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Original Article

Interindividual differences in physical function and their impact on regular player selection among junior high school soccer athletes

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Abstract. [Purpose] Unlike professional teams that use comprehensive evaluations, player selection in local and school-level soccer teams relies on the coaches' practical experience. This study investigated the differences in physical function between regular and non-regular male junior high school soccer players to provide valuable insights into player selection. [Participants and Methods] We assessed grip strength, rebound jumps, muscle strength, agility, short-distance running, anaerobic power, and countermovement jumps in 55 Japanese junior high school boys, who were divided into regular (R) and non-regular (NR) groups. Moreover, the age, height, and weight of the groups were compared. [Results] The analysis revealed significant differences in countermovement jumps and anaerobic power, while accounting for age and physique. [Conclusion] These results suggest that countermovement jumps and anaerobic power may constitute determining factors for regular and non-regular players, even when age and physical characteristics are considered.

Key words: Soccer, Junior high school soccer players, Anaerobic power

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INTRODUCTION

In competitive sports, coaches are crucial in selecting players for matches[1)]. In soccer, 11 players are initially selected as competitors, with additional substitutions from the team during the game. In Japan, up to seven substitutions are permitted during a match at the junior high and high school levels[2)].

Previous studies have defined players as those who start in more than 50% of matches or appear as substitutes for regular players, whereas those below this threshold are considered non-regular[3)].

At the professional level, selecting regular players involves comprehensive assessments by coaches based on information from team staff and fitness test results. However, in local sports teams and school clubs, player selection relies more on practical knowledge acquired in the field[4)]. In domestic volleyball, regular player selection is based on the differences in the agility levels, with psychological factors also impacting the selection decision[5, 6)]. However, the factors influencing regular player selection in soccer have not been studied extensively, with research mainly focusing on comparisons between players selected for higher-level clubs or elite teams and those who were not[7)]. Studies of soccer players aged <14 have reported that factors such as height, explosive power, sprinting ability, and ball control skills are considered in regional selection[8)]. However, the factors related to regular player selection in junior high school soccer teams in Japan remain unclear.

Therefore, this study aimed to identify factors associated with regular player selection among male junior high school soccer players.

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PARTICIPANTS AND METHODS

Fifty-five male junior high school soccer team members were recruited for this study. Participants were recruited from soccer club teams in the Tochigi Prefecture. Prior to the study, explanations were provided regarding the research content and teams, and consent was obtained from the participating coaches, parents, and players. The inclusion criteria required players to engage in specialized athletic training at least five times per week, while the exclusion criteria were individuals who had faced challenges participating in sports for over three months in the past year due to physical or mental illnesses, those who had experienced ligament injuries or fractures within the previous three months, and those who had sustained ankle sprains within the last month. A total of 53 participants were included in the analysis, excluding one player with an upper limb fracture in the past three months and another with an ankle sprain in the past month. The 53 participants were divided into two groups: 20 regular players (median age 14.5 years, median height 164.6 cm, median weight 52.4 kg) and 33 non-regular players (median age 13.2 years, median height 160.8 cm, median weight 49.1 kg). Ethical considerations involved obtaining informed consent from the minor participants' families and club team leaders, and the study was conducted with their consent. This study was approved by the Research Ethics Review Committee of the International University of Health and Welfare (approval number: 21-Io-34-2).

Body measurements were conducted using a height meter, and weight was measured using a digital scale. Physical assessments included grip strength, rebound jump (RJ), countermovement jump (CMJ), lower limb muscle strength, anaerobic power, agility, and short-distance running time.

Grip strength was measured twice on each side using a digital grip strength meter (D-TKK5401, Takei Kiki Co., Ltd., Niigata, Japan), and the average of four measurements was calculated. The higher values were recorded for the CMJ values. Lower limb muscle strength was evaluated using a multipurpose muscle strength evaluation exercise device (BIODEX system4, Biodex Medical System, Shirley, NY, USA). Anaerobic power was assessed using an aerobic bike (Powermax V2, Combi Wellness, Tokyo, Japan), with the load set at 7.5% of the participant's body weight during the Wingate test. Agility was tested using the T-agility test and short-distance running time was measured using a photoelectric sensor (S-CADE, photoelectric gate, Tokyo, Japan).

The participants were categorized into two groups: regular (R group) and non-regular (NR group). Age, height, and weight were compared between the groups using the Mann–Whitney U test. Differences in physical function between the groups were analyzed using analysis of covariance with age, height, and weight as adjustment variables. Statistical analyses were performed using the SPSS ver. 27 (IBM, Armonk, NY, USA), with a significance level of 5%.

