

Adaptation Capabilities of Girls in Arctic Conditions

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Abstract

The article presents research data on psycho-physiological state changes among young women, the medical students, living in the Arctic area after health preventive course with biofeedback (BFB) method and learning diaphragmatic breathing. The research objective is to estimate the biofeedback efficiency using gas discharge visualization method (GDV). Human activity in the climatic and geographical Far North area requires additional resources for successful adaptation to the extreme environment. Investigation and prevention of mental and emotional state of psychosomatic disorders among students is thought to be a prerequisite for effective adaptation and required condition for favorable life activities in the Arctic, which is accompanied by the so-called "polarity" and high anxiety. The article presents the results of positive dynamics of GDV parameters after biofeedback sessions with students, which confirm the hypothesis of this method to have positive impact on the psycho-physiological health of a man. The use of this method allows to draw a conclusion about the efficiency of its application to increase the adaptive resources of people living in the Arctic environment.

Keywords: psycho-emotional; psycho-physiological state; bio-electrography; gas-discharge visualization (gdv); biological feedback; diaphragmatic breathing

Introduction

At present, the problem of comfortable and full-fledged living of a person in the conditions of the Far North is becoming more and more urgent. It is very important that in the professional sphere and in self-development in general, people living in the Arctic can fully show their potential without compromising their health. Life activity in the conditions of the Far North proceeds under the influence of a whole complex of climatic and environmental factors that are unfavorable for humans, such as low air temperatures, lack of ultraviolet radiation, atmospheric pressure drops, magnetic storms, disruption of circadian rhythms (the rhythm of the body's biological clock) in conditions of polar night and day and etc. Human adaptation in the conditions of the Far North has its own specific features, which are characterized by the development of the "polar stress syndrome" - chronic psycho-emotional stress, described in the scientific literature by many authors (Ts.P. Korolenko, 1977, 1978 [7, 8, 23]; V.P. Kaznacheev, 1980 [24, 25], A.P. Milovanov, 1981 [26], A.P. Avtsyn, 1972, 1979, 1985, 1998 [1, 27, 28, 29], E. S. Schernhammer et al., 2001 [30], V. N. Anisimov, [31], S. Davis, D. Mirck, 2006 [32], V. I. Khasnulin, 1986, 2004 [33, 34], V. P. Leutin, 1984, 2005 [35, 36], V. V. Kolyshkin, 1984 [37], S. N. Filippova, 2000 [38], I. Kloog, et al., 2009

[39], N.K. Belisheva [2]; T.S. Zavadskaya et al [40]), which are characterized by the appearance of "polar voltage" (Ts.P. Korolenko, 1977, 1978; V.P. Kaznacheev, 1980; E.R. Boyko 2005, 2010; Avtsyn, 1979, 1985; 1998; V. I. Khasnulin et al. 1986, 2004; N.K. Belisheva, 2012; P.S. Tereshchenko et al, 2017; Solovyovskaya N.L., 2021) [1, 2, 7, 8, 24, 25, 27, 28, 41, 42, 43, 44]. The effectiveness of adaptation processes and resistance to the occurrence of diseases in the conditions of the Far North largely depend on the characteristics of the response of the psycho-emotional sphere to the action of extreme climatic and environmental factors. The solution of important health problems associated with adaptation to the extreme conditions of the Arctic region requires the improvement and expansion, first of all, of measures for the prevention and correction of psychosomatic disorders associated with the development of "polar stress syndrome" among the inhabitants of this region. At the same time, for the improvement and implementation of psychological support for the population, it is important to widely use new health technologies, such as biofeedback, the biofeedback method (BFB), which make it possible to improve the psychoemotional and psychophysiological health of a person in a short time. One of the most

