

DETERMINING THE RELATION OF LOWER LIMBS STRENGTH INDICES IN 12-13-YEAR-OLD SOCCER PLAYERS

B.A. PANĂ^{1,3}

I. MIHAILA^{2,3}

I. MIHAI²

G. TRANDAFIRESCU²

V. POTOP^{2,3,4}

Abstract: *The paper aims to determine the relation of the indices of lower limbs strength in 12-13-year-old soccer players. Methods. Therefore, exploratory research was conducted within the CS Otopeni, soccer department, with a group of 26 children aged 12-13 years. The strength of lower limbs was tested by means of Opto Jump Next system. Specific tests used: Test 1, CMJ (flight time and height), test 2, Squat jumps (SJ) (flight time, height) and test 3, Jumps 15 sec (number of jumps, contact time, flight time, power, pace and RSI). The relation between the measured indices was analyzed using the Pearson correlation coefficient (KyPlot). Determining the relation between lower limbs strength indices of soccer players aged 12-13 highlights differences between the evaluated parameters and their degree of correlation.*

Key words: *parameters, specific jumps tests, young soccer players, correlation analysis.*

1. Introduction

Soccer is an extremely popular sport worldwide, practiced by both genders and players of various ages [1]. Soccer training for children and adolescents focuses on developing motor skills and tactical-technical education, transitioning to

playing position specialization and specific training as players grow up [6], [8], [18], [21].

Motor activities during training include sprints, changes of direction and various running actions, while single-leg jumps and landings are characteristic of older age groups and professionals. In the case

¹ Otopeni Sports Club, Otopeni, Romania.

² Department of Physical Education and Sport, National University of Science and Technology Politehnica Bucharest, University Center Pitesti, Romania; vladimir_potop@yahoo.com

³ Doctoral School of Sport Science and Physical Education, National University of Science and Technology Politehnica Bucharest, University Center Pitesti, Romania.

⁴ State University of Physical Education and Sport, Chisinau, Republic of Moldova

of young players, heading the ball is avoided for health reasons [3], [7].

The practice of soccer for 12-13-year-old children is essential for their physical, social, and emotional development. It provides them with the opportunity to improve their motor skills and learn about responsibility and teamwork. The development of physical and psychophysiological skills in soccer is a crucial aspect. This is investigated through various methods, including mental chronometry and analyzing the effects of stretching procedures on sports performance [2], [11], [15], [23].

Lower limb strength is crucial in the performance of athletes, especially in soccer, where physical abilities are essential for success on the playing field. Understanding the relationship between lower limb strength indices and athletic performance at the age of 12-13 is very important, taking into account their rapid period of physical development and skills formation.

Therefore, this study focuses on assessing and determining this relationship in soccer players aged 12-13. It aims to provide a deeper understanding of the factors influencing their athletic performance and to offer useful information for coaches and specialists in the field of youth sports development.

2. Method

The study included participants from the U13 category of the Otopeni Sports Club, Ilfov County, Romania. For this purpose, observational research was conducted within the CS Otopeni soccer department,

involving a group of 26 children aged 12-13. Parental consent was obtained and signed in accordance with the Helsinki Declaration prior to the start of the research. The study was approved by the Ethics Committee of the Doctoral School of Physical Education and Sports Sciences (ID: 10/22.01.2024), University Center Piteşti, Romania.

The research was conducted in February 2023, for to determine the relation of the indices of lower limbs strength in 12-13-year-old soccer players.

Lower limb strength testing was performed using the Opto Jump Next device. The specific tests used: Test 1, CMJ (flight time and height), Test 2, Squat jumps (SJ) (flight time and height), and Test 3, Jumps 15 sec (number of jumps, contact time, flight time, power, pace and RSI).

Statistical indicators were calculated using KyPlot 6.0 software (KyensLab Inc), including mean, standard deviation (SD), coefficient of variation (CV%), confidence level of mean (0.95), and confidence limit of mean. The analysis of the relationship between the measured indices was conducted using Pearson's correlation coefficient. Statistical significance was established at $p < 0.05$.

