

COMMUNICATION

*Biology*

CORRECTIVE EFFECT OF BREATHING EXERCISES ON  
THE HEALTH OF ECOLOGICALLY UNFAVORABLE  
REGIONAL SCHOOLS CHILDREN

M. A. KARAPETYAN<sup>1\*</sup>, N. Yu. ADAMYAN<sup>1\*\*</sup>, S. R. AGHAJANYAN<sup>2\*\*\*</sup>

<sup>1</sup> *Chair of Human and Animal Physiology, YSU, Armenia*

<sup>2</sup> *Vardenis Basic School No. 3, Gegharkunik Region, Armenia*

The normal course of biochemical and physiological processes that ensure the vital activity of the organism, among other systems, also depends on the normal functioning of the respiratory system. A number of external and internal factors can affect the indicators of respiratory movements: frequency, depth, respiratory volume: atmospheric pressure, the amount of oxygen in the atmosphere, the ecological state of the environment, various pathologies of the organism, etc., which become the cause of diseases. In the risk group of these diseases are the inhabitants of the areas near the ecologically unfavorable environment, especially the open mines, particularly the school children of that region. It is possible to reduce these risks and prevent diseases of the mentioned systems by the method of special breathing exercises. Residents of ecological regions, in particular adolescents, are at risk. This risk can be reduced by using the breathing exercise method.

The purpose of this study was testing the effectiveness of these exercises on the indicators of the respiratory system of teenagers in the Vardenis Region.

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**Keywords:** unfavorable environment, schoolchildren, breathing exercises, breathing indicators, respiratory rates, respiratory volume, lung vital capacity.

**Introduction.** At high altitudes the lack of oxygen in the atmosphere causes oxygen deficiency – hypoxia. As a result, biochemical and physiological processes are disrupted, which leads to the development of pathological disorders in the body. In environmentally unfavorable conditions this risk increases. Cardiovascular and respiratory systems are most sensitive to these conditions [1]. Functional disorders of these systems are often found in people living in the regions of open pit mines. Adolescents from these regions are at risk for these disorders. This risk can be reduced by increasing the adaptive capacity of the organism improving their

\* E-mail: [marieta\\_karapetyan@yahoo.com](mailto:marieta_karapetyan@yahoo.com)

\*\* E-mail: [nona01011966@mail.ru](mailto:nona01011966@mail.ru)

\*\*\* E-mail: [aghajanyan\\_s@mail.ru](mailto:aghajanyan_s@mail.ru)

regulation mechanisms. For this, the method of breathing exercises is used, which strengthen the respiratory muscles, increase the mobility of the chest and diaphragm, the elasticity of the alveolar membranes, improve respiratory mechanisms and coordination of respiratory movements [2–4].

The Vardenis Region is located at an altitude of about 2000 *m* a.s.l. (atmospheric pressure 809.92 *mbar*), which is a naturally moderately hypoxic environment. In this region, the Sotk Gold Mine is operated in an open-pit way. Toxic cyanide compounds are transported by wind into the atmosphere from that mine, exacerbating exogenous oxygen starvation. These conditions cause functional disorders in people living in the region of open mines, including residents of the Vardenis Town. These disorders lead to endogenous hypoxia, contribute to the development of various diseases.

**Materials and Methods.** The research was conducted among high school students (15–17 years old) (25 students) in the Vardenis Town, Gegharkunik Region. Schoolchildren's electrocardiograms (ECG), respiration rate, respiration volume, heart rate, systolic, diastolic-vascular pressure, blood composition, blood oxygen saturation, erythrocyte sedimentation rate were examined. This article presents only the indicators of respiration.

As a control group, adolescents of the same age (23 students) from the ecologically clean resort town of Stepanavan, Lori region (1300 *m* above sea level) were examined.

The research was conducted with the consent of the students' parents. The subjects' respiration rate, lung capacity and respiratory volume (dry spirometer) were measured at rest.

The minute volume of alveolar ventilation (*MV*) was calculated with the formula

$$MV = f (RV - DV),$$

where *f* is the respiratory rate; *RV* is respiratory volume; *DV* is volume of dead airway area (average 150 *mL*).

After the initial examination, breathing exercises were performed, reducing the respiratory rate to six breaths per minute. One breathing movement during training includes three stages: not too deep inhalation, pause and slow exhalation. The ratio between inhalation and subsequent pause + exhalation time should be 1:3. The trainings were conducted every day, 3 times a day, for 10 *min* (in the morning at 8.45, in the afternoon at 14.00, in the evening at 20.00 under the supervision of parents).

After two-months, the participants were re-examined.

Under normal, as well as voluntary reduction of respiration rate, conditions breathing energy expenditure was calculated according to Sherr's – respiration rate  $\times 0.13$  *kcal* [5].

Data validation was performed by statistical analysis using SPSS software package. All studies were conducted in accordance with Articles 5.6 and 7 of the Universal Declaration of Human Rights and Bioethics.

**Results and Discussion.** The basis of breathing exercises is the ability to arbitrarily regulate the depth and frequency of breathing within certain limits [6].

This method led to a positive result in students of health-improving groups of the Armenian State Pedagogical University after Kh. Abovyan, who had disorders of the cardiovascular and respiratory systems – arrhythmia, neurocirculatory dystonia, mitral valve insufficiency, chronic pneumonia and others [7, 8].

Preliminary monitoring of the health status of students showed a significant difference between the indicators of the studied physiological systems of the control and experimental groups, which is undoubtedly a consequence of the ecological environment (see Table).

