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Original research

Two-year changes in anthropometric and motor ability values as talent identification indexes in youth soccer players

Norikazu Hirose [a,*], Taigo Seki [b]

[a] Faculty of Sport Sciences, Waseda University, Japan
[b] Department of Youth Academy, JEF United Football Club, Japan

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ABSTRACT

Objectives: The present study examined 2-year changes in anthropometric variables and motor abilities in elite male youth soccer players to identify potential talent identification indexes.
Design: This was a cross-sequential study examining two different age groups at two time points.
Methods: Height, weight, 40-m sprint speed, muscular power (5-step bounding), and change of direction (COD) ability (10 $m \times 5$ COD) were measured in 12- and 14-year-old soccer players and repeated after 2 years (at 14 and 16 years of age). Correlations and changes in ranking between the two measurements were determined.
Results: Both groups had small ranking changes in height (12–14-year-olds: $r = 0.80$, 14–16-year-olds: $r = 0.89$; $p < 0.01$), weight ($r = 0.94$, $r = 0.80$; $p < 0.01$), 40-m sprint speed ($r = 0.81$, $r = 0.90$; $p < 0.01$), and muscular power ($r = 0.48$, $r = 0.64$; $p < 0.05$), with a statistically significant correlation between the initial values and those obtained 2 years later. However, 10 m × 5 COD ability had a large ranking change, with no statistically significant correlation observed between the first- and second-year values.
Conclusions: Because of the minimal ranking change in sprint speed in normal circumstances of soccer practice, linear sprint speed has the potential to be a useful talent identification index for youth soccer players. On the other hand, muscular power and COD ability is changeable during growth period suggests that these parameters is not useful for talent identification index.

1. Introduction

The process by which athletic growth is achieved among elite athletes is classified into four absolutely essential key stages: detection, identification, selection, and development of talent.[1] This approach is the basis for demonstrating the importance of consistent leadership in top athlete training, coupled with the notion of the "10 years, 10,000 h" rule,[2] where 10,000 h of practice in 10 years are needed for the talent growth of an outstanding artist or athlete. Soccer players are no exception, and many studies on talent identification and development in soccer have been conducted.

Talent identification in soccer must be performed multilaterally, from the sociological, cognitive/psychological, physiological, and anthropometric aspects of the sport. On the physiological and anthropometric aspects, many prior research studies cited body size[3] and motor abilities such as sprint speed,[4–6] change of direction (COD) ability,[7,8] and muscular power[3,4,7] as factors that distinguish elite from sub-elite youth players, and these abilities are considered useful as talent identification indexes.

However, when these indexes are used to actually select players, careful attention is required. These talent indexes are often used to rank players at a given time point to seek the talented players. However, there is a lack of information on whether long-term rankings change over time, as relative abilities at a given time point may or may not change in the future. For instance, in adolescents, muscular power depends on individual biological maturation; thus, ordinal rankings in some groups (i.e., players who participated in the selection) may depend on their early/late maturation to some extent. However, maturation will be equal in players over 18 years of age, and thus, players who reach maturity later with lower muscular power may catch up to their peers in late adolescence.[9] This phenomenon implies that relative abilities such as muscular power at a given time point may change in the future, and this trend indicates the necessity for research regarding the change in long-term ranking in sprint speed, COD ability, and muscular power. In fact, in a training environment, players with advanced biological and physical maturation are successful in being chosen for elite teams, and this trend is inconsistent with

* Corresponding author.
E-mail address: toitsu.hirose@waseda.jp (N. Hirose).

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the intention of developing "talented future players" in a training environment of excellence.[10] To date, research studies on talent identification indexes have cross-sectionally analyzed differences in physique and motor ability between elite and sub-elite athletes, either at a given age [3,4] or limited age ranges (10–14,[5] 14–16,[11] and 13–16 years[12]). However, to be useful as an index for talent selection, the relative abilities at a given age must remain the same over time. Consequently, it is important to understand whether the rankings of abilities for identifying soccer talent have stationarity; if so, this would provide evidence that they can be used as talent identification indexes for soccer and could contribute to the future development of elite soccer players.

Therefore, this study aimed to better understand ranking changes in youth soccer players' sprint speed, muscular power, and COD ability from U13 to U15 and from U15 to U17 to determine ranking changes after a 2-year growth period. To better improve understanding, the tests were conducted before and after a 2-year interval for a cross-sequential investigation of changes in ranking. In addition, previous research reports that linear sprint speed, COD performance, and muscular power develops drastically at peak height age[13] and sprint speed and muscular power are influenced by individual maturation such as skeletal age[14]. These arguments indicate that result of our above investigation will be influenced by the participants' biological maturation level. Thus in this study, we evaluated the peak height velocity age to identify the individual maturation level.

We hypothesized that because sprint speed and muscular power have strong genetic components,[15,16] minimal ranking changes would occur over the growth period, but that because COD ability is also influenced by technical factors (i.e, footwork, posture control and controlling the stride during acceleration/deceleration),[17] rankings would change significantly over the growth period.

