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Aqua Jogging Moderate Intensity Training is Conditioning a Sense of Well-being in Seniors

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Abstract

Hypokinesia in seniors reduces mobility, which results in a decrease in their general well-being and quality of life. In this study, changes in blood pressure and saturation values in seniors after aqua jogging training were assessed. In addition, the subjective average level of fatigue and its impact on HR_{MAX} were analysed. Quality of life was also assessed in the study group of seniors.

In a group of 49 people attending aqua jogging classes (66.3±5.4yr; F:39; M:10), the values of pressure and saturation were measured in 4 subsequent measurements (before and immediately after training, as well as 1 min. and 5 min. after training). The Rating of Perceived Exertion scale (RPE), the SF-36v.2 quality of life questionnaire and the WHO-5 Good Feeling Index were used to assess the level of fatigue during training. Blood pressure measurements were highest immediately after the exercises and thereafter decreased. HR_{MAX} at the fifth minute after the exercise increased significantly (r=0.3) following increasing fatigue (RPE) (p=0.017). A satisfactory level of quality of life in seniors was recorded at 71.1±18.0% [WHO–5] and 59.0±13.0% [SF–36v.2]. A higher level of quality of life was recorded in the psychological sphere (SF-36v.2 MCS:61.1%±7.7%). The greater physical exertion felt by a studied individual resulted in a slower pulse decrease after the exercise.

Key words: *quality of life, physical activity, active aging in place*

Introduction

According to the Central Statistical Office data, the average life expectancy of an individual in Polish society increased for men to 73.8 years, and for women to 81.7 years in 2018. This increases the need for older people to perform activities to maintain their health [1]. The literature on the subject confirms the impact of physical activity on the health of elderly people. After just two weeks, regular endurance training based on swimming, walking, nordic walking and others improves the metabolic stability of muscles and accelerates the kinetics of VO_2. In addition, it results in an improvement in general well-being, an increase in self-esteem, and an improvement in the psychological sphere, leading to an improvement in the overall quality of life. The appearance of these training effects is still the subject of much research. It is believed that the improvement of brain perfusion and the increase in brain and peripheral concentration of brain derived neurotrophic factor (BDNF) is conducive to improving the cognitive function of the elderly [2].

Muscle contraction increases muscle metabolism. The following increase in oxygen demand generates an increase in the volume of the heart, which then directly affects the increase in systolic pressure. For people at age 65, the American Heart Association recommends a heart rate for exercise in the range of 78–132 (HR x min-1) [3]. However, systematic training regulates blood pressure.

Prevention of hypokinesia during aging is important due to the progressive effects of the reduction of locomotor system activity observed in the body and the reduction of the ability to perform endurance efforts, changes in the stimulation of the nervous system and higher content of connective tissue in muscles [2]. The ageing process involves a decrease in muscle quality (MQ) in the upper and lower limbs in a similar percentage in men, while in the group of women, it is observed more often in the lower limbs. The effect of reduced physical activity of the elderly is a decrease in the subjectively felt level of quality of life [4]. While exercising the upper limbs, a significant increase in the frequency of heart contractions has been observed to directly impact blood pressure compared to when exercising the lower limbs and achieving the same frequency of heart contractions [2].

Training conducted in the aquatic environment relieves pressure on the structures of the joints. The value of hydrostatic water pressure is a kind of resistance when performing underwater movements, both in terms of limb movement and in the inspiration phase. Its value increases in proportion to the density of the environment [5].

The purpose of the study was to assess changes in blood pressure and saturation values in seniors after aqua jogging training, to analyse the subjective average level of fatigue and its impact on HR_{MAX}, and to assess the quality of life in the study group.

Materials and methods

Participants

The study was performed at the School of Swimming and Aqua Fitness in the period from January to March 2019. The study group consisted of 49 people participating in Aqua jogging classes. Most of them lived in urban areas (83.7%) and had secondary education (59.2%). The age of the studied people was 66.3±5.4 years on average. The average BMI value was 27.7±2.96. The average time of attending aqua jogging classes was 17.2±13.4 months (Table 1).

