Journal of Physical Education and Sport ® (JPES), Vol. 21 (3), Art 200, pp. 1580 - 1586, May 2021
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Influence of sports specialization and body length on orthostatic test indicators of students majoring in "Physical Education and Sports"

ZHANNETA KOZINA[1], IRYNA BORYSENKO[1], VALENTYNA GRYNYOVA[2], VITALII MASYCH[3], VICTORIA USHMAROVA[2]
[1,2]Department of Olympic and Professional Sports, Sports Games and Tourism, H.S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, UKRAINE
[3,5]Department of Primary and Professional Education Department, H. S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, UKRAINE
[4]Department of Physics and Cyber Technical Systems, H. S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, UKRAINE

Published online: May 31, 2021
(Accepted for publication May 15, 2021)
DOI:10.7752/jpes.2021.03200

Abstract
Purpose: to identify the influence of body length and various sports on the indicators of vascular regulation of students. **Material and methods.** The study involved 42 students who play sports at the amateur level, 18 of them are track and field's sportsmen (short and medium distance running), 12 are football players, 12 are wrestlers. The number of students with a body length of more than 190 cm was 12 people. The number of students whose body length was 150-175 cm was 30 people. There were no students with a body length of 176-189 cm in the study. Following research methods were used in the work: method of analysis of literature sources; method of determining body length; orthostatic test method; method of determining stroke volume and minute blood volume; methods of statistical data processing (comparison of averages by the Student's method, multivariate analysis of variance). **Results.** It was found that the increase in systolic blood pressure during the transition from horizontal to vertical position in students whose body length is above 190, significantly higher than in students whose body length does not exceed 175 cm (p <0,01); diastolic blood pressure, then in students whose body length is above 190 cm, this figure is significantly higher (p <0.01) both horizontally and vertically. Stroke volume of blood in tall (body length more than 190 cm) students in the standing position is significantly less compared to this figure of students with a body length of 150-175 cm. The same applies to the minute volume of blood flow.The lowest values of heart rate in the horizontal position and in the vertical position of the body in judo wrestling. The same applies to blood pressure in the horizontal and vertical position (p <0,001). The highest heart rate and blood pressure intrack and field students-sportsmen. According to these indicators, footballers occupy an intermediate place. **Conclusions.**The results of a more significant impact of judo and football in comparison with running short and medium distances on the indicators of vascular regulation: the best indicators - in judo, the next place - in football, then – in track and field sportsmen. It was found that students with a body length of more than 190 cm have difficulty with vegetative-vascular regulation. To improve the adaptive capacity of vascular regulation to change the position of the body from horizontal to vertical, it is effective to use any exercise, but the most effective exercises that activate aerobic and anaerobic glycolytic energy systems. In addition, exercises that require frequent transitions from lying (sitting) to standing positions, as well as changes in the direction of movement are useful.
Key words: orthostatic test, body length, sport, athletes

Introduction

The idea to use the change of body position in space as an input for the study of the functional state of the organism is implemented in the practice of functional diagnostics (Buhr, Stack, &Luetkemeier, 2013; Nazar, Bicz, & Greenleaf,1996; Pavy-Le Traon, Sigaudo, Vasseur, Maillet, Fortrat, Hughson, et al., 1998). This test provides important information primarily in those sports that are characterized by a change in body position in space (gymnastics, rhythmic gymnastics, acrobatics, trampoline jumping, diving, high jump and the sixth, and more recently - and sports games) (Kozina, Slyusarev, 2002; Hynynen, Iglesias, Feriche, Calderon, Abalos, Vazquez et.al., 2012; Kubala, Smorawinski, Kaciuba-Uscilko, Nazar, Bicz, & Greenleaf, 1996; Lutfullin, &Al'metova, 2014;Lutfullin, &Al'metova, 2014) studied heart rate variability in twenty-seven young athletes (ice hockey) and found special autonomic mechanisms that function both in the supine position and during the orthostatic test, which is likely to be reflects the adaptation of the cardiovascular system to sports.

