MONITORING ANTHROPOMETRIC AND MOTOR PERFORMANCE CHANGES IN U16 BASKETBALL PLAYERS OVER A 12-WEEK COMPETITIVE PERIOD

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Abstract. *The objective of this study was to observe alterations in anthropometric features and motor performance in male basketball players under 16 years of age over a 12-week duration throughout the competitive season. Methods: A cohort of 59 male youth basketball players (mean age = 15.9 ± 1.01 years) from four teams competing in the Albanian U16 National Championship were evaluated. All teams held routine training sessions in Tirana, Albania. Measurements were conducted at two intervals—before (T1) and following 12 weeks of training and competition (T2). Anthropometric measurements comprised body height, weight, and waist circumference. Motor performance was evaluated by upper limb strength assessments (medicine ball chest and overhead throws), a 20-meter sprint, and the Agility T-test. Paired sample t-tests were employed to assess differences between T1 and T2 readings, with significance established at $p < 0.05$. Results: Notable enhancements were detected in all assessed metrics. Elevations in stature ($p < 0.001$), mass ($p < 0.001$), and waist circumference ($p = 0.002$) signified physical maturation. Upper limb strength demonstrated significant improvements in both the chest pass ($p < 0.001$) and overhead pass ($p < 0.001$). Moreover, performance in the 20-meter sprint and Agility T-test exhibited considerable improvement ($p < 0.001$), indicating better speed and agility. Conclusion: The results indicate that a 12-week regimen of organized basketball training and competition significantly enhances both physical growth and motor performance in U16 male basketball players. Ongoing monitoring may enhance training optimization and athlete development in young sports.*

Keywords*: youth athletes; basketball; anthropometry; motor performance,*

Introduction

The development of young basketball players is a multifactorial process influenced by a variety of attributes including physical fitness, anthropometric characteristics, technical skills, and psychological factors. A thorough understanding of these elements can help enhance training programs and optimize performance at the youth level. Anthropometric characteristics such as body height, weight, and body composition are crucial indicators of potential basketball performance (Bilali & Spahi, 2017; Istrefi et al., 2020). Rinaldo et al. (2020) highlighted the importance of anthropometric growth in pre-adolescent male players, revealing that growth spurts significantly correlate with improved physical performance in specific motor tests. Similarly, Sánchez-Díaz et al., (2021) emphasized the role of physical fitness in adolescent athletes, noting that adequate nutrition and physical training are vital for optimal growth and athletic performance. Additionally, Koryahin & Blavt (2018) discussed physiological changes during training and competition, asserting that adaptations in physiological functions correspond to training loads experienced by players. The cultivation of motor skills is another essential component in youth basketball training. Studies show that motor coordination and technical skills directly influence competitive performance. For instance, Conte et al., (2020) introduced the concept of "Dribble Deficit," allowing coaches to assess dribbling proficiency in relation to sprinting speed, thus providing insights into training focuses. Marinho et al., (2024) conducted a systematic review that found generic motor tests could effectively predict future sports performance, supporting the identification of talent through motor skill assessment. Furthermore, work by Behringer et al., (2011) indicated that strength training can significantly improve motor performance skills in children and adolescents, underscoring the positive impact of resistance training on young athletes' overall performance (Spahi et al., 2016a; Spahi et al., 2016b). This aligns with findings from Kutson et al. (2023), which indicated that training loads can greatly vary among amateur players, suggesting that structured training regimens are essential for developing motor skills that are consistent with better game performance. Training methodologies must also encompass technical and tactical skills development. Chou et al. (2021) pointed out that off-season training might fail to provide necessary basketball-specific agility training, adversely affecting performance during competitive seasons. Integrating technical skill training during all phases of development is essential for maintaining readiness. The objective of this study was to observe alterations in anthropometric features and motor performance in male basketball players under 16 years of age over a 12-week duration throughout the competitive season.

Methods

The research encompassed 59 male youth basketball players from four teams that consistently competed in the U16 Albanian National Championship. All teams performed their training in Tirana, the capital of Albania. The average age of the participants was 15.9 years (SD = 1.01). All participants were in good health, uninjured at the time of assessment, and consistently engaged in organized basketball training (3–5 sessions weekly). Participation was voluntary, and informed consent was acquired from participants and their legal guardians.