Questionnaire

A standardised questionnaire was used to assess the level of fatigue during the exercise, i.e. the RPE (Rating of Perceived Exertion) scale. It was applied to subjectively measure the feeling of physical effort exerted by the studied people in the exercises. The scale included levels from 0 to 10, where 0 indicated no fatigue, 5 indicated heavy but pleasant activity, and 10 indicated activity with maximum effort. Quality of life was assessed using two questionnaires, the Well-being index (WHO-5) and SF-36v.2 Quality of Life

Questionnaire, which analysed quality of life in the mental (MCS) and physical dimension (PCS), indicating an overall index of quality of life (ILQ). The raw results of both standardised questionnaires were transformed in accordance with the key into a percentage result [%].

The blood pressure value assessed in the next 3 measurements as well as the pulse and saturation values of the studied seniors before and after the training with intensity of 30–75% of maximum heart rate were also analysed. The assessment of training load due to the obtained percentage of HR_{MAX} was determined using the HR_{MAX}=208-0.7 x age in years. The studies of Tanaka et al. show that this factor is a better indicator of HR_{MAX} in elderly people. The commonly known form, HR_{MAX}=220-age in years, according to the researchers, underestimates HR_{MAX} for the elderly [6].

The study methodology was planned in accordance with the principles indicated in the Helsinki Declaration [7]. The study based on completing the questionnaire, measurement of blood pressure and pulse did not cause any risk. In addition, it was anonymous and voluntary.

Organisation of training and study methodology

The training started with putting on buoyancy belts and entering the water (time:5 min.). Then there was a warm-up: rocking hands sideways, rocking hands forward, rocking hands down, jumping jacks, flutter kicks, torso turns (time:5 min.). Having warmed up, the study group proceeded to the main part (time: 30 min.). The studied participants performed: jogging 4x25m, jogging with a 4x25m hand load, jogging with a 4x25m leg load, jogging with a 4x25m hand and leg load.

At the end of the training, the study group performed stretching exercises at the pool wall for 5 minutes. The total training time was 40 minutes. The studied participants fully completed the training described above.

Blood pressure, pulse and saturation were measured before and immediately after training. Within 1 minute after the exercise, heart rate and saturation were measured. Within 5 minutes after the exercise, blood pressure, pulse and saturation were measured.

Statistical analysis

Qualitative and quantitative variables were presented using basic descriptive statistics (number, percentage, mean, reference, median, lower and upper quartile). The database was analysed in terms of statistics using the t test for dependent samples. The normality of the distribution of measurable variables was assessed using the W Shapiro-Wilk test. The difference in mean values was also assessed. The studies were performed once in five groups of respondents. Statistical dependences were significant if their level of significance was $p<0.05$.

Results

Analysis of the subjective level of fatigue and quality of life of seniors

The average level of fatigue in the study group was 4.0±2.2 on a scale of 0 to 10, which indicates the assessment of physical activity performed by seniors, from light activity to demanding activity, posing a certain challenge to the body. The lowest scale value was 0, while the highest was 7.0. The assessment of quality of life was performed with two questionnaires, SF-36v.2 and WHO-5, which indicated a satisfactory level of subjectively assessed quality of life. In the WHO-5 analysis, the average was 71.1%±18.0%, which confirms the satisfactory level of perceived quality of life in seniors. The SF-36 analysis showed an average level of perceived quality of life: 59.0%±13.0%. A worse average quality of life was recorded in the physical sphere (PCS:56.8%±20.9%) compared to the mental sphere (MCS:61.1%±7.7%) of the studied seniors. However, the highest maximum percentage indicated by seniors was recorded in the sphere of physical quality of life – the highest measurement was 93.8%, which means a very high level of quality of life. The character of the distribution of HR_{MAX} variables was also recorded, considering 3 subsequent measurements. The studied participants obtained average HR_{MAX} percentages after approx. 50% effort, but not less than 31% and not more than 73% HR_{MAX} in the measurements after training (Table 2).

