ORIGINAL ARTICLE

Condition of the autonomic nervous system during the 'sit-stand-sit' orthostatic test in university students in areas of military conflict in Ukraine

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Abstract

Background and Study Aim: Extended residence in a zone of military conflict presents health risks for students. Hence, this research focuses on evaluating the condition of the autonomic nervous system among university students residing in Ukraine's conflict-affected areas.

Material and Methods: The study involved 57 students (30 men and 27 women) from universities across Ukraine. Before the experiment, these students had experienced a prolonged period of inactivity, attributed to the global COVID-19 pandemic since 2020 and the ongoing war in Ukraine since February 24, 2022. Their total time in this difficult environment was 3 years and 6 months. The 'Orthostatic test "seated-to-standing-to-seated" (by Nikolay Teslenko)' was applied in this study. To participate in the study, students were instructed to complete the test and record their findings in a designated Google form. The cardiovascular response (heart rate) was evaluated during the 'sit-stand-sit' sequence for 3 minutes. The experiment's data were statistically analyzed using the PyCharm CE platform and a range of Python coding libraries.

Results: The research on the cardiovascular response to physical activity among male and female students revealed that first-category participants exhibit superior adaptation and consistent heart rate, both while stationary and when moving. The second category experienced more pronounced heart rate variations, signifying an average adaptation level. The third category had the most heart rate variability, potentially indicating inadequate stress adaptation and possible cardiovascular health risks.

Conclusions: Analysis of the data reveals that physical preparedness markedly affects heart and blood vessel system reactions in both genders. The discerned disparities in heart rate reactions among the groups emphasize the necessity for customized physical training strategies, especially for those less adapted to physical demands.

Keywords: health, physical activity, young people, physical preparedness

Introduction

The prevalent nature of military strife brings about various hazards potentially causing major disruptions in students' autonomic nervous systems. Consequently, health surveillance can offer important data on the physiological effects of students' long-term presence in areas of conflict.

Ongoing armed conflicts in areas with student populations have hindered their educational and physical conditioning. The military environment shapes everyday physical activities, learning structures, and pedagogical methods [1, 2, 3, 4]. The COVID-19 pandemic also plays a role in students' physical engagement and health [5, 6, 7, 8]. Under these circumstances, the compulsory transition to online education inadvertently results in diminished hands-on elements of academic preparation [3, 4] and the imperative to adjust to altered environments [9, 10, 11].

It's understood that mere alterations in posture elicit physiological responses to such physical strain. Hence, regularly tracking these responses is logical. The significance of this method is supported by multiple research works, like Robertson et al. [12], who highlight that orthostatic stressors are frequent in everyday life. Zipes et al. [13] point out that vertical positioning leads to orthostatic strain, a result of gravitational effects on blood flow distribution. Inadequate responses to such strain can have critical effects, including passing out.

The critical need to appraise the autonomic nervous system in university students, notably against the backdrop of armed conflicts and the COVID-19 outbreak, is underlined by diverse studies [14, 15]. Coupled with the move to digital

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learning, this context demands regular tracking of students' autonomic nervous functions. Such tracking is achievable through tests evaluating responses to body position shifts, exemplified by the orthostatic test.

Numerous research works highlight the effects of chronic stress on the autonomic nervous system. Kozin et al. [16] is used the orthostatic test as a measure of students' functional preparedness. Moryakina et al. [17] analyzed the heart and blood vessel system's metrics in students under orthostatic testing, taking into account environmental and stress-related factors. Further studies [181, 19] indicate that prolonged inactivity can modify autonomic reactions. In these circumstances, employing tests like 'supine to standing' and 'seated to standing' in different variations is advised. This method is recommended in several research papers [20, 21, 22], highlighting the need to evaluate the autonomic nervous system in college students, particularly under challenging conditions such as warfare, pandemics, and virtual education. This approach aids in comprehensively grasping and alleviating the effects of these situations on students' autonomic nervous health.

This research focuses on evaluating the condition of the autonomic nervous system among university students residing in Ukraine's conflict-affected areas.

Materials and Methods

Participants

The research included participants from three universities in Ukraine (physical education faculties): two situated in the east (Kharkiv, a region experiencing active warfare) and one in the west (Ivano-Frankivsk, a region frequently facing bombardment) region of Ukraine. The study involved 57 students in total – 30 males and 27 females. They were instructed to adhere to safety measures during air raid warnings in the city. Additionally, they were encouraged to use the 'AirAlert' mobile app, which alerts users to potential missile strikes. It's crucial to acknowledge that prior to the experiment, the students had been living a physically inactive lifestyle for a prolonged time because of the worldwide COVID-19 pandemic (beginning in 2020) and the ongoing war in Ukraine (starting February 24, 2022). Altogether, the students spent 3 years and 6 months in such demanding conditions.

Research Design

In the study, the 'Orthostatic test "from sitting to standing and back to sitting" (by Nikolay Teslenko)' was utilized [23, 24]. Participants were required to undergo the test and log their findings in a specific Google form. This form also necessitated entries such as alias, age, height, body mass, course year, specialization, and affiliation with their university.

The assessment should be conducted based on the data provided on a dedicated website [25], which includes comprehensive guidelines and illustrations (Figure 1). Upon finishing the test, the participants should replicate the outcomes and input them into a field in the Google Form. The procedure involves real-time pulse tracking by activating the 'Pulse Slider' button.

