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EFFECT OF A SPECIALIZED PROGRAM ON THE DEVELOPMENT OF SPEED-STRENGTH ABILITIES IN 14-15-YEAR-OLD BASKETBALL PLAYERS

Yavor Asparuhov
National Sports Academy "Vassil Levski", Sofia, Bulgaria

ABSTRACT

Information on coaching practices related to specialized training programs that affect speed and strength qualities in 14-15-year-old basketball players is scarce. The aim of this study was to investigate the impact of a specialized, periodized training program on the development of speed-strength qualities in 14-15-year-old boys playing basketball. Nineteen basketball players aged 14.5 ± 0.5 years who participated in a regular, well-organized training program were studied. A specialized methodology was applied for 5 months, from October 2024 to March 2025. Training sessions were held three times a week, with a wave distribution of intensity: Monday – high-intensity pure strength; Wednesday – explosive focus with variations and sprints; and Friday – emphasis on contrasting methods, including plyometrics and medicine ball throws. To determine the effect, a test battery of 10 tests was applied, including anthropometric measurements (height, weight, horizontal and vertical stretch) and physical fitness indicators (10 m and 20 m running, 5-0-5 test, long jump, push-ups with hands on hips, and isometric pull from mid-hip). The trainings were held three times a week, with a wave distribution of intensity: Monday – high-intensity pure strength; Wednesday – explosive focus with different variations and sprints; and Friday – emphasis on contrasting methods, including plyometrics and medicine ball throws. To determine the effect, a test battery of 10 tests was applied, including anthropometric measurements (height, weight, horizontal and vertical stretch) and physical fitness indicators (10 m and 20 m running, 5-0-5 test, long jump, push-ups with hands on hips, and isometric pull from mid-hip).

After implementing the program, the basketball players showed statistically significant improvements in agility (5-0-5 test), upper-body strength, and lower-body strength (hands-on-hips jump and isometric pull from mid-hip). Positive developments were also observed in speed and explosive lower limb strength across other indicators, such as the 10 m and 20 m sprints and the long jump, although these improvements were not statistically significant.

The results confirm the positive impact of a specialized, periodized strength-training program, which has been proven to enhance the development of speed-strength qualities in 14-15-year-old basketball players. This contributes to higher sports performance and injury prevention.

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ORCID
Yavor Asparuhov
https://orcid.org/0000-0001-9551-0764

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INTRODUCTION

Modern basketball is a highly dynamic and engaging sport, and selecting young basketball players requires not only choosing those with tall stature but also monitoring the proper development of physical qualities and an excellent level of technical skills. To stand out in men's basketball, player profiles are expected to meet the demands of training and competition (Abdelkrim et al., 2010). More specifically, a player's profile is likely linked to both their physical and technical abilities. Therefore, it is not surprising that for young players, the same indicators of physical conditioning are also important predictors of competition success (Ziv & Lidor, 2009; Ramos et al., 2018). Torres-Unda et al. (2013; 2016) report significant correlations ($0.41 \leq r$

≤ 0.53) between the number of points scored per game and the physiological parameters of young players in endurance, sprint, jump, and dribbling tests. Other studies have found that systematic differences in jumping and sprinting ability, as well as the individual's anaerobic capacity, are important factors for individual and team success during competition (Torres-Unda et al., 2016; Ramos et al., 2018; Borukova, 2019). In addition, it has been noted that the biological development of young athletes can affect their physical performance (Baxter-Jones, 1995; Beunen & Malina, 2008; Guimarães et al., 2019; Borukova, 2021).

Basketball players are at high risk of injury due to the intense physical contact in a confined space (Esco, 2020). Strength training is believed to enhance players' strength and endurance, thereby improving performance and reducing the risk of injury (Ransone, 2017). It is also important to understand how individual athletes should adapt their strength training regimen to their regular training routine (Strasunskas, 2020).

The physiological demands of modern basketball require a high level of physical conditioning, with strength and power being key components of sporting success. For adolescent athletes undergoing rapid growth and biological development, integrating structured strength training is crucial not only for enhancing performance but also for preventing injuries. However, the optimal methodology for developing strength abilities in this specific age group remains a subject of ongoing discussion and research. The traditional view that strength training is unsafe or ineffective for young athletes has largely been refuted, with increasing evidence supporting its benefits when applied correctly (Faigenbaum & Myer, 2010; Asparuhov, 2024).