important and urgent tasks is the introduction of new express methods for assessing the functional state of the body for a quick analysis of changes in psychological characteristics and physiological parameters, in order to justify the effectiveness of the measures used in each case. Psycho-physiological adaptation to the extreme environment of the Far North leads to the so-called "polarity" syndrome [1, 2, 4, 10, 11]. Successful adaptation to these conditions is sure to be a prerequisite and requirement for life-sustaining activity in the Arctic environment. It is necessary to draw in the advanced means, comprising modern computer-aided technologies, for risk prevention measures of psycho-somatic disorders accompanied by psycho-emotional tension and high anxiety among students. Classman are under integrated effect of the climatic and geographical conditions, as well as occupational factors and complexity of habituation to new living conditions, teaching and learning process. In the event of stress situations, changes of pulse frequency take place, caused by fluctuation of vagal and sympatic activity. The heart rate changes (HR), induced by the vagal impact, reflect somatic musculature activity and may determine behavioral reactions [3, 5]. The actuation of sympatic reactions, alongside with specific metabolic processes, may be the very mechanism due to which behavioral reactions give rise to some disease state [23]. Training the optimum type of diaphragmatic breathing facilitates the development of capability to have control over level of health [14, 15, 18]. E.G Vaschillo with co-authors (1983) established that under a slow breath, of 6 times per minute, the pronounced modulation of heart rate was revealed on a frequency of 0,1Hz, which was a resonance one for baro -reflex system. E. G. Vaschillo (2008) suggests the capabilities of biofeedback (BFB) method to control heart rate [3]. The baroreflex resonance can be intensified with the help of learning, using biofeedback method and making therapeutic intervention impact on such pathological states as: bronchial asthma, hyperventilation syndrome, hypertension, anxiety attacks, fear, mental depression, pain, chronic fatigue syndrome, psycho-emotional burning out in occupation [3, 5]. The research objective is evaluate biofeedback efficiency method (BFB) with the help of gas discharge visualization one (GDV). GDV or Bio-electrography, is a method for studying biological objects, without limitation of a human being. It includes evaluation of irradiation characteristics which arises close to an object's surface when it is placed into the electrical field with high voltage. This method is based on Kirlian's effect, which was discovered in the first part of the 20-th century. It provides an opportunity to give a snap analysis for a functional organism state on the psycho-emotional and physiological levels [11, 12]. K.G. Korotkov and his contributing authors elaborated the system of fingertips irradiation and its registration under irradiation with short electrical pulses. Under the conditions of such radiation, the automatic photon and electron emission from the surface of finger skin reinforces, and it can be technically registered. Biological molecules, which are in connection with a body perspiration and a man's natural scent and are administered by the vegetal nervous system, contribute significantly to fingertips irradiation phenomenon. Their intensity is defined by the total activity level and balance of parasympathetic and sympatho-adrenaline impact. The above-mentioned have control over the adaptive organism resources, which, in their turn, provide intensity and dynamic characteristics of oxidation-reduction processes, and identify physical well-being and a man's activity. Quality and intensity of fingertips irradiation are defined both by the adaptive resource level and dynamic functional regulation component [5]. Adaptation is a definitive functioning (adjusting with emergence of stability). When using GDV method in the adaptive resources evaluation, the obtained GDV images (from there, GDV-grams) are identified: area size, form coefficient, entropy and symmetry while capturing the images "without filter" and

"with filter" are taken into account. Functional activity of the organs and systems, ensuring adaptation to the environment, osteo-muscular system mechanical work, as well as intelligent-emotional activity are reflected on the GDV-grams "without filter." Processes, providing for life-sustaining activity of cell systems of the organs themselves and their specific function activity are reflected on GDV-grams "with filter". Herewith, metabolism changes leading to structural changes in the tissues can be registered in the type of intensity and other GDV-gram characteristics, as well. The filter purpose is to cut off all the information connected with perspiration and gaseous release impact on skin cover, in other words, the impact of vegetative nervous system. In this case, irradiation will indicate the basic adaptation resource. Irradiation area is characterized by the level of organism adaptation to internal and external factors, metabolism character, approximation of the functional potential, internal stockpile of strength. The area parameter of GDV-gram, which comprises all the medical programs processing GDV irradiation, should not be regarded separately from all the other GDV parameters. Differential diagnostics with the variant "pseudo norm" (O. V. Sorokin's criteria) (high intensity on the background of high form coefficient) is the reflection of inner tension. Entropy characterizes a measure of chaos in the physiological function regulation, the level of dis-regulation. Form coefficient presents multiloop of physiological regulation. The higher the form coefficient, the more regulation systems are involved into the process [22]. Functional state of organs and systems is analyzed with the help of acupuncture zones consistent with them, using Mandel-Korotkov tables. When performing the research, positive dynamics of psycho-physiological state was suggested to be revealed. Consequently, the increase of the adaptive resources among students with a high level of anxiety after using biofeedback method with learning diaphragm-relaxation breathing pattern was expected to be received.