First minute (while seated): Position a finger on your pulse point, like on the neck. Initiate the measurement by activating the 'Pulse Slider', and then mirror your heartbeat using the same 'Pulse Slider'. This process is recorded automatically.

Second minute (in a standing position): Upon receiving the cue, rise to your feet and persist in mirroring your heartbeat with the 'Pulse Slider'.

Third minute (while seated): Upon receiving the cue, take a seat and keep tracking your pulse with the 'Pulse Slider'. The recording ends on its own after this final minute. To evaluate the outcomes, use the 'Export CSV' and 'GRAPH' options for saving. Consult the 'Methodology' part for more information. Once the test is done, hit the 'Copy Results' and insert them into the Google form ('Return to Google Form').

Statistical Analysis

The statistical evaluation of the experimental outcomes was conducted using the PyCharm CE software environment and a range of Python language libraries (applying Shapiro-Wilk and Student's t-tests). The computation included determining the mean and the standard deviation, with a significance level set at 0.05.

Results

Information about the subjects involved in the study is provided in Tables 1 and 2. The normal distribution of data (measuring pulse every 5 seconds) was confirmed using the Shapiro-Wilk test, showing conformity with normal distribution at a 0.05 significance level for women, men, and all subjects combined. The mean reaction values between the two gender groups were compared using the Student's t-test, which identified a significant statistical difference (t-statistic = 2.6575, p-value = 0.0103).

Experiment participants were categorized into three groups based on their physical responses to changes in posture. The first category had students with minimal heart rate changes. The second category involved students with moderate heart rate shifts when moving from seated to standing positions and back. The third category gathered students experiencing the most pronounced heart rate fluctuations.

The assignment of participants into three distinct categories is detailed in Table 3, using their heart rate data collected in intervals of five seconds