RESULTS

Significant differences in age and height were observed between the two groups ($p<0.001$ and $p=0.021$, respectively) but not in weight (Table 1). The correlation analysis revealed significant correlations between age and grip strength ($r=0.68$, $p<0.001$), CMJ ($r=0.62$, $p<0.001$), knee flexor strength ($r=0.57$, $p<0.001$), knee extensor strength ($r=0.54$, $p<0.001$), and anaerobic power ($r=0.59$, $p<0.001$). However, no significant correlations were found between the R-J index, t-test, or short-distance running time.

Analysis of covariance adjusted for age, height, and weight demonstrated that CMJ and anaerobic power were significantly higher in the R group than in the NR group ($p=0.002$ and $p=0.007$, respectively) (Table 2).

DISCUSSION

In this study, we examined the disparities in basic information and physical capabilities between R and NR groups among Japanese male junior high school soccer players. The R group exhibited significantly higher age and height than the NR group. Furthermore, age significantly correlated with grip strength, knee muscle strength, CMJ, and anaerobic power. Even after adjusting for age, the CMJ and anaerobic power of the R group remained significantly higher than those of the NR

Table 1. Comparison of basic information between the R and NR groups

	R group (n=20)	NR group (n=33)	All (n=53)	p-value
Age (years)	14.5 (14.0–15.0)	13.2 (12.0–15.0)	13.7 (12.0–15.0)	*
Height (cm)	164.6 (153.4–180.7)	160.8 (145.5–176.5)	163.2 (145.5–180.7)	*
Weight (kg)	52.4 (42.7–82.7)	49.1 (32.9–61.8)	50.2 (32.9–82.7)	

Values are expressed as medians (Minimum–Maximum).
Mann–Whitney U test. *$p<0.05$.
R: regular; NR: non-regular.

Table 2. Comparison of physical function between the R and NR groups

	R group (n=20)	NR group (n=33)	ALL (n=53)	p-value
Grip strength (kg)	31.7 (23.8–50.0)	26.1 (16.2–33.9)	28.2 (16.2–50.0)	
RJ-index	1.6 (1.0–2.3)	1.6 (0.8–2.1)	1.6 (0.8–2.3)	
Counter movement jump (cm)	44.3 (38.0–52.0)	37.7 (23.0–45.0)	40.2 (23.0–52.0)	*
Knee flexor strength (Nm/kg)	1.3 (1.0–1.8)	1.2 (0.7–1.8)	1.3 (0.7–1.8)	
Knee extensor strength (Nm/kg)	2.4 (2.0–3.6)	2.3 (1.2–3.1)	2.4 (1.2–3.6)	
Anaerobic mean power (W/kg)	8.8 (7.8–10.1)	7.5 (5.2–8.8)	7.9 (5.2–10.1)	*
t-test (sec)	11.0 (10.5–12.4)	11.3 (10.5–14.9)	11.1 (10.5–14.9)	
10 m time (sec)	2.4 (2.2–2.7)	2.4 (2.1–2.9)	2.4 (2.1–2.9)	
20 m time (sec)	3.7 (3.5–4.1)	3.8 (3.5–4.7)	3.8 (3.5–4.7)	
30 m time (sec)	4.9 (4.7–5.5)	5.2 (4.9–6.4)	5.1 (4.7–6.4)	
40 m time (sec)	6.2 (5.8–6.8)	6.5 (6.1–8.1)	6.4 (5.8–8.1)	

Analysis of covariance: *p<0.05.
Covariates: propensity score calculated from age, height, and weight.
R: regular; NR: non-regular; RJ: rebound jump.

group. Thus, the CMJ and anaerobic power have emerged as potentially crucial factors for regular player selection among junior high school soccer players.

Previous research has indicated an association between anaerobic power and age in soccer players under 20, which aligns with our findings, showing a significant correlation between age and anaerobic power. Additionally, a study on CMJ patterns suggested no discrepancies in records between ages 14 and 15, with higher values observed after age 16, peaking around age 20 but possibly continuing to improve beyond age 18 among elite athletes[9]. Hence, age inherently influences these metrics. Studies on anaerobic power among female soccer players have highlighted the superior peak power of starters compared with substitutes, emphasizing its importance in performance evaluation[10]. Similarly, research on the CMJ among college soccer players demonstrated superior results among players at higher competition levels[9]. Together, these studies suggest that age significantly influences these performance indicators, making them valuable tools for assessing the performance of soccer players. Our study contributes to this body of knowledge by revealing that CMJ and anaerobic power are vital factors in player selection, even after accounting for age and body size.

