COMPARATIVE ASSESSMENT OF THE IMPACT OF DRINKING WATER QUALITY ON THE ATHLETES' CONDITION DURING EXERCISE

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Abstract

Integrated studies utilizing methods from physiology, psychophysiology, psychology, and biophysics were conducted. Athletes had the parameters of their condition measured before they began consuming graphene-filtered water as well as after a 30-day period of its consumption during training cycle. The obtained results were compared with the data from a control group of athletes who drank bottled water. It is shown that athletes drinking water passed through a graphene filter experienced growth in aerobic capacity, physical performance, energy potential, and their bodies' adaptive reserves.

Introduction

Water is the main component of the internal environment of an organism. For people whose work involves intense physical activity, the state of water-salt metabolism is an important physiological requirement for maintaining optimum performance. The Federal Service for Supervision of Consumer Rights Protection and Human Welfare notes the poor quality of drinking water in Russia. About 19% of samples from the water supply do not satisfy the sanitary-chemical standards and about 8% do not satisfy the bacteriological standards. Nationwide, up to 30% of the samples of surface water sources do not meet health standards for sanitary-chemical reasons, and up to 25% - for bacteriological reasons. A serious problem is posed by water distributing systems - between 40% and 70% of them are in need of replacement. According to a March 18, 2005 Service memo, "as a result of this, accidents at these systems and the subsequent microbial contamination of drinking water constitute an epidemic risk." The memo states that out of all the disease outbreaks reported in 2004, 77.3% were of an "AQUATIC" nature and were related to the poor state of the water system. As such, the quality of drinking water may, along with a number of other factors, play a certain role in determining the effectiveness of human activity. This holds especially true for activities involving extreme exertion - in particular for sports. This study focuses on identifying the impact of specially prepared water on the organisms of athletes.

ORGANIZATION AND METHODOLOGY OF THE STUDY

Sample

The sample consisted of 40 athletes between the ages of 14 and 25, coming from the Olympic Reserve School (St. Petersburg). Their skill level ranged from first-class sportsmen (regional champions) to candidates for master of sport (nationally ranked players) and masters (national champions) in different kinds of sports - athletics, rowing, triathlon, basketball. Two 20-person groups were randomly selected - experimental and control. Groups were randomized by age, gender, skill level, and sports type. Subjects were aware of the goal of the experiment, but were not told which kind of water they would drink.

For 30 days athletes in the experimental group drank water passed through an HRCM graphene filter [1]. Athletes in the control group consumed bottled water.

Water source

The filtering process utilizes the high-reactivity carbon mix (HRCM) - a new carbon material created based on a discovery that Russian Academy of Natural Sciences member V. I. Petrik first laid out as "The Phenomenon of the Formation of Nanostructured Carbon Complexes". HRCM is obtained by cold destruction of graphite through a patented method [1]. HRCM contains carbon nanostructures that have an enormous surface area (about 2000 m^2 per gram). As such, when moistened, HRCM carbon nanostructures form a mass which “entangles" even the tiniest impurities and suspended particles both of an organic and of an inorganic origin.

Methods

The following methods and corresponding hand-held devices for athletes’ 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 features of cardiovascular regulation (a total of 24 indicators) serve primarily to characterize the adaptive reaction of an athlete to the stressful effects of graduated exercise. Statistical, spectral, and integrated indicators characterizing the state of different levels of the cardiac cycle regulation were used. [2]

2. The Profile of Mood States (POMS) test [3] was used to determine the psychoemotional state and arrive at an integrated assessment of the mood and stress levels of the athletes.

3. To determine the level of the athletes’ physical ability peak oxygen consumption (POC) based on the PWC170 sample was measured. These data access the optimality and efficiency of the athletes’ cardiovascular systems.

4. Stress system “General Electric Healthcare Cardiosoft” with the cycle ergometry “Bike General Electric Healthcare” (General Electric USA).

5. Evaluation of energy potential (EP) and stress level (SL) by Gas Discharge Visualization technique with “GDV-Sport” device (“Biotechprogress” Co, St. Petersburg, Russia, www.ktispb.ru). Measurements were taken from all 10 fingers.

Energy Potential (EP) is a measure of psycho-physiological condition of an athlete; it is calculated as a percentage ranging from 0 to 100%. EP = 100% is correlated with high level of competitive readiness and high energy reserve.

