International Journal of Engineering, Management and Humanities (IJEMH)
Volume 6, Issue 5, Sep.-Oct., 2025 pp: 296-302 ISSN: 2584-2145 www.ijemh.com

POSTURAL SPINE IN BOYS' BASKETBALL PLAYERS

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Date of Submission: 11-10-2025 Date of Acceptance: 24-10-2025

ABSTRACT:
The purpose of this study was to assess how 10 weeks of program corrective exercise affected the improvement of postural stability in boys' basketball players. Spinal abnormalities are seen even in team sports. In total No. 30 boys' basketball players from 3 different Sports Associations in Tirana, Albania mean aged 18 years were chosen at random and split into two groups: Experimental Group No. 15 (EXG) and Control Group No. 15 (COG). Anthropometric measures were taken of the two study groups in Body Height cm (EXG-181.22± 1.73 & COG-179.26 ± 1.69), Body Weight kg (EXG-74.84 ± 4.72 & COG- 82.27 ± 4.24) and BMI kg\m2 (EXG-21.73± 3.34 & COG- 22.27 ± 1.42). Zebris system software, Win Spine 2.3, was used to examine body posture in parameters; Kyphosis/°, Lordosis/°, Left Scoliosis/° Right Before and After training for 10 weeks. Group differences measured in 95% confidence interval was applied to variables. At $p < 0.05$, statistical significance was recognized. Corrective exercises produced a significant change ($p=0.013$), with possible normalization of the lordotic curve. The results of this study showed improvements in postural stability in kyphosis-lordosis by practicing corrective exercises for 10 weeks in U-18 boys' basketball players. These findings highlight the importance of practicing some corrective exercises to maintain correct body posture and contribute to the physical health of adolescents. The overall sagittal shape of the spine may change under the influence of exercises in this age group.

KEYWORDS: basketball boys, posture, spine, lordosis.

I. INTRODUCTION

To meet the demands of this sport, players must demonstrate high levels of both anaerobic and aerobic capacity, as well as attributes such as strength, agility, multidirectional mobility, leaping ability, endurance, and sprinting performance (Ramos et al., 2019). Basketball is one of the most popular sports in the world, requiring a combination of physical, tactical, physiological, and mental skills for success (Erčulj & Štrumbelj, 2015). Because of these requirements, coaches working with young athletes are encouraged to conduct regular physical and anthropometric assessments. Such evaluations help tailor training programs to athletes' developmental stages and maturity levels, ensuring that biological diversity among players is properly addressed (Lloyd et al., 2014; Malina et al., 2004). Postural stability is defined as the ability to maintain the body's center of gravity within the base of support (Huang & Brown, 2013). Effective postural control is achieved through neuromuscular adaptations and sensory feedback, improving athletic performance and lowering the risk of injury (Greig & Walker-Johnson, 2007; Ribeiro et al., 2008). However, fatigue can negatively affect balance, making it a critical factor to consider in training and performance. Previous studies have demonstrated a complex relationship between biological maturity and physical performance (Malina et al., 2004; Lloyd et al., 2014; Ramos et al., 2019). One important aspect of performance in basketball is balance, or postural stability, which plays a vital role in both daily activities and athletic competition (Goldie et al., 1989; Guskiewicz et al., 2001). Such conditions may impair postural control and increase the risk of musculoskeletal problems. Importantly, female athletes may be at higher risk of injury due to biomechanical and neuromuscular differences, particularly during landing tasks (Bahr & Bahr, 1997; Renstrom et al., 2008). Spinal asymmetries and disorders of spinal statics are also common in sports, particularly those involving unilateral or repetitive loads, such as gymnastics, rowing, weightlifting, and figure skating (Grabara & Hadzik, 2009; Baranto et al., 2009). Seasonal fluctuations in training intensity and quality can further influence performance (Montgomery et al., 2008). Furthermore, spinal alignment has been linked to adolescent idiopathic scoliosis (AIS), with sagittal spine form emerging as a key factor in understanding risks of spinal deformities, particularly among females (Gardner et al., 2022). Metrics such as the kyphosis–lordosis (KL) difference have been proposed to better investigate these associations. In basketball, physiological demands extend beyond isolated physical attributes, as the sport requires repeated high-intensity efforts, rapid recovery, and the ability to sustain performance under varying tactical and competitive conditions (Montgomery et al., 2010; Ziv & Lidor, 2009). Athletes must be able to generate muscular force quickly to stabilize their center of gravity under external constraints (Orr, 2010). Training interventions such as isometric strength training, corrective exercises, and proprioceptive drills have been shown to improve postural stability in basketball players (Arazi & Asadi, 2011; Zemková & Hamar, 2010). Differences in anthropometric characteristics and playing positions may also influence postural control in basketball (Ostojic et al., 2006). Muscle strength and power—two critical components of neuromuscular fitness—are fundamental for maintaining balance and preventing injuries (Caspersen et al., 1985; Gruber et al., 2007). Despite the growing number of initiatives promoting youth sports participation, data on the effects of structured training programs on postural control remain limited, particularly in boys' basketball players in Albania. Addressing this gap is crucial, as postural stability is directly linked to both performance optimization and injury prevention. Therefore, the present study aims to evaluate the effects of a specific training program on the postural control of boys' basketball players.