3. Results

The determination of lower limbs strength development levels in young soccer players aged 12-13 was conducted using the Opto Jump Next device. The results of the measured parameters are presented in Tables 1 and 2, while the analysis of the relationship between the measured indices is presented in Table 3.

Descriptive statistics

Table 1

Tests	Variables	Mean \pm SD	CV (%)	Confidence Level of Mean (0.95)	Confidence Limit of Mean	
					Lower	Upper
CMJ	TFlight (sec)	0.41; \pm 0.03	7.75	0.01	0.40	0.43
	Height (cm)	21.44; \pm 3.37	15.72	1.36	20.08	22.79
SJ	TFlight (sec)	0.39; \pm 0.04	11.90	0.02	0.37	0.41
	Height (cm)	16.28; \pm 4.56	23.66	1.84	17.44	21.13

Descriptive statistics

Table 2

Variables	Mean \pm SD	CV (%)	Confidence Level of Mean (0.95)	Confidence Limit of Mean	
				Lower	Upper
Jumps (no. reps)	26.95; \pm 2.18	8.09	0.88	26.08	27.84
TCont. (sec)	0.23; \pm 0.04	16.62	0.02	0.22	0.25
TFlight (sec)	0.34; \pm 0.05	13.61	0.02	0.33	0.36
Height (cm)	14.96; \pm 3.69	24.66	1.49	13.47	16.46
Power (w/kg)	21.76; \pm 5.39	24.79	2.18	19.58	23.94
Pace (step/s)	1.73; \pm 0.14	8.18	0.06	1.67	1.79
RSI (m/s)	0.68; 0.22	32.28	0.09	0.59	0.77

Linear correlation analysis

Table 3

Variables		CMJ		Squat Jumps	
		TFlight (sec)	Height (cm)	TFlight (sec)	Height (cm)
Jumps 15 sec	Jumps (no. reps)	-0.36	-0.36	-0.89*	-0.48*
	TCont. (sec)	-0.14	-0.14	-0.31	-0.28
	TFlight (sec)	0.49*	0.48*	0.71***	0.69***
	Height (cm)	0.52**	0.52**	0.74***	0.72***
	Power (w/kg)	0.40*	0.40*	0.66***	0.63***
	Pace (step/s)	-0.41*	-0.41*	-0.52**	-0.52**
	RSI (m/s)	0.37	0.36	0.63***	0.60**

Note. * - $p < 0.05$, ** - $p < 0.01$, *** - $p < 0.001$

The results of the comparative analysis between the CMJ and Squat Jumps (SJ) Tests (Tables 1, 2) highlight higher values in CMJ by 0.02 sec in Flight Time (TFlight) and 5.16 cm in Jump Height (Height), an

increase in the Confidence Level of Mean (0.95) (CLM) in the SJ test by 0.01 sec in TFlight and by 0.48 cm in Height. Meanwhile, the Confidence Limit of Mean (Lower & Upper) shows higher values in the limit interval in the SJ test by 0.04 sec in

TFlight and by 3.69 cm in Height.

In the analysis of parameters in the Jumps 15 sec Test (Table 2), an average of 26.95 jumps is observed, a greater difference in Flight Time of 0.11 sec compared with Contact Time, a Height of 14.96 cm, Power of 21.76 w/kg, Pace of 1.73 step/s and RSI of 0.68 m/s.

The relationship between lower limbs strength indices was determined through the Pearson's linear correlation analysis (Table 3). Twenty-eight relationships between the parameters of the Jumps 15 sec test and the CMJ and SJ tests were analyzed. Thus, 28 correlations were identified (57.1% positive and 42.9% negative), with 71.4% strong associations at $p < 0.001$ (25%), $p < 0.01$ (17.8%) and $p < 0.05$ (28.6%). Regarding the significant correlations between the parameters of the Jumps 15 sec test with CMJ and SJ, strong negative associations were observed for the number of jumps (No) with TFlight and Height (SJ) at $p < 0.05$, T Contact showed non-significant negative associations ($p > 0.05$), while Height, Power and RSI had significant positive correlations ($p < 0.05$, $p < 0.01$ and $p < 0.001$) and significant negative correlations with Pace ($p < 0.05$, $p < 0.01$). All these strong correlations (positive and negative) highlight the reciprocal influence between the measured parameters, specific to the applied tests. They also determine the degree of connection between the lower limbs' strength indices in 12-13-year-old soccer players.