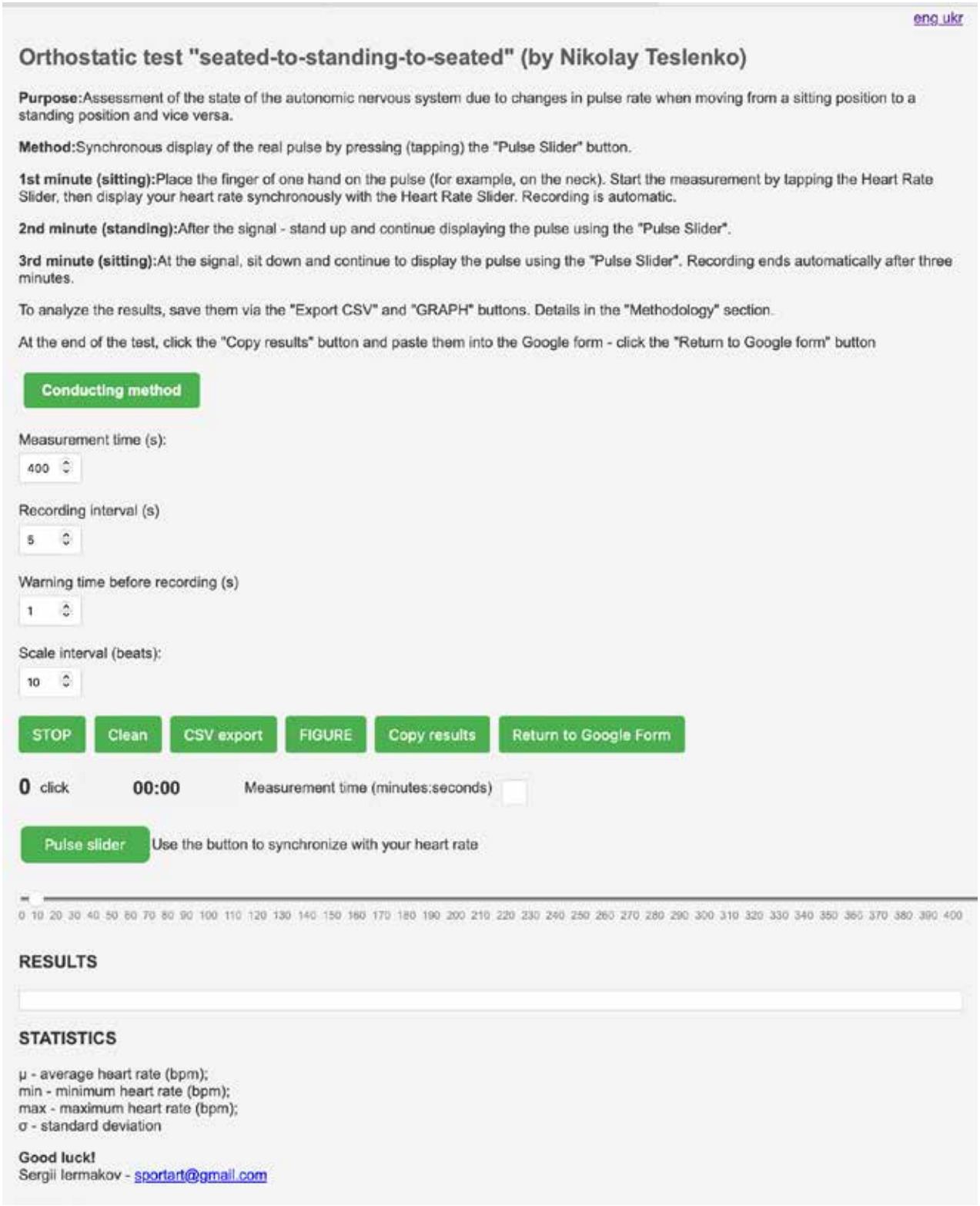

Figure 1. Orthostatic test online interface

as the basis for classification. The categorization and gender-based assessment of participants showed that men were more prevalent in the first category. In contrast, the second category had a larger proportion of women, suggesting their increased engagement or interest. This tendency is more evident in the third category, where women's presence is even more substantial.

Characteristics of the student groups are detailed in Table 4. Analyzing this data enables individual descriptions of each gender category. The women in this group show uniform results, with notably small variations in standard deviations for all measured criteria. The male participants' data reveal a more

Table 1. Experimental participants' information (female)

Name	Age (years)	Height (cm)	Weight (kg)	Course	Specialty	University	BMI (kg/m^2)	Heart Rate (s)	Std Dev	Max	Min
1	22	168	56	5	1	3	19.84	6.28	0.51	7.0	5.0
2	20	161	51	4	1	3	19.68	4.39	0.96	8.0	4.0
3	20	165	57	4	1	3	20.94	5.36	0.8	7.0	4.0
4	20	168	52	3	1	3	18.42	6.5	1.3	9.0	4.0
5	19	168	53	3	2	3	18.78	4.92	0.81	7.0	4.0
6	17	176	89	1	2	1	28.73	7.97	2.05	14.0	4.0
7	18	165	56	2	2	1	20.57	5.31	0.79	7.0	4.0
8	17	170	65	1	2	1	22.49	6.42	0.6	7.0	5.0
9	18	166	56	2	2	1	20.32	6.69	1.01	8.0	4.0
10	19	161	53	3	1	3	20.45	6.5	1.38	9.0	4.0
11	19	177	75	3	1	3	23.94	4.36	0.64	6.0	4.0
12	19	169	61	3	1	3	21.36	5.03	0.74	7.0	4.0
13	19	155	54	3	1	3	22.48	7.11	0.85	8.0	4.0
14	19	171	54	3	1	3	18.47	5.86	0.96	9.0	4.0
15	19	168	57	3	1	3	20.2	7.58	0.84	9.0	5.0
16	19	152	46	3	1	3	19.91	5.61	1.1	8.0	4.0
17	19	168	53	3	1	3	18.78	5.19	1.01	8.0	4.0
18	19	178	68	3	1	3	21.46	4.92	1.13	8.0	4.0
19	17	168	59	1	2	2	20.9	9.14	4.16	14.0	4.0
20	18	160	53	2	1	2	20.7	7.56	3.83	24.0	4.0
21	19	170	60	3	1	2	20.76	4.08	0.37	6.0	4.0
22	18	160	56	2	2	2	21.87	6.67	0.59	8.0	5.0
23	17	165	68	1	1	2	24.98	5.25	2.5	17.0	4.0
24	21	160	48	4	1	2	18.75	5.47	1.08	7.0	4.0
25	18	173	62	4	1	2	20.72	6.31	1.8	14.0	4.0
26	18	168	58	4	1	2	20.55	6.5	1.8	14.0	4.0
27	17	173	56	1	2	1	18.71	5.17	0.97	8.0	4.0

Note. Heartbeat Rate (s) – 5-second pulse measurement

extensive spread in values, notably in areas such as body weight and BMI, evidenced by the elevated standard deviation. This contrasts with the female group, which shows more consistency across the studied factors, unlike the male group that presents a wider spectrum of variation.

Analyzing the mean response metrics across the male and female groups reveals significant statistical variances. Consequently, the subsequent examination was carried out distinctly for each gender. The cardiovascular responses in various postures over a three-minute period are depicted in Figures 1 and 2.

In assessing the pulse rates of men, sorted based on their physical exertion responses, these conclusions emerge (Figure 2):

– *Category 1*. In this group, students display an optimal cardiovascular performance under exertion. Their resting pulse rate is calm and low, with a modest uptick during upright positioning, denoting proficient adjustment to positional changes. The pulse remains controlled when reverting to a seated stance, indicative of rapid restoration.
– *Category 2*. Students here demonstrate significant variations in heart rate, especially when changing from a seated to an upright position. This variation could point to a medium level of adaptation to the physical activity. The increased heart rate peaks during standing suggest that this activity is more strenuous for students in this group.
– *Category 3*. Participants in this category exhibit the most significant heart rate variability, suggesting poor physical adaptability. Notable heart rate increases, particularly when standing up, could signal challenges in cardiovascular health. The act of standing and then sitting back down leads to evident pulse variations, necessitating careful monitoring during exercise.

It's crucial to recognize that the variations in heart rate within each group not only indicate the students' physical condition but also their unique cardiovascular responses to exercise and stress.

