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A STUDY ON THE DYNAMIC OF HEART RATE WHEN EXECUTING FREE THROWS IN BASKETBALL

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Abstract: *The objective of the research centered on how the pulse oximeter was used to identify heart rate dynamics when performing free throws under standardised conditions in the male and female experimental groups (U14-U18). The study was conducted in 2021, and the functional test consisted of monitoring the heart rate with the help of the pulse oximeter during the execution of the ,'10 Experimental Throws Test' used to identify how the heart rate varies during the execution of free throws. In the case of the functional test, heart rate differences monitored with the pulse oximeter, recorded between the initial and final testing of the study, were statistically significant for all female and male experimental groups, showcasing the ability of the subjects to adapt and recover from the effort, which can have positive effects on their ability to concentrate and enhance their accuracy when executing free throws in basketball.*

Key words: *pulse oximeter, basketball, innovating system, free throw, heart rate*

1. Introduction

Sport training can be analyzed from a multidimensional perspective as the specialized pedagogical, instructional, and educative processes, which involve a systematic longitudinal phasing of the contents that are meant to capitalize on identifying potential, specialized knowledge, technical skills, and abilities of athletes for the purpose of obtaining valuable results in sports competitions [7], [13]. The constitutive components of sports training are adapted to the particularities of the basketball game and refer to various aspects, spanning from specificity and personalised training, to aspects such as prevention and recovery

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after effort, as well as to those regarding physical overload and overtraining [14], [17].

The performance level of players practicing team sports is influenced and determined by the weight and quality of technical and tactical training along with physical, psychological, and theoretical training for all categories of children and juniors. The technical training of juniors must focus on increasing the level of their technical skills and the efficiency of technical procedures in relation to multilateral sports training [2]. Information technologies using real-time filming and analysis of executions is an ongoing interest for specialists in the last decades. Video recording the individual activity of a thrower is considered by many specialists [1], [10], [15] as having an important role in sports training with direct effects on performance during basketball games.

Basketball specialists pay special attention to the effectiveness of free throws at the level of all types of sports and especially in large-scale sports confrontations. All studies show that the percentage of missed free throws, especially at the junior level, is high. A determining role in optimizing the motor potential of players that are practicing team sports games is the level of functional capacity as physiological support for improving the motor capacity [9], [16]. Changes in selected physiological parameters following training block of specific circuit training among national top-level basketball players [3].

A good physical condition is determined by the body's ability to recover the major functions highlighted by the respiratory and cardiac rhythms. The studies that addressed the aspects of the correlation between the dynamics of functional capacity indicators and technical aspects in basketball are relatively few and did not focus on the investigation of changes in the heart rate during the execution of free throws [12]. Possible cause of performing the standard actions incorrectly in game sports and hypothesis of increasing performance [4], [5]. Experimental study on improving the quality of life through the standardization of an aerobics program and of effort parameters control using the pulse tester.

Based on these arguments, we consider that approaching this topic will contribute to expanding the knowledge of how functional capacity influences the technical level of basketball players when executing free throws.

- The hypothesis of the study - the dynamics of the heart rate evaluated by using the pulse oximeter will decrease during the performance of the motor tests conducted at the level of the experimental male and female basketball groups, which highlights a good physical condition;
- The objective of the study was based on the implementation of a pulse oximeter in order to identify the dynamics of the heart rate during free throws in standardised conditions in the male and female experimental groups.

2. Description of the equipment

The pulse oximeter is used to monitor the health status of people with any type of condition that affects the level of oxygen in the blood, but also a person's ability to tolerate physical activity. With the help of a pulse oximeter, you can monitor the capacity for physical exertion, using the device during physical exercises.

The pulse oximeter will be able to show the level of oxygen saturation, but also the heart rate. Due to the small size of the pulse oximeter and the speed of measurement, it can be used anywhere.

2.1. Methods and materials

The experiment consisted in evaluating the heart rate at the beginning of the training period and at the end of it. The research took place at the gym of the Faculty of Physical Education and Mountain Sports in Brasov, within the Transilvania University in Brasov, in 2021.

The Functional Test – heart rate monitoring with a pulse oximeter during the "10 Experimental Throws Test" identifies how the heart rate varies during free throws.

The way to apply this test is to monitor the pulse before the start of the test and at the end of it. The number of beats per minute for each athlete is recorded. This functional test was applied in the final tests only to the experimental groups of the actual research.

3. The subjects of the study

It is important to mention that the athletes from the experimental and control groups have been practicing basketball for 3-5 years, being enrolled in the national junior competition system - the National Junior Championship, categories: U14, U16, U18. The samples of junior athletes involved in the actual research were structured as follows:

- male experimental samples U14 (16 subjects), U16 (16 subjects), and U18 (14 subjects) registered active athletes aged between 12-18 years;
- female experimental samples U14 (16 subjects), U16 (16 subjects), and U18 (14 subjects) active athletes aged between 12-18 years.