Stress Level (SL) is characteristic of the level of anxiety and stress, measured on a scale from 0 to 10. SL = 10 is correlated with high anxiety level and poor competitive readiness. Interpretation criteria are given in Table 1.

GDV Technology is based on the well-known Kirlian effect: when an object is placed on a glass plate and stimulated with current, a visible glow occurs, the gas discharge. With gaseous discharge visualization (GDV) bioelectrography cameras, the Kirlian effect is quantifiable and reproducible for scientific research purposes. Images captured of all ten fingers on each human subject provide detailed information on the person’s psycho-somatic and physiological state [4]. The GDV camera systems and their accompanying software are being used in medicine and psychology [5-8]. Through investigating the fluorescent fingertip images, which dynamically change with emotional and health states, one can identify areas of congestion or health in the whole system. The mild electrical stimulation initiated by the GDV creates a neurovascular reaction that registers on the skin. The characteristics of this reaction are influenced by the nervous-humoral status of all organs and systems. Images of these reactions are digitally captured and analyzed. In addition, for most healthy people GDV readings vary less than 10% over time, indicating a high level of precision in this technique [5]. It is interesting to note that using GDV technology over the course of several years to study Russian paralympic teams, no significant differences between paralympic athletes and healthy population were found [9]. At the same time analysis of data for handicapped individuals in Russia with the same type of problems indicated much worse states of their psycho-physiological condition. This suggests that athletic training may play a vital role in maintaining the body's energy level along with other key homeostatic parameters. For years GDV technology has been accepted by the Russian Ministry of Sport as one of several techniques used to rapidly evaluate an athletes' psycho-physiological state.

Table 1. Interpretation criteria for Energy Potential (EP) and Stress Level (SL) indexes

	SL		
EP	0-4	4-5	5-10
100%-80%	High level of psycho-physiological condition, low emotional tension	High level of psycho-physiological condition, moderate emotional tension	High level of psycho-physiological condition, high emotional tension
80%-60%	Moderate level of psycho-physiological condition, low emotional tension	Moderate level of psycho-physiological condition, moderate emotional tension	High level of psycho-physiological condition, moderate emotional tension
60%-40%	Affordable level of psycho-physiological condition, low emotional tension	Affordable level of psycho-physiological condition, moderate emotional tension	Affordable level of psycho-physiological condition Energy and emotional depletion is possible; risk of traumas; overtraining.
40%-0%	Low level of psycho-physiological condition, low	Low level of psycho-physiological condition, moderate emotional	Energy and emotional depletion; high level of stress; risk of traumas; overtraining.

	emotional tension	tension	Detailed medical analysis is needed.

Experimental protocol

First, athletes were given psychological tests, and their heart rate variability parameters (HRV) and gas discharge visualization parameters (GDV method) were measured. The athletes then used a velo ergometer (bicycle exercise, a variant of the PWC test 170), and their heart rate (HR) and arterial blood pressure (ABP) were recorded. At the end of the exercise HRV and GDV data were again recorded, along with the time it took to recover baseline heart rate and blood pressure. Psychological testing was then repeated. All this was conducted before and after the 30-day period.

The variance of the data was analyzed. Indicator changes relative to the baseline in the two groups of athletes were analyzed using Student's t-test. Fisher's exact test was used to assess the significance of differences in the sampling fractions.

RESULTS

Based on the analysis of obtained data we can make the following conclusions:

1. The criteria for measuring the impact of graphene-filtered water on the athletes were their bodies' reactions to exercise. During the standard veloergometric test in the experimental group, the analysis of the mean values of hemodynamic parameters comparing the initial and final test results yielded statistically significant differences in the dynamics of the following seven (out of nine) parameters. Systolic ABP prior to the exercise ($p = 0.015$), diastolic ABP prior to the exercise ($p = 0.012$), HR prior to the exercise ($p = 0.001$), systolic ABP after exercise ($p = 0.001$), peak oxygen consumption ($p = 0.001$), ABP recovery time ($p = 0.018$), HR recovery time ($p = 0.003$). The values ABP, HR and their recovery times decreased, while POC values increased (Fig. 1). The direction of these changes indicates a tendency toward the optimization of the functioning of the athletes' cardiovascular system in the experimental group

These changes indicate the economization in the functioning of the cardiovascular system when that system is at rest, a reduction in the hemodynamic cost of exercise for the subjects, a reduction in recovery time following exercise, and an enhancement of the athletes' aerobic capacity. This, in turn, shows a reduction in the physiological price of exercise and an increase in the athletes' performance following a month of drinking graphene-filtered water.