Methods

To improve psycho-emotional state, the integrated educational and preventive program "Wave" for learning diaphragm breathing and skills of psycho-physiological self-direction was used (OOO "Nauchno-Proizvodstvennaya Firma "Amalteya", St. Petersburg). This program enables within a short time (10-15 sessions) to master the skills of neuromuscular relaxing, improve the work of cardio-vascular and breathing systems, learn to overcome and suppress disease state, restore high working capacity, well-being and mood. It allows, as well, to use game possibilities of computer technology based on the principles of encouragement for the proper done tasks, which provide high emotional motivation and irregularity of processing correlation sessions [17]. To process health-improving sessions of BFB, twenty girls with high anxiety level were chosen. They were tested using responsive and personal anxiety scale after Ch. D. Spilberger-U. L. Khanin [6, 15]. Their average age was 22.9 ± 3.57 . Each tested person received 8-12 sessions, at least twice every week. The sessions were given by the instructor training skills of diaphragm breathing and principles of program work during the whole treatment-correlation course. He had control over the accuracy of accomplishing tasks taking into account individual and psychological habits of the learners. Before health-improving course and after it, the research on psycho-physiological state of the experiment participants was fulfilled using gas discharge visualization method (GDV). All the tests were carried out with the use of pulse analyzer "GDV-compact". The received GDV-grams were elaborated in the program GDV Energy Field. Showings of area (S), entropy (E), form coefficient (K) and symmetry were defined before and after the studies. As the result of processing in this program, all the showings, with exception of symmetry, were presented in three projections: right (r), frontal (f), left (l), as well as the

average showings were in three projections. Symmetry is represented in the frontal projection. GDV measuring was carried out in the registration regimen of GDV-grams: measuring of GDV-grams of fingertips "without filter"(Sr; Sf; Sl; S; Er; Ef; El, E; Kr; Kf; Kl; K; C, and "with filter"(Sr2; Sf2; Sl2; S2; Er2; Ef2; El2, E2; Kr2; Kf2; Kl2; K2; C2). During investigation, certain conditions which were necessary for GDV tests in the regimens "without filter" and "with filter" were complied. In total, more than 200 BFB sessions and more than 100 GDV tests were carried out. Statistical review of the data received was performed. Their data adequacy was estimated upon criterion T, upon criterion U after Mann-Witny, upon criterion Kolmogorov-Smirnov in the Program STATISTICA 10.

Results: As a result of correctional BFB sessions with students, changes of GDV-grams data measured "without filter" and "with filter" were analyzed in three projections: area, entropy, form coefficient, as well as their average showings in three projections, and symmetry in the frontal

projection. In the right projection, the average area was 24109.1±3216.49 before BFB course. After the course, the index raised up to 26801.85±2486.93, that is, by 11% higher. In the frontal projection, the index increased from 23454.95±2662068 up to 25942.75±2547.06, that is, by 10.5% higher. In the left projection, it increased from 24203.4±2901.23 up to 26401.8±2533.95, by 9% higher. The average area index in three projections increased from 23922.48±2841.67 up to 26382.13±2446.81, by 10.2% higher. Data analysis of GDV-grams, while measuring "without filter", after BFB sessions revealed considerable positive changes of the area at the level p<0.05 upon criterion T, and upon criterion U after Mann-Witny in three projections; and upon Kolmogorov-Smirnov criterion in the frontal projection (Table1). The increase of the irradiation area testifies to the increase of adaptive possibilities and improving psycho-physiological state of students due to the impact of health-improving BFB method.