3.1. Results

Table 1

Statistical analysis of heart rate for male experimental groups U14, U16, U18

Group	Testing	Min	Max	Median	Variation	Skewness
U18	Initial testing	108,00	132,00	120	54,286	,001
	Final testing	102,00	121,00	11,5	36,615	-,046
U16	Initial testing	108,00	133,00	120,5	61,717	-,082
	Final testing	102,00	126,00	114	51,200	,145
U14	Initial testing	108,00	136,00	122	66,517	-,031
	Final testing	102,00	128,00	115	62,917	,134

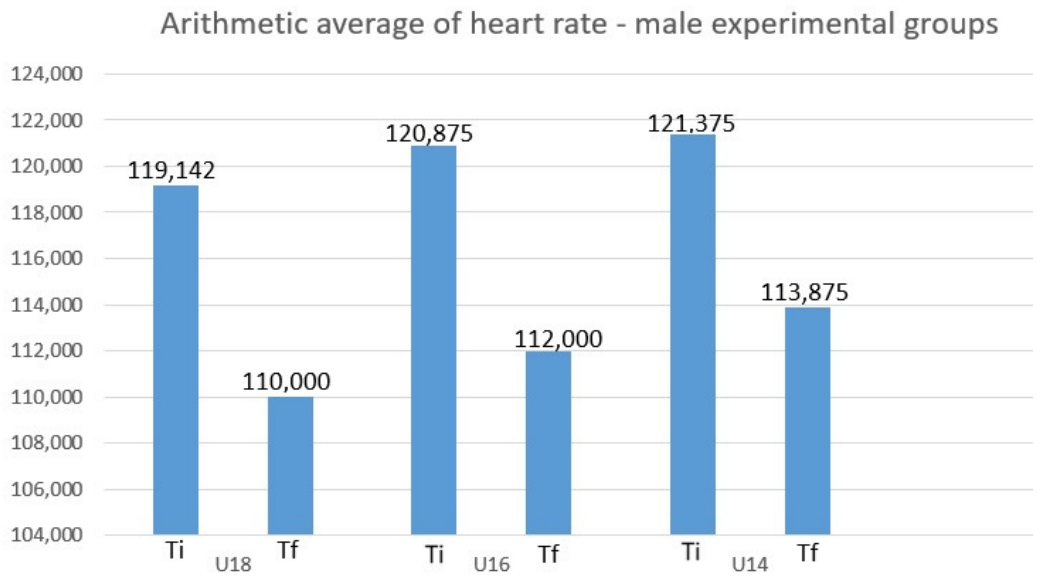

Fig. 1. *Arithmetic average of heart rate, male experimental groups*

Table 2

Descriptive heart rate statistics for male experimental groups U14, U16, U18

Group	Testing	X	SD	X Tf-Ti	t	p	95% CI	
							Lower	Upper
U18	Initial testing	119,142	7,367	9,142	8,817	,000	6,902	11,383
	Final testing	110,000	6,051					
U16	Initial testing	120,875	7,856	8,875	5,329	,000	5,325	12,424
	Final testing	112,000	7,155					
U14	Initial testing	121,375	8,155	7,500	4,456	,000	3,912	11,087
	Final testing	113,875	7,932					

Table 3

Statistical analysis of heart rate for female experimental groups U14, U16, U18

Group	Testing	Min	Max	Median	Variation	Skewness
U18	Initial testing	108,00	130,00	119	35,016	-,331
	Final testing	100,00	118,00	119	34,374	-,132
U16	Initial testing	108,00	133,00	121	52,829	-,069
	Final testing	102,00	124,00	113	40,496	,082
U14	Initial testing	108,00	134,00	126	67,800	-,163
	Final testing	102,00	127,00	114,5	56,896	-,097

Table 4

Descriptive heart rate statistics for female experimental groups U14, U16, U18

Group	Testing	X	SD	X Tf-Ti	t	p	95% CI	
							Lower	Upper
U18	Initial testing	119,357	5,917	10,071	9,141	,000	7,691	12,451
	Final testing	109,285	5,862					
U16	Initial testing	120,187	7,268	8,500	4,874	,000	4,782	12,217
	Final testing	111,687	6,363					
U14	Initial testing	121,750	8,234	6,437	7,275	,000	4,551	8,323
	Final testing	115,312	7,542					