II. METHODS

Participants:

Total No.30 boys' basketball players from four different Sports Associations in Tirana, Albania were chosen at random and split into two groups: Experimental Group (EXG-No. 15) and Control Group (COG-No. 15). The subjects are boys' basketball players with at least 4 years of experience who practice for 90 minutes four times a week. All of the participants chosen for the study from the 3 sports associations were supposed to be equivalent in terms of age, competitive experience, and training methods; training days and hours were also supposed to be identical across groups. Anthropometric measures were taken of the two study groups (EXG and COG). Anthropometric measurements did not significantly differ between the two groups, based on the data shown in Table 1.

Table 1. Anthropometric measurements of the female basketball players

Mean	EXG	COG
Age	18.1± *0.53*	17.2± *0.32*
BH cm	1.81.22± *1.73*	179.26 ± *1.69*
BW kg	67.84± *4.72*	82.27± *4.24*
BMI kg/m^2	21.73± *3.34*	22.27 ± *1.42*

Procedure:

All of the basketball players boys agreed to participate in the study after being informed about the intervention process. The body posture and spinal deviation were assessed before and after a controlled exercise intervention using the "Zebris" System, Win Spine 2.3 software. In compliance with the Declaration of Helsinki's ethical guidelines, and all participants, together with their parents/coaches, signed a written informed consent form voluntarily, before participating. Postural asymmetries were shown by posture analysis in the upright standing sagittal projection.

Instruments and test protocol:

ZEBRIS spinal examination method is an external, non-invasive measurement method that uses an ultrasound-based motion analysis system. ZEBRIS System (Zebris Medical GmbH, Isny im Allgaeu, Germany), Win Spine 2.3 software, was used to evaluate boys' basketball players in column deviation in the parameters; Kyphosis/°- Lordosis/° (KL), Left Scoliosis/° Right with 95% confidence interval for the mean. The Win-Spine program (Zebris Medical GmbH, Isny im Allgaeu, Germany) records and stores the spatial positions of the receivers numerically. The basketball players were taken in the sagittal and frontal planes, and analysed using the free internet Postural Analysis Software to obtain quantitative measures of the shoulders, and trunk. The spinous processes were determined on each subject and each measurement was performed before and after training for 10 weeks with experimental group.