In all these sports, orthostatic stability is a necessary condition for athletic performance. Under the influence of systematic training orthostatic stability increases (Rodrigues, Goncalves, De Souza, & Da Silva

Corresponding Author: ZHANNETA KOZINA, E-mail: zhanneta.kozina@gmail.com

Soares, 2014; Rodriguez, Iglesias, Feriche, Calderon, Abalos, Vazquez, et al., 2012; Vesterinen, &Nummela, 2018).

The indicators of orthostatic stability are influenced by various factors. Kubalaet.al. (1996) determined circulatory and hormonal parameters in endurance athletes and control subjects during orthostatic tolerability tests performed before and after three days of bed rest. Changes in heart rate and blood pressure due to bed rest were the same in both groups. However, hormonal changes in these two groups were different: athletes decreased the activity of sympathoadrenal acid and increased the activity of renin in plasma. Untrained subjects had changes only in cortisol secretion.

Wi (Borysenko, Marian, &Kozina, 2020) found that students with a body length of more than 190 cm have difficulty with vegetative-vascular regulation. The effect of body length on the orthostatic test was also significant for the following data: systolic blood pressure in the vertical position, diastolic blood pressure in the vertical position; change in diastolic blood pressure when changing body position from horizontal to vertical; heart rate in vertical and horizontal positions; change in heart rate during the transition from horizontal to vertical position; stroke volume of blood in the vertical position; change in stroke volume of blood during the transition from horizontal to vertical position; all indicators of minute blood volume. However, the question of the joint influence of body length and sports specialization on the indicators of the orthostatic test has not been investigated.

Orthostatic reactions of the athlete's body are due to the fact that the transition of the body from horizontal to vertical in the lower half is deposited a significant amount of blood (Schafer, Olstad, & Wilhelm, 2015; Vesterinen, &Nummela, 2018; Wolthuis, Hull, Fischer, McAfoose, & Curtis, 1979). As a result, the venous return of blood to the heart deteriorates and blood emission decreases. Compensation for this adverse effect is mainly due to an increase in heart rate.In addition, an important role belongs to the change in vascular tone.

Thus, in the basis of development of the various reactions connected with change of position of a body in space, the main role is played by the considered mechanisms.The degree of reduction of venous return of blood to heart at change of position of a body to a greater extent depends on a tone of large veins. If it is reduced, the increase in venous return may be so significant that the transition to an upright position due to a sharp deterioration in the blood supply to the brain may develop unconsciousness. Low venous tone can also cause fainting during prolonged stay in an upright position - orthostatic collapse (Vesterinen, &Nummela, 2018; Wolthuis, Hull, Fischer, JMcAfoose, & Curtis , 1979; Schafer, Olstad, & Wilhelm, 2015; Rodrigues, Goncalves, De Souza, & Da Silva Soares, 2014; Buhr, Stack, &Luetkemeier, 2013).

Orthostatic collapse is rare in people engaged in physical culture and orthostatic collapse is a fairly common phenomenon in people of high body length and asthenic physique. Most representatives of game sports, as well as some athletics, have a high body length and asthenic physique. In addition, the question of the peculiarities of the reaction to the orthostatic test of students majoring in "Physical Education and Sports" (Muszkieta, Napierala, Cieslicka, Zukow, Kozina, Iermakov, Górny, 2019). Therefore, the topical issue is to determine the characteristics of the reaction to the orthostatic test of students of different sports specializations with different body lengths.

The hypothesis was set in this study: 1 - students who play different sports, have different adaptive capabilities of vascular regulation; 2 - students whose body length exceeds 190 cm have less adaptive capacity for vascular regulation compared to students of average and below average body length.

Purpose: to identify the influence of body length and various sports on the indicators of vascular regulation of students.

Material and methods

Participants

The study involved 42 students who play sports at the amateur level, 18 of them are track and field's sportsmen (short and medium distance running), 12 are football players, 12 are wrestlers. The number of students with a body length of more than 190 cm was 12 people. The number of students whose body length was 150-175 cm was 30 people. There were no students with a body length of 176-189 cm in the study. This was the basis for the division of students into such groups according to body length, because it is known that large values of body length (over 190 cm) negatively affect the adaptation of the cardiovascular system in the transition from horizontal to vertical position.