Analysing the average HR_{MAX} value in the study group, it was indicated that the lower the RPE value, i.e. the lower the subjective degree of fatigue, the clearer the difference between HR_{MAX} measurement performed in the first and the fifth minute after the exercise. The HR_{MAX} value measured in the fifth minute after the exercise increased significantly (r=0.3) with an increasing value on the RPE scale (p=0.018). This means that the subjectively heavier the physical effort was, the slower the pace of the pulse after exercise. In the study group, lower resting heart rate values were found among persons indicating higher values on the RPE scale after physical effort (r=-0.19). However, this relationship was not statistically significant (p=0.15) (Figure 1).

Analysis of pressure, pulse and saturation parameters in subsequent measurements

Having analysed the differences between the three measurements of systolic pressure (SP), a significant difference was found between the pressure value before and immediately after the training. Pressure values averaged 135.2 and 145.1 (p<0.000). Diastolic blood pressure values were significantly different in each of the analysed variable pairs (p <0.05). The largest difference was recorded in two consecutive measurements before and immediately after the exercise. The pressure increased by 11.3 mmHg (p<0.001). The differences between successive heart rate measurements were assessed. Apart from one pair of analysed measurements, a significant difference was confirmed in each case. In the analysis of the pulse measurement immediately after and 1 minute after the exercise, no statistically significant difference was noted (p=0.258). The measurement average was respectively 89.6 and 87.3 HR/min. The largest significant difference between the measurements was recorded before and immediately after the exercise. The post-exercise heart rate compared to resting heart rate increased by 13.8 HR/min. (p<0.001) (Table 3).

The mean pre-training blood pressure was 135.2/80.5 mmHg, increasing to 145.1/91.8 mmHg just after the exercise. In the last measurement performed in the fifth minute after the training, the total pressure decreased to 134.1/87.7 mmHg, which was close to the measurement of the pressure before the training (135.2/80.5 mmHg). The analysis of the saturation level in the next

4 measurements did not show significant differences ($p=0.785$). The saturation value remained almost at one level of SP O_2 96.1 - 96.6. The above graph of means confirms the lack of significant differences in the level of saturation in subsequent measurements before and after the training. The value of the saturation measurement remained at the level of general norms for the population (Figure 2).

Analysing the time of attending aqua jogging classes and % HR_{MAX} values, no significant relationships were found ($p>0.05$). Therefore, the time of exercising aqua jogging did not significantly affect the recorded value of HR_{MAX} in the study group. The studied people did not exceed 75% of HR_{MAX} assessed using the form $HR_{MAX}=208-0.7 \times age$ [in years].

Discussion

The aquatic environment is not a natural environment for the human body. However, the physical properties of water allow for an effective use of the aquatic environment for physical activity. Studies confirming the effective process of recovering lost functions at the level of the musculoskeletal system are known [8, 9, 10, 11]. While shortening the recovery process in a group of patients after an injury, it is possible to introduce exercises in water earlier than exercises on land. The correctly chosen exercises allow us to regulate the functions of the nervous and cardiovascular systems, while exercising in water reduces the risk of falling, especially in the elderly group [12].

Fully completed aqua jogging training performed by the study group allowed them to obtain a heart rate not exceeding 75% HR_{MAX}. Blood pressure values, not only during exercise, but also at rest, allow us to assess the risk of cardiovascular health [13]. The conclusion from the obtained values of % HR_{MAX} is that aqua jogging training is safe for a group of seniors and does not indicate high intensity exercise. The highest blood pressure values were recorded just after aqua jogging, while in subsequent measurements, according to physiological processes occurring in the body, the pressure values significantly decreased.

The SpO_2 value did not exceed the normal value. Therefore, aqua jogging training does not cause the risk of hypoxia. In the studies comparing haemoglobin values in the group of people training in the aquatic environment and on land and in the control group (without training), the value of haemoglobin increased significantly in the group of people doing aqua jogging ($p=0.001$) [14]. An increase in haemoglobin parameters increases the level of tissue oxygenation by binding haemoglobin to oxygen molecules. Therefore, training in water deepens breathing and increases breathing capacity.

