RESEARCH ARTICLE

# COMPLEX METHOD FOR ASSESSING THE PSYCHOPHYSIOLOGICAL STATE OF THE ARCTIC ZONE OF RUSSIA RESIDENTS

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## Abstract

*Objectives*: **For the timely detection of the people's health problems in the Arctic zone we used in parallel methods of heart rhythm variability (HRV) and gas-discharge visualization (GDV).**
*Subjects:* **A group of 120 volunteers - male residents of Murmansk region in Russia's Arctic zone divided into two age groups: 58 people aged 31.54±5.69 and 62 people aged 54.31±7.26 participated in a study.**
*Results:* **Age-related differences in the associated indicators of GDV grams and HRV were shown with many correlations between the two methods.**
*Conclusions:* **The results obtained testify to a deep interrelation and coherence of the system energetic processes of metabolism in the human body, and the fact that the human body is an integral complex hierarchical system of information-energetic interactions, the scientific study, and understanding of which can lead to further advances in both fundamental pieces of knowledges and contribute to the optimization of diagnosis, treatment, and prevention of non-infectious diseases. The results obtained confirm the validity of using the selected set of methods as promising methods for evaluating the human body's psychophysiological state for further practical implementation in practical health care.** ***ASEAN Journal of Psychiatry, Vol. 22 (2): April 2021: 1-4.***

**Keywords: Gas Discharge Visualization, Heart Rate Variability, Functional State of the Organism, Psychology, Residents of the Arctic Zone of the Russian Federation**

## Introduction

The Arctic zone of Russia is rich in deposits of natural resources, which constitute Russia's national wealth. The powerful industry operates in the Arctic zone, processing oil, gas, gold, and rare metals with thousands of people. Climatic conditions there are extreme: winter temperatures drop to minus 30$^{o}$C - minus 40$^{o}$C, all rivers, and lakes are frozen, permafrost remains in the ground, and positive summer temperatures last no more than three months. The indigenous people Saami and Komi are engaged in reindeer breeding and fishing [1,2]. Simultaneously, there are large cities and industrial settlements in this zone, where tens of thousands of people live permanently. Residents of the Arctic zone are exposed to the complex impact of extreme factors of the Arctic environment and anthropogenic agents, which significantly affect the population's morbidity and life expectancy [3,4,5]. For the timely detection of the people's health problems in the Arctic zone, it is necessary to use express-diagnostics methods, which would allow identifying premorbid conditions for the prevention of further disease development. We used methods of heart rhythm variability (HRV) and gas-discharge visualization (GDV) for these purposes.

## Methods

The following methods and corresponding hand-held devices for express-analysis were used in the study:

1. Heart Rate Variability (HRV) measurements by "Cardio-meter – MT" ("Mycard-Lana" Co. St. Petersburg, Russia, www.mikard.ru).

HRV indicators, which reflect cardiovascular regulation features (a total of 24 parameters), serve primarily to characterize an athlete's adaptive reaction to the stressful effects of graduated exercise. Statistical, spectral, and integrated indicators characterizing the state of different cardiac cycle regulation levels were used according to the European Society of Cardiology standards and the North American Society of Electrostimulation and Electrophysiology [6, 7].
Evaluation of the GDV parameters was done with the "Bio-Well" device (www.bio-well.com). Measurements were taken from all ten fingers.

GDV Technology uses computer processing of images of light stimulated from the subject in the high-intensity electromagnetic field. Images captured of all ten fingers on each human subject provide detailed information on the person's psychosomatic and physiological state [8]. The GDV method is being actively used in medicine and psychology [9-12]. By investigating fluorescent fingertip images, which dynamically change with emotional and health states, one can identify congestion or health areas in the whole system. GDV readings vary less than 10% over time for most healthy people, indicating a high precision level in this technique [9]. For years GDV technology has been accepted by the Russian Ministry of Sport as one of several methods used to evaluate an athletes' psychophysiological state [13].

This study was approved by the Institutional Review Board (IRB) of the Saint-Petersburg Scientific-Research Institute for Physical Culture" (SPbSRIPC). The ethics committee of the IRB of the SPbSRIPC approved the protocols used in the study. The official trial registration number is 58/01/2020.