Observation of female pulse patterns during

Table 2. Experimental participants' information (male)

Name	Age (years)	Height (cm)	Weight (kg)	Course	Specialty	University	BMI (kg/m²)	Heart Rate (s)	Std Dev	Max	Min
1	20	178	70	4	1	3	22.09	5.81	0.71	7.0	4.0
2	20	182	85	4	1	3	25.66	5.19	0.52	6.0	4.0
3	20	180	74	4	1	3	22.84	4.06	0.23	5.0	4.0
4	19	175	64	3	1	3	20.9	4.67	0.72	6.0	4.0
5	19	172	68	3	1	3	22.99	4.75	0.73	7.0	4.0
6	18	181	65	3	1	3	19.84	6.67	1.04	9.0	5.0
7	19	168	49	2	1	3	17.36	5.67	1.07	8.0	4.0
8	19	194	97	3	2	3	25.77	4.75	0.65	6.0	4.0
9	19	178	65	3	2	3	20.52	5.06	1.77	14.0	4.0
10	19	180	95	3	2	3	29.32	5.14	0.87	7.0	4.0
11	19	170	67	3	2	3	23.18	4.72	0.81	7.0	4.0
12	19	182	102	3	2	3	30.79	7.28	1.68	14.0	4.0
13	20	186	86	3	1	3	24.86	4.75	1.02	7.0	4.0
14	19	187	70	1	2	1	20.02	4.11	0.32	5.0	4.0
15	21	180	87	3	1	2	26.85	4.28	0.51	6.0	4.0
16	19	176	60	2	1	3	19.37	5.25	1.0	7.0	4.0
17	18	175	62	2	1	3	20.24	4.11	0.32	5.0	4.0
18	18	184	68	2	1	3	20.09	4.33	0.72	7.0	4.0
19	18	175	86	2	1	3	28.08	4.78	0.54	6.0	4.0
20	18	186	79	2	1	3	22.84	6.17	0.97	8.0	4.0
21	22	170	60	5	1	2	20.76	4.0	0.0	4.0	4.0
22	22	192	78	5	1	2	21.16	4.97	0.88	7.0	4.0
23	21	180	96	5	1	2	29.63	5.58	0.73	7.0	4.0
24	23	191	105	2	1	2	28.78	6.67	0.93	8.0	5.0
25	33	185	76	5	1	2	22.21	4.92	0.55	6.0	4.0
26	18	180	65	4	1	2	20.06	5.33	0.63	7.0	4.0
27	18	168	56	2	1	2	19.84	4.94	1.07	8.0	4.0
28	20	180	74	4	1	2	22.84	6.31	1.06	9.0	4.0
29	24	183	108	5	1	1	32.25	6.44	0.97	8.0	4.0
30	21	191	86	5	1	1	23.57	5.08	0.91	7.0	4.0

Note. Heart Rate (s) – Heartbeat Rate (s) – 5-second pulse measurement.

Table 3. Categorizing students by 5-second pulse readings

Category	Female, n	Male, n	Female (%)	Male (%)	Female and Male, n
Category 1	10	22	31.25	68.75	32
Category 2	8	5	61.54	38.46	13
Category 3	9	3	75.0	25.0	12
Total, n	27	30			57

Table 4. Statistical data of students

Statistical indicators	Age, years	Height, cm	Weight, kg	BMI, kg/m²
Female				
Mean	18.7	166.78	58.37	20.92
Max	22.0	178.0	89.0	28.73
Min	17.0	152.0	46.0	18.42
Std Dev	1.23	6.26	8.79	2.23
Male				
Mean	20.1	180.3	76.77	23.49
Max	33.0	194.0	108.0	32.25
Min	18.0	168.0	49.0	17.36
Std Dev	2.89	6.97	15.4	3.87

