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THE EXPLOSIVE POWER AND SPEED ABILITIES OF LOWER EXTREMITIES OF YOUNG BASKETBALL PLAYERS

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Summary: The authors compared selected somatic data and test results in 20 m sprint and countermovement jump (CJM) of 14-year-old Lithuanian players from Sabonis Center (LT, n=143; body height: 173.7 ± 8.99 cm; body mass: 59.30 ± 11.40 kg), and Slovenian (SLO, n=84; body height: 172.8 ± 9.96 cm; body mass: 60.10 ± 12.49 kg) and Slovak national team players (SVK, n=42, body height: 177.5 ± 9.07 cm; body mass: 63.32 ± 11.36 kg). The SVK players were divided into the narrow pick (A-team, n=16) and broader roster (B-team, n=26). Within the SVK groups, significant differences between the A-team and B-team have been found in terms of body height ($p<0.05$) and body mass measurements ($p<0.01$), and in the test 20 m sprint ($p<0.05$). In CMJ results, the differences of the A-team and B-team have not been statistically significant. In the international comparison SVK players were taller than SLO and LT players ($p <0.05$). In the test 20 m sprint SVK players have achieved significantly better results (LT $p <0.05$, SLO $p <0.01$). On the contrary, in CMJ test the results (height of the jump) of SVK players were significantly worse than SLO and LT players ($p<0.01$).

Key words: young basketball players from Slovenia, Lithuania, Slovakia; motor testing

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Introduction

Basketball is a multifaceted and complex team game where players must quickly react and adapt to the rapidly changing game situations. Making the right decisions quickly with the appropriate and efficient execution of technical and tactical components decides the success of the performance of players and, consequently, determines the outcome of a particular game (Gallová 2015). The quality of performance depends on player abilities, e.g. the coordination of lower and upper limbs, the proper execution of sequences of movements, and the specific basketball speed and reaction and players cooperation in tactical combinations. These abilities are mostly related to explosive (take-off) power, speed, and agility, as most of the movements with and without the ball (e.g. rapid starts, stops, changes of direction, jumps, shots) are performed as high intensity activities in an intermittent manner (Erčulj and Bračič 2008; Köklü et al. 2011; Alemdaroğlu 2012; Gottlieb et al. 2014). Players spend about 2.1 - 8.8 % of live time in high "specific movements", sprinting and jumping, respectively (Abdelkrim et al 2007). Maximal sprints or other brief activities are changing approximately every 2 seconds, which corresponds to distances of approximately 10 meters (Delextrat and Cohen 2008; Köklü, et al. 2011; Lockie et al. 2013). Schelling and Torres-Ronda (2013) stated that the density of game activity (work-to-rest ratio) varies depending on the action, intensity and the moment of the game: medium-to high-intensity actions have a 1:1 density (with 15 s of duration approximately), high-to maximal intensity actions last 2 – 5 s (2 s predominantly) and have a 1:10 density. Therefore, lactate as a metabolic by-product is incorporated less often in game situations (when a high intensity activity lasts for 10-30 s). This happens during full court press situations or during quick transitions from defense to offence and vice-versa, which are considered as the most important strategies in youth basketball.

Hence, emphasis in practice should be put on the ability to accelerate in form of short distance sprints 3 – 10 m, including changing directions (linear and lateral) and chaotic speed (agility); it should also focus on the proper running technique and speed dribbling with a ball (Canada Basketball 2008; Delextrat and Cohen 2008).

Aim

The primary objective of this research was to compare the somatic parameters and level of chosen motor abilities of young Slovak basketball national team players. The second purpose of this paper was to compare them with players from Slovenia and Lithuania, two European countries of a good international level in basketball.

Methods

The subjects of the first part of the study were 42 Slovak national team players (body height: 177.5 ± 9.07 cm; body mass: 63.32 ± 11.36 kg; BMI: 19.98 ± 2.37) in age 13.19 to 14.42 years-old. Based on the information from national team coaches, these players were divided into two groups: those who were selected for the narrow pick of the national team (A-team, n = 16) and the broader team (B-team, n = 26). The somatic parameters of each group are shown in Table 1.