Index	average before BFB	average after BFB	t-value	typical free	p	deviation standard before 1	deviation standard after 2	F- relative dispersity	p dispersity
Sr	24109.10	26801.85	-2.96	38	0.01	3216.49	2486.94	1.67	0.27
Sf	23454.95	25942.75	-3.02	38	0.00	2662.68	2547.07	1.09	0.85
Sl	24203.40	26401.80	-2.55	38	0.01	2901.24	2533.95	1.31	0.56
S	23922.48	26382.13	-2.93	38	0.01	2841.67	2446.81	1.35	0.52
Er	3.80	3.76	0.86	38	0.39	0.17	0.13	1.57	0.34
Ef	3.80	3.71	2.57	38	0.01	0.12	0.12	1.08	0.87
El	3.78	3.76	0.58	38	0.57	0.15	0.14	1.14	0.78
E	3.80	3.74	1.41	38	0.17	0.13	0.11	1.30	0.57
Kr	15.86	13.01	3.70	38	0.00	3.09	1.50	4.22	0.00
Kf	15.56	15.56	3.42	38	0.00	3.35	2.05	2.66	0.04
Kl	15.16	13.07	2.88	38	0.01	2.86	1.54	3.44	0.01
K	16.52	13.88	3.53	38	0.00	2.93	1.61	3.30	0.01
C	0.91	0.93	-2.08	38	0.04	0.03	0.03	1.16	0.75

Table 1: Update values of GDV-grams (without filter) before and after BFB sessions upon criterion T (the marked criteria are significant at the level p<0.05000; N=20 observations)

The study of changes in the entropy showings after BFB sessions "without filter" revealed some decrease of its indexes in the right projection from 3.80±0.17 up to 3.76±0.13. In the frontal projection, it reduced from 3.80±0.15 up to 3.76±0.14. The average entropy index lessened from 3.80±0.13 up to 3.74±0.11; by 1%, 2.7%, 1%, 1%, respectively. The most and statistically significant entropy decrease took place in the frontal projection at the level p<0.05, upon criterion T, upon criterion U after Mann-Witny. Entropy decrease testifies to stabilization of general homeostasis system. The form coefficient index among students after BFB sessions in the regimen "without filter" in the right projection lessened by 18% (from 15.86±1.50 up to 13.01±1.5). In the frontal projection, it decreased by 16% (from 15.56±2.05 up to 13.88±1.61). In the left one, it declined by 10% (from 15.16±1.54 up to 13.07±1.54). The average form coefficient index in three projections lessened from 16.52±1.61 up to 13.88±1.61, almost by 12%. Students' form coefficient after BFB sessions in the regimen "without filter" decreased in all three projections. It was

statistically significant at the level p<0.050 upon criterion T, upon criterion after Kolmogorov-Smirnov, as well as upon criterion U after Mann-Witny. The decrease of form coefficient reveals less reaction of vegetative nervous system among the experiment participants to the environment impact. In the given regimen, symmetry increased from 0.91±0.028 up to 0.93±0.026, and it was statistically significant (p<0.050) upon criterion T, upon criterion after Kolmogorov-Smirnov (Tables 1, 2). While performing GDV investigations after BFB course in the regimen "with filter", the average area indexes increased: in the right projection from 26741.05±1629.0 up to 28522.2±2250.64. In the frontal projection, there was increase from 26378.5±1626.543 up to 27785.65±2305.06. In the left one, it enlarged from 27056.7±1820.17 up to 27749.8±2176.66. On the average, the indexes grew in all three projections from 26310.62±2351.49 up to 28018.85±2146.966; by 6,6%; 5,3%; 2,6%; 6,5%, respectively (Table 2).

Index	average before BFB	average after BFB	t-value	typical free	p	diviation standard before 1	diviation standard after 2	F- relative dispersity	p dispersity
Sr2**	26651.75	28495.35	-3.00	38.00	0.00	1564.62	2259.67	2.09	0.12
Sf2	26383.25	27787.95	-2.23	38.00	0.03	1627.46	2303.93	2.00	0.14
Sl2	25896.85	27773.25	-1.37	38.00	0.18	5747.20	2163.47	7.06	0.00
S2	26310.62	28018.85	-2.40	38.00	0.02	2351.49	2146.96	1.20	0.70
Er2	3.71	3.71	-0.01	38.00	0.99	0.17	0.16	1.16	0.74
Ef2	3.65	3.67	-0.36	38.00	0.72	0.15	0.15	1.08	0.87
El2	3.73	3.69	1.08	38.00	0.29	0.14	0.14	1.02	0.96
E2	3.70	3.69	0.23	38.00	0.82	0.13	0.13	1.04	0.93
Kr2	12.75	12.21	1.86	38.00	0.07	0.89	0.92	1.08	0.87
Kf2	14.45	14.17	1.16	38.00	0.25	0.68	0.86	1.58	0.32
Kl2	12.10	12.15	-0.17	38.00	0.87	0.92	0.86	1.13	0.79
K2	13.10	12.84	1.14	38.00	0.26	0.61	0.81	1.77	0.22
C2	0.94	0.94	-1.43	38.00	0.16	0.02	0.01	4.95	0.00