A group of 120 volunteers - male residents of Murmansk region in Russia's Arctic zone divided into two age groups: 58 people aged 31.54±5.69 and 62 people aged 54.31±7.26 participated in a study. All the subjects had a parallel recording of the GDV and HRV indices.

The research was conducted within the framework of the state task "Study of integrative effects and mechanisms of separate and combined effects of natural factors of the Arctic environment and associated agents on the population living in the Arctic region" under the general supervision of Professor N.K. Belisheva.

**Results**

The complex research by HRV and GDV methods showed multiple significant correlations of their parameters at the level $p<0.05$, which testifies to the fact of a common psychophysiological basis of these methods. Both methods allow revealing the peculiarities of the sympathetic-parasympathetic activity of an organism, and their joint use enables demonstrating the specificity of the autonomic nervous system (ANS) activity. Analysis shows [9-12] that GDV parameters reflect the sympathetic regulation contribution to HRV, the prevalence of sympathetic regulation is reflected in the sign of relation between GDV parameters and HRV indices: the less the GDV area and the higher the fractality factor, the more significant the sympathetic regulation contribution. The increase of the luminescence area correlates with prolongation of the cardio-interval. These relationships indicate that the GDV indices are associated with the ANS contribution to heart rhythm regulation. Simultaneously, the increase of sympathetic component contribution correlates with the decrease of luminescence area, symmetry coefficient, and shape coefficient value growth.

Significant connections were also found between the values of GDV indices as indicators of the integral state of the organism and the state of the immune system (the content of leukocytes, monocytes, circulating immunocomplexes (CIC) in saliva and blood), indicating high sensitivity and reflection of the functional state in the indices of the GDV method [2,3].

Table 1 presents the GRV-grams and HRV indicators between the two age groups having a statistically significant difference, which shows that the glow area in the group of younger workers is higher than in the older group, but this difference is not statistically significant. At the same time, entropy, stress, and fractality coefficients are higher in the first group, which indicates a decreased coherence of physiological processes, lower adaptive potential in young men, and the dominant influence of the sympathetic branch of the ANS in heart rhythm regulation, which is also confirmed by higher values of vasomotor waves power (LF and VLF).

Simultaneously, the young group has higher indexes of adaptation of the cardiovascular system, autonomic regulation, central regulation, and the general index of psychoemotional state. This is not surprising since the high probability of cardiovascular diseases in the elderly population is known [2,3,4].

**Table 1. Comparison of parameters between the groups of young and mature men. Significant differences are shown (T-criterion at the p<0.05 level).**

| Parameter | Young | Mature | p |
|---|---|---|---|
| Age | 31.54±5,69 | 54.31±7,26 | < 0.001 |
| S | 25168.42 ± 350 | 24762.41 ± 345 | 0.36 |
| E | 3.91 ± 0.11 | 3.84 ± 0.13 | 0.007 |
| Stress | 4.91 ± 1,01 | 4.04 ± 0.80 | < 0.001 |
| EC | 2.42 ± 0,25 | 2.21 ± 0.17 | < 0.001 |
| Kf | 3.17 ± 1,19 | 2.55 ± 0.64 | 0.001 |
| HR | 82.06 ± 0.56 | 80.96 ± 0.57 | 0.42 |
| LF, $ms^2$ | 559.43 ± 15 | 353.90 ±16 | 0.01 |
| VLF, $ms^2$ | 710.37 ± 54 | 505.01 ± 63 | 0.03 |
| SDNN, ms | 37.33 ± 2.2 | 30.19 ± 3.4 | 0.001 |
| A | 39.02 ±2.3 | 24.72 ±4.5 | < 0.001 |
| B | 46.17 ±2.5 | 33.51 ±4.3 | < 0.001 |
| C | 44.52 ±3.2 | 33.10 ±3.5 | < 0.001 |
| D | 46.51 ±2.1 | 34.86 ±2.6 | < 0.001 |
| Health | 44.06 ±3.3 | 31.55 ±2.8 | < 0.001 |

S: Glow area (pixels), E: Entropy, EC: Shape factor, Kf: Fractality factor, HR: Heart rate frequency, LF: Low-frequency component: 0.04-0.15 Hz, VLF: Very Low-Frequency, Component: 0.0033-0.04 Hz, A: Cardiovascular system adaptation level, B: Autonomic regulation index, C - central regulation index, D: Psychoemotional state index, health: Integral state index.