An intriguing finding was the lack of significant differences in agility or short-distance running ability between the two groups. All players demonstrated basic ball-handling skills, indicating the effectiveness of the technical training[11]. These fundamental skills allow players to instinctively approach or evade the ball and opposing players, regardless of their role[12]. Although significantly lower agility and short-distance abilities were associated with an increased risk of injury, our results did not show significant differences between the R and NR groups, suggesting a need for caution when interpreting these metrics[13, 14].

However, this study has several limitations. First, the age range of 12–15 years coincides with the period of secondary sexual characteristics, potentially causing a mismatch between the calendar and biological age[15]. As our study only considered calendar age, accounting for biological age in the subject grouping may have yielded different results. Second, the study's limited sample size and cross-sectional nature hindered its generalization. Collaboration with specific teams may limit the applicability of our findings to all junior high school soccer players, necessitating data collection from older age groups and increasing the sample size to include participants from various competition levels. Third, regional characteristics were not considered as our study focused on junior high school club teams in the Tochigi Prefecture. Therefore, a comparison of data from different regions is warranted. Finally, this study did not assess soccer-specific performance. Evaluating performance metrics such as dribbling and ball distance can provide deeper insights into the attributes of regular players.

Conflicts of interest

The authors declare no conflicts of interest.

REFERENCES

1) Nakagawa A: My view of coaching elite athletes. Jpn J Coach Stud, 2011, 24: 89–93 (in Japanese).
2) Japan Football Association: Laws of the Game. https://www.jfa.jp/documents/pdf/soccer/lawsofthegame_202324.pdf (Accessed Dec. 1, 2024) (in Japanese).
3) Yamai K, Umeda T, Suda Y, et al.: Muscle organization and neutrophil function change before and after exercise at the game match and the relationship between them—comparison between regular members and sub members. J Phys Fitness Nutr Immunol, 2009, 19: 124–126 (in Japanese).

4) Koido M, Haranaka M, Nakamura T: Practical wisdom related to member selections in competition: a case study of the college football short-term tournament. Jpn Soc Sport Movement Behaviour, 2016, 29: 29–43 (in Japanese).
5) Aruga S, Tsukiyama M, Fujii M, et al.: A study on training methods for improving performance of change in direction movements—the relationship between the characteristic of rebound jump ability and the ability of change in direction—. Tokai J Sports Med Sci, 2013, 25: 7–19 (in Japanese).
6) Ito M, Matsuoka Y, Takahashi T, et al.: A study on personality of junior soccer players—consideration about the competition level, grade and position. Bulletin of Sports Research Center, Hosei Univ, 2019, 37: 11–18 (in Japanese).
7) Castillo D, Pérez-González B, Raya-González J, et al.: Selection and promotion processes are not associated by the relative age effect in an elite Spanish soccer academy. PLoS One, 2019, 14: e0219945. [Medline] [CrossRef]
8) Coelho E Silva MJ, Figueiredo AJ, Simões F, et al.: Discrimination of u-14 soccer players by level and position. Int J Sports Med, 2010, 31: 790–796. [Medline] [CrossRef]
9) Yamada K, Okudaira M, Kuki S, et al.: The relationship between lower limb explosive power and ability of sprint and change of direction in male college soccer players: focusing on the difference between jumping types. Footb Sci, 2020, 17: 1–10 (in Japanese).
10) Nikolaidis, Pantelis: physiological characteristics of elite Greek female soccer players. Medicina dello sport, rivista di fisiopatologia dello sport, 2010, 63: 343–351.
11) Anderson L, Orme P, Di Michele R, et al.: Quantification of seasonal-long physical load in soccer players with different starting status from the English Premier League: implications for maintaining quad physical fitness. Int J Sports Physiol Perform, 2016, 11: 1038–1046. [Medline] [CrossRef]
12) Doğanay M, Bingül BM, Álvarez-García C: Effect of core training on speed, quickness and agility in young male football players. J Sports Med Phys Fitness, 2020, 60: 1240–1246. [Medline] [CrossRef]
13) Rudisill SS, Kucharik MP, Varady NH, et al.: Evidence-based management and factors associated with return to play after acute hamstring injury in athletes: a systematic review. Orthop J Sports Med, 2021, 9: 23259671211053833. [Medline] [CrossRef]
14) Hrysomallis C: Relationship between balance ability, training and sports injury risk. Sports Med, 2007, 37: 547–556. [Medline] [CrossRef]
15) Hirose N, Hirano A: The relationship between individual biological maturation and birth-month distribution in adolescent elite soccer players. Jpn J Hum Growth Dev Res, 2008, 37: 17–24 (in Japanese). [CrossRef]