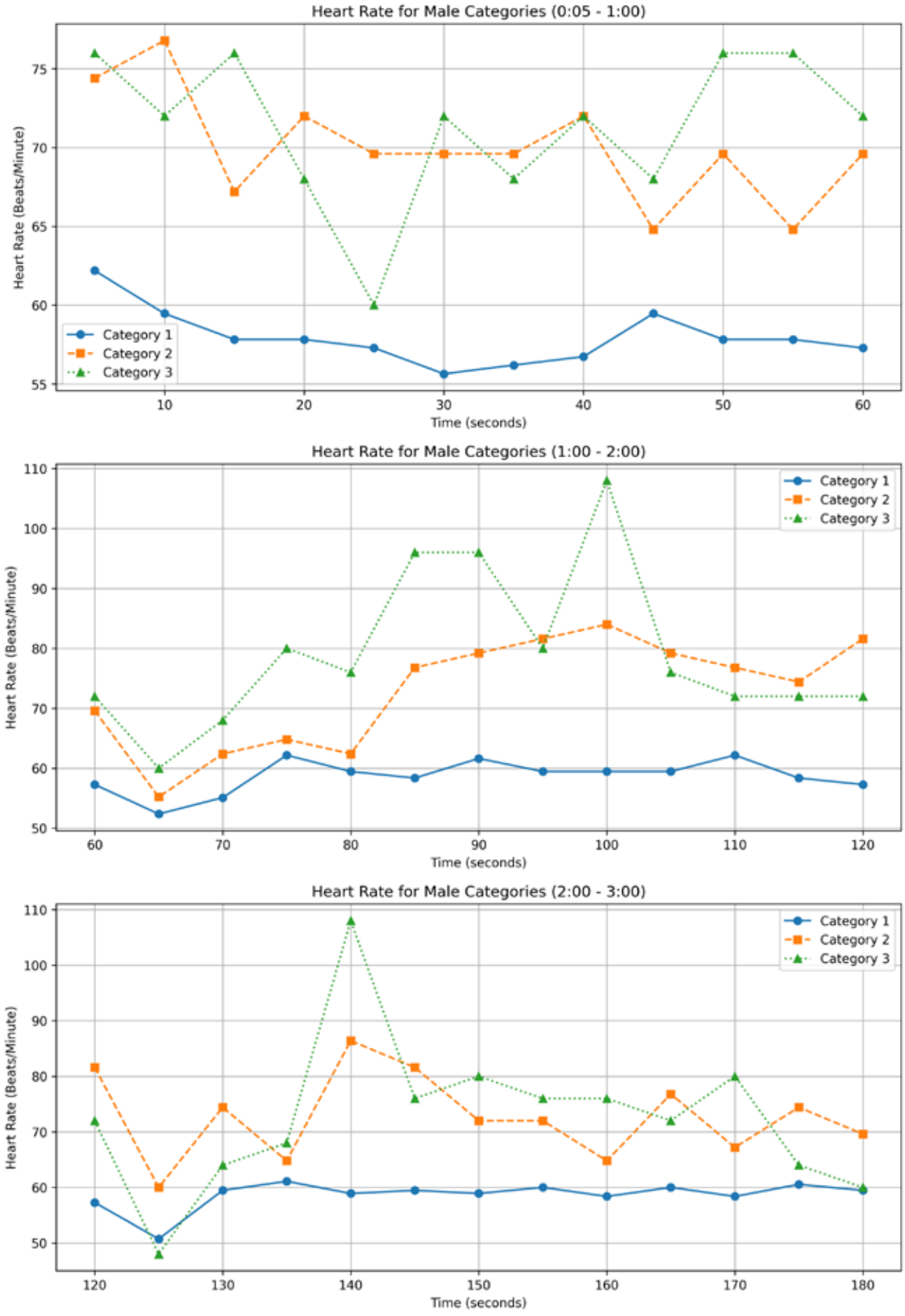

Figure 2. Pulse changes during the 1st, 2nd, 3rd minutes of the test (male)