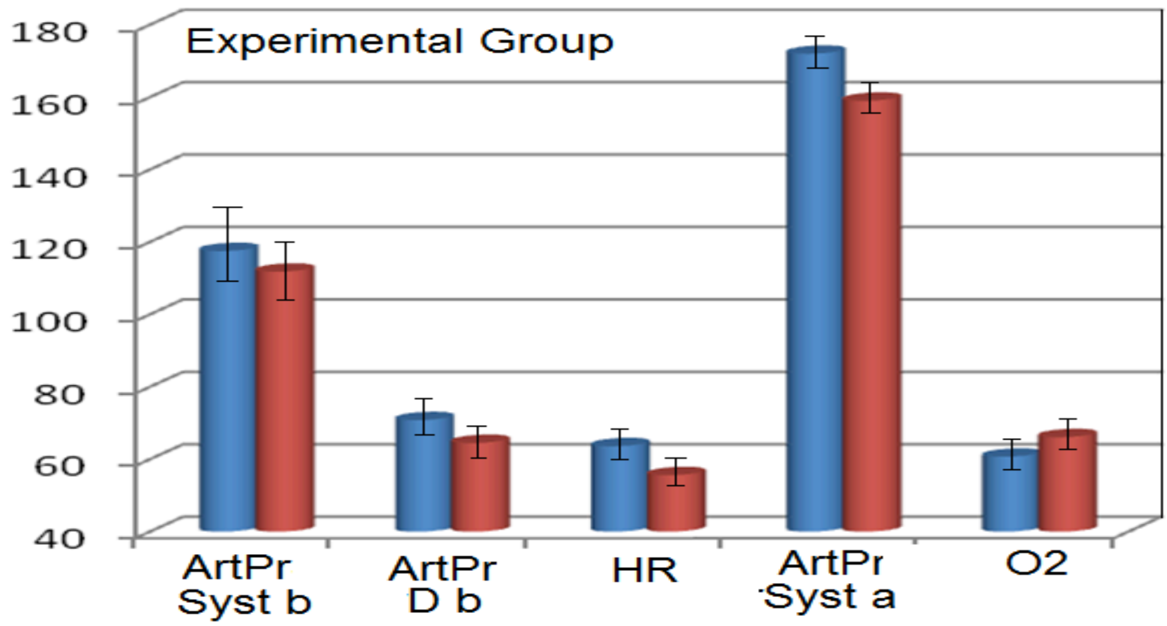

Fig.1. Dynamics of the statistically significant changes in the values of hemodynamic parameters in the experimental group.

2. Out of the corresponding parameters in the control group only post-exercise HR values had statistically significant changes ($p = 0.001$). Even this HR decrease was small.

3. In the control group of athletes a statistically significant reduction was found in the values of the pre-exercise energy potential (EP) when comparing data from the initial and the final test ($p \leqslant 0.001$). There was no statistically significant change after the exercise.

4. In the experimental group baseline EP values slightly increased during the active period of the training cycle and this increase was different for different systems and organs in accordance with GDV measurements.

5. The analysis of the energy performance of individual organs and organ systems showed a substantial increase in the EP values obtained during the final testing in the experimental group relative to those obtained in the control group. This applies to a number of organs and organ systems, as illustrated by Figure 2, which shows the difference in the EP values of athletes in the experimental group and those in the control group in the first and second trials.

