m × 5 shuttle runs. Speed of Agility was one of the physical characteristics of Japanese players. 4) Players from the 4 countries showed no significant differences in the vertical jump.

Keywords: Soccer, Physical fitness, Motor ability, Talent

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1. Introduction

Japan's national U-23, U-20, and U-17 soccer teams have placed in Asian qualifiers and played in world cup tournaments. In addition, their achievements in a wide range of competitive tournaments have been remarkable. Up until the 2002 world cup, Japan was usually eliminated in the preliminary stage, dashing its hopes to move to the finals. However, they have steadily closed the gap separating them from the world's top-level teams, winning in the preliminary stage and finishing in the top 16 at the 2002 and 2010 world cups. At the 1999 U-20 world cup, young soccer players achieved impressive results; however, abilities among teams with older players continue to differ from the world's top level teams. The apparent differences in physical ability as well as technique and tactics between youth soccer players of Japan and the world's top level teams suggest the importance of identifying and training players with potential to reduce such differences.

Soccer games are 90-minute matches, and ball possession time per player is approximately two minutes (Reilly, 1994). In addition to ball possession, each player is engaged in a wide range of movements without the ball, such as jogging, sprinting, and jumping, with total distance covered during a game being approximately 10 to 13 km (Stolen, 2005). For each 10 km moved, distance covered with the ball measures only 3.7% (Silva, 2007). Of the total distance covered during a game, the time when each player is engaged in intermittent sprinting accounts for 1 to 11% (Wong, 2009). These figures show that the time during which soccer players are in possession of the ball is extremely short, and that the majority of time involves high-intensity movement without the ball. This suggests the importance of physical as well as technical and tactical elements (Bangsbo, 2006).

Physical and motor abilities are components of talent in soccer players (Nishijima, 2002). Talent is classified into five areas; namely, individual technique, individual tactics, physique and physical and motor abilities, intelligence and personality, and growth potential. Of these, three are considered the major areas: physique and physical and motor abilities, individual technique, and individual tactics. Physical and motor abilities include five subcategories; namely, speed, stamina, power, agility,

and coordination (Nishijima, 2002). In addition, many studies report significant differences in muscle mass with regard to physique, and in speed and agility with regard to physical and motor abilities. These findings suggest the importance of physical and motor abilities as elements in the effective identification of talented players (Williams and Reilly, 2001; Nishijima and Yamada, 2002; Relavas et al., 2008; Hirose and Fukubayashi, 2008; Hirose, 2011).

However, the majority of studies focusing on physique and physical and motor abilities come from Europe and the US. In fact, there are almost no comparable studies on top-level Japanese youth soccer players. The Japanese Football Association (JFA) Physical Fitness Project (2006) reported that the mean height of players on the Japanese team in the U-20 world cup 2005 was 17th among the 24 teams, and mean weight was the lowest. It was also reported that mean maximal oxygen consumption (VO2 max) and 10m sprint of players on the Japanese team were higher than those of players on the French team, while mean height, weight, and lean body mass, and vertical jump of players on the Japanese team were lower than those of players on the French team. Franck Le Gall (2002) compared height and weight between Japanese and French players and reported that there were no significant differences between two groups up to 16 years of age; however, the differences in weight were significant thereafter.

These measurements were not conducted with the same devices and methods. They were the results of the comparison in measurements conducted in different countries by different examiners. Instructors, including coaches, need to employ measurements and methods to assess physical and motor abilities that are useful and easy to conduct, and which place a lower burden on players. This study was conducted by the same examiners employing the same field tests.

Recently, Germany has become a top level country in competitions at both the national and club-league levels. In Asia, Korea has the most world cup appearances; and Korea and Japan are the top two countries in Asia. In China, while the national team has yet to fulfill its potential, one club team has competed in the Asia championships and is considered to be one of the stronger teams in Asia. Considering the performance levels of individual teams, we selected German, Korean, and Chinese teams as the subjects of this study. Physical and motor ability measurements utilizing field tests have been conducted on J-League club teams; however, the data has not been disclosed due to individual team anxiety about releasing the information on tactics and selection standards to other J-League club teams (Hoshikawa, 2007). In this study, therefore, we gained approval of J-League club teams and overseas clubs to report data acquired in this study for the purpose of reporting academic results under the condition of not identifying specific individuals.