Table 2: Update values of GDV-grams (with filter) before and after BFB sessions upon criterion T (the marked criteria are significant at the level $p < 0.05000$; $N = 20$ observations)

Statistically prominent changes revealed at the level $p < 0.05$ upon criterion T and upon criterion U after Mann-Witny in the right projection (the increase was from 26651.75 ± 1564.62 up to 28495.35 ± 2259.69); frontal (from 26383.25 ± 1627.46 up to 27787.95 ± 2303.93), as well as in the average area index (from 26310.62 ± 2351.49 up to 28018.85 ± 2146.96), that is by 6,8%; 5,3%; 6,4%, respectively. By Kolmogorov-Smirnov's criterion, area values increased for a fact in the right projection. Some form coefficient decrease, mostly in the right projection ($p < 0.1$) was revealed, as well as entropy reduction in the left projection ($p < 0.1$), and symmetry increase ($p < 0.1$). These data testify to the positive influence of this method on somatic system of the individuals under test. While studying GDV-gram showings, we have received

reliable evidence indicating positive dynamics in psycho-emotional and psycho-physiological students' state. Positive dynamics of bio-electrography values in the regimen "with filter" allows for some positive conclusion about changes in the students' state on the somatic level, as well. Beneficial effect of BFB method, while using to learn diaphragmatic breathing, is also contributive to somatic state. Without any doubt, these positive changes occur slower at a bodily level. To restore and support health, the repeated attempts for arranging BFB sessions with individually selected chart in accordance with individual's health level, age and other peculiarities should be taken into consideration. Comparison in changing of the area size, entropy, form coefficient and symmetry is shown on fig. 1 – 4.