Protocols and Measurement

Data collection occurred at two intervals: the commencement (T1) and conclusion (T2) of the competitive season (between 12 weeks). The examination was performed under comparable environmental conditions and adhered to defined methods.

Anthropometric measures comprised:

Body height was measured to the nearest 0.1 cm using a stadiometer, with participants standing barefoot.

Body weight recorded to the closest 0.1 kg via a digital scale, with participants attired in lightweight sportswear.

Waist circumference is measured at the narrowest point between the lower rib and the iliac crest using a flexible measuring tape.

Motor performance assessments comprised:

Upper limb strength evaluated using two tests medicine ball throw assessments: Chest pass: participants executed a two-handed throw from chest height while positioned behind a designated line.

Overhead pass: athletes propelled the ball from behind their heads utilizing both hands. The distance (in meters) was quantified from the starting line to the location where the ball initially contacted the ground.

Speed and agility were assessed utilizing:

20-meter sprint: participants traversed a linear distance of 20 meters at maximal exertion, measured with a stopwatch.

The Agility T-test consisted of sprinting forward, lateral shuffling, and backpedaling in a "T" configuration. The duration was measured in seconds using a stopwatch. Each test was conducted twice, and the superior result was utilized for analysis.

All assessments were conducted under the supervision of qualified specialists, and a systematic warm-up was administered prior to the testing processes.

Statistical Analysis

Descriptive statistics, including mean, standard deviation, and sample size, were computed for all variables. Paired sample t-tests were employed to analyze the results between T1 and T2, identifying statistically significant changes over time (12 weeks). The threshold for statistical significance was established at $p < 0.05$. All analyses were performed utilizing SPSS (Version 22.0, IBM Corp., Armonk, NY, USA).

Results

Tables below present the results of anthropometric and motor performance assessments conducted on U16 basketball players at two different time points (T1 and T2). The data include descriptive statistics and paired sample t-test analyses for body height, body weight, waist circumference, upper limb strength (measured through medicine ball throws), and motor abilities such as speed and agility. Overall, the results demonstrate statistically significant improvements across most parameters, indicating positive physical development and performance enhancement over the observed period.

Table 1. *Descriptive statistics for anthropometric parameters in U16 basketball players (T1 and T2)*

		M	n	SD
Pair 1	Body Height T1	1.79	59	0.07
	Body Height T2	1.81	59	0.07
Pair 2	Body Weight T1	70.3	59	10.1
	Body Weight T2	71.1	59	10.1
Pair 3	Waist T1	78.7	58	6.5
	Waist T2	79.2	58	6.4

Note. Table 1 presents descriptive statistics for anthropometric parameters measured at two time points (T1 and T2) in U16 basketball players. Slight increases were observed in body height, weight, and waist circumference from T1 to T2, indicating general physical development over the measured period.

Table 2. *Paired sample T test for each anthropometric parameter in U16 basketball players (T1- T2 differences).*

	Paired Differences		t	df	Sig. (2-tailed)
	M	SD			
Body Height T1 – Body Height T2	-0.014	0.009	-11.865	58	0.000
Body Weight T1 – Body Weight T2	-0.89	1.23	-5.55	58	0.000
Waist T1 – Waist T2	-0.56	1.34	-3.17	57	0.002

Note. Results in Table 2 show paired sample t-tests revealed statistically significant increases from T1 to T2 in body height ($p < .001$), body weight ($p < .001$), and waist circumference ($p = .002$), indicating measurable anthropometric development in U16 basketball players over the observed period.