The studies of many authors point to the high therapeutic value of training in water, especially in the elderly group [13]. The literature indicates that there are many studies comparing training in water with training on land. The authors' study covers only a group of people training through aqua jogging. In addition to the measurement of pressure, pulse and saturation, the study used questionnaires to assess RPE fatigue and the SF-36 questionnaire assessing the quality of life. In the study group, it was shown that lower resting HR_{MAX} values significantly determined a higher RPE after the training ($r=0.34$; $p<0.05$). However, according to those studied, the total average rating of aqua jogging indicated the intensity of the training from light to demanding (4.0±2.2 RPE points).

The quality of life of the seniors assessed by two independent questionnaires indicated that it was at a satisfactory level – an average of 59.0±13% [SF-36] and 71.7±18.0% [WHO-5]. Similar values for quality of life as indicated through the SF-36 questionnaire were shown in the study of a group of women with obesity. In the study group of women, a higher average level of perceived quality of life in the physical sphere of SF-36 was noted [15], which was not confirmed in the authors' study. The mental sphere of life was rated higher [MCS]. The exercises in the aquatic environment significantly increase the elasticity of musculoskeletal tissues [16]. People participating in classes in the aquatic environment emphasise the positive impact of the exercises on the physical sphere [17].

The exercises in the aquatic environment minimize the risk of falling and the risk of injuries to the musculoskeletal system. In addition, they allow participants to feel relief from resistance. However, in the literature there are a small number of publications indicating the possibility of inducing pneumothorax by training in the aquatic environment or aqua jogging [18, 19].

Training in water and the use of hydrostatic properties of water stimulates the musculoskeletal system, relieving pressure and increasing mobility. However, studies should be conducted to verify the impact of training in water on the human body, especially in seniors, since they often have cardiovascular and respiratory comorbidities.

Conclusions

- → The general indicator of quality of life in the study group was rated at an average level. The seniors assessed the mental dimension of quality of life slightly better than in the physical dimension.
- → The higher the subjective level of fatigue on the RPE scale after the training, the lower the difference in the HR_{MAX} measurements in the first and the fifth minute after the exercise and the lower HR_{MAX} values before the training.
- → Having analysed the differences between the three measurements of systolic pressure, a significant difference was found between the pressure value before and immediately after the training. Pressure values increased significantly.
- → The largest significant difference between the pulse measurements was recorded before and immediately after the exercise. The post-exercise heart rate compared to resting heart rate increased by 13.8.
- → The pulse value between the first and the fifth minute after the exercise decreased significantly.
- → There were no significant changes in the saturation index in any of the performed measurements.
- → The seniors emphasised a satisfactory level of well-being.

References

1. Life expectancy tables of Poland 2018. Statistics Poland [online]. Retrieved from: https://stat.gov.pl/obszary-tematyczne/ludnosc/trwanie-zycia/trwanie-zycia-w-2018-r-,2,13.html [December 2020].

2. Górski J. Basic of physiology of physical effort. Warszawa: PZWL; 2015.

3. American Heart Association. Retrieved from: https://www.heart.org/ [December 2020].

4. Arnold AS, Egger A, Handschin C. PGC – 1 and myokines in the aging muscle – a mini – review. Gerontology 2011; 57: 37–43.

5. Łubkowska W, Szark-Eckardt M. Correcting body posture through swimming and exercises in water. Bydgoszcz: Remedia; 2015.

6. Tanaka H, Monahan KD, Seals DR. Age – predicted maximal heart rate revisted. J Am Coll Cardiol 2001; 37: 153–156.

7. World Medical Association. Retrieved from: https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/ [December 2020].

8. Jae-Hyun L, Eunsook S. The effects of aquatic walking and jogging program on physical function and fall efficacy in patients with degenerative lumbar spinal stenosis. Journal of Exercise Rehabilitation 2015; 11(5): 272–275.

9. Fisken AL, Waters DL, Hing WA, Steele M, Keogh JW. Comparative effects of 2 aqua exercise programs on physical function, balance, and perceived quality of life in older adults with osteoarthritis. J Geriatr Phys Ther 2015; 38: 17–27.