A meta-analysis by Behringer et al. (2010) found that age-appropriate, supervised strength programs lead to significant increases in muscular strength. Furthermore, Ratel et al. (2009) demonstrated that specialized training tailored to the unique developmental stage of young athletes can result in superior neuromuscular adaptations compared to the general physical education programs. These findings highlight the importance of transitioning from general training protocols to a more specific approach that considers the sport and the athlete's age.

For 14- to 15-year-old basketball players, who are in a critical period of physical development and skill acquisition, a targeted strength program is essential. This age group is transitioning from early to late adolescence, undergoing significant hormonal changes and rapid increases in body mass, which can affect both performance and injury risk. Although the general benefits of strength training for youth are well documented, there is a relative lack of studies examining the specific impact of specialized training methodologies on strength development in this particular demographic of basketball players. For example, Lloyd et al. (2012) focus on long-term athlete development models but fail to address the specific effects of a single specialized program on a cohort of this age.

We concluded that the world-renowned, well-established Serbian basketball school employs a strength-training methodology for 15- to 16-year-old competitive basketball players (Jakovljevic, 2009). This methodology was adapted and implemented in the training process for 14- to 16-year-old competitive basketball players in Bulgaria over a single sports season. Statistically significant differences indicate that the specialized methodology applied to develop speed-strength abilities in young athletes had a positive effect (Asparuhov, 2024).

Training during childhood and adolescence is a widely discussed topic in the literature.

Organized basketball activities contribute not only to children's physical development but also to the balanced advancement of fundamental motor skills across different age stages. To accurately track these changes, it is essential to implement monitoring across the various components of sports preparation systematically. Accordingly, many researchers employ diverse test batteries (AAHPERD, 1984; Gyosheva et al., 1990; Pattison, 1990; Karalejič & Jakovljevič, 1998; Tzarova & Borukova, 2012; Borukova, 2018; Asparuhov, 2020; Pino-Ortega et al., 2020; Borukova, 2022).

The aim of this study was to examine the impact of a specialized, periodized training program on the speed-strength abilities of 14- to 15-year-old boys playing basketball. By implementing and evaluating a methodology that accounts for the unique physiological characteristics and sport-specific demands of this age group, the study aims to provide valuable insights into effective coaching practices.

METHODOLOGY

The sample consisted of 19 male basketball players. The majority were members of the U14 Bulgarian Championship-winning team for the 2024/2025 season. Five players also participated in the U16 team, as no U15 category existed in Bulgaria during the 2024/2025 season. The participants' mean age was 14.5 ± 0.5 years, with an average height of 182.43 ± 10.9 cm, body mass of 65.45 ± 11.04 kg, and body mass index (BMI) of 20.68 ± 2.24 kg/m². All were engaged in regular, well-structured training.

At the time of testing, all players were in good health, injury-free, and not taking any medication. Both the club and the players' parents provided informed consent for participation in the study. The research was conducted in accordance with the ethical standards outlined in the Declaration of Helsinki (World Medical Association, 2013).

Measurments

Table 1 presents the test battery. The test battery includes 10 indicators covering basic physical development and physical preparedness. The indicators are divided into two groups: those for physical development from the 1st to the 4th; for physical preparedness from the 5th to the 10th. The tests for physical development and physical preparedness are the standard ones used in sports practice for many years; indicator No. 10, "Isometric Mid-Thigh Pull," will be described, as it is somewhat different from those currently in use.

Table1. *Description of The Test Battery*

Indicators	Measurments	Exact. of measurem	Direction of increase
Height - H	cm	1.0	+
Weight - W	kg	0.1	+
Horizontal Stretch - HS	cm	1.0	+
Vertical Stretch - VS	cm	1.0	+
Run 10 m – R10	s	0.01	-
Run 20 m – 20	s	0.01	-
5-0-5 Test - 5T	s	0.01	-
Long jump - LJ	cm	1.0	+
Rebound Hands on Waist - RHW	cm	1.0	+
Isometric Mid-Thigh Pull - IMTP	kg	0.5	+

Procedure

To achieve the aim and objectives of this study, the following research methods were applied: a review of specialized literature and sport-pedagogical testing.