The study was conducted on the basis of H.S. SkovorodaKharkiv National Pedagogical University.

Procedure

The following research methods were used in the work: method of analysis of literature sources; method of determining body length; orthostatic test method; method of determining stroke volume and minute blood volume; methods of statistical data processing (comparison of averages by the Student's method, multivariate analysis of variance). An orthostatic test measures heart rate and blood pressure. These values are measured in a horizontal position, then repeat these measurements in the subject after actively getting up in a vertical position at the 10th minute.A natural reaction to the orthostatic test is an increase in heart rate. As a result, the minute volume of blood is slightly reduced. In well-trained athletes, heart rate is relatively small and ranges from 5 to 15 beats per minute. In young athletes, the reaction may be more pronounced. Systolic blood pressure either remains unchanged or even decreases slightly (by 2-6 mm Hg); diastolic blood pressure naturally increases by 1O-15% relative to its value in the horizontal position. If during a 10-minute study the systolic pressure approaches the initial values, the diastolic pressure remains elevated. Signs of orthostatic instability are a sharp drop in blood pressure and a very large increase in heart rate (Kozina, Slyusarev, 2002; Lutfullin, &Al'metova, 2014).

Measurements of body length are performed in a standing position using a vertical height meter. The person stands on a wooden plane with his back to the vertical bar, touching her heels, buttocks, interscapular area with the shoulders set back (head not resting). The arms should be lowered along the torso, the abdomen - tightened, the heels - together, the socks - separately. The position of the head should be such that the upper edge of the earlobe and the lower edge of the orbit are in the same horizontal plane. The movable bar is attached to the head without pressure, but tightly.

The magnitude of the stroke volume depends on the force of the heart contraction and the amount of blood flowing to it during diastole through the veins. Stroke volume (SV) can be calculated by Starr's formula (Kozina, Slyusarev, 2002):

The minute volume of blood (MBV) is determined by the stroke volume and heart rate, depending on the position of the human body, its sex, age, fitness, environmental conditions and many other factors.

Calculate the minute blood volume (MBV) according to the formula:

MBV = SV × heart rate.

Statistical analysis

For each indicator, the arithmetic mean, standard deviation S (standard deviation), error of the mean (m) and estimation of the probability of discrepancies of indicators by Student's t-test with the corresponding level of probability (p) were determined. The comparison was made for groups of students involved in football, track and field sportsmen, judo, as well as for groups of students with body length above average (more than 190 cm) and medium (below average) (150-175 cm). Differences and relationships were considered reliable at a significance level of $p < 0.05$.

Multivariate analysis of variance was also used using a general linear model. The dependent values were heart rate, systolic and diastolic blood pressure, stroke volume and minute blood flow in horizontal and vertical positions, as well as the difference between these indicators in different body positions. Independent values were body length and sport. Body length of 150-175 cm was denoted by the number 1, body length greater than 190 cm was denoted by the number 2. There were no students with body length values of 175-190 cm in the study. Numbers of the sports that students were involved in: track and field - 1; football - 2; judo wrestling - 3. For statistical processing of the obtained data were used computer programs Microsoft Excel "Data Analysis" - 2013, SPSS - 17.

Results

We found that in different groups there is a different severity of adaptive responses to the orthostatic test in terms of blood pressure and heart rate (Borysenko, et.al., 2020). Thus, when comparing students with different body lengths revealed significant differences in systolic blood pressure in students of the two groups (Table 1). The increase in systolic blood pressure in students whose body length is above 190 cm, significantly higher than in students whose body length does not exceed 175 cm ($p < 0{,}01$) (table 1). With regard to diastolic blood pressure, in students whose body length is above 190 cm, this figure is significantly higher ($p < 0.01$) in both horizontal and vertical position (Table 1). Stroke volume of blood in tall (body length more than 190 cm) students in the standing position is significantly less compared to this figure of students with a body length of 150-175 cm. The same applies to the minute volume of blood flow (Table 1).