10. Odinets T, Briskin Y, Pityn M. Effect of individualized physical rehabilitation programs on respiratory function in women with post-mastectomy syndrome. Physiother Theory Pract 2019; 35(5): 419–426. https://doi.org/10.1080/09593985.2018.1444117.

11. Williams RE, Barreira TV, Tseh W. Fitness-related benefits: land-based versus aqua-base. J Sports Med Phys Fitness 2000; 60(1): 26–31.

12. Buckthorpe M, Pirotti E, Della Villa F. Benefits and use of aquatic therapy during rehabilitation after ACL reconstruction – a clinical commentary. Int J Sports Ther 2019; 14(6): 978–993.

13. Hogan C, Joubert DP. Ambulatory Blood Pressure Lower Following Aquatic Exercise than Land Treadmill Exercise. International Journal of Exercise Science: Conference Proceedings 2018; 2(10): article 49 [online]. Retrieved from: https://digitalcommons.wku.edu/ijesab/vol2/iss10/49.

14. Mukarromah SB, Hardono S. The Impact of Aqua Jogging Exercise on Hematological Response in Obese Women. Advances in Health Science Research 2019; 12: 162–165.

15. Karim NLB, Jalil ADBA, Hasri NHB, Rahman HABA, Shari MB, Idris NIB. Effects of Aqua Exercises Towards Improving The Quality of Life (QoL) of Obese Women in Malaysia. IOP Conf. Series: Journal of Physics: Conf. Series 2018; 1020(1): 012010.

16. Sarina Md Y, Maisarah S, Zulkifli, K, Aishah A, Teh Lay K, Suhana A, Norizzati MI, Mastura J. Aqua zumba versus aqua jogging: comparative effects on health parameters among obese middle-aged women. Movement, Health & Exercise 2018; 7(2): 11–21.

17. Fisken AL, Waters DL, Hing WA, Keogh JW. Perceptions towards aqua-based exercise among older adults with osteoarthritis who have

discontinued participation in this exercise mode. Australasian Journal on Ageing 2016; 35(1): 12–17.

18. Grünig H, Nikolaidis PT, Moon RE, Knechtle B. Diagnosis of Swimming Induced Pulmonary Edema – A Review. Front Physiol 2017; 8: 652.

19. Wenger M, Russi EW. (2007) Aqua jogging-induced pulmonary oedema. Eur Respir J 2007; 30: 1231–1232. https://doi.org/10.1183/09031936.00116407

Table 1. General characteristics of the research group of the respondents

Characteristic		n		%		
Gender (n – 49) – **female/male**		39/10		79.6/20.4		
Place of residence (n – 49) – **village/city**		8/41		16.3/83.7		
Education (n – 49) – **higher/secondary/vocational/lack of education**		17/29/1/2		34.7/59.2/2.0/4.1		
Variable	**M**	**SD**	**Reference**	**Me**	**Q1**	**Q3**
Age (n – 49) [years]	66.3	5.4	52.0–81.0	67.0	63.0	70.0
BMI (n – 49)	27.7	2.96	22.7–35.8	27.5	25.3	29.4
Time to attend aqua jogging classes [in months] (n – 49)	17.2	13.4	1–52	15.5	5.50	24.0

Note. M – mean; SD – standard deviation; Reference – minimum to maximum; Me – median; Q1 – lower quartile; Q3 – upper quartile.

Table 2. Analysis of RPE scale results, SF – 36v.2 questionnaire, WHO – 5 and HRMAX

Variable	N	X	SD	Reference	Me	Q1	Q3
RPE Scale [n]	49	4.0	2.2	0,0–7.0	4.0	2.0	6.0
SF – 36v2.							
PCS [result in %]	49	56.8	20.9	20.0–93.8	58.8	37.5	72.9
MCS [result in %]	49	61.1	7.7	39.5–75.0	62.0	58.5	66.6
ILQ [result in %]	49	59.0	13.0	32.7–81.9	59.8	49.9	68.5
WHO – 5							
[result in %]	49	71.1	18.0	32.0–100	72.0	60.0	84.0
%HR_{MAX} [HR_{MAX}=208 – 0,7 x age in years] [result in %]							
HR_{MAX} BEFORE	49	47	6	37–59	47	42	52
HR_{MAX} AFTER 1 min	49	54	9	35–73	53	49	60
HR_{MAX} AFTER 5 min	49	50	8	31–68	49	45	55

Note. M – mean; SD – standard deviation; Reference – minimum to maximum; Me – median; Q1 – lower quartile; Q3 – upper quartile.