In this study, we measured physique and physical and motor ability in top-level youth soccer players in Japan, Korea, China, and Germany utilizing broadly employed field tests in accordance with JFA Physical Measurement Guidelines (2006) to clarify the characteristics of Japanese youth soccer players. Clarifying such characteristics is useful in identifying and training talented players from the viewpoint of their physical and motor abilities, and will contribute to reducing the gap between Japanese and the world's top-level players. Furthermore, the broad application of measurement items stipulated by the JFA Physical Measurement Guidelines increases both the convenience and ease of comparisons with data acquired in Japan. We examined results and extracted problems related to physical abilities for discussion on future training.

2. Method

2.1. Subjects

The subjects of this study were youth players (between 16 and 18 years of age) on teams that belong to top national leagues or players on teams that have risen to the best eight or higher positions in national-level tournaments in Japan, Korea, China, and Germany. We selected teams that belong to the top leagues in Japan and Germany, and teams that rose to the best eight or higher positions in national-level tournaments in Korea and China. Japanese, Chinese, and German teams were subsidiaries under professional clubs, and the Korean team was a high school team. The subjects were 37 Japanese, 25 Korean, 47 Chinese, and 50 German players (**Table 1**). Goalkeepers were excluded as subjects due to the characteristics of the position. All measurements were performed by the same investigator.

2.2. Measurement Period

Measurements were performed during the January preseason for Japanese, Korean, and Chinese players. German players were measured during their January winter break. Measurements were performed in winter in all four countries during daytime in temperatures between 5 and 10 degrees C.

2.3. Measurement Items

Measurement items in field tests of physical and motor abilities in this study are shown below (**Table 2**). An artificial turf was used for field testing of Japanese and Korean players, natural lawn was used for Chinese players, and an athletic field was used for German players. All subjects were wearing spike or training shoes designed for soccer. While it is desirable to have a unified ground surface for the measurements, due to the situations of individual club teams, weather conditions, and other considerations, we measured on different ground surfaces. Prior to measurement, all players warmed up for approximately 30 minutes following their customary routines. The number of measurements for each item differed due to limitations of time and individual club team programs. Details of the measurements are described below.

(1) Physique

We measured body height, weight, and percent

Table 1 Number and mean age of subjects

	Japanese	Korean	Chinese	German
Number	37	25	47	50
Average age	16.8±0.8	17.4±0.8	17.9±0.6	17.0±0.8

Table 2 Field Tests

Test	Ability	Units of Measurement
10m Sprint	Speed	Time(s)
30m Sprint	Speed	Time(s)
50m Sprint	Speed	Time(s)
10m×5 Shuttle run	Agility	Time(s)
Vertical Jump	Power	Distance(cm)
5 Step Jump	Power,Coordination	Distance(m)
Yo Yo Test	Stamina	Number

body fat. Percent body fat was calculated by measuring subcutaneous fat thickness under the triceps brachii and scapula utilizing a subcutaneous fat thickness meter (My Doctor manufactured by YAMASA) following the two-point method (Yamamoto, 2001). Lean body mass was also calculated with the obtained percentage body fat.

(2) 10-m, 30-m, and 50-m Sprint

Photoelectric measurement devices (manufactured by Brower) were set up at the starting point and at the 10-m, 30-m, and 50-m points. Subjects started at arbitrary times and the time required to travel to each device was measured. Measurement was performed once.

(3) Shuttle Run (10-m×5)

Subjects performed shuttle run (10-m×5) according to JFA Physical Measurement Guidelines. Subjects performed two and a half 10-m sprints, and time traveled was measured by photoelectric measurement device. Subjects started at arbitrary times. Measurement started when the following, not the leading, leg left the ground. Subjects were asked to turn using their left and right legs alternately to avoid the gaps between left and right legs. They practiced shuttle run twice and were measured once.

(4) Standing 5-step Jump

Subjects were asked to start from a standing position sans initial run up, and we measured the shortest distance from the starting point to the fifth step point. After subjects practiced twice, we measured twice and chose the higher result as the measurement value.

(5) Vertical Jump

Subjects were asked to jump utilizing their arms and legs. After they practiced twice, we measured twice with a digital vertical jump measurement device and chose the higher result as the measurement value.

