

ICEST 2020

International Conference on Economic and Social Trends for Sustainability of Modern Society

VEGETATIVE MAINTENANCE OF ACTIVITY IN CHANGED LIVING CONDITIONS OF OVER-50 POPULATION

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Abstract

The article presents the results of evaluating the vegetative support of activity of people over 50 years old. The study involved 210 people. Assessment of the vegetative support of the activity was carried out under conditions of a simulated change in body position. It was found that in 34.7% of cases in people aged 50-55 years an excessive autonomic reaction was observed against the background of a predominance of activity of the sympathetic part of the autonomic nervous system and the "inclusion" of the central regulation loop, which indicates an increase in the "price" of physiological adaptation, uneconomical expenditure of functional resources organism. The pronounced predominance of the activity of the parasympathetic division of the autonomic nervous system in 24.5% of cases in the group of people 56-59 years old, in 30.3% of cases in the group of people over 60 years of age reflects the state of fatigue, dysfunction of the sinus node of the heart, rhythm and conduction disturbances. A prolonged, chronic manifestation of reactions associated with violations in the activity of governing and regulatory mechanisms predetermines the depletion of functional human life support systems, an increase in the rate and rate of aging of the body.

2357-1330 © 2020 Published by European Publisher.

Keywords: Pre-retirement age, health, cardiorthymography, orthostatic test.



1. Introduction

Currently undoubted interest has issues related to the reform of the pension system. The overwhelming majority of scientific research in the field of human behavior in changed living conditions, in particular during the transitional period of pension reform, is noted in the social and economic sphere (Bussolo et al., 2017; Fedotenkov, 2016; Grishchenko, 2016; Guerin & Toland, 2020; Zhang et al., 2020). However, any activity is accompanied by a change in the functional systems of the human body (Agadzhanian et al., 2015; Belovol et al., 2018). The autonomic nervous system plays an important role in regulating the body's vital processes.

The autonomic nervous system ensures the constancy of the internal environment of the body (homeostasis) which is the first aspect of its functions (Pyatin et al., 2019). The mechanisms of homeostasis aimed at maintaining the constants of the internal environment allow a person to adapt to various fluctuations in the external environment. These mechanisms are evolutionarily perfected and fixed to the body. Hard constants are distinguished, the changes of which can lead to irreversible consequences (blood pH, ion concentration in the interstitial fluid, the amount of glucose in the blood) and plastic constants with a sufficient limit of deviations from the norm (weight, blood pressure, heart rate).

A second aspect of the functions of the autonomic nervous system arises due to the necessity of autonomic provision of mental and physical activity of the body through the resources of the cardiovascular system, circulatory and respiratory systems (Owens et al., 2017; Carrive, 2009; Pogosova et al., 2010).

Unstable homeostasis provides the mobilization of energy resources necessary for the body in the implementation of intensive work programs due to plastic constants. In this case, the restoration or return of constants to the initial state within homeostatic changes is a function of life. Insufficient or excessive vegetative support occurs, even at the level of one indicator, for example, blood pressure, violate human behavior.

2. Problem Statement

The problem of preserving and strengthening the health of the population of Russia is a priority for the Russian government. Particular attention is drawn to data on a negative increase in the rate of natural movement of the population of the Volgograd Region which was 2.5 (2016), 3.1 (2017) and 3.5 (2018). Diseases of the circulatory system are among the main causes of death: 51.8%. At the same time, in 2014 - 2018, the proportion of people over working age increased from 25.5% to 27.4%. On the contrary, the proportion of people of working age decreased from 58.2% to 55.4%. It is also important to note that the number of people aged 50-59 years from 2014 to 2018 decreased by 7.9%, and the number of people of other age groups increased (30-39 years by 3.9%; 40-49 years by 1.1%; 60-69 years old by 19.2%).

In connection with the foregoing, the study of the functional state of human life-supporting systems is relevant.

3. Research Questions

This article addresses the following issues and challenges:

- The study of the vegetative support of activity against the background of an orthostatic test,

- Analysis and interpretation of cardiac rhythmography data,
- Adaptation of the human body to the changing conditions of the external and internal environment,
- Correlation of types of qualitative reaction of the cardiovascular system against the background of orthostatic test in different people, depending on age,
- The impact of pension reform on the emotional health of people near retirement and retirement age.

4. Purpose of the Study

The purpose of the paper is to study the features of the autonomic provision of professional activities of people over 50 years old.