Table 3. Analysis of differences in systolic pressure and pulse values in subsequent measurements in the study group

Variables	Averages of subsequent analyzed pairs of measurements					
	$\bar{x}_1$	SD	$\bar{x}_2$	SD	$\bar{x}_1$ vs $\bar{x}_2$	p
SP before x SP after	135.2	13.4	145.1	14.4	**9.9 ↑**	**0.000**
SP before x SP 5min	135.2	13.4	134.1	16.2	**1.0 ↓**	**0.634**
SP PO x SP 5min	145.1	14.4	134.1	16.2	**11.0 ↓**	**0.000**
DP before x DP after	80.5	9.8	91.8	13.0	**11.3 ↑**	**0.000**
DP before x DP 5min	80.5	9.8	87.7	12.9	**7.2 ↑**	**0.000**
DP after x DP 5min	91.8	13.0	87.7	12.9	**4.2 ↑**	**0.026**
HR before x HR after	75.8	9.8	89.6	15.6	**13.8 ↑**	**0.000**
HR before x HR 1 min	75.8	9.8	87.3	13.8	**1.5 ↑**	**0.000**
HR before x HR 5 min	75.8	9.8	c	13.2	**4.6 ↑**	**0.015**
HR after x HR 1 min	89.6	15.6	87.3	13.8	**2.3 ↓**	**0.258**
HR after x HR 5 min	89.6	15.6	80.4	13.2	**9.2 ↓**	**0.000**
HR 1 min x HR 5min	87.3	13.8	80.4	13.2	**6.9 ↓**	**0.000**

Note. SP before– systolic pressure before aqua jogging; SP after – systolic pressure after aqua jogging; SP 5min – systolic pressure 5 min after aqua jogging; DP before – diasystolic pressure before aqua jogging; DP after – diasystolic pressure after aqua jogging; DP 5min – diasystolic pressure 5 min after aqua jogging; HR before – heart ratio before aqua jogging; HR after – heart ratio after aqua jogging; HR 1 min – heart ratio 1 min after aqua jogging; HR 5min – heart ratio 5 min after aqua jogging; $\bar{x}$ – average, t – Student t test; p – level of significance; SD – standard deviation; $\bar{x}_1$ vs $\bar{x}_2$ – difference between the measurements of the mean.

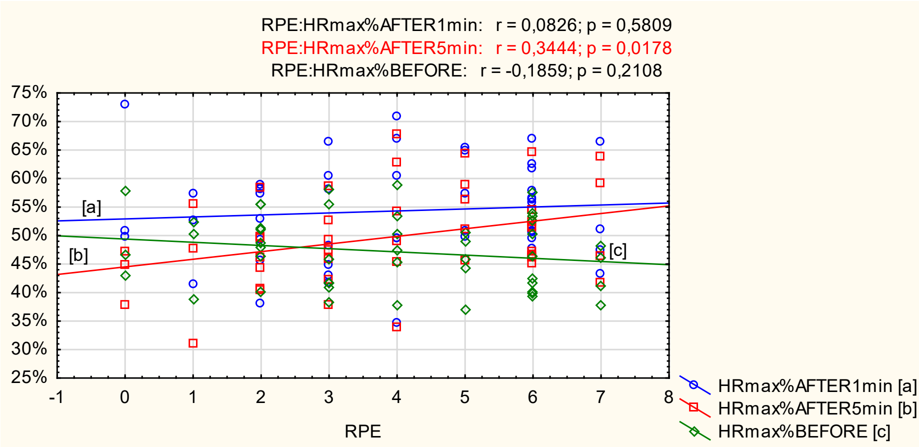

Figure 1. Average HRMAX value in 3 measurements considering the RPE fatigue scale value

Note. RPE – Rating of Perceived Exertion scale; HR_{MAX}%BEFORE – maximum heart rate before aqua jogging; HR_{MAX}%AFTER1min – maximum heart rate 1 min after aqua jogging; HR_{MAX}%AFTER5min – maximum heart rate 5 min after aqua jogging.