Two testing sessions were conducted with the team, the first on October 9, 2024, and the second on March 6, 2025. During the five months between the two assessments, the team followed Asparuhov's (2024) specialized methodology to develop sport-specific strength and endurance without compromising basketball performance. The approach was carefully structured, taking into account the athletes' individual characteristics and needs at different stages of the season and their level of training. At the core of the training plan was a wave-like distribution of intensity and load types, creating conditions for effective adaptation without excessive fatigue accumulation. The primary focus was on developing strength and speed-strength abilities through systematic manipulation of intensity, volume, and specificity of training loads within the weekly cycle. The specialized methodology was incorporated into the regular training sessions three times per week:

Monday: Day of the week with the highest intensity – above 75% of one-repetition maximum (1RM). Core multi-joint exercises are performed with a relatively low number of repetitions and limited proximity to failure. The aim is to generate maximal tension and develop pure strength.

Wednesday: Explosive-focused day. Strength exercises are performed at approximately 70–75% of 1RM with a high movement velocity. The session includes resisted sprints with bands, Olympic lifting variations (such as cleans, hang cleans, and snatch variations), and strength exercises to develop explosive power and reactivity.

Friday: Contrast-method emphasis. The session begins with flying sprints and plyometric drills (such as tuck jumps, bounding, and hurdle jumps), followed by strength exercises at approximately 65–70% of 1RM performed at maximal speed. Medicine ball throws (rotational, from the floor, and overhead) are also incorporated to develop the strength–speed profile in sport-specific planes.

For the research team, it was important that the second testing session be conducted before the team's most important competitions of the year, held in April and May (May and June).

Both testing sessions were carried out at 10:00 a.m. in the sports hall where the team regularly trains. Anthropometric measurements were performed first, with athletes measured barefoot and wearing shorts. This was followed by a standardized 20-minute warm-up, including stretching and drills closely related to the testing exercises.

Statistics

All statistical operations were carried out using Microsoft Excel 2010 and SPSS for Windows, Release 23, for statistical analysis. Depending on the research tasks, the following statistical methods were applied: Descriptive Statistics and Student's t-test for dependent samples (*t*-critical = 2.028*)*.

RESULTS

Results for the descriptive statistics (Mean and Standard deviation) of the observed characteristics after two tests are shown in Tables 2 and 3.

Table 2. *Descriptive Statistics of the first test results*

Indicators	*N*	Min	Max	*Mean*	*SD*	As	Ex	V
H	19	153.00	198.00	179.03	10.890	-0.154	0.887	6.08
W	19	42.60	84.70	65.45	11.040	-0.112	-0.356	16.87
HS	19	148.00	198.00	179.75	13.050	-0.510	0.564	7.26
VS	19	198.00	257.00	232.83	14.403	-0.345	0.717	6.19
R 10m	19	1.48	1.90	1.68	0.108	0.141	0.054	6.41
R20m	19	2.78	3.40	3.15	0.147	-0.771	1.067	4.66
5Test	19	2.20	2.65	2.43	0.101	0.322	1.684	4.18
LJ	19	145.00	238.00	212.22	21.929	-2.187*	5.168*	10.33
RHW	19	24.54	37.70	31.39	4.115	-0.233	-0.754	13.11
IMTP	19	125.00	205.00	169.78	25.390	-0.399	-0.929	14.95

***Legend**: Height – H; Weight – W; Horizontal Stretch – HS; Vertical Stretch – VS; Run 10 m – R10; Run 20 m – R20; 5-0-5 Test – 5T; Long jump – LJ; Rebound Hands on Waist – RHW; Isometric Mid-Thigh Pull - IMTP*

Table 3. *Descriptive Statistics of the Second Test Results*

Indicators	*N*	Min	Max	*Mean*	*SD*	As	Ex	V
H	19	157.00	200.00	182.84	10.294	-.0230	1.177	5.63
W	19	45.70	84.90	69.38	10.539	-0.377	-0.191	15.19
HS	19	151.00	200.00	183.29	12.511	-0.690	0.918	6.83
VS	19	202.00	261.00	236.58	14.450	-0.234	0.456	6.11
R 10m	19	1.50	1.84	1.66	0.080	0.693	1.237	4.80
R20m	19	2.87	3.39	3.12	0.135	0.239	0.006	4.33
5Test	19	2.13	2.50	2.35	0.108	-0.496	-0.493	4.61
LJ	19	183.00	239.00	222.63	15.682	-1.698*	2.492*	7.04
RHW	19	28.53	38.10	34.21	3.111	-0.537	-0.616	9.09
IMTP	19	130.00	310.00	230.21	43.957	-0.280	0.770	19.09