4. Discussions

The aim of the study was to analyze the

relationship between lower limbs strength indices in soccer players aged 12 to 13 years. To assess the level of lower limbs strength development, three jump tests were used. Specifically, the CMJ and SJ tests were compared to identify differences between the measured parameters and the specificity of each test.

The results reveal higher values in the CMJ test as for flight time (TFlight) and jump height (Height), while the SJ test showed an increase in the Confidence Level of Mean (CLM), as presented in Table 1. The analysis of parameters in the Jumps 15 sec test (Table 2) highlighted an average of 26.95 jumps, as well as a greater difference between flight time and contact time. Additionally, a height of 14.96 cm, a power of 21.76 w/kg, a Pace of 1.73 steps/second and a Reactive Strength Index (RSI) of 0.68 m/s were recorded.

Pearson's linear correlation analysis (presented in Table 3) investigated the relationship between the parameters of the Jumps 15 sec test and the CMJ and SJ tests, examining a total of 28 relationships. It was observed that 71.4% of these relations showed strong connections, at significance levels of $p < 0.001$, $p < 0.01$ and $p < 0.05$. These results highlight the mutual influence between the measured parameters, emphasizing the connections between lower limbs strength indices in 12-13-year-old soccer players.

There are several concerns and studies regarding the training of 12-13-year-old soccer players and the relationship between various variables. The study of

Radnor et al. [22] found that there were no significant differences between each birth quartile in terms of weight, height, and performance parameters in boys from an English soccer academy. However, the boys with early maturation were significantly taller and heavier compared to those with on-time or late maturation.

Malina et al. [17] emphasized that an advanced level of maturity brings temporary competitive benefits through increased values of physical fitness and anthropometry. Other studies suggest that body height and maturation do not specifically influence technical tasks.

Skeletal age had a minor impact on motor performance in athletes aged 10 to 15, but body size, proportions, training hours and motivation for participation explained a more significant proportion of motor performance variation [10].

Hespanhol [13] evaluated the sensitivity and specificity of different protocols for measuring vertical jump tests in diagnosing explosive power in soccer and volleyball players during puberty.

The purpose of the research conducted by Kozina [14] was to provide a comparative characteristic of the dynamics of psychophysiological functions and indicators of physical and technical training of young soccer players aged 12-13 and 15-16 over a period of 3 months.

Özdemir [20] investigated the effects of soccer training and lower limbs strength training on the functional capacities of adolescent soccer players. The conclusion was that biological maturity significantly influences functional capacity, and training has notable contribution to

aerobic endurance, while body weight and height are important factors for sprinting and vertical jumps.

Mitrousis [19] examined the effect of a balance training program on the balance and technical skills of adolescent soccer players, concluding that this type of training program considerably improved static and dynamic balance, as well as accuracy in shooting with the dominant foot.

5. Conclusions

The conclusions reveal significant differences between the CMJ and SJ jump tests, with higher results in CMJ for flight time and jump height, while the confidence level of the mean was higher in the SJ test, indicating greater stability of results.

The analysis of parameters in the 15-second Jumps Test showed a balanced approach between power and execution speed. The correlations between the parameters of this test and the CMJ and SJ tests revealed strong connections, suggesting an important interdependence between lower limbs strength indices.

Additionally, flight time and height were negatively correlated with the number of jumps, while power and reactive strength index were positively correlated, reflecting the complexity of relationships between different lower limbs strength parameters in 12-13-year-old soccer players in the context of physical performance in soccer.

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