Relationship of speed-strength and anthropometric indicators of highly qualified football players 16-17 years of different roles

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Abstract

Objective of the study was to determine the relationship between the anthropometric and speed-strength characteristics of football players in laboratory and field conditions to identify differences in these indicators relative to their role.

Methods and structure of the study. An examination of the players of the Russian youth football team aged 16-17 years was carried out. In laboratory conditions, the players' body composition, isometric strength of the hip adductor and abductor muscles were measured; the strength of the extensor muscles of the leg joints when performing an upward jump with the arm squatting on the belt; hamstring strength in eccentric, yielding, mode. 6 hours later, during an evening training session, the players performed 10, 20 and 30 m runs and a standing long jump.

Results and conclusions. As a result of the experiment, a profile of speed-strength readiness of highly qualified football players aged 16-17 years was obtained. Sports selection of taller, heavier players under 17 years of age, and generally better physically fit, may have an advantage in the short term, but in the long term there is a risk of weeding out talented.

Keywords: *anthropometry, speed, strength, height, weight, football, preparedness.*

Introduction. A player's speed and strength abilities are one of the most important components that determine success in football. Players perform high-intensity technical and tactical actions associated with the manifestation of speed-strength abilities at distances from 5 to 20 m, less often up to 30-40 m, and fight for the ball in the air, performing powerful jumps. At the same time, the characteristics of football players of different roles can vary significantly. For example, body length and weight are closely related to physical performance in children and young people [1] and are factors determining results in sprinting [2-5]. In many studies, the authors draw conclusions about the presence of a positive, linear relationship between weight-height and speed-strength indicators in football players of different ages [1-5], however, in the available sources there is no data on the presence of the same relationship between players of youth national teams. Therefore, testing in the practice of training football players is an important link in the selection of players, planning and management of the training process.

Objective of the study was to determine the relationship between the anthropometric and speed-strength characteristics of football players in laboratory and field conditions to identify differences in these indicators relative to their role.

Methods and structure of the study. A study was carried out on 19 players of the Russian youth football team in the laboratory of the scientific direction Interdisciplinary Sports Research of the Sirius University of Science and Technology and in natural conditions at a football stadium with artificial turf. The average age of the players is 16.6±0.3 years, height – 181.4±6.4 cm, body weight – 71.1±7.0 kg, muscle component – 37.2±3.7 kg or 52, 4±1.4%, fat com-

ponent – 5.7±1.9 kg or 8.0±2.4%. Body composition measurements were taken in the morning fasting on the Inbody 770 analyzer. Isometric strength of the hip adductors and abductors was determined on the Vald ForceFrame. Leg extensor muscle strength was assessed during a squat jump using Vald ForceDesk dual force platforms. The Vald NordBord system was used to assess hamstring muscle strength in the eccentric yielding mode. Four repetitions of each test exercise were performed. 6 hours later, in the evening training, after warming up, the players ran 10, 20 and 30 m, the results were recorded by the Witty timing system (Microgate, Italy) with an accuracy of 0.001 seconds and a standing long jump. Three repetitions of each exercise were performed. To calculate the correlation coefficients between indicators and the reliability of differences between roles, nonparametric statistics methods were used: Spearman's correlation coefficient and the Kruskal-Wallis test in the Statistica 10.0 program.

Results of the study and discussion. All players were divided into roles: GK - goalkeeper, CD - central defender, FD - flank defender, CMF - central midfielder, FMF- flank midfielder, F - forward. Goalkeepers and central defenders turned out to be the tallest, while central midfielders and forwards were the least tall (Table 1). Goalkeepers are characterized by the largest body mass values, while full-backs, central midfielders and forwards have the smallest.

The greatest muscle mass is observed in flank defenders, the least - in central midfielders. The greatest lean muscle mass of the legs was found in goalkeepers, the smallest - in central midfielders. The identified differences characterize the preparedness profile of football players in relation to their playing role and are comparable with literature data [5]. Goalkeepers have the greatest strength and speed of muscle contraction, including performing exercises in the form of bending forward and high jump, standing long jump (Tables 2 and 3).