## Discussion

An increase of sympathetic link contribution to the heart rhythm regulation refers to an organism's ergotropic reactions, which performs adaptation to the environment and is energy-consuming. It is this process that is reflected in the parameters of GDV-grams. The revealed correlations between GDV-grams and HRV indices are prognostic: it shows that when the luminescence area indices decrease, and the stress coefficient values increase, the organism switches on the reserve ergotropic mechanisms, which can be caused by stressful influences and can lead to homeostasis disturbance.

The difference of GDV and HRV coefficients in the two age groups may indicate that the energy-consuming (ergotropic) mechanisms of homeostasis maintenance prevail over the trophotropic ones in the older age group. The ergotropic system in the process of homeostasis maintenance interacts with the trophotropic system, the equilibrium between which provides restoration of the body's internal environment. Still, in the older group with a higher work experience under unfavorable conditions, the interaction between the ergotropic and trophotropic systems could lead to adaptation (allostasis) [2,3,14] in a more energy-consuming way.

## Conclusion

The results obtained testify to a deep interrelation and coherence of the system energetic processes of metabolism in the human body, and the fact that the human body is an integral complex hierarchical system of information-energetic interactions, the scientific study, and understanding of which can lead to further advances in both fundamental pieces of pieces of knowledges and contribute to the optimization of diagnosis, treatment, and prevention of non-infectious diseases. The results obtained confirm the validity of using the selected set of methods as promising methods for evaluating the human body's psychophysiological state for further practical implementation in practical health care.

## References

1. Belisheva NK, Melnik NA, Balabin YV. Contribution of man-made and natural sources of ionizing radiation to the morbidity structure of the population of the Murmansk region. Vestnik of Kolsk Scientific Center of the Russian Academy of Science, 2013; 4: 9-28.
2. Martynova AA, Mikhailov RE, Pryanishnikov SV. Peculiarities of heart rate variability in mining workers in the Murmansk region. Human Ecology, Arkhangelsk. 2017; 3: 31-37.
3. Belisheva NK. Contribution of high-latitude heliogeophysical agents to the morbidity of the population of the Euro-Arctic region. Bulletin of the Ural Medical Academy of Science, 2014; 2(48): 5-11.
4. Dobrodeeva LK. Immunological reactivity, the state of health of the population of the Arkhangelsk region. Yekaterinburg: Ural Medical Academy of Science, 2004.
5. Kim LB. Oxygen transport in human adaptation to Arctic conditions and cardiorespiratory pathology. Novosibirsk: Nauka, 2015.
6. McCraty R, Atkinson M, Tomasino D, Bradley RT. The Coherent Heart, HeartMath Research Center, Institute of HeartMath, 2006.
7. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart Rate Variability. Standards of Measurement, Physiological Interpretation and Clinical Use. [Text]. Circulation. 1996; 93: 1043-1065.
8. Korotkov KG. The energy of health. 2017. Amazon.com Publishing.
9. Korotkov KG. Review of EPI papers on medicine and psychophysiology published in 2008-2018. International Journal of Complementary and Alternative Medicine. 2018; 11(5): 311–315.
10. Bhat RK, Guru Deo, Mavathur R, Srinivasan TM. Correlation of electrophotonic imaging parameters with fasting blood sugar in normal, prediabetic, and diabetic study participants. Journal of Evidence-Based Complementary & Alternative Medicine 2016: 1-8.
11. Yakovleva EG, Fedorov ED, Korotkov KG, Belonosov SS. Results of research on identifying patients with colon neoplasias with gas discharge visualization technique In: Research Trends and Challenges in Medical Science, 9: 16-27.
12. Sankhala SS, Deepeshwar S, Kotikalapudi S, Chatterjee S. Determining bioenergy field of autistic and normal healthy children: An electrophotonic imaging study. Int J Community Med Public Health 2020; 7: 1547-1554.
13. Drozdovski A, Gromova I & Korotkov K. Express evaluation of the psycho physiological condition of Paralympic athletes. Open Access Journal of Sports Medicine 2012; 3: 215-222.
14. Krivoshchekov SG, Belisheva NK, & Nikolaeva EI. The concept of allostasis and human adaptation in the North. Human Ecology. Arkhangelsk. 2016; 7: 17-25.

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