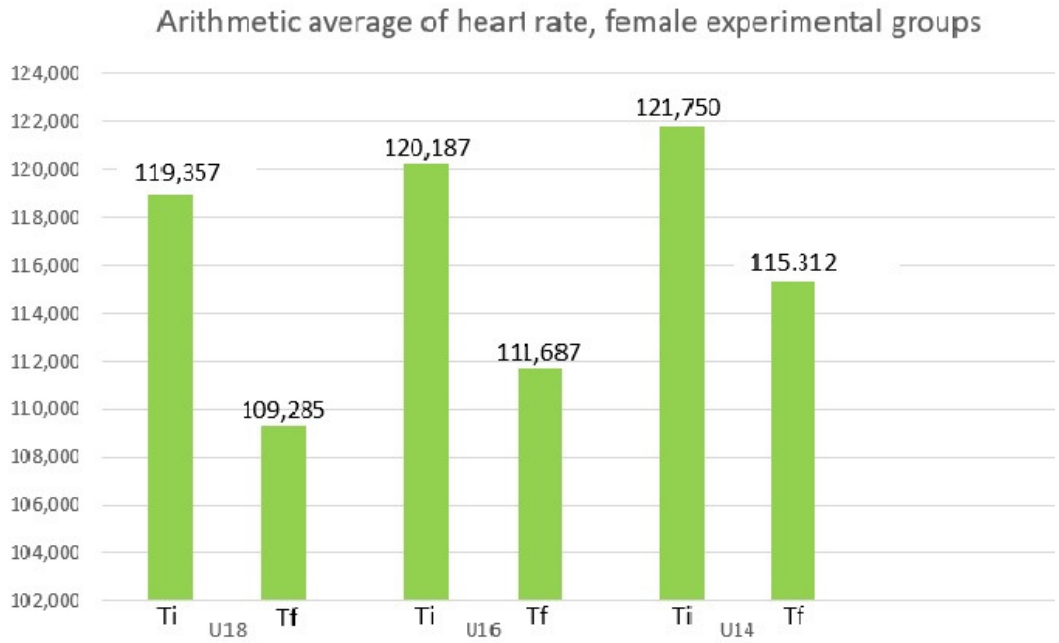

Fig. 2. *Arithmetic average of heart rate, female experimental groups*

4. Interpretation of results regarding heart rate dynamics in male experimental samples

The heart rate analysis that was taken with the pulse oximeter in the male experimental samples revealed that the pulse values of the players were in a considerable decrease, a fact which shows us that they are prone to long-term effort, to a better focus on obtaining a much higher free throw success, to an increase in personal and team percentage from the free throw line and why not, to an increase in the level of performance at the level of the respective age group competition.

The analysis of the test shows that the results in all three female experimental groups were statistically significant, with

the significance threshold values being .000 less than the reference value of .05 established for this study. The values of the Skewness parameter for all age groups U18, U16, and U14 show that the distribution of the data was within the limits of normality.

Correlating and comparing the results that we previously presented in the tables, it is worth mentioning that the findings for the U18 male experimental groups at the initial testing recorded a heart rate of 119.142 beats/minute and at the final testing of 110.000 beats/minute, the difference being 9.142 beats/minute. In the U16 age category, the male experimental group registered a heart rate of 120.875 beats/minute at the initial test and 112.000 beats/minute at the final test, the difference being 8.875 beats/minute. In the U14 age category, the male experimental group recorded a heart rate of 121.375 beats/minute at the initial test and 113.875 beats/minute at the final test, the difference being 7.500 beats/minute.

4.1. Interpretation of results regarding heart rate dynamics in female experimental samples

In the female experimental samples, the heart rate dynamics, which were measured with the help of the pulse oximeter, reveal that the players have a good physical condition and a good capacity for recovery, which has positive effects on the ability to concentrate and their accuracy when executing free throws.

The analysis of the 'Student's Statistical Test' shows that the results in all three female experimental groups were statistically relevant, with the significance threshold values being .000 less than the reference value of .05 established for this study. The values of the Skewness parameter for all age groups U18, U16 and U14 show that the distribution of the data was within the limits of normality.

The results of the female experimental groups in the U18 group show that during the initial test, a heart rate of 119.357 beats/minute was recorded, while at the final test the average heart rate of the subjects was 109.285 beats/minute, the difference being 10.071 beats/minute. In the U16 age category, the female experimental group registered a heart rate of 120.187 beats/minute at the initial test and 111.687 beats/minute at the final test, the difference being 8.500 beats/minute. The Gemini experimental group U14 registered a heart rate of 121.750 beats/minute at the initial test and 115.312 beats/minute at the final test, the difference being 6.437 beats/minute.