Post hoc we compared the Slovak players (SVK, n = 42) with a sample of the same age group of Slovenian national team players (SLO, n = 84; body height: 172.8 ± 9.96 cm; body mass: 60.10 ± 12.49 kg; BMI: 19.93 ± 2.49) and Lithuanian players from Sabonis Center (LT, n = 143; body height: 173.7 ± 8.99 cm; body mass: 59.30 ± 11.40 kg; BMI: 20.40 ± 1.91), whose national teams play regularly at the European Championships in the A division. The level of chosen motor abilities of young basketball players was conducted by using tests of 20 m sprint and countermovement jump. For measuring the results in 20 m sprint test, the used photocells were placed at the start and finish lines. Players self-started from standing ready position 50 – 70 cm before the start line, and performed 2 maximal sprints on the basketball court. There was a recovery period of 3 – 5 minutes between the sprints. The best attempt was taken into consideration.

The height of the CMJ was measured with the jump ergometer – FITRO Jumper (contact plate, Slovakia), the contact plate Kistler (Lithuania) and the bilateral force plates (Slovenia). Regarding CMJ, the Bosco jump test protocol had been used. Players in Slovakia and Slovenia were instructed to perform a maximum vertical jump after dropping into a semi-squat position (knee angle of 90°) with trunk in an upright posture and to push off vertically as fast as possible with their hands being kept on their hips, and to land on both feet. Each player had 3 attempts and only the best attempt was taken into consideration.

In Lithuania the players were squatting into a 135° angle (measured with the goniometer) and performed the jump with arms swing – first they moved their arms backward (during the downward movement), and then during the push-off phase forward and upwards. Again, players performed 3 attempts and only the best was taken into consideration.

We were aware of the fact that different protocols/specific techniques affected the results in CMJ, which will be discussed later, but we considered it more important to present an international comparison of U14 male basketball players from 3 different European countries. Basic descriptive statistics were used to compare the results of motor tests and somatic data of the testing groups. Means ($\bar{x}$) and standard deviations (SD) were used as measures of centrality and spread of data. The differences between them were established by using T-tests for independent samples. The level of significance was set at $p<0.01$ and $p<0.05$.

Results and Discussion

The somatic parameters and test results of Slovak players divided into the A-team (the selected roster) and B-team (broader roster) are presented in Tables 1 and 2. The A-team players were significantly taller than B-team players were ($p<0.05$; Table 1), not only in the average values (181.35 cm in A-team, 174.5 cm in B-team) but also in the maximum (201.7 cm, respectively 192.6 cm), and minimum body height values (170.1 cm, respectively 159.8 cm). The importance of body height was taken into consideration by the Slovak-national team coaches when doing the narrow selection of the players (A-team pick).
The increased values of body height logically influenced the values of body mass (A-team average 68.91 kg, B-team 59.88 kg), significantly on $p<0.01$ level (Table 1). Furthermore, the A-team difference in range was lower than the B-team's (37 kg, respectively 49.5 kg) and therefore the A-team was more homogeneous in terms of somatic parameters than B-team.

Table 1

The somatic parameters of SVK players: selected players (A-team) and the broader roster (B-team)

Variable	SVK group	Players	$\bar{x}$	SD	U – test	Sign.
Body height [cm]	A-team	16	181.35	8.55	2.305*	p<0.05
	B-team	26	174.50	8.45		
Body mass [kg]	A-team	16	68.91	9.07	3.304**	p<0.01
	B-team	26	59.88	11.40		

To compare the acceleration speed of the players we chose the test 20 m sprint. This test is widely used for the testing of basketball players (Paulauskas 2003; Abdelkrim et al. 2007; Erčulj and Bračič 2008; Tanner and Gore 2013; Gottlieb et al. 2014) then it is close to the length of a basketball court (Delextrat and Cohen 2008) and it is used in selection testing in Slovenia and Lithuania.