***Legend**: Height – H; Weight – W; Horizontal Stretch – HS; Vertical Stretch – VS; Run 10 m – R10; Run 20 m – R20; 5-0-5 Test – 5T; Long jump – LJ; Rebound Hands on Waist – RHW; Isometric Mid-Thigh Pull - IMTP*

An analysis of the two assessment sessions shows that, in both cases, the distributions of values were normal or nearly normal. The only exception was the *Standing Long Jump* indicator, where the values deviated from the normal range ($As_1 = -2.187$ and $As_2 = -1.698$), as confirmed by the high Ex values in both assessments. This deviation is to be expected, given the groupis high homogeneity, as evidenced by the coefficient of variation (Table 2). In the second assessment, only for the indicator related to upper body strength (V10 = 19.09), was relative homogeneity observed. This is typical for boys aged 14–15, who are in a prepubertal and pubertal stage, during which strength training should be carefully planned and dosed according to each athlete‘s abilities. Youths—both athletes and non-athletes—can successfully and safely improve their strength and overall health by participating in a well-controlled program. Qualified fitness professionals play a crucial role in ensuring correct technique, form, exercise progression, and safety within this age group (Dahab & McCambridge, 2009).

As shown in Figure 1, the differences between the two assessment sessions for the examined indicators reveal that, in terms of physical development, the basketball players increased their height by 3.81 cm, body weight by 2.82 kg, horizontal reach by 3.54 cm, and vertical reach by 3.75 cm.

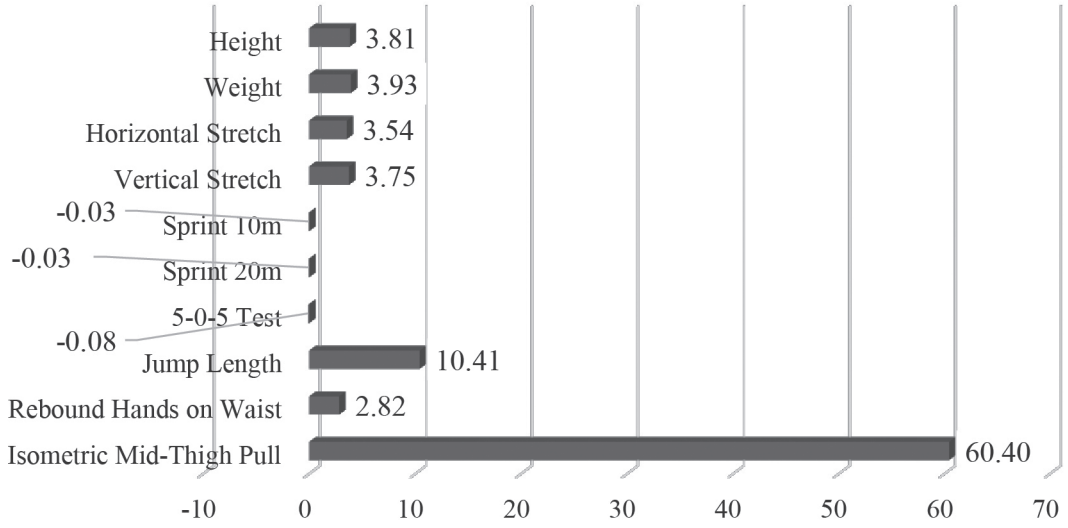

Figure 1. *Difference in indicators between the two tests*

The presence of differences between the two assessments prevents us from drawing general conclusions about the studied sample. For this purpose, a comparative criterion must be applied; in this case, a paired Student's *t*-test for dependent samples was used, with *t*-critical = 2.08.

Table 3 presents the results of the comparative analysis. Examination of Table 3 shows that statistically significant differences were observed in only three of the measured indicators: the 5-0-5 agility assessment (t_7 = 2.385), the jump from a platform without the use of arms—reflecting lower-body and core strength (t_9 = 2.090), and the deadlift assessment (t_{10} = 3.867).

