

CORRECTION OF HEALTH DEVIATIONS CAUSED BY UNFAVORABLE ENVIRONMENTAL CONDITIONS USING NON-PHARMACOLOGICAL MEANS

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Lack of atmospheric oxygen (exogenous hypoxia) in residents of high mountain areas leads to functional disturbances of blood circulation, blood composition, activity of tissue respiration enzymes and resulting other biochemical abnormalities, causing a number of diseases. And the open mines operating in these regions create an unfavorable ecological environment, contributing to the deepening of functional disorders of the body among the population. Adolescents in this region are also at risk for the development of pathological processes. These risks can be reduced, and diseases can be prevented using non-drug means, using herbs with antihypoxic effects and special breathing exercises.

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Introduction. The normal course of biochemical and physiological processes that ensure the life of the body, among other systems, is due to the normal functioning of the respiratory and cardiovascular systems. The physiological indicators of these systems can be influenced by a number of external and internal factors: atmospheric pressure, the amount of oxygen in the atmosphere, various pathologies of the body, etc. Natural conditions become more complicated when environmental problems arise in the region: open mines operate [1–3].

The Vardenis Region of Armenia is located at an altitude of about 2200 *m* above sea level (atmospheric pressure 809.92 *mbar*), which is a naturally temperate hypoxic environment. There is an open-pit gold mine in this region. As a result of its activities, toxic cyanide compounds are released into the atmosphere, aggravating the atmospheric, exogenous oxygen deficiency. Under these conditions, in the body of residents of settlements adjacent to the mine, functional deviations lead to the development of endogenous oxygen starvation, causing a number of diseases.

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Research has shown that these risks can be reduced by using antihypoxic medicinal plants, which increase the body's adaptive capabilities by improving its regulatory mechanisms. This is also facilitated by special breathing exercises, in particular voluntary reduction of respiratory rate (VRF) [4–7]. These exercises strengthen the respiratory muscles, increase the mobility of the chest and diaphragm, help increase the elasticity of the pleura, improve breathing mechanisms and coordination of movements [8, 9].

The purpose of the study is to investigate the combined effect of an antihypoxic medicinal plant – hawthorn flowers and breathing exercises on some physiological indicators of adolescents in the Vardenis Region.

Materials and Methods. The study was conducted among high school students (15–17 years old) in the city of Vardenis, Gegharkunik Region of Armenia (40 students). At rest, the subjects' breathing rate, vital capacity and tidal volume (with a dry spirometer), and blood pressure were measured. For comparison, the same indicators of students (30 students) of the same age in the resort town of Stepanavan were studied, who served as a control.

The minute volume of alveolar ventilation (VA) was calculated using the formula

$$VA = f(VT - VD),$$

where f is respiratory rate, VT is the tidal volume, VD is volume of dead space in the respiratory tract (average 150 mL).

The studies were carried out with the consent of students and parents and under the direct supervision of clinic doctors. Both girls and boys participated in the study. This article presents data for boys only.

After preliminary (normal) recording of the parameters, breathing exercises were performed: voluntary reduction of the respiratory rate (RRF) to six respiratory movements/*min*. During the exercise, one breathing movement includes three stages: not a deep breath, a pause and a slow exhalation. In this case, the ratio of the time of inhalation and subsequent pause + exhalation should be 1:3. Classes were held daily 3 times a day for 10 *min* (in the morning at 8:45, in the afternoon at 14:00 and in the evening at 20:00 under the supervision of parents).

As a result of our experiments on animals, it was established that hawthorn flowers play a corrective role in conditions of exogenous hypoxia, increasing the adaptive capabilities of the body [10]. Taking this into account, along with breathing exercises, the subjects also consumed tincture of hawthorn flowers. For infusion, one tablespoon of dried hawthorn flowers is infused in 200 mL of boiled water for 45 *min*. The students took the tincture twice (100 mL each): immediately before morning classes and after classes, before going home. Two months after taking the herbal decoction and breathing exercises, the participants were re-examined.