Although Delextrat and Cohen (2008) suggests to use the 5 – 10 m sprint tests instead, based on results of their study about factors of performance in basketball, we preferred to use the 20 m sprint, because, as mentioned earlier, “the running game” with a lot of fast breaks and full court press situations is recommended for youth basketball. Young at al. (2008) stated that the correlations between 10 m and 20 m times in their study were high, which indicates that both measures assessed very similar speed qualities. Moreover, according to Alemdaroğlu (2012), Ingebrigtsen and Jeffreys (2012), jump performances were significantly related to sprint performances with stronger relationship to the 10 m sprint, and for our study was important to distinguish the more independent aspects of overall performance of youth basketball players. In the test 20 m sprint the A-team achieved better results, significantly on $p<0.05$ level (Table 2). Furthermore, the best result of A-team was 2.98 s, while in the B-team the best result was 3.11 s. However, it should be noted that, when testing this relatively simple locomotion, several basketball players (not just the tall ones), had problems to coordinated their movement smoothly and to run the distance of 20 m without a hint of fall. This should be the warning signal for the coaches that in practice, the players need to spend accurate time on the development of proper running technique, as this is one of the fundamental locomotions.

The vertical jump test is very specific to basketball (Harman 2008) and one of the factors of success (Delextrat and Cohen 2008) as it is applied in many game like situations (e.g. rebounding, blocking, shooting). Šimonek, Doležajová and Lednický (2007) consider jumping ability as one of the crucial factors in the structure of basketball performance, which they acknowledged by the fact that 52 – 73 % of the points in a game are achieved from jump shots. Test results in CMJ of Slovak A-team and B-team showed that the players of the A-team achieved better performances comparing players of the B-team but they are not statistically significant (Table 2). The reported means in 20 m sprinting times ranged from 3.21 – 3.31 s, which suggests that the players of A-team were on average about two meters ahead of the B-team players after a sprint of 20 m. Similarly, the slight differences between the high jump assessments (about 2.50 cm, Table 2) can decide the success in e.g. rebounding, and therefore, we have to take into consideration that these differences can influence the result of a game.

Table 2

The comparison of test results between Slovak A-team and B-team

Variable	SVK group	Players	$\bar{x}$	SD	U – test	Sign.
Sprint 20 m [ms^{-1}]	A-team	16	3.21	0.158	1.998*	$p<0.05$
	B-team	26	3.31	0.150		
Vertical jump [cm]	A-team	16	32.48	5.46	1.321	-
	B-team	26	29.90	5.45		

The comparison of somatic data of Slovak and Slovenian national U14 teams, and Lithuanian players are presented in Table 3 and 4. The average body height of LT players was

173.7 cm, 172.8 cm of SLO, and 177.45 cm of SVK players, in both cases with statistical significance on p<0.05 level in favour of Slovak players. Therefore, we can say that in this physical parameter the players from Slovakia possessed potential advantages when compared with the players from elite basketball countries, as body height is one of the factors, which positively affects the players' performance.

Table 3
The comparison of somatic data of players from Slovenia (SLO) and Slovakia (SVK)

Variable	Country	Players	x̄	SD	t – test	Sign.
Body height [cm]	SLO	84	172.80	9.96	2.551*	p<0.05
	SVK	42	177.50	9.07		
Body mass [kg]	SLO	84	60.10	12.49	1.394	-
	SVK	42	63.32	11.36		
BMI [I]	SLO	84	19.93	2.49	0.107	-
	SVK	42	19.98	2.37		

Table 4
The comparison of somatic data of players from Lithuania (LT) and Slovakia (SVK)

Variable	Country	Players	x̄	SD	t – test	Sign.
Body height [cm]	LT	143	173.70	8.99	2.391*	p<0.05
	SVK	42	177.50	9.07		
Body mass [kg]	LT	143	59.30	11.40	1.999*	p<0.05
	SVK	42	63.32	11.36		
BMI [I]	LT	143	20.40	1.91	1.176	-
	SVK	42	19.98	2.37		

To determine the level of the explosive (take-off) power and speed abilities of young players the tests of 20 m sprint and CMJ (jump height) were performed. Novak, Neljak and Sporiš (2008) distinguishes between different types of explosive power, such as power of vertical or horizontal jumping, sprinting, throwing and hitting. Gottlieb et al. (2014) state that in basketball power and speed are usually performed in two forms of explosive-type actions: vertically (jumping to shoot, rebound) or horizontally (running for fast breaks, penetrations). The comparison of the test results of the SVK group with the SLO and LT group is shown in Tables 5 and 6.