(6) Yo-Yo Intermittent Recovery Test

We conducted Yo-Yo Intermittent Recovery Test Level 2 (YYIR2) in accordance with JFA Physical Measurement Guidelines. YYIR2 was developed as a field test to assess endurance, particularly recovery from higher intensity exercise during intermittent exercise (Bangsbo, 2008). Subjects were asked to run a 20-m circuit with an audible signal indicating start and finish. We measured total distance traveled. Subjects failing to return to the starting point by the audible signal were warned once and asked to stop the second time. Measurement was conducted once. Due to the weather conditions in Germany, measurement was performed in only three countries, Japan, Korea, and China.

2.4. Data Processing

All figures are expressed as mean ± standard deviation. After performing One-way ANOVA, differences in mean values among groups were evaluated by Sheffe's multiple contrast. Data was processed with statistical software SPSS STATISTICS Version 19.0. Significance in statistical testing was set at 5%.

3. Results

3.1. Physique

Table 3 shows physique measurement results from

Table 3 Anthropometric characteristics of players in each country (mean ± SD)

	Japanese	Korean	Chinese	German
Age	16.8±0.8	17.4±0.8	17.9±0.6	17.0±0.8
Height(cm)	173.0±5.3[b]	176.7±5.3	176.0±5.4	180.0±7.4
Weight(kg)	64.4±6.1[ab]	66.5±6.3	69.7±7.2	72.8±7.8
Lean body weight(kg)	57.5±5.2[ab]	59.3±5.2	61.6±5.4	65.1±6.7
Fat(%)	10.7±1.4	10.9±1.7	11.5±2.5	10.5±1.7
BMI	21.5±1.4[ab]	21.3±1.3	22.5±1.8	22.4±1.6

[a] Significantly different (P<0.05) from Chinese.
[b] Significantly different (P<0.05) from German.

players in the four countries. Mean body height was 173.0±5.3cm in Japanese players, 176.7±5.3cm in Korean players, 176.0±5.4cm in Chinese players, and 180.0±7.4cm in German players. Japanese players showed the lowest height among the four groups, and were significantly shorter than German players.

Mean body weight was 64.4±6.1kg in Japanese players, 64.4±6.1kg in Korean players, 69.7±7.2kg in Chinese players, and 72.8±7.8kg in German players. Japanese players showed the lowest weight among the four groups, and statistically significant differences from German and Chinese players.

No significant differences in percent body fat were observed among the four groups.

Mean lean body mass was 57.5±5.2kg in Japanese players, 59.3±5.2kg in Korean players, 61.5±5.6kg in Chinese players, and 65.1±6.7kg in German players. Similar to the body weight, Japanese players showed the lowest values among the four groups. Statistically significant differences were observed between Japanese and German players, and between Japanese and Chinese players.

Mean BMI was 21.5±1.4 in Japanese players, 21.3±1.3 in Korean players, 22.5±1.9 in Chinese players, and 22.4±1.6 in German players. Japanese players showed the second lowest values among the four groups. Statistically significant differences were observed between Japanese and German players, and between Japanese and Chinese players.

3.2. Physical and Motor Abilities

Table 4 shows physical and motor ability measurement results. The mean time for 10-m sprint was 1.80±0.08 seconds in Japanese players, 1.89±0.05 seconds in Korean players, 1.82±0.06 seconds in Chinese players, and 1.85±0.06 seconds in German players. Japanese players had the lowest (fastest) times among the four groups. Statistically significant differences were observed between Japanese and German players, and between Japanese and Korean players.

The mean time for 30-m sprint was 4.34±0.21 seconds in Japanese players, 4.42±0.12 seconds in Korean players, 4.32±0.13 seconds in Chinese players, and 4.30±0.12 seconds in German players. Japanese players showed the third lowest (fastest) times among the four groups. No statistically significant differences were observed among the four groups.

The mean time for 50-m sprint was 6.75±0.28 seconds in Japanese players, 6.88±0.21 seconds in Korean players, 6.68±0.19 seconds in Chinese players, and 6.64±0.20 seconds in German players. Japanese players showed the third lowest (fastest) time among the four groups. No statistically significant differences were observed among four groups.

