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The Effects of Specific Balance Training on the Stability Level of Young Basketball Players

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Summary
The aim of this research was to examine the effects of specific balance training on stability level of young basketball players (n=14; chronological age 14-15 years). Testing and SBT program was conducted during the competition season for young basketball players. For the purposes of this research, i.e. the assessment of stability level (Biodex Balance System), three variables were used in order to determine neuromuscular ability of maintaining dynamic bilateral and unilateral postural stability on a static and unstable surface. Difference between two measuring points and their correlation before and after the SBT program implementation was analysed by univariate parametric test determining differences – student t-test for dependable samples. Differences between initial and final status (sig.=.01 and .05) indicate that SBT program including specific content, training aids, load intensity and extensity, total volume, organisation and training method have effectively contributed to the stability level of young basketball players.

Key words: **stability index, specific program, basketball players**

Introduction

Movement requirements in basketball depend on a range of internal and external factors. Basketball abounds in a number of complex motions, requiring the acquired movement structure to be integrated into situational game requirements which are unpredictable and variable. Apart from coordination, explosive strength, central stability and other factors, the prerequisite for changing directions after stopping and a safe landing after the jump, is achieved by stable leg positioning. *Šimek, Milanović and Jukić (2007)* determine the changes in the agility level and the type of explosive strength for jump performance after completing proprioceptive training program. During speed-explosive movements, the athlete is not always able to control his/her own movement at a given time. Good physical stability affects the movement quality which can probably protect the athlete from possible injuries. Likewise, during the last couple of years due to unstable training and competition surfaces, balance training in basketball is gaining more popularity as an additional exercise for athletes *(Panwar et al., 2014).*

Maintaining balance has been made increasingly difficult when establishing contact with the opponent, along with air resistance, friction and gravity forces which likewise affect maintaining stable posture *(Retert, 2010)*. According to the previously mentioned author, if the training is more specific and extensive, an athlete will have better balance and stability during performance.

Proprioceptive stimuli can assist athletes in performing efficient and safe movements on a subconscious level. *Eils and Rosenbaum (2001)* state that a multi-station proprioceptive exercise program can be recommended for prevention and rehabilitation in case of ankle joints injuries, and according to (*Kraemer & Knobloch, 2009*) specific balance training reduces the frequency of injuries regarding anterior cruciate ligament and ankle joints. Training consisting of proprioceptive exercise program can effectively stabilize an unstable joint using muscle and postural control *(Zouita et al., 2013).*

Proprioceptive exercises should be an integral part of conditional training in sport games. *Alić (2012)* states that additional improvement was achieved in regards to the current situation of the footballers U-18 balance level, based on a three month long specific proprioceptive training. Positive effects of proprioceptive training program on the stability level in students of sport and physical education were determined in research conducted by *Kazazović and co-authors (2007), and Šebić et al. (2007).*

Following the assumption (H) which states that the six month long training program will produce positive changes in the balance abilities of young basketball players, one can conclude that the aim of this research is to establish the effects of six week specific balance training program (SBT) on the level of stability in young basketball players.

Results of this paper might be used as additional segment and more inclusive integration of the balance training, if taking into account the general conditional preparation of young athletes.

Methods

Subjects

Sample consisted of 14 young basketball players. Chronological age of the subjects was 14 – 15 years. Overall training process lasted for about 5 years. Subjects were clinically healthy during the testing procedures. Testing procedure and SBT program was conducted during competition season in which case subjects participated in regular training sessions six times per week for 60-90 minutes.

Tests

For the purposes of this research 3 variables were used in order to assess the level of stability *(Biodex Balance System SD, 2006.):*
Overall Stability Index (OIS);
A/P Stability index (APIS) and
M/L Stability Index (MLIS).

Biodex Balance System SD application enabled determining individual neuromuscular control by quantifying the abilities of maintaining dynamic bilateral and unilateral postural stability on a static and unstable surface.