Table 3. *Statistical significance of the results*

Indicators	*n*	*I testing*		*II testing*						
		M_1	SD_1	M_2	SD_2	d	d%	*Cohen d*	*t*	Sig. (2-taiiled)
H	19	179.03	10.89	182.89	10.29	-3.86	-2.16	0.242	1.027	.32
W	19	65.45	11.04	69.57	10.54	-4.12	-6.29	0.268	1.138	.27
HS	19	179.75	13.05	183.69	12.51	-3.94	-2.19	0.196	0.833	.42
VS	19	232.83	14.40	236.94	14.45	-4.11	-1.77	0.190	0.807	.43
R 10m	19	1.69	0.11	1.66	0.08	0.03	1.88	0.370	1.526	.15
R20m	19	3.17	0.12	3.12	0.14	0.05	1.54	0.310	1.277	.22
5Test	19	2.43	0.10	2.35	0.11	0.08	3.43	0.539	2.221	.04
LJ	19	212.22	21.93	222.78	15.68	-10.56	-4.97	0.446	1.893	.08
RHW	19	31.11	4.41	33.99	3.11	-2.88	-9.25	0.699	2.319	.04
IMTP	19	169.78	25.39	230.50	43.96	-60.72	-35.77	1.323	5.612	.00

***Legend**: Height – H; Weight – W; Horizontal Stretch – HS; Vertical Stretch – VS; Run 10 m – R10; Run 20 m – R20; 5-0-5 Test – 5T; Long jump – LJ; Rebound Hands on Waist – RHW; Isometric Mid-Thigh Pull - IMTP*

DISCUSSION

Young athletes may engage in strength training because they believe it will improve their sports performance. Although strength training can improve sports performance, many other factors influence performance. Increased strength can improve certain motor skills, such as the standing long jump (Falk &

Mor, 1996; Lillegard et al., 1997).

During the season, athletes focus more on endurance and maintaining the level of physical fitness they developed in the off-season than on improving their overall athletic preparedness (Fulton, 1992).

Most basketball teams conduct strength training during the off-season, when they experience less stress in relation to games. The off-season provides more time to improve both strength and endurance. Adding strength training to the regular training program is valuable in competitive sports, as it helps athletes achieve higher performance and prevent injuries (Helming, 2019).

One of the most common injuries in basketball is an anterior cruciate ligament (ACL) injury. This type of injury can be devastating for a young athlete. Even a simple strength training program can reduce the risk of such injuries (Lephart et al., 2005). Several studies demonstrate the positive effects of specialized strength and power-speed training in adolescent athletes at the prepubertal and pubertal stages (Falk & Mor, 1996; Lillegard et al., 1997; Dahab & McCambridge, 2009; Borukova, 2022; Asparuhov, 2024).

CONCLUSION

The aim of this study was to examine the impact of a specialized, periodized training program on the development of speed-strength abilities in 14–15-year-old boys playing basketball. In summary, the period during which the specialized program was applied has a proven effect on young basketball players. They significantly improved their agility, upper-body strength, and lower-body strength. Better performances in some other indicators related to speed and explosive lower-limb power (Run 10 m; Run 20 m; Long Jump) indicate positive development of these abilities, although these improvements are not statistically significant. This is likely due to the athletes‘ age, during which a very dynamic, yet asymmetrical, development of anthropometric parameters is observed.

The results of this study demonstrate the positive impact of general strength and power-speed training on young 14–15-year-old athletes. Within two months, the young competitors faced a very demanding sports schedule but managed to perform excellently in competitions, achieving first place in the U14 National Championship. At present, none of them suffers from injuries.

Incorporating strength training into regular training programs for basketball players could enhance their physical conditioning, support higher athletic performance, and help prevent injuries.

The findings of this study could contribute to the accumulation of knowledge in the field of youth strength and conditioning, offering evidence-based recommendations for coaches and sports scientists working with adolescent basketball players.

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Corresponding author:
Yavor Asparuhov
Department of Basketball, Volleyball, Handball,
Faculty of Pedagogy
National Sports Academy "Vassil Levski"
21 Acad. Stefan Mladenov Str.
Sofia, 1700, Bulgaria
E-mail: yavor.asparuhov@nsa.bg