Mean time for 10m×5 shuttle run was 11.25±0.32 seconds in Japanese players, 11.49±0.42 seconds

Table 4 Physiological characteristics of players in each country (mean ± SD)

	Japanese	Korean	Chinese	German
10m Sprint(s)	1.80±0.08[ab]	1.89±0.05	1.82±0.06	1.85±0.06
30m Sprint(s)	4.34±0.21	4.42±0.12	4.32±0.13	4.30±0.12
50m Sprint(s)	6.75±0.28	6.88±0.21	6.68±0.19	6.64±0.20
10m×5 Shuttle run(s)	11.25±0.32[b]	11.49±0.42	11.34±0.34	11.82±0.30
Vertical Jump(cm)	57.8±4.0	59.4±4.8	60.4±6.1	56.6±5.9
5 Step Jump(m)	12.24±0.68[b]	12.04±0.59	12.57±0.82	11.51±0.77
Yo Yo Test(m)	961.1±175.9	1066.7±306.9	987.7±231.8	

[a] Significantly different (P<0.05) from Korean.
[b] Significantly different (P<0.05) from German.

in Korean players, 11.34±0.34 seconds in Chinese players, and 11.82±0.30 seconds in German players. Japanese players showed the lowest (fastest) times among the four groups. Statistically significant differences were observed between Japanese and German players.

The mean height of vertical jump was 57.8±4.0cm in Japanese players, 59.4±4.8cm in Korean players, 60.4±6.1cm in Chinese players, and 56.6±5.9cm in German players. Japanese players showed the third highest value among the four groups. No statistically significant differences were observed among the four groups.

The mean distance for standing 5-step jump was 12.24±0.68m in Japanese players, 12.04±0.59m in Korean players, 12.57±0.82m in Chinese players, and 11.51±0.77m in German players. The mean distance for standing 5-step jump in Japanese players was the second highest (longest) among the four groups. Statistically significant differences were observed between Japanese and German players.

The mean distance for YYIR2 was 961.1±175.9m in Japanese players, 1066.7±306.9m in Korean players, and 987.7±231.8m in Chinese players. Japanese players showed the lowest value (shortest) among the three groups. No statistically significant differences were observed among the three groups.

4. Discussion

4.1. Physique

According to School Health Statistics published by MHLW (2011), mean body height in 17-year-old Japanese is 170.7cm, and mean body weight is 63.1kg. Japanese players in this study had greater height and weight than the mean value for 17-year-old Japanese high school students. In addition, studies on teams under J-League clubs report mean body height in 17 year olds as 172.4±6.7cm, and mean body weight as 64.8±6.9 kg. Similar to our study, among J-League club teams, mean height and weight were relatively close (Hoshikawa, 2007; Hoshikawa et al., 2012). Furthermore, mean U-17 Japan team height was 176.7cm, and body weight was 65.4kg, which was greater than those for Japanese players belonging to J-League club teams (JFA Physical Fitness Project, 2006). Certain studies published in Japan and overseas have reported higher values in each measurement in national team players than in players belonging to top-level teams in individual countries (Hoshikawa, 2002; Gall, F.L., 2008).

According to a comparison of teams that participated in the world cup for each age category and the Japanese national team (JFA Physical Fitness Project, 2006), mean body height in Japanese players at the U-17 world cup was 176.7cm, which represented the 11th place among the 17 teams, and mean body weight was 65.4kg, which was 14th among 17 teams. Mean body height in Japanese players at the U-20 world cup was 178.7cm, which was 17th among the 24 teams, and mean body weight was 71.4kg, which was the lowest among the 24 teams. Mean body weight in particular has been relatively lower, showing significant gaps in growth up to 20 years of age compared with other countries. The JFA Physical Fitness Project (2006) suggested body weight as a major element that had an impact on physical contact ability, which was weak in Japanese players.

In the present study as well, body height, weight and lean body mass in Japanese players were the lowest among the four countries. Japanese players showed significantly lower height compared with German players, and they were even lower than Korean and Chinese players. Weight and lean body mass in Japanese players differed significantly from German and Chinese players, and were even lower than Korean players. BMI in Japanese players was higher than in Korean players; however, it was significantly lower than German and Chinese players. Other studies conducted in Japan have also suggested the importance of considering muscle mass, which is associated with weight and lean body mass (Hoshikawa, 2007; Tsukoshi, 2010). Hoshikawa (2007) compared players who became professionals with those who did not. He suggested the importance of muscle mass and the possibility of lean body mass as an indicator of muscle mass. Regular soccer training is not enough to increase muscle mass to the level of professional soccer players. Hoshikawa also pointed out that the level of muscle mass was often extremely specific. Tsukoshi (2010) showed that selection of players in J-League club teams was influenced more by weight than height. Gustafsson (2009) argued that the latitude of the player birthplace was associated with height, and that environmental factors had a significant impact. These findings imply that while training has little impact on height, it is possible to increase weight and lean body mass along with the increase of muscle mass through training.