*Table 1*Comparative characteristics of orthostatic test indicators of student-athletes with different anthropometric data (body length)

Indexes	Body length	Statistical indicators					
		N	$\bar{x}$	S	m	t	p
Systolic pressurein thehorizontal position, mmHg	>190	12	113.50	1.57	0.45	1.82	0.077
	150-175	30	110.00	6.56	1.20		
Systolic pressurein the vertical position, mmHg	>190	12	131.00	1.04	0.30	3.28	0.002
	150-175	30	121.60	9.83	1.80		
Systolic pressure Difference, mmHg	>190	12	17.50	2.61	0.75	2.75	0.009
	150-175	30	11.60	7.21	1.32		

Diastolic pressurein the horizontal position, mmHg	>190	12	79.00	1.04	0.30	2.72	0.010
	150-175	30	70.80	10.34	1.89		
Diastolic pressurein thevertical position, mmHg	>190	12	86.00	6.27	1.81	3.15	0.003
	150-175	30	76.20	9.97	1.82		
Diastolic pressure Difference, mmHg.	>190	12	7.00	7.31	2.11	-1.76	0.085
	150-175	30	11.00	6.37	1.16		
Heart rate in the vertical position,beats·min^{-1}	>190	12	59.00	13.58	3.92	-0.42	0.678
	150-175	30	60.60	10.14	1.85		
Heart ratein the vertical position, beats·min^{-1}	>190	12	68.50	8.88	2.56	0.54	0.595
	150-175	30	67.00	7.90	1.44		
Heart rate difference, beats·min^{-1}	>190	12	9.50	4.70	1.36	0.97	0.339
	150-175	30	8.40	2.62	0.48		
Stroke volume in a horizontal position, ml	>190	12	57.85	1.93	0.56	-1.89	0.066
	150-175	30	64.82	12.64	2.31		
Stroke volume in the upright position, ml	>190	12	58.90	7.42	2.14	-2.67	0.011
	150-175	30	64.98	6.38	1.16		
Stroke volume, Difference, ml	>190	12	8.95	1.10	0.32	-2.01	0.051
	150-175	30	12.60	6.20	1.13		
Minute blood volume a horizontal position, l·min^{-1}	>190	12	3.44	0.90	0.26	-1.56	0.126
	150-175	30	3.91	0.88	0.16		
Minute blood volume in the upright position, l·min^{-1}	>190	12	3.97	0.02	0.00	-2.74	0.009
	150-175	30	4.32	0.44	0.08		
Minute blood volume Difference, l·min^{-1}	>190	12	0.85	0.56	0.16	0.68	0.503
	150-175	30	0.71	0.61	0.11		
Body length, cm	>190	12	192.50	2.61	0.75	16.67	0.000
	150-175	30	165,20	5,40	0,99		

Significantly lower values of stroke volume and minute blood flow in tall students compared to students of medium body length indicate insufficient adaptation to changes in body position in tall students compared to students with a body length of 150-175 cm. In tall students there is no significantly greater difference in heart rate when changing body position from horizontal to vertical compared with students of average and below average body length, and the change in heart rate is within normal limits (Table 1). Comparison of orthostatic tests of students - representatives of different sports showed that the lowest values of heart rate in the horizontal position and in the vertical position of the body in judo. The same applies to blood pressure in the horizontal and vertical position ($p < 0,001$). The highest heart rate and blood pressure in students - track and field sportsmen. According to these indicators, footballers occupy an intermediate place. To more accurately confirm the results of the impact of various sports on the performance of orthostatic samples, a multivariate analysis of variance was performed using a general linear model (Table 2).

Table 2 Indicators of multivariate analysis of variance of the influence of kinds of sport and body length on the orthography of students-athletes (multivariate tests)