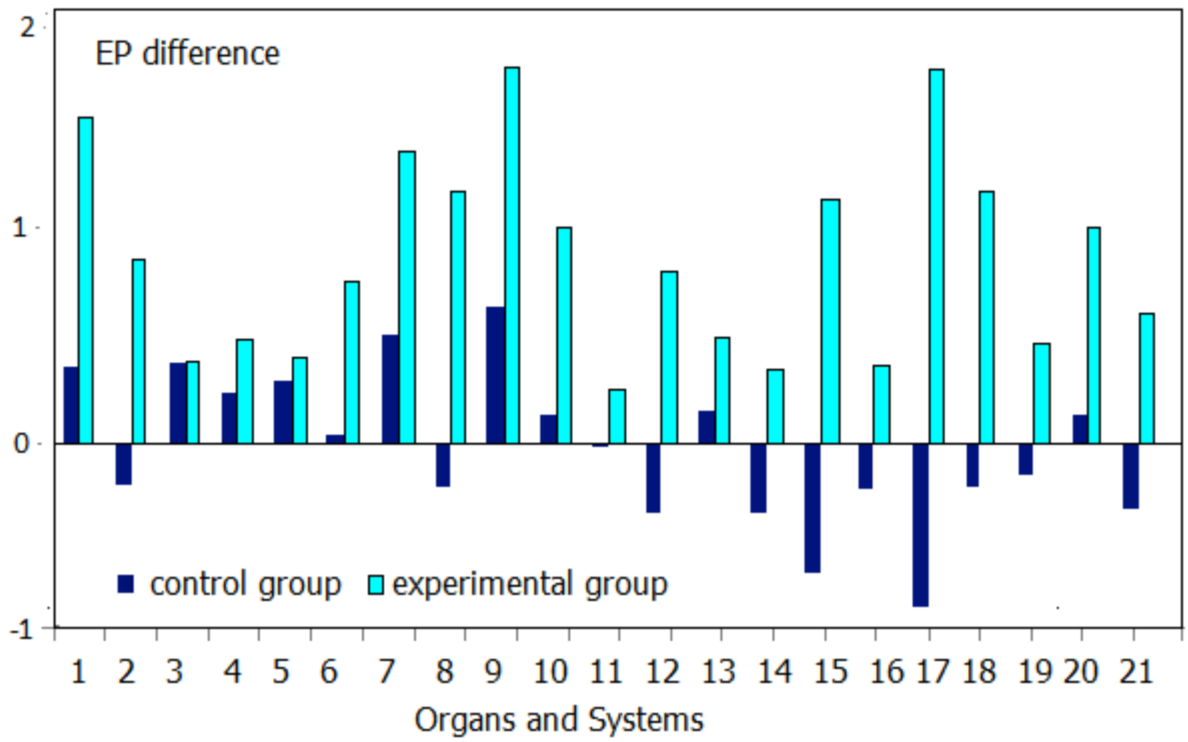

Fig. 2. The difference between the values of the indicator of the energy potential of athletes in the experimental and control groups in the first and the second trials. EP is measured in the scale from 0 to 10. 1 - Cardiovascular system, 2 - heart, 3 – blood vessels, 4 – mammary glands, 5 - hypothalamus, 6 – pineal gland, 7 – pituitary gland, 8 - pancreas, 9 - adrenal glands, 10 - genitourinary system., 11 - the spine, 12 – sigmoid colon, 13 - Rectum, 14 - cecum, 15 – ascending colon, 16 – transverse colon, 17 - the liver, 18 - pancreas, 19 – appendix, 20 - genitourinary system, 21 - kidney.

6. At the same time the difference in the values of averaged on the group parameters obtained through the GDV method when comparing samples of data from the experimental and control groups, either in the initial or in the final test was not statistically significant. Nor were such differences found before or after dosed exercise.

7. The use of rhythmocardiography made it possible to evaluate the state of the system of regulation of the HRV and the adaptive capacity of the athletes. In the experimental group comparing the data of the initial and the final testing prior to physical activity revealed statistically significant differences (by the t-test) in the dynamics of 14 indicators. I.e. the average duration of the cardiac cycle (P = 0.006), mode (p = 0.001), the minimum duration of the cardiac cycle (P = 0.007) and the maximum duration of the cardiac

cycle (p = 0,002); SDNN (p = 0,048); RMSSD (p = 0,010); NN50count (p = 0,025); pNN50 (p = 0,025); MD (p = 0.007), vegetative equilibrium index (VEI) (p = 0.041); vegetative index of rhythm (VIR) (p = 0.030), indicator of the adequacy of regulatory processes (IARP) (p = 0.023), stress index (SI) (p = 0,034); VLF (p = 0.029). The F-test also found statistically significant differences for the vegetative equilibrium index (VEI) (p = 0.043) and the stress index (SI) (p = 0.005). The direction of changes in the indicator values reflects a downward trend in the sympathicotonic activity, an increase in the parasympathetic effects, and a centralization of heart rhythm management. This testifies to the improving capabilities of the body.