Intervention:

The experimental group underwent a 10-week training program, which was conducted 2 times a week (Monday, Wednesday) with a duration

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of 20 minutes, at the end of the training. In contrast, the control group underwent only 4 training sessions according to the method of their trainer. The intervention program consists of 5 exercises selected from literature research;1) Shoulder stand for 15 sec, elbow stand for 15 sec. 3x reps, 2) shoulder stand 3x15sec, 3) Knee stand with opposite leg and hand extended 3x15sec, 4) Cat pose. Hold for 2 sec in each position for 10 reps, 5) Half cobra pose for 15 sec, then 30 sec inverted pose, 10 reps. The ratio of work time to rest time was 1:2. This intervention did not affect the duration of their usual training program. Special emphasis was placed on the phase of familiarizing and mastering the technique of performing the exercises, which was extended over the first 2 weeks.

Data analysis:

The means, standard deviation (±SD), were calculated using normal statistical procedures. Group differences were measured using a T-test two paired samples for averages. A 95% confidence interval was applied to variables. At $p<0.05$, statistical significance was recognized.

III. RESULTS

Table 2 presents the data obtained from the Zebris test for both EXG and COG groups of boys basketball players taken into the study. In EXG before Intervention, the following values were obtained from the measurements for the variables: Kyphosis: 36.79°, Lordosis: 30.31°, Scoliosis: 1.86° (left) and 1.80° (right). While after Intervention, the following values were obtained for the variables: Kyphosis 34.43°, Lordosis 29.43°, Scoliosis 1.61° (left) and 1.33° (right). While COG before in the study presented these values for the variables; Kyphosis 36.56°, Lordosis 25.35°, Scoliosis 1.93° (left) and 1.93° (right). While after 14 weeks, the following values for the variables; Kyphosis 36.29°, Lordosis 25.35o, Scoliosis 2.07 ° (left) and 1.87 ° (right).

Table 2. Descriptive statistics for column deviation tests Zebris Before & After Intervention

	Experimental Group Before				Experimental Group After			
			Scoliosis/°				Scoliosis/°	
	Kyphosis/°	Lordosis/°	Left /	Right	Kyphosis/⁰	Lordosis/⁰	Left /	Right
Average	36.79	30.31	1.86	1.8	34.43	29.43	1.61	1.33
SD	*3.45*	*6.04*	*2.47*	*2.75*	*3.61*	*5.57*	*2.44*	*2.09*
Max.	42.00	39.20	8.00	8.00	39.00	38.00	7.00	6.00
Min.	29.70	21.80	0.00	0.00	25.30	22.00	0.00	0.00
Control Group Before					Control Group After			
			Scoliosis/°				Scoliosis/°	
	Kyphosis/°	Lordosis/°	Left /	Right	Kyphosis/°	Lordosis/°	Left /	Right
Average	36.56	25.35	1.93	1.93	36.29	25.33	2.07	1.87
SD	*4.66*	*12.00*	*2.57*	*2.54*	*4.41*	*11.85*	*2.57*	*2.50*
Max.	45.00	44.30	8.00	6.00	43.00	44.00	7.00	6.00
Min.	23.00	6.00	0.00	0.00	23.00	6.00	0.00	0.00

Table 3 presents the data of the paired T-test statistical test, to confirm that the statistically significant changes in the measurements where; EXG (Before & After); Kyphosis (p=0.0389) where the p value <0.05 indicates a statistically significant difference between the measurements before and after the intervention. This suggests that the intervention had a significant effect on the kyphosis of boys' basketball subjects. While COG (Before &After) presents Kyphosis (p=0.4350) where the p value >0.05 indicates that there is no statistically significant difference between the measurements before and after the study period. This suggests that, apart from the intervention, no significant change has occurred in the kyphosis of the basketball players included in the study.