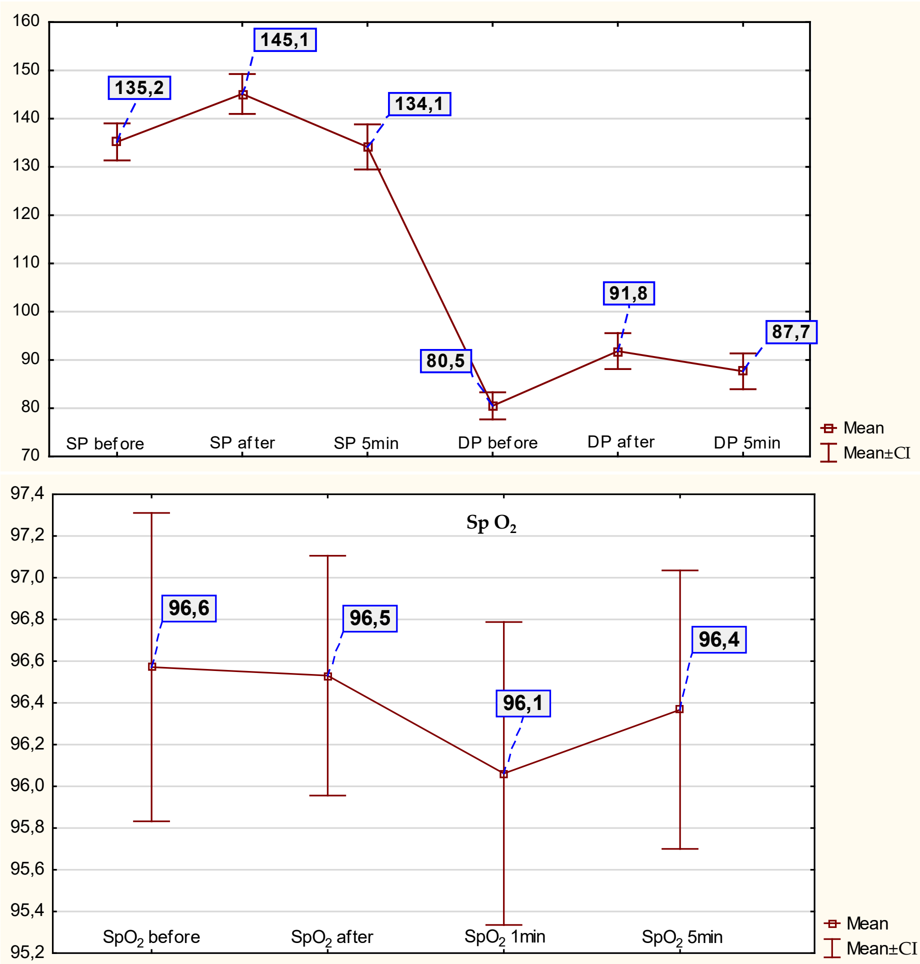

Figure 2. Average blood pressure and saturation level in subsequent measurements in the study group

Blood pressure: SP before – systolic pressure before aqua jogging; SP after – systolic pressure after aqua jogging; SP 5min – systolic pressure 5 min after aqua jogging; DP before – diasystolic pressure before aqua jogging; DP after – diasystolic pressure after aqua jogging; DP 5min – diasystolic pressure 5 min after aqua jogging; b) SpO_2 – Blood Oxygen Saturation; SpO_2 before - Blood Oxygen Saturation before aqua jogging; SpO_2 after – Blood Oxygen Saturation after aqua jogging; SpO_2 1min – Blood Oxygen Saturation 1 min after aqua jogging; SpO_2 5min – Blood Oxygen Saturation 5 min after aqua jogging.