2. Methods

All participants of this study were elite male youth soccer players from J. League Academy teams which were the Japanese professional soccer team. Thirty eight U13 players (13.0–13.9 year-olds; mean age, 13.2 ± 0.2 years) and twenty U15 players (15.0–15.9 year-olds; mean age, 15.2 ± 0.2 years) participated in the initial measurement. For the 2-year follow-up measurements, twenty-six of thirty-eight U13 players (U13–U15 group) and twelve of twenty U15 players (U15–U17 group) were participated. Thus, finally the data of thirty-seven players were analyzed. Reasons for non-participation in the 2-year follow-up included injury ($n = 5$) or departure due to failure to meet the team's competitive level ($n = 15$).

All study protocols were approved by the Ethics Committee on Human Research of Waseda University. This study conforms to the Declaration of Helsinki. All subjects and their parents were fully informed of the procedures and the purpose of this study, and provided written informed consent. The participants were free to withdraw from participation at any time without fear of consequences.

The anthropological measurements included body height, body weight and sitting height. Motor performance test included 40-m sprint speed (speed), 10 m × 5 COD ability, and 5-step bounding (muscular power). Except for the sitting height, all measurements were re-measured again after 2 years by same tester. Sitting height was measured at the initial test only and it was used to estimate each player's peak height velocity age (PHVA) using the maturity offset method.[18] Then the difference between PHVA and chronological age (CA) at this time point was calculated. Although the maturity offset method has limited reliability,[19] it has achieved a certain amount of recognition as a useful, noninvasive, and appropriate method for measuring physical maturity in the field of sports.[20] All anthropometric measurements were conducted before motor performance testing.

Body height (YL-65S, Yagami Inc., Nagoya, Japan) and sitting height (ST-110ND, Yagami Inc., Nagoya, Japan) were measured twice using 0.1-cm units, and the mean value was used. The intra-class correlation coefficients (ICCs) for the two measurement values for body height and sitting height were both ICC(1,1) = 0.99. Body weight was measured once in 0.1-kg units using a body composition analyzer (TBF-551, Tanita Inc., Tokyo, Japan). These anthropometric measurements were measured while the subject was barefoot but wearing pants and a shirt.

Participants were instructed to avoid exercising to exhaustion within 24 h prior to measurement. The motor performance tests were performed between 4:00 pm and 7:00 pm in September for both the initial and follow-up measurements. Both the initial and follow-up measurements had clear weather conditions, with air temperatures of 18–20 °C. Before motor performance testing, participants spent ~15 min completing the same warm-up exercises (i.e., static stretching, ballistic stretching, bounding, COD, and 40-m sprint). Measurements were performed in the following order: 5-step bounding, 40-m sprint, and 10 m × 5 COD test. After warming up, the participants completed one or two practice trials before completing two test trials, with the better score (faster value for 40-m sprint and 10 m × 5 COD test, longer value for 5-step bounding) used for the statistical analysis. Participants were allowed >2 min of rest between each trial. The players wore shorts, a t-shirt, and football boots during testing. All of the motor performance tests were performed outside on artificial turf and according to the physical fitness testing guidelines of the Japan Football Association. [21)]

The 40-m sprint was evaluated using phototubes (TC Timing System, Brower Timing Systems, Utah, USA). They were installed approximately 1 m above the ground at a starting point and a 40-m point. The participants chose when to start, and the time to travel

Table 1
The distribution of Elite (N; 26 for U15, 12 for U15) and Sub-elite (N; 7 for U13 and 8 for U15) soccer players.

		40-m sprint		10 m × 5COD		5-step bounding	
		Elite	Sub-elite	Elite	Sub-elite	Elite	Sub-elite
U13	<25%	8 (6.3)	0 (1.7)	7 (6.3)	1 (1.7)	6 (6.3)	2 (1.7)
	<50%	7 (6.3)	1 (1.7)	5 (6.3)	3 (1.7)	7 (6.3)	1 (1.7)
	<75%	3 (6.3)	5 (1.7)	6 (6.3)	2 (1.7)	6 (6.3)	2 (1.7)
	≥75%	8 (7.1)	1 (1.9)	8 (7.1)	1 (1.9)	7 (7.1)	2 (1.9)
	$\chi 2$	12.2[a]		2.3		0.5	
U15	<25%	4 (3.0)	1 (2.9)	4 (3.0)	1 (2.0)	3 (3.0)	2 (2.0)
	<50%	1 (3.0)	4 (2.9)	3 (3.0)	2 (2.0)	4 (3.0)	1 (2.0)
	<75%	4 (3.0)	1 (2.3)	3 (3.0)	2 (2.0)	3 (3.0)	2 (2.0)
	≥75%	3 (3.0)	2 (2.9)	2 (3.0)	3 (2.0)	2 (3.0)	3 (2.0)
	$\chi 2$	2.4		1.7		1.7	

[a] $p < 0.05$ for $\chi 2$ test. ( ) means expected value. < 25% in 40-m sprint and 10 m x 5COD means faster sprint and COD ability.