Under conditions of natural breathing, as well as a voluntary decrease in respiratory rate, energy costs were calculated according to J. Scherrer: “respiratory rate” $\times 0.13$ kcal [11].

The reliability of the data was determined by statistical analysis using the SPSS software package. All studies were conducted in accordance with Articles 5.6 and 7 of the Universal Declaration of Human Rights and Bioethics.

Research Results. A comparison of the physiological indicators of adolescents of the same age (15–17 years old) from the City of Vardenis to the resort town of Stepanavan revealed obvious differences between them (Tab. 1, Fig. 1).

The heart rate of schoolchildren living in Vardenis is 16.6% higher than that of schoolchildren in the control group.

Blood pressure indicators also differ. Pulse pressure (the difference between systolic and diastolic pressure) is an important indicator of blood circulation, which is normally 40 mm Hg. Its increase or decrease indicates certain functional disorders in the body, in particular, the elasticity of blood vessels. In the Vardenis groups this figure is higher by 29.7% compared to the control group.

Table 1

Indicators of the cardiovascular system of students (* $p < 0.05$)

Study indicator	Stepanavan	Vardenis	
		A	B
Heart rate, beats/min	78.38 ± 1.62	93.47 ± 1.20 *	76.05 ± 0.16 *
Systolic pressure, mm Hg	105.0 ± 3.27	124.70 ± 1.50 *	104.38 ± 2.02 *
Diastolic pressure, mm Hg	73.12 ± 2.28	77.55 ± 0.21 *	65.10 ± 0.19 *
Pulse pressure, mm Hg	37.72 ± 1.59	49.97 ± 1.15 *	37.07 ± 1.82 *

** before (A) and after two months of using an infusion of hawthorn flowers and breathing exercises (B)

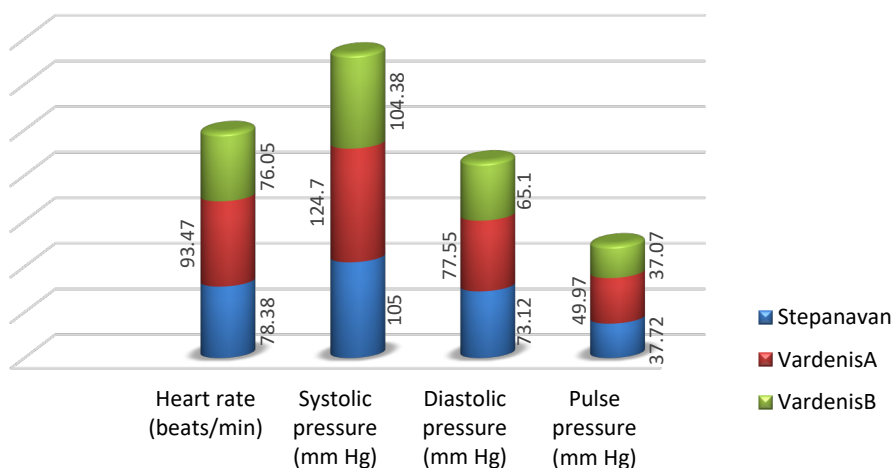


Fig.1 Indicators of the cardiovascular system of students

Pulse pressure is directly related to the driving force of blood flow, due to which tissues are supplied with oxygen. High pulse pressure in Vardenis adolescents may have a compensatory (compensatory) significance for ensuring cellular metabolic processes. However, high pulse pressure and high heart rate indicate an overload of the cardiovascular system of adolescents in this region, where there are certain risks of heart disease. This is evidenced by data obtained from medical care centers in the region: a fairly high percentage of cardiovascular disorders in these

age groups (myocardia, tachycardia, respiratory arrhythmia, blockade of various parts of the conduction system of the heart).

In Vardenis adolescents, serious functional abnormalities are also observed in the respiratory system: high respiratory rate, low vital capacity, high energy consumption (Tab. 2).