8. Particularly noteworthy was the decrease in the average of the vegetative index of rhythm (VIR) from 3.0 to 2.5 units. The predictive value of VIR in respect to the athletes' aerobic capacity is shown above [2]. Similarly, in this series of experiments, the increase in the peak oxygen consumption (POC) was 8.9%. In the control group of athletes a similar dynamic of the parameters was not seen. Instead, there were shifts of indexes (VEI, VIR, and SI) in the other direction. For example, the value of VIR increased from 2.3 to 2.8 units (p = 0.01).

9. There were no significant changes in the values of HRV parameters for athletes in experimental group after a bicycle exercise. But the overall trend of their dynamic shows the growth in their bodies' adaptive capacities, primarily due to the activation of the sympathetic nervous system (the LF parameter). At the same time, control group data included indicator values changing significantly in the opposite direction. This is evidence of some reduction of the functional reserves of athletes in the control group during the bicycle exercise test.

10. While examining the psychological state of the athletes the POMS test was conducted twice - before and after exercise. No significant changes in the groups' values of psychological profile indicators were found. The exception was the increase in the mental strength factor following exercise in the experimental group (the V factor p=0.001) (Fig. 3). At the same time, the trends in the psychological states, as measured by the POMS test, in the two groups went in opposite directions. Prior to exercise, the total cumulative index S in the experimental group had an optimizing tendency. Other parameters moved slightly in the direction of optimization. In the control group comparing the data from the initial and final

tests prior to exercise revealed a decrease in values of mental strength (V) and the cumulative index (S). The values of depression and fatigue indicators increased.