Characteristics of a specific balance training (SBT)

Tables 1, 2, 3, 4 and 5 demonstrate the most significant SBT program information (general notes, exercise description, load distributions, technical aids and a total number of performed activities), which was conducted on young basketball players categorised by age groups U-14 and U-15.

Table 1. General Information on SBT

Period of the season	Competition
Total duration of the program	6 weeks
Training frequency	4 trainings per week
Part of the training	Introduction and preparatory phase
Duration of balance stimulus	15-20 minutes

Table 2. Description of SBT exercises

1. **SK, PS, Z on the: a) D-N leg; b) PV D-N leg.**
2. **SK, PS, Z on the: a) D-N leg; b) ZV D-N leg.**
3. **SK, PS, Z in small groups on the: a) D-N leg; b) the game "who's faster"D-N leg; c) the game "tickling the palms" D-N leg.**
4. **SK, PS, Z in pairs on the: a) D-N leg; b) lean on the back of partners D-N leg; c) lean on the side of partners D-N leg.**
5. **SK, dribbling L, PS, Z on the: a) D-N leg; b) PV and ZV D-N leg; c) L rotation on the hand D-N leg.**
6. **RP, B D-N leg: a) keeping between the forehead; b) holding L between breasts of partners; passing L with two hands from the chest; d) passing L from behind.**
7. **SBD On feet: a) ONN; b) OLD.**
8. **SBD, hands up: a) ON, ONN i OLD; b) D-N leg ONN and OLD.**
9. **SBD D-N leg: a) ONN/ passing L from the chest; b) OLD/manipulation L.**
10. **SBD ON: a) ONN touching of laterally spaced racks; b) OLD touching racks that are set forward and back.**
11. **RP, SBD ONN i OLD: a) reception and passing L with two hands from the chest; b) passing L with two hands above the head with reception and L feint.**
12. **Jump with feet on balance board, B: a) ONN; b) OLD.**
13. **Standing on the ball: a) ON; b) D-N leg.**
14. **Standing D-N leg / free leg simulating the skating step: a) eyes open; b) eyes closed.**
15. **PV, from bent position touch the ground, and again stand up: a) D leg; b) N leg.**
16. **RP, touching and reception with medical ball (1kg): a) D leg; b) N leg.**

D-N: dominant and non-dominant leg; SBD: standing on the balance board; SK: free movement; PS: change of direction; Z: stopping; L – ball; ONN: axle forward and backward; OLD: axle left and right; B: balance; PV: front balance; ZV: rear balance; RP: exercise in pairs; ON: both legs

Table 3. Distribution of load SBT (modified according Alić, 2012)

Type and order of execution the exercises	Extensity		Intensity	Rest		Character of exercise
	Duration (s)	The total number of series		Time rest (s)	Rest mode	
1a; 1b	10	15	N	20	Ak	Ad
2a; 2b	10	15	N	20	Ak	Ad
3a; 3b; 3c	10	15	N	20	Ak	Ad
4a; 4b; 4c	10	15	N	20	Ak	Ad
5a; 5b; 5c	15	15	N/S	25	Ak	Ad + rzv
6a; 6b; 6c; 6d	15	15	N/S	25	Ak	Ad + rzv
7a; 7b	15	15	N/S	25	Ak	Ad + rzv
8a; 8b	15	15	N/S	25	Ak	Ad + rzv
9a; 9b	20	15	S	30	Ak	Rzv
10a; 10b	20	15	S	30	Ak	Rzv
11a; 11b	20-30	15	S	30	Ak	Rzv
8a; 8b; 9a; 9b	20-30	15	S	30	Ak	Rzv
10a; 10b; 11a; 11b	30	12	S	30	Ak	Rzv
12a; 12b; 16a; 16b	30	12	S	30	Ak	Rzv
15a; 15b	30-40	12	S/V	40	Ak	Rzv
10a; 10b; 11a	30-40	12	S/V	40	Ak	Rzv
13a; 13b; 15a: 15b	40	10	S/V	50	Pa	Rzv
6a; 6b; 12a; 12b	40	10	S/V	50	Pa	Rzv
7a; 7b; 10a; 10b	40-50	10	S/V	50-60	Pa	Rzv
12a; 12b; 14a; 14b	40-50	10	S/V	50-60	Pa	Rzv
1a; 1b; 16a; 16b	30	10-15	N/S	20-30	Ak	Od
2a; 2b; 15a; 15b	30	10-15	N/S	20-30	Ak	Od
3a; 3b; 13a; 13b	30	10-15	N/S	20-30	Ak	Od
4a; 4b; 12a; 12b	30	10-15	N/S	20-30	Ak	Od