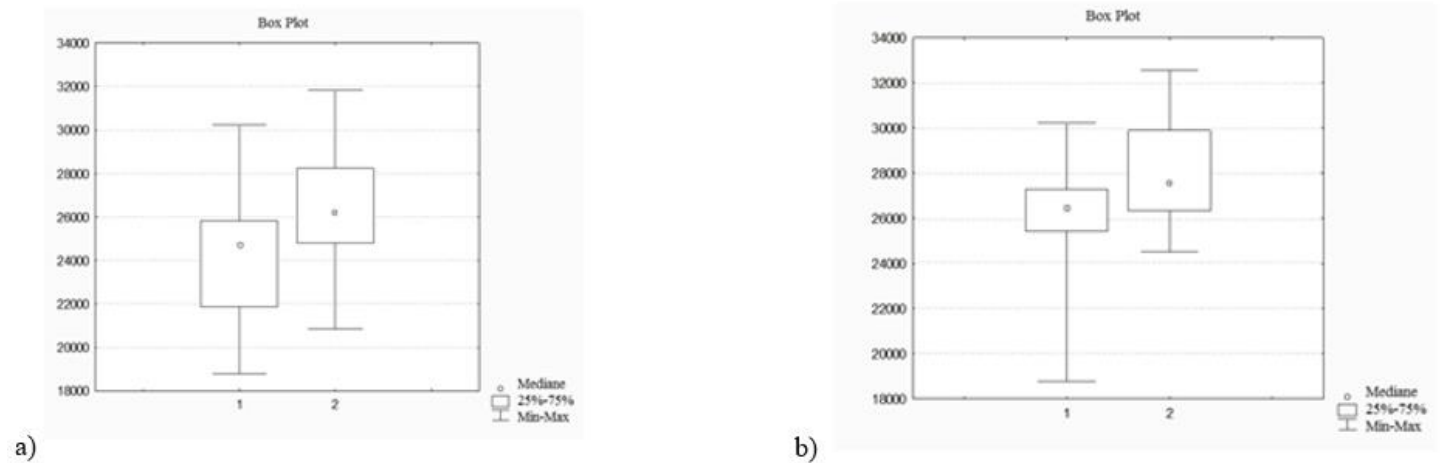
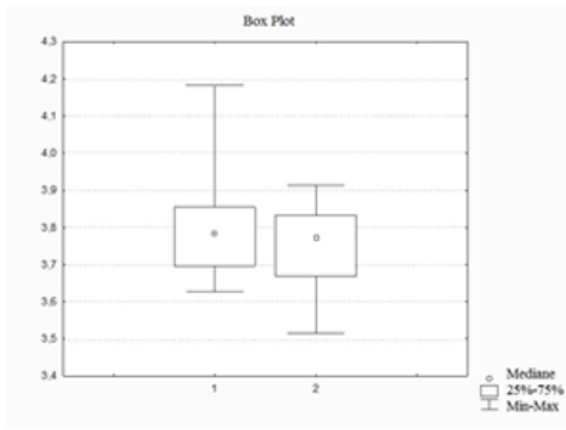
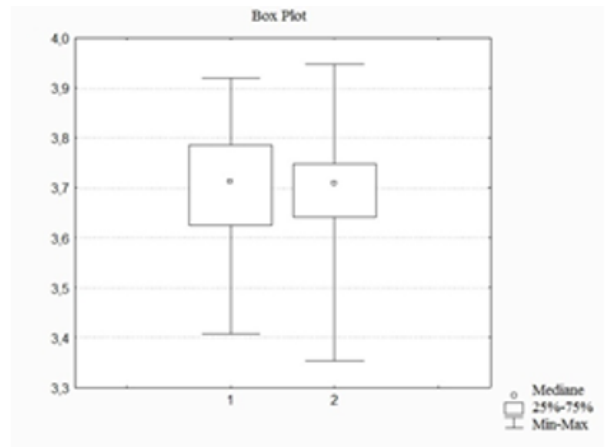


Figure 1: Comparison of the area size before and after BFB (a. with the filter, b. without the filter)

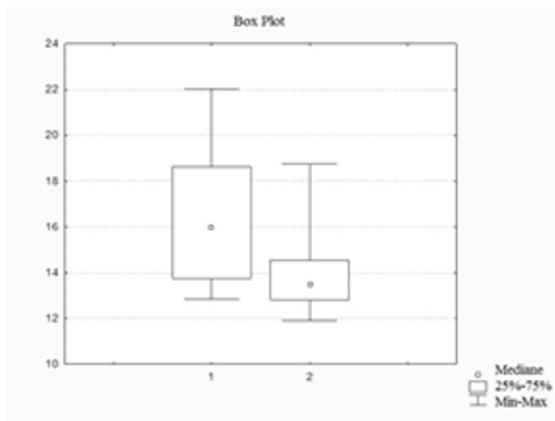


a)

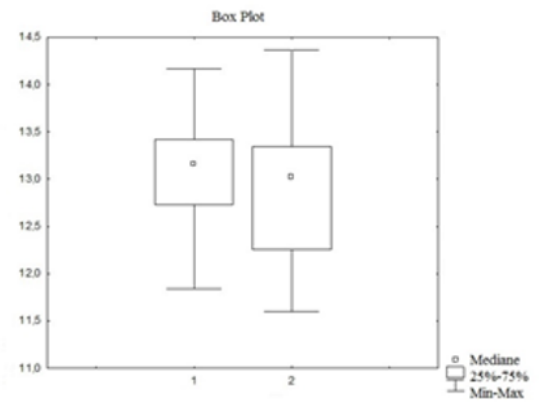


b)

Figure 2: Comparison of entropy before and after BFB, a) with the filter, b) without the filter

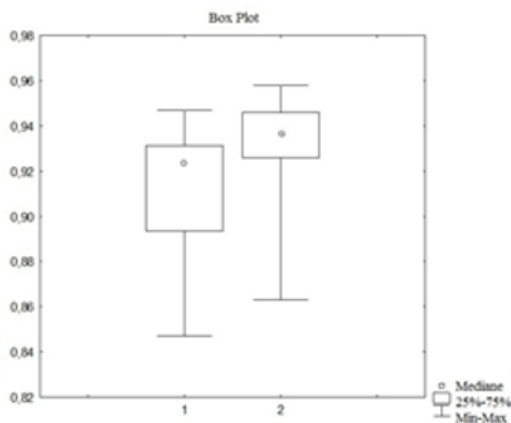


a)