The observed differences between the indicators of physiological functions of the two groups of students can be explained by the geographical conditions of Vardenis. Vardenis is located at an altitude of 2200 *m* above sea level, and Stepanavan – 1300 *m* a.s.l., therefore, the difference in atmospheric pressure cannot be excluded. However, some literature data exclude this hypothesis [12]. As a result of studies conducted in normobaric and hypobaric oxygen conditions, it was established that the main factor in the development of endogenous hypoxia is not atmospheric pressure, but the partial pressure of oxygen in the atmosphere, which may decrease due to the presence of other gases in the atmosphere. Monitoring carried out in this region showed that the amount of gases emitted by the mine into the atmosphere several times exceeds the permissible norm. From the discussion of the data obtained, it becomes clear that the differences in the recorded indicators are a consequence of the unfavorable environmental environment [13].

Table 2

Some indicators of the respiratory system of students ($p < 0.05$)*

Study indicator	Stepanavan	Vardenis	
		A **	B **
Respiration rate, movements/ <i>min</i>	14.88 ± 0.35	25.12 ± 0.61	16.42 ± 0.39 *
Tidal volume (<i>l</i>)	0.47 ± 0.02	0.35 ± 0.002	0.54 ± 0.002 *
Vital capacity of the lungs (<i>l</i>)	3.65 ± 0.02	2.64 ± 0.02	4.15 ± 0.03 *
Minute volume of pulmonary ventilation (<i>l</i>)	6.77 ± 0.04	5.02 ± 0.02	6.41 ± 0.03 *
Energy consumption per minute, <i>kcal</i>	0.91 ± 0.01	1.64 ± 0.02	1.20 ± 0.01 *

** before (A) and two months after using a decoction of hawthorn flowers and breathing exercises (B)

Subsequent experiments showed that a decoction of hawthorn flowers and breathing exercises for two months significantly corrected functional deviations caused by an unfavorable external environment, significantly reducing heart rate, systolic, diastolic and blood pressure, bringing them closer to those of the control group. Relief is also observed in breathing parameters.

Results and Discussion. Lack of oxygen in the atmospheric air (exogenous hypoxia) due to the high geographical position of the area (2200 *m* a.s.l.) or unfavorable ecological environment causes various diseases or complicates the course of existing diseases. This factor causes disturbances in blood circulation, blood composition, activity of tissue respiration enzymes and other biochemical abnormalities, the main cause of which is a violation of redox processes in the body [14–16].

Biochemical studies revealed that the amide groups of proteins increase as a result of lipid peroxidation in the brain of rats under conditions of hypoxia. After taking hawthorn extract, their total number decreased significantly. In a series of biochemical experiments, the antioxidant properties of *Crataegus laevigata* were investigated in the process of lipid peroxidation in the brain of rats [10].

Free radicals have a free electron, which makes them very active and unstable, and can bind electrons to other compounds, disrupting their structure and, therefore, their biochemical activity. This is a chain process of chemical reactions, during which new free radicals are formed, which disrupt the structure of cell membranes, disrupt the normal course of metabolism, causing many diseases and premature aging. These processes can be stopped with the help of antioxidant substances, which remove some of the free radicals from the body's cells, preventing functional disorders.

A number of medicinal plants, including hawthorn (*Crataegus*) used in folk medicine, have antioxidant properties. Its flowers, leaves and fruits contain vitamins (A, B, C, K, E), flavonoids, glycosides, etc. [17–20].

As a result of previous studies, it was established that the use of a decoction of hawthorn flowers has a certain corrective effect for functional abnormalities of the respiratory and cardiovascular systems [10]. This study showed that the positive effects of hawthorn flowers are more effective when combined with breathing exercises. Breathing exercises are based on an arbitrary decrease in the depth and frequency of breathing within certain limits, as a result of which the saved energy helps to improve the body's adaptive mechanisms [21–23].

With each breathing movement, a certain amount of energy is expended to overcome the resistance of the walls of the upper respiratory tract, the elastic force of the walls of the lungs, the resistance of the abdominal cavity and the diaphragm. The saved energy, as a result of reducing the number of respiratory movements, is used to improve other adaptive mechanisms of the body. As a result, the physical capabilities of the body and the reserve capabilities of the cardiorespiratory system increase [24].