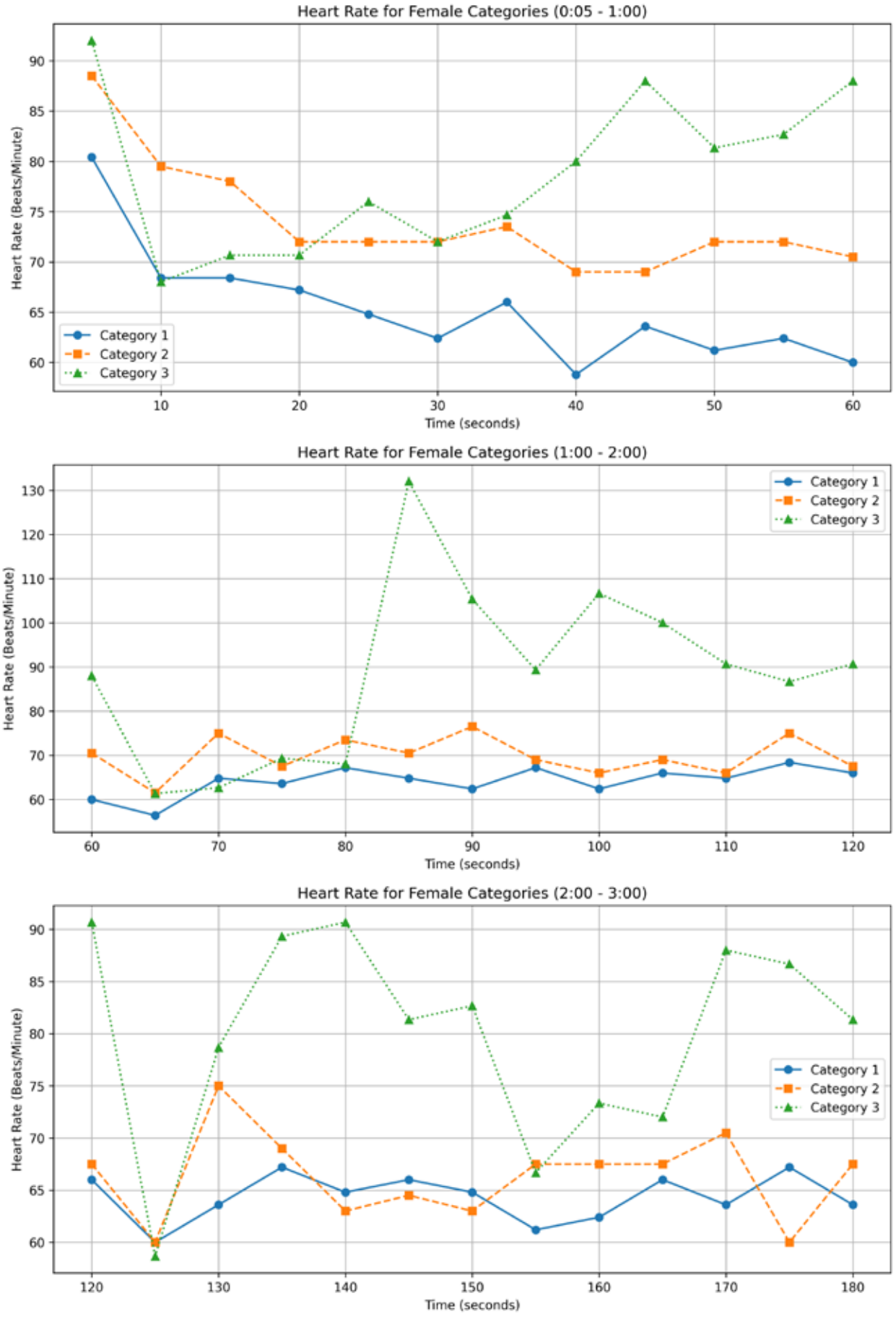

Figure 3. Pulse changes during the 1st, 2nd, 3rd minutes of the test (female)

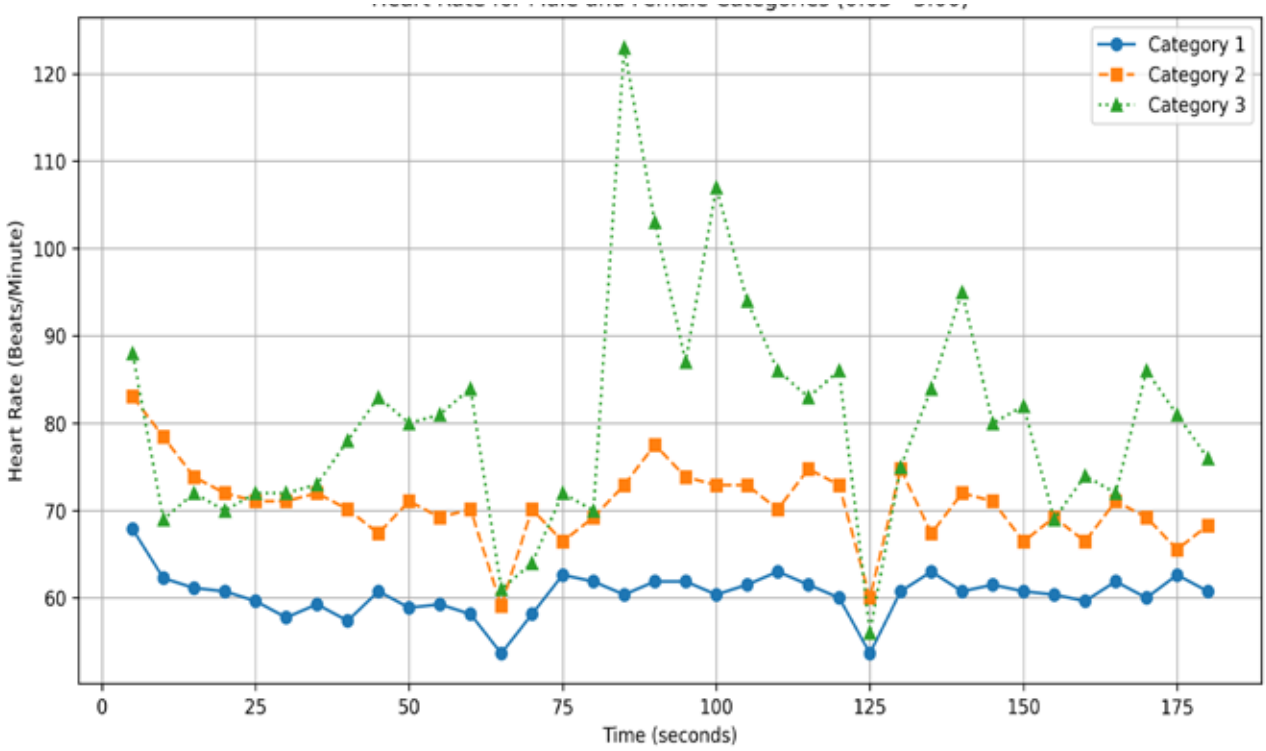

Figure 4. Pulse changes during the 1st, 2nd, 3rd minutes of the test (male, female)

exercise uncovered the following category-based distinctions (Figure 3):

– *Category 1.* Females in this category display optimal responsiveness to physical activity changes. There's a modest heart rate fluctuation, with a minor elevation during the transition from seated to upright. The heart rate rapidly normalizes when they sit back down, signifying proficient cardiovascular response to physical stress and prompt post-activity recovery.
– *Category 2.* Females in this category demonstrate a medium degree of adjustment. Their pulse rate stays relatively constant with body movement, yet shows more pronounced swings, especially in the upright position, implying a higher impact of physical stress.
– *Category 3.* In this category, Females show the greatest fluctuations in heart rate, particularly during postural shifts from seated to upright and vice versa. It reflects a reduced adaptability level and potential recovery issues after physical activities. Extremely elevated pulse rates might signal excessive cardiovascular stress.