Effect		Multivariate Tests(c)				
		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	1,000	1632000,000	2,000	36,000	0,000
	Wilks' Lambda	0,000	1632000,000	2,000	36,000	0,000
	Hotelling's Trace	90689,733	1632000,000	2,000	36,000	0,000
	Roy's Largest Root	90689,733	1632000,000	2,000	36,000	0,000
Kind of sport	Pillai's Trace	1,229	29,503	4,000	74,000	0,000
	Wilks' Lambda	0,002	376,356a	4,000	72,000	0,000
	Hotelling's Trace	367,969	3219,730	4,000	70,000	0,000
	Roy's Largest Root	367,667	6801,843b	2,000	37,000	0,000
Body length	Pillai's Trace	0,868	118,697a	2,000	36,000	0,000
	Wilks' Lambda	0,132	118,697a	2,000	36,000	0,000
	Hotelling's Trace	6,594	118,697a	2,000	36,000	0,000
	Roy's Largest Root	6,594	118,697a	2,000	36,000	0,000
Kind of sport * Body length	Pillai's Trace	0,930	238,011a	2,000	36,000	0,000
	Wilks' Lambda	0,070	238,011a	2,000	36,000	0,000
	Hotelling's Trace	13,223	238,011a	2,000	36,000	0,000
	Roy's Largest Root	13,223	238,011a	2,000	36,000	0,000

a. Exact statistic
b. The statistic is an upper bound on F that yields a lower bound on the significance level.
c. Design: Intercept;kind of sport; body length; kind of sport * body length

Significant influence of both body length and sport on most indicators of orthostatic test was found (Table 2). The results of analysis of variance confirmed the results of comparing the averages of the Student's t-test. The influence of sport on heart rate, systolic and diastolic pressure, as well as the calculated values of stroke volume and minute blood flow in the supine and standing positions was significant for almost all indicators (p <0,05; p <0,001) (Table 2) . The only exception is the rate of stroke blood volume in the horizontal position (p> 0.05) (Table 2).

Body length also significantly affects the indicators of vascular regulation (Table 2). There is a significant effect of body length on systolic blood pressure in the standing position, diastolic blood pressure in the supine and standing positions, heart rate in the supine and standing positions, stroke volume in the standing position, minute blood flow in the supine and standing positions (p <0,001) (Table 2).

The influence of both factors (body length and sport) on the orthostatic test was also significant for the following data: systolic blood pressure in the vertical position, diastolic blood pressure in the vertical position; change in diastolic blood pressure when changing body position from horizontal to vertical; Heart rate in vertical and horizontal positions; change in heart rate during the transition from horizontal to vertical position; stroke volume of blood in the vertical position; change in the stroke volume of blood during the transition from horizontal to vertical position; all indicators of minute volume of a blood-groove (p <0,005; p <0,01; p <0,001).

Discussion

The hypothesis presented in this study was fully confirmed. It has been shown that students who engage in different sports have different adaptive capabilities in terms of vascular regulation. It was also shown that students with a body length greater than 190 cm have less adaptive capacity for vascular regulation compared to students of medium and below average body length.

A more pronounced increase in systolic and diastolic pressure in tall students compared with students of medium and below average body length indicates the activation of mechanisms of adaptation to changes in body position. It is known that (Kozina, Slyusarev, 2002; Borysenko, Marian, &Kozina, 2020) that in people of high body length the change in performance in the transition from horizontal to vertical position This leads to more pronounced adaptation mechanisms of heart rate and blood pressure.In our study, the increase in heart rate in tall people does not differ significantly from this figure in students of medium and below average body length. But blood pressure, both systolic and diastolic, is significantly higher in tall students than in others.This fact can be seen as a more pronounced adaptive response of students with a body length above 190 cm from the cardiovascular system and vascular regulation. adaptive reactions are not sufficient, because the values of the shock volume of blood and the minute volume of blood flow in the vertical position in students of high lengths and the body is significantly smaller compared to students with a body length of 150-175 cm.

We can explain the obtained results by the fact that sports games (Lutfullin, &Al'metova, 2014) and judo (Rodrigues, Goncalves, De Souza, & Da Silva Soares, 2014;Kozina, Z., Goloborodko, Boichuk, , ... Drachuk, Stsiuk, I2018) is a load of mixed aerobic-anaerobic orientation, while running short and medium distances is mainly a job , which requires creatine-phosphate and glycolytic mechanisms of energy supply.