Table 3**.** T-test two paired samples for averagesP(T<=t)Before and After for players

	T-test: two paired samples for averages	
	Experimental Group Before & After	Control Group Before & After
Kyphosis/°	.038911399*	0.435039561
Lordosis/°	0.339655839	0.498184297
Scoliosis/° - Left	0.389923461	0.444155874
Scoliosis/° - Right	0.302831578	0.471447876

IV. DISCUSSION

Kyphosis and Lordosis changes is a method that examines the magnitude of kyphosis and lordosis as a whole. The data presented in tab.2 show that it is statistically significant in the development of KL change. In our study, the experimental group (boys who followed an intervention) showed a statistically significant change in spinal kyphosis, with a p-value of 0.0389. This result is consistent with the findings of other studies that have examined the impact of physical activities on the development of spinal curvatures in adolescents. A study conducted by Grabara (2016) has shown that regular exercises, such as basketball, can affect the shape of spinal curvatures, leading to a flattening of kyphosis and a deepening of lordosis. This phenomenon may be related to the strengthening of the back extensor muscles during physical activities.

On the other hand, the control group (boys without intervention) did not show significant changes in kyphosis, with a p-value of 0.4350. This result is consistent with studies suggesting that adolescent girls, especially those who are not physically active, have a greater predisposition to develop spinal kyphosis. A study conducted by De Vasconcelos et al. (2010)has shown a higher prevalence of kyphosis in girls, suggesting that this phenomenon may be related to physiological changes and physical development of girls during adolescence.

According to Gardner et al. (2022), the KL change was calculated for 117 males and 79 females over 7 years. For females, the KL change returned to 5° at age 16 and for males, there was a gradual decrease to 5° at age 17, for both sexes the parameter development was statistically significant. Sports science and the training levels of athletes are constantly evolving. The foundations of this development are mainly based on an ever-expanding understanding of how the body adapts to different physical and psychological loads according to (Bompa & Buzzichelli, 2015).Since physical development is very high, especially in adolescence, exercises that support correct posture are very important, they positively affect the musculoskeletal system and this is reflected positively in the individual, therefore it is recommended that adolescents should be trained for the changes at this age and should develop activities such as sports and various exercises. According to Cengiz and Delen (2024) it is thought that the effect of the age-training variable on posture structures varies specifically according to sports, where posture is negatively affected as training age increases in volleyball and soccer players. Our values — ~36° kyphosis, ~29–30° lordosis, and 1–2° scoliosis — are typical for adolescent basketball players, with little lordosis as part of the sports postural profile. According to Grabara (2014), among 57 females and 104 males (14–17 years old), including basketball players, it was found that: boys athletes had lower kyphosis than the control group ($p<0.01$). Kyphosis in female basketball players is usually lower than in non-athletic women, around 30-35°. This suggests that female basketball players in this age group tend to have below average kyphosis and flattened lordosis, due to intense training. Our values are typical for teenage basketball players, with little lordosis as part of the sports postural profile.

When the studies and the field index are examined, the results obtained show negative and positive results in both postural aspects and performance in basketball players (Cengiz, 2022).

Due to the high susceptibility to postural defects in adolescence, it is thought that training programs applied to adolescent athletes should be supported with corrective exercises and studies in the literature on the detection of asymmetry should be added to shed light on sports coaches. However, values tend to vary greatly depending on measurement methods (radiographic versus clinical means, age, gender). According to this research, the musculoskeletal systems of basketball players are affected by the applied exercises, which also reveal a process of postural adaptation.

V. CONCLUSION

This study presented the change in KL from the exercises used for 10 weeks in basketball players, a new parameter that describes how the overall sagittal shape of the spine changes slightly under the influence of exercise at this age. The results of the study suggest that this exercise program in basketball players had an impact on the reorientation of the spine posture in adolescent boys. The values shown in this age group indicate a tendency for below-average kyphosis and flat lordosis, due to the intense training performed previously. Boys who are not physically active may be at greater risk of having kyphosis. These findings emphasize the importance of regular physical activity for spinal health in adolescents.

Acknowledgements

Thank you to all the boys' basketball players who participated in this study.

Conflict of Interest

The authors declare no conflict of interest.

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