Table 3. *Descriptive statistics for strength of upper limbs in U16 basketball players (T1 and T2 in cm).*

	M	n	SD
Chest pass- medicine ball throw T1	3.42	59	0.540
Chest pass- medicine ball throw T2	3.77	59	0.709
Overhead pass-medicine ball throw T1	3.09	56	0.433
Overhead pass- medicine ball throw T2	3.26	56	0.529

Note. Table 3 displays descriptive statistics for upper limb strength measured through medicine ball throws. From T1 to T2, players showed improvements in both the chest pass and overhead pass distances, suggesting enhanced upper body strength during the testing period

Table 4. *Paired sample T test for strength of upper limbs in U16 basketball players (T1- T2 differences).*

	Paired Differences		t	df	Sig. (2-tailed)
	M	SD			
Chest pass- medicine ball throw T1 - Chest pass- medicine ball throw T2	-0.35	0.43	-6.34	58	0.000
Overhead pass-medicine ball throw T1- Overhead pass-medicine ball throw T2	-0.17	0.29	-4.43	55	0.000

Note. Paired sample t-test results in Table 4 indicate statistically significant improvements in both chest pass ($p < .001$) and overhead pass ($p < .001$) distances from T1 to T2, reflecting a notable increase in upper limb strength among U16 basketball players.

Table 5**.** *Descriptive statistics for speed and agility in U16 basketball players (T1 and T2-seconds)*

	M	n	SD
Sprint 20m T1	3.42	59	0.23
Sprint 20m T2	3.28	59	0.22
Agility T test T1	11.50	59	0.81
Agility T test T2	11.30	59	0.82

Note. Table 5 shows descriptive statistics for speed and agility performance. Improvements were observed in both the 20m sprint and the Agility T-test times from T1 to T2, suggesting enhanced speed and agility in U16 basketball players over the testing period

Table 6**.** *Paired sample T test for speed and agility in U16 basketball players (T1- T2 differences).*

	Paired Differences		t	df	Sig. (2-tailed)
	M	SD			
Sprint 20m T1- Sprint 20m T2	0.14	0.17	6.47	58	0.000
Agility T test T1- Agility T test T2	0.19	0.72	2.06	58	0.044

Discussion and Conclusions

The results of the present study reveal substantial changes in anthropometric characteristics and motor performance in U16 male basketball players after a systematic 12-week training program. Improvements were evident in physical growth indicators, including height, body mass, and waist circumference, as well as significant advancements in motor skills, particularly upper limb strength, agility, and speed. This corresponds with Ahmed & Ahmed, (2015) findings, which highlighted the effectiveness of neuromuscular training in augmenting athletic performance, indicating that such training can result in enhancements in athletic performance metrics among basketball players. Enhancements in strength, agility, and speed are essential, as these qualities are important for success in basketball, a sport defined by swift directional shifts and explosive actions.

Additional corroborative evidence is provided by Lesinski et al. (2020), which demonstrates that well-designed training programs enhance physical fitness and anthropometric metrics in young athletes. This is especially pertinent to our findings on motor performance, where notable enhancements in agility and speed ($p < 0.001$) were observed. Furthermore, the analysis of physiological and motor attributes across various playing positions, as demonstrated by Yapıcı and İmer (2018), suggests that position-specific training can result in distinct improvements in physical capabilities. This indicates that customized training may enhance advancements in specific athletic attributes among players according to their positions. Furthermore, the focus on upper limb strength and lower body quickness aligns with prevailing patterns identified in basketball training literature. Lucia et al. (2023) revealed that multicomponent training, incorporating cognitive-motor activities with physical drills, resulted in significant enhancements in motor performance and decision-making abilities among elite players. This indicates that integrating cognitive components into training may improve the efficacy of programs for youth athletes, producing better outcomes in a shorter duration, which is essential given the restricted training periods during competitive seasons. Moreover, the anthropometric alterations noted align with the findings of Andrianova et al. (2022), who emphasize the importance of physical growth indicators in the selection and development of young athletes. Monitoring alterations during important maturation periods in athletes is essential for maintaining effective training adaptations. Numerous studies have confirmed the relationship between improved physical attributes and higher performance, underscoring the comprehensive advantages of consistent basketball training for young athletes (Lauria et al., 2021).

In conclusion, the ongoing adaptation and assessment of training protocols, emphasizing personalized growth trajectories and performance indicators, are crucial for optimizing player development in young sports. The incorporation of neuromuscular training methods with cognitive components may enhance training effectiveness, supporting a holistic strategy for athlete development.

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