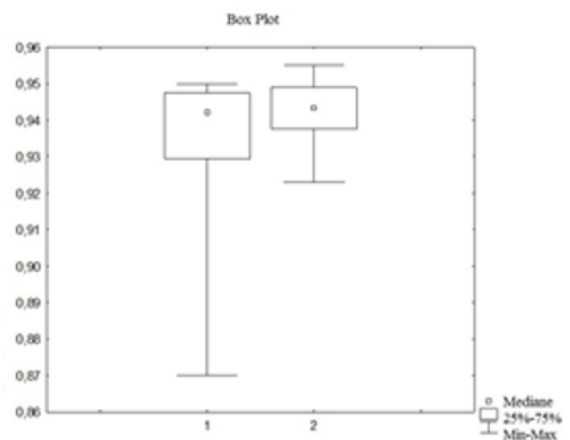


b)

Figure 3: Comparison of form coefficient before and after BFB, a) with the filter, b) without the filter



a)



b)

Figure 4: Comparison of symmetry before and after BFB, a) with the filter, b) without the filter

Discussion

Residents of the Far North region, such as students, deserve special attention. It seems appropriate to study the psycho-emotional state of girls, among whom socially dependent and professionally caused health defects (disadaptation syndromes, social and environmental fatigue and overwork, stress diseases) are widespread. The study of the psycho-emotional sphere of girls can justify support in the adaptation of students in the process of teaching the medical profession, as a preventive measure, to select adequate methods for assessing the psycho-physiological state in order to identify risk groups, including mental adaptation disorders, and provide psycho-physiological support to people living and exercising their labor activities in extreme conditions.

Nowadays, the problem of comfortable and full-fledged living of a person in the conditions of the Far North is becoming more and more urgent. It is very important that, both in the professional sphere and in personal self-development in general, people living in the Arctic can fully show their potential without compromising their health. In the course of investigating the impact of BFB health-improving method, alongside with learning optimum alternative of diaphragmatic breathing and its impact on psycho-physiological state of the students using GDV (bio-electrography), we have revealed the following:

1. More expressive and statistically significant positive changes in GDV values took place in the measuring regimen "without filter" in both groups.
2. This method enabled to restore psycho-emotional and psycho-physiological state of the persons under test, and to increase their adaptive resources in a short period of time.
3. The happened insignificant changes at the somatic level in the regimen "with filter" during a short course of health-improving practice makes it possible to presume that its extensive use will have health-improving efficiency for preventive measures and disease treatment.

Conclusion

The high vulnerability of the inhabitants of the Arctic region to the impact of high-latitude extreme environmental factors indicates the need to develop health-saving technologies and methods for correcting psycho-emotional stress, taking into account the specifics of living in the North. At the same time, the low efficiency of medical care in the North, which is typical for the present, is due to the actual lack of a training system for medical personnel focused on helping the contingent living in the Arctic, the lack of evidence-based programs for primary and secondary prevention of the most socially significant human diseases in the region. Girls are at risk for the development of maladaptive disorders, psychosomatic disorders due to psycho-emotional stress, which manifests itself in the conditions of the Far North, as a result of the combined influence of socio-psychological and professional factors with climatic and geographical features of the environment, which can have a negative impact on the psycho-emotional state. The proposed methodology for express testing of various categories of residents in the Far North using a comprehensive study of the psychological state and psychophysiological state using standardized methods allows you to effectively analyze the functional state of the body and its changes in the process of applying health practices and the influence of climatic, geophysical and cosmophysical factors. The use of BFB method with learning diaphragmatic breathing may promote rising of adaptive people resources in the Arctic environment. It suits to the ground for teaching and educational process as one of the health protecting methods both at school and in the vocational educational establishments. It will be also actionable

for use in the occupational personnel to prevent psycho-emotional burning out, psychosomatic disorders and diseases among elderly people.

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