5. Research Methods

The study involved 210 people living in the city of Volgograd (93 respondents aged 50-55 years, 75 respondents aged 56-60 years and 42 respondents over 60 years old). The proportion of men and women participating in the study was as follows: 32.5% and 67.5%. respectively. All participants were informed about the examination methods and guaranteed non-disclosure of personal data and examination results (compliance with the principle of informed consent).

The assessment of the vegetative support of the activity was carried out under the conditions of a simulated change in the position of the body of the subject, namely, an independent transition from horizontal to vertical position (active orthostatic test). Vegetative shifts were recorded when changing position and maintaining a new body position (Vejn et al., 1981).

Active orthostatic test technique included the following: at rest in a horizontal position, blood pressure, heart rate was measured and the duration of R-R intervals between contractions for 5 minutes was recorded (cardiorhythmography). Then the examinee changed the position of the body from horizontal to vertical independently and slowly, without unnecessary movements. One got up and stood in a comfortable position near the couch. In a standing position, blood pressure, heart rate was recorded and the recording of the work of the heart continued.

Analysis and interpretation of cardiac rhythmography data (histogram of the distribution of R-R ECG intervals; frequency analysis of N-N intervals) were based on Baevsky et al. (2015), and Shlyk (2016).

Mathematical processing and analysis of primary data were carried out using a software package «SPSS-17».

6. Findings

Adaptation of the human body to changing conditions of the external and internal environment is achieved due to the coordinated interaction of the central and autonomous (sympathetic and parasympathetic) parts of the nervous system. The minimum costs of regulatory systems determine its optimal result. There are 4 types of autonomic regulation:

- Type I - moderate predominance of sympathetic regulation;
- Type II - a pronounced predominance of sympathetic regulation;
- Type III - moderate prevalence of parasympathetic activity;
- Type IV - a marked predominance of activity of the parasympathetic department of the autonomic nervous system over the sympathetic.

According to our study, regardless of age, people over 50 have a pronounced predominance of the sympathetic department in the regulation of autonomic activity (Figure 01).

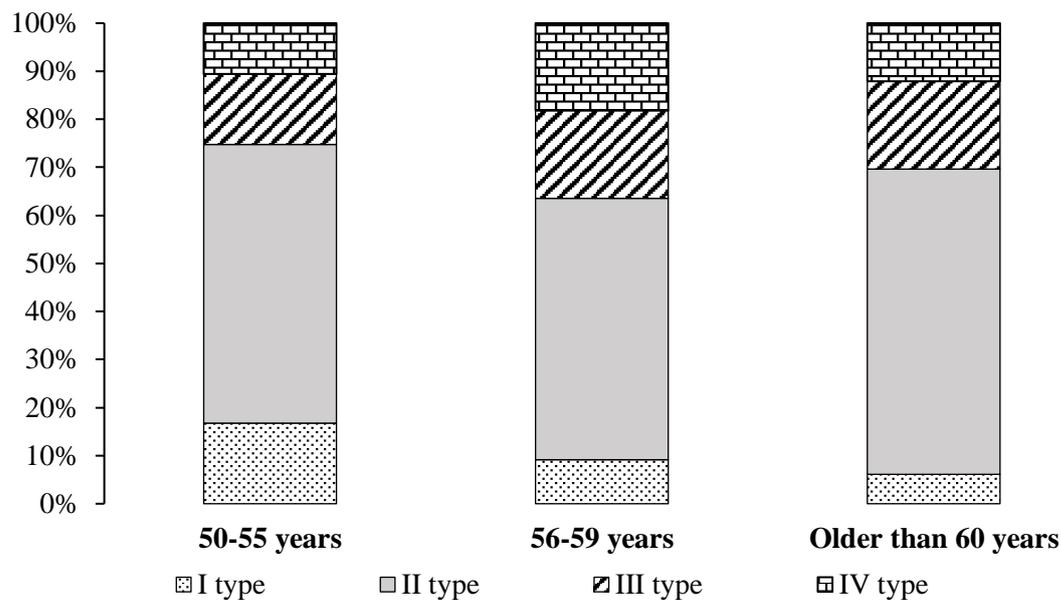


Figure 01. The ratio of types of vegetative regulation (the types are described in the text)

An increase in the activity of the central control loop over the autonomous one indicates the stress of the functional state of life-supporting systems, an increase in the “physiological cost” of vegetative support for people older than 50 years (57.9% - 50-55 years; 54.5% - 56-59 years; 63.6% are over 60).

In 16.8% of cases in people aged 50-55, a decrease in the activity of the central regulatory circuit and moderate tension of regulatory systems (type I) was detected, which is a favorable prognostic sign in assessing the activity of the whole organism.