The assessment of cardiac responses to physical stress in both genders, divided into categories, yields the following observations (Figure 4):

– *Category 1.* In this group students maintain a consistent heart rate initially, reflecting a healthy resting cardiovascular condition. Their pulse rate moderately rises during physical activities, like moving from a seated to a standing position, and settles quickly when seated again, demonstrating efficient adaptability and swift recuperation.
– *Category 2.* In this group students exhibit a mild elevation in heart rate, especially upon standing, indicative of moderate physical conditioning. Fluctuations in heart rate readings, especially beyond the second minute, may signal some cardiovascular stress.
– *Category 3.* In this group students experience the highest heart rate levels and the most evident fluctuations, especially when they stand up. This might reflect poorer adaptability to physical activities and heightened cardiovascular stress. The lack of quick pulse reduction upon resting indicates potential issues in regaining equilibrium after physical strain.

The outcomes underscore that the disparities in cardiovascular responses to physical stress among the categories might signify different extents of physical preparedness and adjustment.

Discussion

The objective of this study was to analyze the autonomic nervous system's status in university students residing in Ukraine's war-torn areas, through the 'Orthostatic test "seated-to-standing-to-seated"'. The outcomes indicated substantial variation in how the cardiovascular system adapts among different student categories, possibly indicating the influence of stress due to military conflict on the body's functional state.

Our research corroborates with others in establishing orthostatic tests as effective for

gauging the autonomic nervous system's response to different body positions. As per Robertson et al. [12] and Zipes et al. [13], orthostatic stress induces significant physical reactions. This is especially apparent in our study's third category, where the highest variability in pulse rate may indicate difficulties in coping with orthostatic stress.

Moreover, our findings are in line with the research of Grobman et al. [20], Juraschek et al. [21], and Earle et al. [22], advocating for the application of orthostatic tests in diverse configurations to evaluate physical stress adaptation. This highlights the necessity of consistent evaluation of the autonomic nervous system in students, particularly under heightened stress scenarios like wartime conditions.

The research of Joshua et al. [1] and Kudak et al. [2] corroborates the impact of armed conflicts and pandemic conditions on students' daily routines and educational settings. Findings by Savci et al. [3] and Dos Santos et al. [4] intriduce variations in student physical behavior and health due to the COVID-19 pandemic and the enforced switch to remote learning. The relative assessment of outcomes across categories for both genders indicates that first-category students exhibit superior adaptation to stressors compared to those in the second and third categories. This enhanced adaptability could stem from individual stress resilience and greater physical fitness, crucial under the heightened physical and emotional strain of military conflict.

Kozin et al. [16] and Moryakina et al. [17] indicate that students' physical state and cardiovascular responses may act as indicators of their stress adaptation. Derzon Jesus et al. [18] and Fanning et al. [19] also highlight that decreased physical activity, typical during the shift to online education, can markedly impact autonomic control. These insights are consistent with our study's outcomes, where third-category members show the highest pulse variation and a potential higher risk to stress. Priority should be given to the development and implementation of programs targeting the improvement of students' physical and psychological health. Such strategies will not only boost physical endurance but also strengthen resistance to the prolonged stress due to military engagements and the pandemic's aftermath.

Conclusions

Analysis results imply that the degree of physical readiness markedly impacts the cardiovascular system's behavior in males and females. Detected pulse response differences among categories stress the need for bespoke physical fitness programs, particularly for individuals with diminished adaptability to physical demands."

References

1. Joshua B. An exploration of spillover effects: evidence from threat-induced education reform. *Journal of Education Policy*, 2021;36(5): 643–670. https://doi.org/10.1080/02680939.2019.1704065
2. Kudak K, Mashiko K, Pityulych M. Evaluation of migration attitudes and expectations of the population in the context of military conflict. *Baltic Journal of Economic Studies*, 2023;9(3): 125–136. https://doi.org/10.30525/2256-0742/2023-9-3-12
3. Savci C, Akinci AC, Keles F. The association of perceived sociability and social intelligence with loneliness in online learning among nursing students. *Nurse Education Today*, 2022;109: 105226. https://doi.org/10.1016/j.nedt.2021.105226
4. Dos Santos LM. Learning Taekwondo Martial Arts Lessons Online: The Perspectives of Social Cognitive Career and Motivation Theory. *International Journal of Instruction*, 2022;15(1): 1065–1080. https://doi.org/10.29333/iji.2022.15160a
5. Beserra V, Nussbaum M, Navarrete M, Garrido N. Online physically active academic lessons in COVID-19 times: A pilot study. *Teaching and Teacher Education*, 2022;116: 103750. https://doi.org/10.1016/j.tate.2022.103750
6. Dergham P, Ni Saudagar F, Jones-Nazar CC, Hashim SA, Saleh K, Mohammedhussain AA, et al. Medical Students? Perceptions Towards Online Teaching During the Covid-19 Pandemic: A Cross- Sectional Study from Saudi Arabia. *Advances in Medical Education and Practice*, 2023;14: 407–419. https://doi.org/10.2147/AMEP.S396912
7. Drozdz R, Pasek M, Zajac M, Szark-Eckardt M. Physical Culture and Sports as an Educational Basis of Students' Healthy Physical Activities during and Post-Lockdown COVID-19 Restrictions. *International Journal of Environmental Research and Public Health*, 2022;19(18): 11663. https://doi.org/10.3390/ijerph191811663
8. Hossain MJ, Ahmmed F, Khan MR, Rashid PT, Hossain S, Rafi MO, et al. Impact of Prolonged COVID-19 Lockdown on Body Mass Index, Eating Habits, and Physical Activity of University Students in Bangladesh: A Web-Based Cross-Sectional Study. *Frontiers in Nutrition*, 2022;9: 873105. https://doi.org/10.3389/fnut.2022.873105
9. Hrytsak L, Hrytsak N, Mishchuk N, Zhyrska H, Hryhorieva V. Blended learning - a new educational paradigm. *Ad Alta-Journal of Interdisciplinary Research*, 2023;13(2): 34–39.
10. Marynchenko H, Nosovets N, Bezruchenkov Y, Oliinyk Y, Bykova S. Distance education in the conditions of martial law in institutions of higher education: development and practice. *Eduweb-Revista de Tecnologia de Informacion y Comunicacion en Educacion*, 2022;16(3): 79–90. https://doi.org/10.46502/issn.1856-7576/2022.16.03.6