It is also possible that diet may have an impact on weight and lean body mass, which are possibly improved, although we did not investigate this in the present study.

4.2. Physical and Motor Abilities

According to the Physical and Motor Ability Survey conducted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the mean time for 50-m sprint, which is an indicator of running ability, in 17 year olds was 7.50±0.62 seconds. The mean time for 50-m sprint in Japanese players in this study was, of course, significantly higher than that for the average high school student. The 10, 30, and 50-m sprints are considered to be indicators of speed. Although the mean time for 10-m sprint in Japanese players was the lowest (fastest) among the four groups, mean times for 30-m and 50-m sprints were third lowest (fastest) among the four groups. Times for the 10-m sprint revealed significant differences between Japanese and German players, and Japanese and Korean players. Both 30-m and 50-m sprints showed no significant differences among the four groups. In the 10-m sprint, it is thought that pitch, which does not change significantly after 13 years of age, may have more impact on speed than stride, which is associated with height (Kato, 1994). Comparison between French and Japanese national teams by the JFA Physical Fitness Project (2006) revealed that mean time for 10-m sprint in Japanese players was faster than French players while French players showed better results in height, weight, and vertical jump than Japanese players. Furthermore, due to the relationship among physical scale, muscle strength and speed, shorter players dash faster in short-distance sprints, and taller players show faster top speed in the last half (Tanimoto, 2011). These findings suggest that the low mean body height of Japanese players may have produced the faster times in the 10-m sprint. It is also possible that the high mean body height of German players may have produced the faster times in the 30-m and 50-m sprints. Sprinting is divided into two phases, dashing (acceleration) and top speed (after acceleration); and the two phases shift completely at approximately the 20-m point from the start (Tanimoto, 2011). As for the measurements in this study, at the 30-m and 50-m points, which were completely different from the 10-m and 20-m points, speed may be reversed due to the influence of physique.

During 10-m×5 shuttle run, Japanese players showed the lowest (fastest) times among the four groups, and Japanese and German players showed statistically significant differences. The 10-m×5 shuttle run is an indicator of agility whose importance has been reported by a number of researchers at home and abroad. Tsukoshi (2010) reported that agility in 10-m×5 shuttle run had an impact on the promotion or retirement of junior youth players in J-League club teams. Thus, agility has been considered an important factor in physical and motor abilities when selecting players (Reilly, 2000; Vaeyens, 2006; Gil, 2007). Young (2002) classified agility into the ability to make decisions and change direction. We did not measure agility with regard to decision making, but the ability to change direction. The ability to change direction was divided into three factors, technique, sprint speed, and leg muscle strength. Among these factors, Japanese players showed the fastest times in 10-m sprint, which may have led to the faster times in 10-m×5 shuttle run. The ability to change direction was highly correlated with sprint speed (Young, 2002); therefore, high ability to change direction in 10-m sprint in Japanese players may have been related to the fact that Japanese players, whose mean height was low, were faster in 10-m sprint. Therefore, if Japanese players become larger, their 10-m sprint times will increase, and their ability to change direction will decrease. Since Japanese players measuring approximately 170cm in height are playing in German leagues, whose players' mean height is 183±6 cm (Bloomfield, 2005), high agility in Japanese players can be employed in dribbling and running to change direction against taller players. This suggests fast agility as a physical characteristic of Japanese players.

Japanese players showed the third highest values in vertical jump among the four groups. No significant differences were observed among the four groups. Japanese players showed the second highest distances (longest) in standing 5-step jump among the four groups, and statistically significant differences were observed between Japanese and German players.