In 18 - 20% of cases, in groups of people over 56 there is a III type of autonomic regulation, which is characterized by a moderate prevalence of parasympathetic activity and indicates the optimal state of the body's regulatory systems.

The highest percentage of type IV vegetative regulation is observed in the group of people 56-59 years old. The pronounced predominance of activity of the parasympathetic department of the autonomic nervous system can reflect a state of overwork, overstrain, dysfunction of the sinus node of the heart, rhythm and conduction disturbances.

A study of the vegetative provision of activity against the background of an orthostatic test showed that age-related involution (aging of the body) correlates with the quality of the body's response to exposure

(Table 01). According to the data obtained, the response to orthostasis within the physiological age norm was observed in 33.7% of cases in the group of people 50-55 years old; in 48.5% - in the group of 56-59 years old and in 54.5% of cases in people over 60 years old.

Table 01. The ratio of types of qualitative reactions of the cardiovascular system against the backdrop of orthostatic

| Groups | Reaction Types | | | |
|---------------------|--|-------------------------------|----------------------------------|--------------------------------|
| | The reaction of the physiological norm | Excessive vegetative reaction | Insufficient vegetative reaction | Inadequate vegetative reaction |
| 50-55 years | 33.7% | 34.7% | 22.1% | 9.5% |
| 56-59 years | 48.5% | 18.2% | 9.1% | 24.2% |
| Older than 60 years | 54.5% | 12.1% | 3.0% | 30.3% |

In the transition from a horizontal to a vertical position they showed an increase in systolic blood pressure, increase in heart rate. During standing, the pulse pressure decreased briefly due to an increase in diastolic pressure or did not change. Thus, the amplitude of blood pressure was equalized against the background of the load and did not significantly differ from the values obtained at rest, which is a criterion for favorable autonomic support of the cardiovascular system.

In 34.7% of cases, people aged 50-55 had an excessive autonomic reaction against the background of a predominance of activity of the sympathetic part of the autonomic nervous system and the "inclusion" of the central regulation loop. The reactions were characterized by an increase in systolic and diastolic blood pressure by more than 20 mm Hg. Art., an increase in heart rate. Subjectively, such reactions manifested themselves in a sensation of a rush of blood to the head.

In 22.1% of cases, in subjects aged 50-55 years a hypotonic type reaction was noted (reaction of insufficient vegetative support of activity): the systolic blood pressure did not change, the diastolic blood pressure decreased by no more than 5-10 mm Hg. Art.

Noteworthy is the high percentage of people who have observed an inadequate response to orthostatic test: 24.5% of people in the group 56-59 years, 30.3% of cases in the group of people over 60 years. At the time of getting up noted unequal reduction in systolic and diastolic blood pressure increase, which leads to a drastic reduction in pulse pressure. Subjectively, such a reaction was manifested by swaying, a feeling of weakness.

7. Conclusion

Professional human activity depends on many factors: the living and working conditions, emotional state, functioning of life support systems. The reform of the pension system causes some uncertainty in society and a person's misunderstanding of what is happening, which in turn leads to an increase in emotional tension.

Excessive autonomic support of activity against the background of long-lasting emotional reactions is manifested in the activation of the sympathetic department of the autonomic nervous system and the inclusion in the regulation of the mechanisms of the central circuit (higher parts of the central nervous

system), which ensure the mobilization of energy, plastic, and protective resources of the body. However, a prolonged, chronic manifestation of such reactions can lead to fatigue, decreased performance.

The marked predominance of activity of the sympathetic part of the autonomic nervous system, revealed in people aged 50-55, as well as in most cases, excessive reactions of the autonomic support of the cardiovascular system against the background of the orthostatic test, indicate an increase in the “price” of physiological adaptation, uneconomical expenditure of the body’s functional resources, which may ultimately lead to a breakdown of adaptation.

Adaptation disorders associated with the constant tension of the controlling and regulating mechanisms predetermine the depletion of the person’s functional life support systems, increasing the rate and rate of aging of the body.

Acknowledgments

The reported study was funded by of Russian Foundation for Basic Research (project № 20-013-00387).