It is known (Rodrigues, Goncalves, De Souza, & Da Silva Soares, 2014) that mixed loads (aerobic and glycolytic) have the greatest impact on the cardiovascular system. It can be concluded that in this case, the load on the cardiovascular system, which provide football and judo, have a greater impact on the adaptive capacity of vegetative-vascular regulation compared to loads exclusively running, mixed creatine-phosphate and In addition, judo training requires a large number of changes in body position, rapid transitions from horizontal to vertical position, and vice versa. changes in the direction of movement, which also requires changes in body position (tilts, turns, "rolls", etc.). exerts a certain load on vestibular stability. And so we can conclude that football and judo have a training effect onvegetative-vascular regulation is greater than exclusively running exercises.

On the other hand, our study did not involve qualified athletes, but athletes of amateur level, mass categories according to the classification in Ukraine. Therefore, our results can be considered as a basis for similar studies involving qualified athletes to obtain more detailed information on the impact of exercise from different sports on vascular regulation, which is reflected in the orthostatic test. This is planned in further research.

Conclusions

1. It was found that the increase in systolic blood pressure during the transition from horizontal to vertical position in students whose body length is above 190, significantly higher than in students whose body length does not exceed 175 cm (p <0,01). diastolic blood pressure, then in students whose body length is above 190 cm, this figure is significantly higher (p <0.01) both horizontally and vertically. Stroke volume of blood in tall (body length more than 190 cm) students in the standing position is significantly less compared to this figure of students with a body length of 150-175 cm. The same applies to the minute volume of blood flow.

2. The lowest values of heart rate in the horizontal position and in the vertical position of the body in judo wrestling. The same applies to blood pressure in the horizontal and vertical position (p <0,001). The highest

heart rate and blood pressure intrack and field students-sportsmen. According to these indicators, footballers occupy an intermediate place.

3. The influence of sport on heart rate, systolic and diastolic pressure, as well as the calculated values of stroke volume and minute blood flow in the supine and standing positions was significant for almost all indicators ($p <0,05$; $p <0,001$. The only exception is indicator of stroke volume of blood in the horizontal position ($p> 0,05$).

4. It was revealed by the results of analysis of variance that body length significantly affects the indicators of vascular regulation. There is a significant effect of body length on systolic blood pressure in the standing position, diastolic blood pressure in the supine and standing positions, heart rate in the supine and standing positions, stroke volume in the standing position, minute blood flow in the supine and standing positions ($p <0,001$). The influence of both factors (body length and sport) on the orthostatic test was also significant for the following data: systolic blood pressure in the vertical position, diastolic blood pressure in the vertical position; change in diastolic blood pressure when changing body position from horizontal to vertical; Heart rate in vertical and horizontal positions; change in heart rate during the transition from horizontal to vertical position; stroke volume of blood in the vertical position; change in the stroke volume of blood during the transition from horizontal to vertical position; all indicators of minute volume of a blood-groove ($p <0,005$; $p <0,01$; $p <0,001$).

5. The results of a more significant impact of judo and football in comparison with running short and medium distances on the indicators of vascular regulation: the best indicators - in judo, the next place - in football, then –in track and field sportsmen. It was found that students with a body length of more than 190 cm have difficulty with vegetative-vascular regulation. To improve the adaptive capacity of vascular regulation to change the position of the body from horizontal to vertical, it is effective to use any exercise, but the most effective exercises that activate aerobic and anaerobic glycolytic energy systems. In addition, exercises that require frequent transitions from lying (sitting) to standing positions, as well as changes in the direction of movement are useful.

Acknowledgments

The study was conducted according to: research work, which is funded by the state budget of the Ministry of Education and Science of Ukraine for 2019-2020: “Theoretical and methodological bases of technology development for the restoration of the musculoskeletal system and functional state and injury prevention of representatives of different age groups in physical culture and sports” (State Registration No: 0119U100634).

Conflict of interest

The authors declare that there is no conflict of interest.

References

Borysenko, I., Marian, C., &Kozina, Z. (2020). Influence of body length on orthostatic test parameters of student-athletes. *Health, Sport, Rehabilitation*, *6*(4), 47-57. https://doi.org/10.34142/HSR.2020.06.04.05

Buhr, L. K., Stack, C. I., &Luetkemeier, M. J. (2013). The Effects Of Hydration Status On Pulse Rate And Heart Rate Variability During A Stand Test Of Orthostatic Tolerance. *Medicine and Science in Sports and Exercise, 45*(5), 37-37.