Whereas in the 10, 20 and 30 m sprint races, goalkeepers are not inferior to field players. Central midfielders are characterized by the lowest values of strength and speed of contraction of the leg muscles, the same applies to the standing long jump, running 10, 20 and 30 m; players also have an asymmetry in

Table 1. *Indicators of anthropometric study of football players*

Role	Height, Cm	Body weight, kg	Fat component,%	Muscle component, %	Lean muscle mass of legs, kg
GK	190,1±1,3$#§¶	81,2±5,1$#§¶	10,0±2,1$§	51,2±1,2	23,8±0,7$#§¶
CD	187,0±1,8$#§¶	74,4±6,9	8,5±1,2	52,3±0,8	22,3±1,6#¶
FD	180,7±7,6	68,4±7,6	5,2±2,8	54,0±1,5*#•	21,1±2,4
CMF	176,2±6,0	66,9±3,8	10,0±2,4$§	51,0±1,5	18,8±1,5
FMF	180,7±2,7	71,6±5,1	6,4±1,5	53,5±0,6*#•¶	21,0±0,9#
F	176,8±5,4	67,4±8,5	8,4±0,9	52,1±0,4	19,0±2,1

*Significance of differences at p<0.05. * - more than CD; $ - more than FD; # - more than CMF; § - more than FMF, ¶ - more than F; •- more than GK*

Table 2. *Assessment of speed-strength abilities of the muscles of the lower extremities of football players*

Role	Jump height, cm	Power when jumping, W/kg	Max strength of two legs (N), bending	Max strength (N), abduction	Max strength (N), adduction
GK	42,5±4,7*¶	52,8±0,6¶	776 ±22#§	850±111#	826±19
CD	34,6±1,4	49,7±2,3	746±137	747±117	780±153
FD	35,8±4,0	49,8±4,7	742±214	723±127	759±99
CMF	34,6±3,5	51,3±4,4	636±53	661±56	722±145
FMF	36,9±4,5	54,0±4,5	713±40	772±97#	816±66
F	36,4±2,9	47,6±4,4	674±161	677±103	842±170

*Data are presented as mean and standard deviation. Significance of differences at p<0.05. * – more than CD; $ - more than FD; # – more than CMF; § – more than FMF, ¶ – more than F.*

Table 3. *Assessment of speed-strength abilities of football players when performing pedagogical tests*

Role	Standing long jump, cm	10 m from standstill, s	20 m from standstill, s	30 m from standstill, s
GK	275±4,2*$#§¶	1,77±0,09	3,10±0,15	4,17±0,07
F	246±8,4	1,86±0,04	3,17±0,06*	4,31±0,12*
FD	251±4,4	1,82±0,08	3,07±0,12	4,23±0,10
FMF	249±9,3	1,79±0,05	3,07±0,07	4,23±0,12
CD	254±9,0	1,82±0,08	3,07±0,06	4,22±0,02
CMF	240±10,9	1,85±0,08	3,15±0,11	4,30±0,14

*Data are presented as mean and standard deviation. Significance of differences at p<0.05. * – more than CD; $ – more than FD; # – more than CMF; § – more than FMF, ¶ – more than F.*

Indicators	Anthropometry					Jump		Max. strength of two legs (N)		
	Height, cm	Weight, kg	Fat, kg	Muscles, kg	Lean muscle mass of legs, kg	Height, cm	W, W/kg	Nordic tilt	abducti on	adduction
Standing long jump, cm	0,69	0,74	0,23	0,76	0,76	0,77	0,54	0,53	0,63	0,58
10 meters from a standstill, time, s	-0,58	-0,24	0,21	-0,32	-0,53	-0,35	-0,37	-0,09	-0,32	0,00
20 meters from a standstill, time, s	-0,54	-0,18	0,47	-0,34	-0,56	-0,23	-0,33	-0,29	-0,35	-0,07
30 meters from a standstill, time, s	-0,66	-0,42	0,27	-0,55	-0,68	-0,54	-0,50	-0,34	-0,45	-0,22

Figure 1. *Correlation analysis of indicators characterizing the anthropometric and speed-strength abilities of football players*

the strength of the muscles responsible for hip adduction and abduction, as well as low strength levels when performing the exercise - bending forward. Flank players are characterized by some of the highest rates of muscle speed-strength abilities, however, in flank midfielders it is worth noting the asymmetry of the muscles responsible for abducting and adducting the hip in the direction of reducing the strength of the hip abductor muscles. Attackers have low values of strength and speed of muscle contraction, in particular in the high jump, standing long jump, sprint, and in the strength of the hip adductor muscles compared to the hip abductor muscles.

To study the dependencies between the studied indicators, a correlation analysis was carried out (Figure 1).

It was revealed that tall football players with greater body mass and lean muscle mass in their legs demonstrate better results in long jump and sprint. Obviously, this is due to the earlier physical development of players compared to their peers, since it was previously established that in football players under 17 years of age, body length and weight have a great influence on physical fitness indicators [1]. After this age, the contribution of the training process itself to the players' preparedness increases.

Conclusions. As a result of the study, a profile of speed-strength readiness of highly qualified football players aged 16-17 years was obtained. Athletic selection of taller, heavier under-17 footballers, and generally better fit, may have an advantage in the

short term, but in the long term there is a risk of weeding out talented players who are lagging behind in their maturation.

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