References

- Agadzhanyan, N. A., Tsaturian, L. D., & Kuvandykova, R. H. (2015). Osobennosti vegetativnoj regulyacii serdechnogo ritma, pokazatelej perifericheskoy krovi i gormonal'nogo profilya u podrostkov Stavropol'skogo kraja: etnofiziologicheskij aspekt [Features of vegetative regulation of heart rhythm, peripheral blood and hormonal profile in adolescents of Stavropol region: ethnophysiological aspects]. *Human Ecology*, 8, 26-31. https://www.elibrary.ru/download/elibrary_24125604_82711312.pdf [in Rus.]
- Baevsky, R. M., Berseneva, A. P., Baevsky, P. A., & Master, M. (2015). Primenenie principov kosmicheskoy mediciny v monitoringe sostoyaniya zdorov'ya pozhilyh lyudej [Application of principles of space medicine to health monitoring of the aging population]. *Cardiometry*, 6, 22-29. <https://doi.org/10.12710/cardiometry.2015.6.2229> [in Rus.]
- Belovol, E. V., Boyko, Z. V., Radysh, I. V., Shurupova, E. Yu., Torshyn, V. I., & Radysh, B. B. (2018). Vozmozhno li zamedlit' kognitivnoe starenie, ili o pol'ze obucheniya v zreloom i pozhilom vozraste [Is it possible to slow down cognitive aging or benefits of education in middle and late adulthood] *Human Ecology*, 2, 59-64. https://www.elibrary.ru/download/elibrary_32412427_50509011.pdf [in Rus.]
- Bussolo, M., Schotte, S., & Matytsin, M. (2017). Accounting for the bias against the life-cycle hypothesis in survey data: An example for Russia. *The Journal of the Economics of Ageing*, 9, 185-207. <https://doi.org/10.1016/j.jeoa.2017.03.001>
- Carriev, P. (2009). Emotional Control of the Autonomic Nervous System. *Encyclopedia of Neuroscience*, 923-928. <https://doi.org/10.1016/B978-008045046-9.02001-5>
- Fedotkov, I. (2016). Ignorance is bliss: Should a pension reform be announced? *Economics Letters*, 147, 135-137. <https://doi.org/10.1016/j.econlet.2016.08.029>
- Grishchenko, N. (2016). Pensions After Pension Reforms: A Comparative Analysis of Belarus, Kazakhstan, and Russia Procedia. *Economics and Finance*, 36, 3-9. [https://doi.org/10.1016/S2212-5671\(16\)30010-7](https://doi.org/10.1016/S2212-5671(16)30010-7)
- Guerin, R. J., & Toland, M. D. (2020). An application of a modified theory of planned behavior model to investigate adolescents’ job safety knowledge, norms, attitude and intention to enact workplace safety and health skills. *Journal of Safety Research*, 72, 189-198. <https://doi.org/10.1016/j.jsr.2019.12.002>
- Owens, A. P., Low, D. A., Iodice, V., Mathias, C. J., & Critchley, H. D. (2017). Emotion and the autonomic nervous system – a two-way street: insights from affective, autonomic and dissociative disorders.

Reference Module in Neuroscience and Biobehavioral Psychology. <https://doi.org/10.1016/B978-0-12-809324-5.01799-5>

- Pogosova, N. V., Baichorov, I. K., Yufereva, Yu. M., & Koltunov, I. E. (2010). Quality of Life of Patients with Cardiovascular Diseases. *Contemporary State of the Problem Kardiologiya*, 50(4), 66-78. https://elibrary.ru/download/elibrary_23212200_84444405.pdf
- Pyatin, V. F., Eskov, V. V., Filatova, O. E., & Bashkatova, Yu. V. (2019). Novye predstavleniya o gomeostaze i evolyucii gomeostaza [New presentation of human homeostasis and evolution]. *Arhiv klinicheskoy i eksperimental'noj mediciny*, 28, 21-27. https://www.elibrary.ru/download/elibrary_37078106_94073922.pdf [in Rus.]
- Shlyk, N. I. (2016). Upravlenie trenirovochnym processom sportsmenov s uchedom individual'nyh karakteristik variabel'nosti ritma serdca [Management of athletic training taking into account individual heart rate variability characteristics] *Human Physiology*, 42(6), 655-664. <https://doi.org/10.7868/S0131164616060187> [in Rus.]
- Vejn, A. M., Solov'eva, A. D., & Kolosova, O. A. (1981) *Vegetososudistaya distoniya* [Vegetative vascular dystonia] Moskva. [in Rus.]
- Zhang, J., Fu, J., Hao, H., Fu, G., Nie, F., & Zhang, W. (2020). Root causes of coal mine accidents: Characteristics of safety culture deficiencies based on accident statistics. *Process Safety and Environmental Protection*, 136, 78-91. <https://doi.org/10.1016/j.psep.2020.01.024>