Ak: Active; Pa: Pasive; Ad: Adaptation; Rzv: Development; Od: Maintenance; N: Low; S: Middle; V: High.

Table 4. Technical equipment

Balance boards	NN Axles and lateral
Balls	Basket and medical (1kg)
Racks	Vertical racks (1,5m)

Table 5. Total number of activities

Testing / Initial and final	2
Balance training - proprioception	24
Club training, regular training	30
Active rest, prepares for competition	6
Official games	6

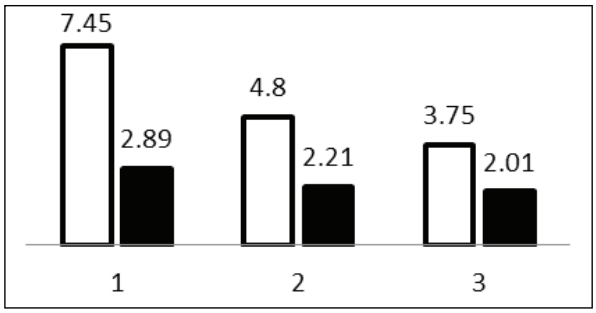
Statistical analysis

For the analysis of the results obtained during the initial and final measurements, following descriptive values were calculated: arithmetic mean (*m*), standard deviation (*SD*) and variation coefficient (*CV*). Differences between two measuring points and their correlation was analysed by univariate parametric test determining differences – student t-test for dependable samples. The results were processed in statistical software package IBM SPSS 22 Statistic.

Results

Once we compare descriptive parameters of tests for balance assessment in their initial and final status (table 6 and 7), differences in *m* values become noticeable. Lower values in final measurement stages indicate better results after the completion of SBT program. The highest range of

m values for all the variables was noticed in OIS test, so one can assume that SBT has contributed the most to the development of overall stability. However such assumptions need to be verified by *t-test.* The analysis of central tendency and variability results in their initial and final status, and based on subsequent calculation of CV value, revealed heterogenic results in tested subjects. Coefficient of variation is a relative measure of deviation which represents the correlation between arithmetic mean and standard deviation expressed in percentages. In order to satisfy the homogeneity requirements, this parameter should not exceed the threshold limit value of 30%, which is a conventional threshold limit value specific for homogeneous properties in kinesiological research. For both measurements, the CV value of all treated variables is above the acceptance limit (55%-75%). Results demonstrated in table 8 indicate statistically significant differences for all the treated variables with 1% and 5% conclusion error.



Graph 1. Relations of arithmetic means between initial and final states (lower M represent better values)

Table 6. Descriptive indicators of the initial state

Varijabla	M	SD
OIS	7.45	5.60
APIS	4.80	3.15
MLIS	3.75	2.46

Table 7. Descriptive indicators of the final state

Variable	M	SD
OIS	2.89	1.79
APIS	2.21	1.22
MLIS	2.01	1.19

Table 8. Student T - test for paired samples

Pair	Var iable	t	df	Sig.
Pair 1	OIS1 - OIS2	2.923	13	.012
Pair 2	APIS1 - APIS2	2.967	13	.011
Pair 3	MLIS1 - MLIS2	2.228	13	.044

Discussion

Factors based on nerve processes, space and balance ability of a human are still insufficiently explained. Variability of tests for the purposes of balance assessment has been noticed even in this research. Information received by outside surrounding and registered by receptors of vestibular and proprioceptive apparatus, and visual and hearing analysers can influence in different ways the regulation and coordination of muscle tonus responsible for balance in athletes. Proprioceptive feedback is significant in both conscious and subconscious control of common physical activities during movement *(Ergen & Ulkar, 2008).* Posture correction at the most urgent moment probably depends on the control and contraction intensity regulation as well as muscle relaxation.