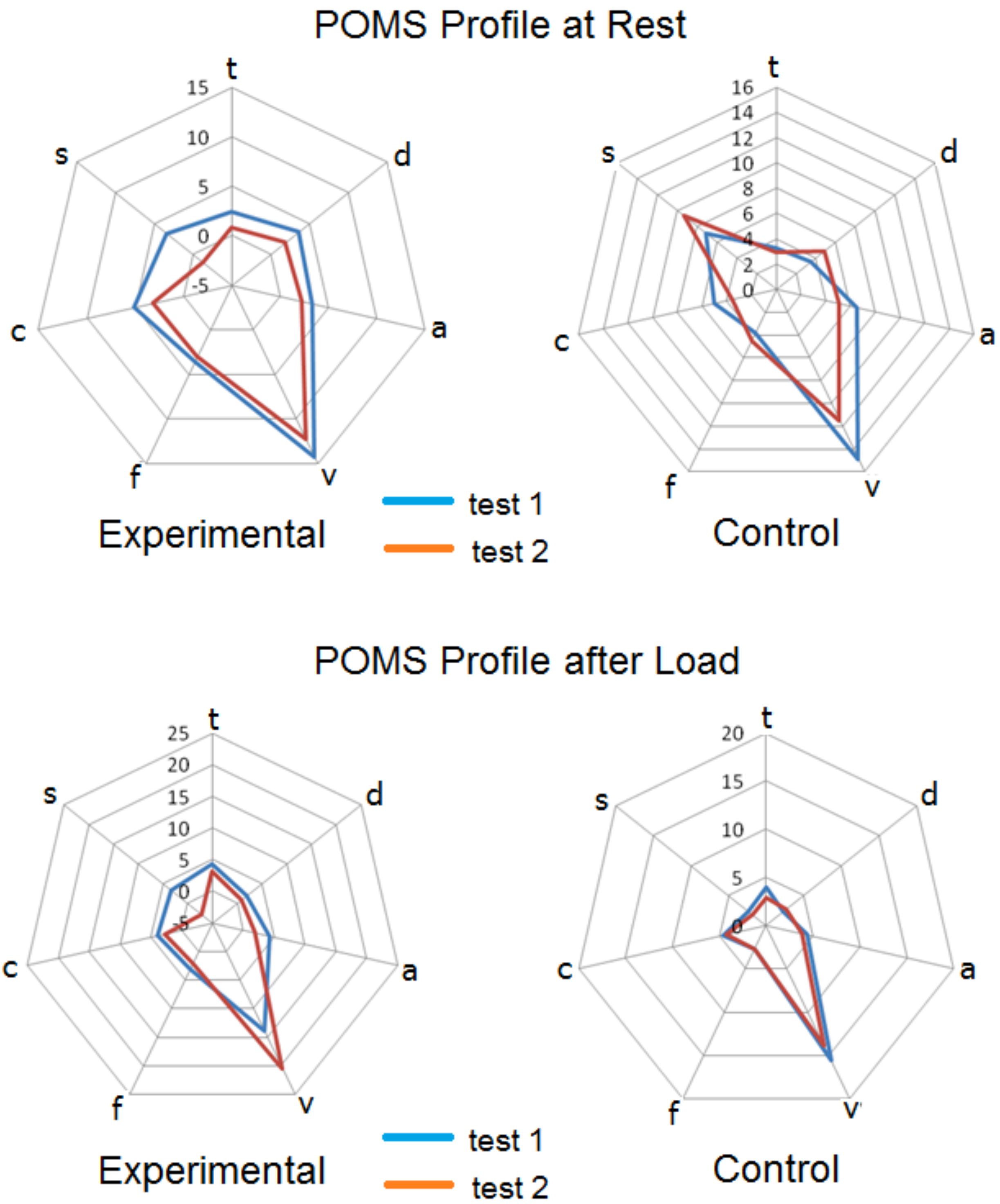

Figure 3. The dynamic of the POMS psychological profile in the experimental and control groups.

CONCLUSION.

1. The results of the experiment have shown that after a month of drinking water passed through a graphene filter, athletes experienced statistically significant changes in their cardiovascular system. The values of HR, ABP at rest, and diastolic blood pressure after exercise decreased. POC increased by 9%, while HR recovery time following exercise decreased by 18% - and ABP by 10%. These data indicate improvement in physical performance, optimization of the circulatory system, and enhanced exercise tolerance. Such trends were not observed in the control group.

2. Based on variation pulsometry data, members of the experimental group had a tendency towards the optimization of the vegetative balance (increased parasympathetic effects on the HRV and decreased sympathetic ones). This testifies to the improving body capabilities of the body.

3. In response to exercise athletes in the experimental group saw an increase in the values of their mental strength factor, reflecting the level of competitive readiness.

4. Data obtained using the GDV method suggest that the values of energy parameters for the athletes in the experimental group remained stable, whereas the control group exhibited a decline in the values of these parameters. At the same time, in the experimental group there was a significant increase in energy potential values pertaining to specific organs and organ systems.

FINDINGS

1. It is shown that athletes drinking water passed through a graphene filter experienced growth in aerobic capacity, physical performance, energy potential, and their bodies' adaptive reserves.

2. The results obtained can serve as a basis for planning more extensive research in this direction.

Work Cited

1. Parent RU №2163883, Patent US 7,842,271 B2 "Mass production of carbon nanostructures".
2. McCraty R., Atkinson M., Tomasino D. and Bradley RT. The Coherent Heart, HeartMath Research Center, Institute of HeartMath. 2006.

3. Mc Nair D.D., Lorr M., Droppleman L.F. Edits manual for the profile of mood staits. SanDiego. California. - 1992.- 15 p.
4. Korotkov K.G. Energy fields Electrophotonic analysis in humans and nature. 2012. 240 p. e-book: Amazon.com
5. Jakovleva E., Korotkov K. Electrophotonic Analysis in Medicine. GDV Bioelectrography research. 2012. 160 p. Amazon.com Publishing.
6. Bundzen P., Korotkov K., Nazarov I., Rogozkin V. Psychophysical and Genetic Determination of Quantum-Field Level of the Organism Functioning. Frontier Perspectives, 2002, 11, 2, 8-14.
7. Korotkov K.G., Matravers P, Orlov D.V., Williams B.O. Application of Electrophotonic Capture (EPC) Analysis Based on Gas Discharge Visualization (GDV) Technique in Medicine: A Systematic Review. J Altern Complement Med. 2010, 16(1): 13-25.
8. Polushin J, Levshankov A, Shirokov D, Korotkov K. Monitoring Energy Levels during treatment with GDV Technique. J Sci Healing Outcome. 2009, 2(5): 5-15.
9. Drozdovski A., Gromova I., Korotkov K., Shelkov O., Express evaluation of the psycho physiological condition of Paralympic athletes. Open Access Journal of Sports Medicine. 2012 http://www.dovepress.com/article_11692.t14245241