Hynynen, E., Iglesias, X., Feriche, B., Calderon, C., Abalos, X., Vazquez, J., . . . Rodriguez, F. A. (2012). Heart Rate Variability in Orthostatic Test During Different Training Periods in Elite Swimmers. *Medicine and Science in Sports and Exercise, 44*, 782-782.

Kozina, Z., Slyusarev, V. (2002). The influence of the use of medicinal plants and mummy on some indicators of the autonomic nervous and vegetative-vascular systems of highly qualified basketball players, *Pedagogy, psychology and medical and biological problems in sports.* 11, 81-89.

Kozina, Z., Goloborodko, Y., Boichuk, Y., ...Drachuk, A., Stsiuk, I. (2018). The influence of a special technique for developing coordination abilities on the level of technical preparedness and development of psycho-physiological functions of young volleyball players 14-16 years of age. *Journal of Physical Education and Sport, 18(*3), 1445–1454

Kubala, P., Smorawinski, J., Kaciuba-Uscilko, H., Nazar, K., Bicz, B., & Greenleaf, J. E. (1996). Effect of three day bed-rest on circulatory and hormonal responses to active orthostatic test in endurance trained athletes and untrained subjects. *Journal of gravitational physiology : a journal of the International Society for Gravitational Physiology, 3*(2), 40-41.

Lutfullin, I. I., &Al'metova, R. R. (2014). Heart rate variability in young hockey players at rest and during active orthostatic test. *Fiziologiiacheloveka, 40*(2), 105-111.

Muszkieta, R., Napierała, M., Cieślicka, M., Zukow, W., Kozina, Z., Iermakov, S., Górny, M. (2019). The professional attitudes of teachers of physical education. *Journal of Physical Education and Sport, 19* (1), 92–99

Pavy-Le Traon, A., Sigaudo, D., Vasseur, P., Maillet, A., Fortrat, J. O., Hughson, R. L., . . . Gharib, C. (1998). Cardiovascular responses to orthostatic tests after a 42-day head-down bed-rest. *European Journal of Applied Physiology, 77*(1-2), 50-59.

Roberson, K. B., Signorile, J. F., Singer, C., Jacobs, K. A., Eltoukhy, M., Ruta, N., . . . Buskard, A. N. L. (2019b). Hemodynamic responses to an exercise stress test in Parkinson's disease patients without orthostatic hypotension. *Applied Physiology Nutrition and Metabolism, 44*(7), 751-758. doi:10.1139/apnm-2018-0638

Rodrigues, G. D., Goncalves, T. R., De Souza, S. C., & Da Silva Soares, P. P. (2014). Comparison of Cardiac Vagal Modulation From the Orthostatic Stress Test Between Untrained Individuals and Athletes. *Medicine and Science in Sports and Exercise, 46*(5), 341-342. doi:10.1249/01.mss.0000494205.70884.8a

Rodriguez, F. A., Iglesias, X., Feriche, B., Calderon, C., Abalos, X., Vazquez, J., . . . Levine, B. D. (2012). Effects of Altitude Training on Heart Rate Variability in Orthostatic Test in Elite Swimmers. *Medicine and Science in Sports and Exercise, 44*, 364-364.

Schafer, D., Olstad, B. H., & Wilhelm, M. (2015). Can Heart Rate Variability Segment Length During Orthostatic Test Be Reduced To 2 Min? *Medicine and Science in Sports and Exercise, 47*(5), 48-48. doi:10.1249/01.mss.0000476531.84848.dd

Vesterinen, V., &Nummela, A. (2018). Nocturnal Heart Rate Variability and Morning Orthostatic Test as Tools to Monitor Training Load. *Medicine and Science in Sports and Exercise, 50*(5), 118-119.

Wolthuis, R. A., Hull, D. H., Fischer, J. R., McAfoose, D. A., & Curtis, J. T. (1979). Blood-pressure variability of the individual in orthostatic testing. *Aviation Space and Environmental Medicine, 50*(8), 774-777.