In the test 20 m sprint, the average results of SLO and LT players were worse than SVK players, significantly on p<0.01 level (SLO), respectively p<0.05 level (LT). These results could be affected by a variety of details. We can consider the photocells (single- or dual-beam, the manufacturer), the administration or where and how the player starts at the starting line (with the fixed position of the feet, mostly the recoil-foot), or their distance from the starting line. In addition, the acceleration in growth of the players could have played a role. In addition, results could be influenced by vertical or horizontal force production, as well as other variables: contact and flight time, stride length and frequency, centre of mass displacement, and different facets of technique (Brughelli, Cronin and Chaouachi 2011; Lockie et al. 2013).

On the contrary, in CMJ test the results (height of the jump) of SVK players were worse than SLO and LT players, significantly on $p<0.01$ level. Obviously, the results of LT group were affected by different jump protocol. According to Gerodimos et al. (2008) arm swing can improve the CMJ performance by 4-7 cm (16 – 20 %) in young basketball players; while in a study carried out on adults Harman et al. (1990) reported that arm motion increased CMJ height or take-off velocity by 4 – 10 cm (5 – 12 %). If we consider this, the average of LT players was still better than SVK group.

We are aware of the fact that beside the arm swing other variables could have affected the test results of the groups in CMJ, as according to Linthorne (2001) the more vigorous the preliminary downward phase, the higher the jump. Also, the depth of the squat could have played a role as Markovic et al. (2013) stated in their study, because it inevitably alters the jumping kinematic pattern. Delextrat and Cohen (2008) and Köklü et al. (2011) reported similar anomalies in results of jump height and sprint test. While Delextrat and Cohen (2008) study showed no significant difference between the 2 groups of players in 20 m sprint performance, elite players achieved a significantly higher VJ height ($p\leq0.05$) compared to average-level players. Köklü et al. (2011) presented the findings that although 1st division players' showed significantly better CMJ performance than 2nd division players, 2nd division players had significantly better 10 m sprint performance ($p\leq0.05$). Those results, in agreement with our findings, suggest that jump performance might be a major factor of success in basketball. Therefore, these test results without a deeper analysis could lead to the conclusion that jump performance might also be the factor why our youth national teams are behind their peers from different countries, where basketball is on good international level.

Table 5

The comparison of test results between Slovenian (SLO) and Slovak players (SVK)

Variable	Country	Players	$\bar{x}$	SD	t – test	Sign.
Sprint 20 m [ms^{-1}]	SLO	84	3.499	0.226	5.753**	p<0.01
	SVK	42	3.273	0.159		
Vertical jump [cm]	SLO	84	38.67	4.815	7.250**	p<0.01
	SVK	42	30.88	5.530		

Table 6
The comparison of test results between Lithuanian (LT) and Slovak players (SVK)

Variable	Country	Players	$\bar{x}$	SD	t – test	Sign.
Sprint 20 m [ms^{-1}]	LT	143	3.350	0.190	2.379*	p<0.05
	SVK	42	3.273	0.159		
Vertical jump [cm]	LT	143	41.70	6.25	10.06**	p<0.01
	SVK	42	30.88	5.53		

Conclusions and Recommendations

The results of somatic data measurements have shown that SVK players have a good starting point in the body height factor, players were taller on $p < 0.05$ statistically significant level. The comparison in the test 20 m sprint has shown that SVK players have achieved significantly better results (LT $p < 0.05$, SLO $p < 0.01$); on the contrary, in the results of the CMJ the LT and SLO players were significantly better than SVK ($p < 0.01$). These results confirm the findings of other studies that explosive power of lower extremities is an important ability for basketball players, which can significantly affect playing performance in basketball and its importance increases with the intensity of the games and level of the competitions. Therefore, we recommend to the coaches to focus on the development of different types of strength and explosive power, using short and high-intense exercises with longer rest periods (e.g. vertical and horizontal jumping, very short sprint 3-10 m), with accent on the first 2 strides in agility, reactive and basketball specific drills. In season they should focus on skill-based conditioning which enhances the ability to repeat high-intensity efforts and small-sided games.

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