Indicators of the cardiovascular and respiratory systems, which provide the body with oxygen, are an indicator of a person's adaptive activity. Automation of low breathing frequency during breathing exercises leads to normalization of heart rate, which is the main factor in regulating the functional state of the body [25].

There is a positive close correlation between minute volume of breathing, heart rate and minute volume of blood, that is, between indicators characterizing the intensity of physical work. This suggests that during physical work of the same duration, a decrease in minute breathing volume is accompanied by a decrease in heart rate, which helps maintain its activity [22].

Conclusion. Thus, the research data obtained confirm that the natural antioxidants of hawthorn flowers in combination with breathing exercises cause adaptive changes in the respiratory and cardiovascular systems, helping to activate metabolic processes in the body and improve physical capabilities. As a result, there has been a decrease in student illness and the number of absences from classes. Consequently, for the prevention of pathological developments in the body of adolescents, and not only those living in environmentally unfavorable regions, we

can recommend the use of the method of this research, which does not require special costs, but strengthens the volitional qualities of students.

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ԷԿՈԼՈԳԻԱԳՐԵՍ ԱՆԲԱՐԵՆՊԱՍՏ ՊԱՅՄԱՆՆԵՐՈՒՄ ԱՌԱՋԱՑԱԾ
ԱՌՈՂՋԱԿԱՆ ՇԵՂՈՒՄՆԵՐԻ ՇՏԿՈՒՄԸ ՈՉ ԴԵՂՈՐԱՅՔԱՅԻՆ
ՄԻՋՈՑՆԵՐՈՎ

Մթնոլորտային թթվածնի պակասը (էկզոգեն հիպօքսիա) բարձր լեռնային շրջանների բնակիչների մոտ առաջացնում է արյան շրջանառության, արյան կազմի, հյուսվածքների շնչառական ֆերմենտների ակտիվության և կենսաքիմիական այլ շեղումներ, որոնք օրգանիզմում առաջացնում են ֆունկցիոնալ խանգարումներ են՝ նպաստելով մի շարք հիվանդությունների զարգացմանը: Իսկ այդ շրջաններում գործող բաց հանքերը ստեղծում են անբարենպաստ էկոլոգիական միջավայր՝ ավելացնելով թթվածնաքաղցը, նպաստելով բնակչության շրջանում օրգանիզմի ֆունկցիոնալ խանգարումների խորացմանը: Այս տարածաշրջանի բնակչության ռիսկի խմբում են նաև դեռահասները: Այս ռիսկերը կարելի է նվազեցնել և հիվանդությունները կանխարգելել՝ օգտագործելով ոչ դեղորայքային միջոցներ՝ օգտագործելով հակահիպօքսիկ ազդեցություն ունեցող դեղաբույսեր և հատուկ շնչառական վարժություններ:

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КОРРЕКЦИЯ НЕФАРМАКОЛОГИЧЕСКИМИ СРЕДСТВАМИ
ОТКЛОНЕНИЙ ЗДОРОВЬЯ, ВЫЗВАННЫХ ЭКОЛОГИЧЕСКИ
НЕБЛАГОПРИЯТНЫМИ УСЛОВИЯМИ

Дефицит кислорода воздуха (экзогенная гипоксия) вызывает у жителей высокогорных регионов нарушения кровообращения, состава крови, активности ферментов тканевого дыхания и другие биохимические отклонения,

которые вызывают функциональные нарушения в организме и способствуют развитию ряда заболеваний. А действующие в этих регионах открытые шахты создают неблагоприятную экологическую среду, усиливая кислородное голодание, способствуя углублению функциональных нарушений организма у населения. Подростки также входят в группу риска среди населения этого региона. Снизить эти риски и предотвратить заболевания можно, применяя немедикаментозные меры, используя травы с антигипоксическим действием и специальные дыхательные упражнения.