Standing 5-step jump is an indicator of power and is, therefore, closely associated with competitive ability. Although significant differences were observed in standing 5-step jump among four groups in this study, Japanese players had the lowest results when we considered mean body height. Helgerud et

al. (2001) reported that the mean value for standing 5-step jump in 18-year old top-level players in Norway was 54.7±3.8 cm, and Reilly et al. (2000) reported that the mean value for standing 5-step jump in 16 or 17 year old players belonging to the lower organization of a professional soccer club in the UK was 55.8±5.82 cm, which showed that no significant differences existed between players in the same age categories in Europe, including Germany. In addition, Hoshikawa (2007) reported that muscle volume did not increase in youth players, but increased in players aged 21 or older. Tsukoshi (2010) reported higher values in vertical jump among youth players than professional adult players. These findings suggested that differences in power may appear after the age of 20 although no significant differences were observed in youth players. Significant differences were revealed in standing 5-step jump between Japanese and German players. Standing 5-step jump is an indicator of power; however, it also included factors related to coordination (JFA Physical Fitness Project, 2006). Therefore, differences in coordination may have caused the significant differences in standing 5-step jump between Japanese and German players while no significant differences were observed in vertical jump.

YYIR2 could not be conducted for German players due to the weather conditions. We compared the results of YYIR2 from Japanese, Chinese and Korean players. Japanese players were the lowest (shortest) among the three groups; however, no significant differences were observed. Results of YYIR2 for Japanese players in each age category showed obvious differences by age category, for example, 1,019 m in adult players, 935 m in U-18 players, and 781 m in U-15 players; and the older the players were, the higher the results were (JFA Physical Fitness Project, 2006). Krustrup et al. (2006) reported that among professional players between 22 and 30 years of age in Northern Europe, national team players showed 1059±35 m, and players in the second division showed 771±26 m, which revealed significant differences according to the level of performance. Krustrup et al. also reported that player conditions tended to be better during the season than during the pre-season. According to a comparison between Japanese and German players in the same age categories, the three other groups were higher than Japanese players. However, measurement periods and conditions were not considered well; therefore, it is difficult to reach a conclusion. Measurements were performed in the pre-season, and results may have been even higher if measurements were performed during the season. Recovery ability in high-intensity exercise among endurance revealed no significant differences among the three countries in East Asia. Measurements were performed in the pre-season in three countries; however, the number of off-duty days and pre-season schedules were not specified. Since these elements have a significant impact on YYIR2 results, it is difficult to conclude that YYIR2 did not show differences among the three countries in East Asia.

The above-mentioned results for physique, physical and motor abilities in Japanese players revealed differences in height, weight, lean body mass, and BMI compared to top-league players in Korean, China, and Germany, and that Japanese players were better in speed, agility, and coordination in shorter distances such as 10-m sprint. No significant differences were observed in power among youth players. It is necessary to increase weight and lean body mass along with the increase in muscle mass through future training. The field tests we used in this study were relatively easy to use and useful in clarifying the characteristics of physique, physical and motor abilities of Japanese players. Since there are few studies that compare top-league players by age in several countries, the field tests are considered useful in fostering and selecting players. Although we were unable to unify the surface of the ground used for measurements in the four countries due to the weather conditions, the data we acquired in this study was useful as data on top-level youth players.

This study focused on physique, and physical and motor abilities of youth players in four countries. Subjects were between 16 and 18 years of age, and we analyzed the characteristics of Japanese players. Although the subject club teams were at the top level in each country, we examined only one club team in each country. In the future, it is necessary to analyze players on other club teams to increase samples. It is also essential to analyze not only physical and motor abilities, but also technical and tactical factors. This study did not include a comparison by position. Therefore, it is extremely important to increase the number of samples and perform comparisons considering the characteristics of each position. Recent technology makes it possible to process a large amount of physical data, including maximum speed,

total distance traveled, distance traveled by speed, and number of sprints during matches (Bradley, 2010), which enables a greater degree of physical and motor ability assessment during matches.

5. Conclusion

This study applied field tests that have been broadly used in accordance with JFA Physical Measurement Guidelines (2006) to clarify the characteristics of physique, physical and motor abilities of Japanese players through comparison of top-level youth players in Japan, Korea, China, and Germany. Our main results were as follows: 1) Regarding physique (height, weight, and lean body mass), Japanese players showed the lowest values among the four countries. This suggested the need to increase weight and lean body mass along with the increase of muscle mass; 2) Japanese players achieved the fastest times in 10-m sprint, and Japanese players with lower height tended to perform better in 10-m sprints than in other sprints; 3) Japanese players were the fastest in 10 m × 5 shuttle runs, and speed of agility was a physical characteristics of Japanese players; and 4) Players from the 4 countries showed no significant differences in the vertical jump; however, the differences may appear after players are 20 years old.

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