With certainty higher than 99 %, that is 95 % one can claim that the SBT program conducted during the competition season with specific content, training aids, intensive and extensive load, overall volume, training methods and organisation resulted in effective impact on the level of stability in young basketball players. Assumption is that the designed program with all its specificities in movement structure affects the anticipation quality, change and posture correction. All the above stated contributes to achieving a more stable position. Proprioception is transferred to all levels of central nervous system *(Riemann & Lephart, 2002).* Implemented content focusing on rapid establishment of balanced posture after previously inducing general instability can affect the contractions for a certain group of muscles which maintain the projection of the body's centre of gravity above the support surface. Process of achieving stability is related to mutual work between ligaments and muscles along with a complex network of neural connections which link all the elements above *(Salva-Coll et al., 2013).*

Establishing balance when the support surface is of a smaller size and with constant variations of pelvic height changes conditioned by unpredictive circumstances, resulted in progressive increase of load intensity. A well established balance enables the players to control their body in static and dynamic positions while at the same time protecting them from falling and injuries which might occur during fast movements *(Panwar etal., 2014)*. It is a generally known fact that the difficulty of maintaining stable posture is mostly conditioned by the size of the support surface, height of the body's centre gravity and the position of unrestrained body parts. In basketball the balance is a very important ability for young players, especially due to its application during one-to-one defensive actions, which requires ability to control one's own body in order to reduce errors *(Mahmoud, 2011).* In complex circumstances establishing and maintaining position while at the same time manipulating a basketball (dribbling, passing the ball from different positions), the body needs additional corrections and adjustments at the given situations, which makes

it much more difficult to maintain stability. The balance is a very delicate ability which requires good kinesthetic sense, good evaluation of aim parameters and kinesthetic movement control on a specific path, as well as concentration time *(Malacko and Rađo, 2004).*

SBT program should not be regarded as an isolated unit, but as an integral segment of the overall athlete sport preparation. One can assume that the SBT program can efficiently influence the movement coordination, body's central stability and the strength of ankle ligaments and muscle tendons. Apart from the effects SBT program has on the stability level, positive effects can be achieved at a motor coordination level *(Šebić et al., 2007). Zemková & Hamar (2010)* conclude that the combination of *agility - balance* training one can improve dynamic balance, not only by visual control but even in closed-eyes circumstances. For the coaches it is very important to plan training programs, which will combine balance exercises with specific reactive tasks, in order to apply them as means for neuromuscular athlete performance.

Conclusion

Results of this paper indicate that the designed SBT program produced positive effects on the stability level in young basketball players. The most probable conclusion is that the efficient transfer of the sense of ankle positioning and a fast reply of the muscle-ankle connectors – effectors is induced by the specific content. Optimum content for the stability development of ankles are most probably those which are formed in accordance to structural, biomechanical and functional analysis of the basketball game. However, in this research it was difficult to conclude whether the maximum of SBT program was achieved. Rapid growth and development of the treated age category U-14 and U-15 can in addition worsen the coordination and balance abilities. The flaw of this research is the lack of experimental group which would probably offer much clear explanation to the problem at hand. Benefits of this SBT program are the possibilities of simple organisation; it can be conducted in different locations with the help of cheap and available equipment. For the future research it would interesting to examine the effects of combined strength SBT training at a level of stability and agility, along with experimental and control group testing, for the purpose of contributing to time-effective training procedures.

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