11. Yuzyk O, Yuzyk M, Bilanych L, Vitalii H, Bilanych H, Myroslava F. Distance Learning in Higher Education Institutions in Conditions of Quarantine and Military Conflicts. *International Journal of Computer Science and Network Security*, 2022;22(4): 741–749. https://doi.org/10.22937/IJCSNS.2022.22.4.87
12. Robertson D, Biaggioni I, Burnstock G, Low PA, Paton JFR, [eds.] In: *Primer on the Autonomic Nervous System (Third Edition)*, San Diego: Academic Press; 2012. p. 693–703. https://doi.org/10.1016/B978-0-12-386525-0.00152-9
13. Zipes DP, Jalife J, [eds.]. Index. In: *Cardiac Electrophysiology: From Cell to Bedside (Sixth Edition)*, Philadelphia: W.B. Saunders; 2014. P. 1333–1365. https://doi.org/10.1016/B978-1-4557-2856-5.00134-5
14. Balikci I, Tok S, Binboga E. The effect of background audio and audiovisual stimuli on students' autonomic responses during and after an experimental academic examination. *Brain and Behavior*, 2023;13(9). https://doi.org/10.1002/brb3.3153
15. Korovina LD, Zaporozhets TM, Silkova OV. Personal characteristics and anxiety of students against the background of the covid-19 pandemic in ukraine. *World of Medicine and Biology*, 2022;80(2): 83–88. https://doi.org/10.26724/2079-8334-2022-2-80-83-88
16. Kozin O, Kozina Z, Korobeinik V. Functional readiness and properties of the nervous system peculiarities of art specialties? future teachers. *Pedagogy of Physical Culture and Sports*, 2022;26(6): 407–414. https://doi.org/10.15561/26649837.2022.0607
17. Moryakina S, Anzorov VA. The influence of psychological stress on the cardiovascular system of students in interaction with orthostatic. *Cardiometry*, 2021;(19): 15–19. https://doi.org/10.18137/cardiometry.2021.19.1519
18. Derzon Jesus PM, Routman Edson H, Rodriguez Elsa V. Orthostatic hypotension in public health hospital medicine students. *Salud Arte y Cuidado*, 2020;13(2): 71–76. https://doi.org/10.5281/zenodo.6828840
19. Fanning J, Silfer JL, Liu H, Gauvin L, Heilman KJ, Porges SW, et al. Relationships between respiratory sinus arrhythmia and stress in college students. *Journal of Behavioral Medicine*, 2020;43(2): 308–317. https://doi.org/10.1007/s10865-019-00103-7
20. Grobman B, Turkson-Ocran RAN, Staessen JA, Yu YL, Lipsitz LA, Mukamal KJ, et al. Body Position and Orthostatic Hypotension in Hypertensive Adults: Results from the Syst-Eur Trial. *Hypertension*, 2023;80(4): 820–827. https://doi.org/10.1161/HYPERTENSIONAHA.122.20602
21. Juraschek SP, Hu JR, Cluett JL, Ishak A, Mita C, Lipsitz LA, et al. Effects of Intensive Blood Pressure Treatment on Orthostatic Hypotension: A Systematic Review and Individual Participant–based Meta-analysis. *Annals of Internal Medicine*, 2021;174(1): 58–68. https://doi.org/10.7326/M20-4298
22. Earle WB, Kondo JK, Kendrick KN, Turkson-Ocran RA, Ngo L, Cluett JL, et al. Association of Supine Hypertension Versus Standing Hypotension With Adverse Events Among Middle-Aged Adults. *Hypertension*, 2023;80(11): 2437–2446. https://doi.org/10.1161/HYPERTENSIONAHA.123.21215
23. Teslenko NE. Simple Test for Assessing the Cardiovascular System in Physical Education Students. *Voprosy fiziologii sporta*, 1964;1:122-129. (In Russian).
24. Grueva LG. Using the Orthostatic Test to Characterize the Functional State of Adolescents. *Gigiena i sanitariia*, 1967;4:105-108. (In Russian).
25. Orthostatic test «seated-to-standing-to-seated» (by Nikolay Teslenko). [Internet] 2023 [updated 2023 Jun; cited 2023 Sep 28]. Available from: https://www.physcult.org.ua/test/ortoproba

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