5. Conclusions

The analysis of the heart rate showed that it decreased during the tests, thus providing evidence to support the idea that the experimental male and female groups have a good physical condition and a good recovery capacity after physical activity. By correlating and comparing the functional test results of the male and female experimental groups, the following relevant results for the final research can be highlighted, as follows:

1. In the male U18 groups, a heart rate of 119.142 beats/minute was recorded at the initial test and 110.000 beats/minute at the final test,

with a difference of 9.142 beats/minute;

2. In the male U16 category, the experimental group recorded a heart rate of 120.875 beats/minute at the initial test and 112.000 beats/minute at the final test, with a difference of 8.875 beats/minute;
3. In the male U14 category, the experimental group recorded a heart rate of 121.375 beats/minute during the initial test and 113.875 beats/minute during the final test, with a difference of 7.500 beats/minute.
4. The U18 female experimental group registered a heart rate of 119.357 beats/minute at the initial test and 109.285 beats/minute at the final test, with a difference of 10.071 beats/minute.
5. The U16 female group registered a heart rate of 120.187 beats/minute at the initial test and 111.687 beats/minute at the final test, with a difference of 8.500 beats/minute.
6. The U14 group recorded a heart rate of 121.750 beats/minute at the initial test and 115.312 beats/minute at the final test, with a difference of 6.437 beats/minute.

References

1. Argaj, G.: *Analysis of training and game loads in selected sports games*. In: Proceedings of scientific works of the Department of Games FTVŠ UK Bratislava, Faculty of Physical Education and Sports, Civic Association of Sports Games, 2005, p. 65-68.
2. Bădău, D.: *Ambidextria în activitatea motrică (Ambidexterity in motor activity)*. Brașov, Editura Universității Transilvania, 2006.
3. Bădău, D., Camarda, A., Șerbănoiu, S., et al.: *Sport for all–implementation modern methods of performance management*. In: WSEAS Transactions on Business and Economics, Vol. 7, no. 3, 2010, p. 191-200.
4. Bădău, D., Larion, A., Bădău, A., et al.: *Experimental Study On Improving The Quality Of Life Through The Standardization Of An Aerobics Program And Of Effort Parameters Control Using The Pulse Tester.* In: MMACTEE'09 Proc. 11th WSEAS Int. Conf. Math methods Comput. Tech. Electr. Eng. 2009.
5. Coves, A., Caballero, C., Moreno, F.J.: *Relationship between kinematic variability and performance in basketball free-throw*. In: International Journal of Performance Analysis in Sport, Vol. 20, no. 6, 2020, p. 931-941.
6. Deckard, L.R.: *Motor Control: Theory and Practical Application for the Youth Basketball Coach.* Mahurin Honors College Capstone Experience/Thesis Projects, 2014. Available at: https://digitalcommons.wku.edu/stu_hon_theses/511/
7. Dumitrescu, G.: *The Sport training-Football*. Note de curs, Oradea, 2011.
8. Ghițescu, I.G., Moanță, A.: *Basketball. Theoretical and methodical foundations.* București, Editura ANEFS, 2005.
9. MacKnight, J.M., Sridhar, A.M.: *Team Medical Coverage in College Basketball.* In: Basketball Sports Medicine and Science, Springer, 2020, p. 135-144.

10. Macura, P., Potocky, F.: *The influence of an individual's game activities on winning a basketball game.* In: Proceedings of Scientific Works, Department of games, FTVŠ UK, Vol. 14, 2009, p. 7–13.
11. Pulatov, F.A.: *Possible cause of performing the standard actions incorrectly in game sports and hypothesis of increasing performance.* In: European Journal of Research and Reflection in Educational Sciences, Vol. 7, no. 3, 2019, p. 30-33.
12. Sampaio, J., Drinkwater, E.J., Leite, N.M.: *Effects of season period, team quality, and playing time on basketball players' game-related statistics.* In: European Journal of Sport Science, Vol. 10, no. 2, 2010, p. 141-149.
13. Sava, C., Jercălău, T., Hagimă, M.: *The sports training between traditional and modern*. Editura Alma Mater, Bacău, 2014.
14. Tarragó, J.R., Massafred-Marimón, M. Seirul-lo, F., et al.: *Training in team sports: structured training in the FCB*. In: Apunt. Educ. Física i Esports, Vol. 137, 2019, p. 103–114. https://dx.doi.org/10.5672/apunts.2014-0983.es.(2019/3).137.08
15. Tomanek, L., Vencurik, T.: *Individualization of assessment of training and match load in basketball.* In: Športové hry, Vol. 13, no. 1, 2008, p. 2-9.
16. Tonon, B.A., Gouthon, P.N., Nigan, I. et al.: *Changes in selected physiological parameters following a training block of specific circuit training among national top-level basketball players*. In: International Journal of Exercise Science, Vol. 13, no. 6, 2020. p. 1156-1166.
17. Vieira de Castro A.C., Araújo, Â., Fonseca, A., et al.: *Improving dog training methods: Efficacy and efficiency of reward and mixed training methods.* In: PLoS ONE, Vol. 16, no. 2, 2021, e0247321. https://doi.org/10.1371/journal.pone.0247321