*Breathing parameters of students of Stepanavan Town (control) and Vardenis Town (experimental group) before and after breathing training (\*  $p < 0.05$ )*

Research indicator	Stepanavan Town	Vardenis Town (experimental group)	
	control group	before the training	after the training
The frequency of respiratory movements (breathing movement/ <i>min</i> )	14.88 ± 0.35	24.50 ± 1.80*	16.62 ± 0.59*
Respiratory volume (l)	0.47 ± 0.02	0.51 ± 0.01*	0.55 ± 0.02*
Vital capacity of the lung (l)	3.65 ± 0.21	2.66 ± 0.11*	4.12 ± 0.30*
Pulmonary ventilation, volume per <i>min</i> (l)	6.77 ± 0.41	12.13 ± 0.031*	8.89 ± 0.51*
Energy consumption per <i>min</i> , <i>kcal</i>	0.91 ± 0.01	1.62 ± 0.01*	1.19 ± 0.02*

Research data show that the method of voluntary reduction of respiratory rate has an effective corrective effect even in disorders caused by unfavourable environmental conditions.

As a result of the two-month breathing exercise in the experimental groups, positive changes in the activity of the respiratory system were registered among students (see Table). The frequency of breathing decreased, approaching the indicator of the control group, the respiratory volume and the vital capacity of the lungs increased. As a result of exercises, the minute volume of the lungs decreases significantly (from 12.13±0.03 to 8.89±0.03). In the case of voluntary reduction of the breathing rate, due to the reduction of the volume of air in the dead space of the airways, the volume of breathing air increases and the vital capacity of the lungs increases from 2.66±0.01 to 4.12±0.03. As a result, the energy costs of breathing also decrease from 1.62±0.01 to 1.19±0.02, that is, bioenergy saving occurs.

It is known during inhalation some energy is used to overcome the resistance of the walls of the upper respiratory tract, the elasticity of the lungs and chest muscles, as well as the resistance of the bronchial tree [9, 10]. Naturally, with a decrease in the respiratory rate, part of the saved energy can be spent to improve the adaptive mechanisms and the functional state of the organism [11–14].

Breathing energy savings calculations showed that the energy cost of breathing in the experimental group significantly decreased after exercise (1.62±0.01 became 1.19±0.02), which confirms the effectiveness of the method of voluntary reduction of breathing frequency.

Consistent communication of the positive results of the research to students and their parents ensures that these exercises are also carried outside of classes and during school holidays.

**Conclusion.** Thus, breathing exercises have a noticeable corrective effect on the health of the population of ecologically problematic regions, particularly schoolchildren. The effectiveness of this method is also due to the fact that it does not require technical means and can be used in school physical education classes. It should be emphasized that performing exercises at home in the evening under the supervision of parents strengthens the volitional qualities of adolescents and ensures their continuity outside the lessons.

The research shows that breathing exercises can be important not only for school children, but also for the local population and mine workers.

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Մ. Ա. ԿԱՐԱՊԵՏՅԱՆ, Ն. ՅՈՒ. ԱԴԱՄՅԱՆ, Ս. Ռ. ԱԳԱԶՅԱՆ

ՇՆՉԱՌԱՎԿԱՆ ՎԱՐԺՈՒԹՅՈՒՆՆԵՐԻ ՇՏԿՈՂ ԱԶԴԵՑՈՒԹՅՈՒՆԸ  
ԷԿՈԼՈԳԻԱԳԵՍ ԱՆԲԱՐԵՆՊԱՍՏ ՏԱՐԱԾԱԾՐՁԱՆԻ  
ԴՊՐՈՑԱԿԱՆՆԵՐԻ ԱՌՈՂՋՈՒԹՅԱՆ ՎՐԱ

Օրգանիզմի կենսագործունեությունն ապահովող կենսաքիմիական և ֆիզիոլոգիական պրոցեսների բնականոն ընթացքը կախված է շնչառական համակարգի բնականոն աշխատանքից: Շնչառության ցուցանիշների՝ հաճախության, խորության, շնչառական ծավալի վրա կարող են ազդել մի շարք արտաքին և ներքին գործոններ՝ մթնոլորտային ճնշումը, թթվածնի քանակը մթնոլորտում, շրջակա միջավայրի էկոլոգիական վիճակը, օրգանիզմի տարբեր պաթոլոգիաները և այլն, որոնք կարող են դառնալ հիվանդությունների պատճառ: Այս հիվանդությունների ռիսկային խմբում են գտնվում էկոլոգիապես անբարենպաստ միջավայրում, հատկապես բաց հանքերին հարող տարածքների բնակիչները, այդ թվում նաև դպրոցականները: Հատուկ շնչառական վարժությունների մեթոդով հնարավոր է նվազեցնել այդ ռիսկերը և կանխարգելել նշված համակարգերի հիվանդությունները:

Այս ուսումնասիրության նպատակն է եղել ստուգել այս վարժությունների արդյունավետությունը Վարդենիսի տարածաշրջանի դեռահասների շնչառական համակարգի ցուցանիշների վրա:

M. A. KARAPETYAN, N. YU. ADAMYAN, S. P. AGADJANYAN

КОРРЕКТИРУЮЩЕЕ ВЛИЯНИЕ ДЫХАТЕЛЬНЫХ  
УПРАЖНЕНИЙ НА ЗДОРОВЬЕ ШКОЛЬНИКОВ  
ЭКОЛОГИЧЕСКИ НЕБЛАГОПРИЯТНОГО РЕГИОНА

Нормальное течение биохимических и физиологических процессов, обеспечивающих жизнедеятельность организма в числе других систем зависит также и от нормального функционирования дыхательной системы. На показатели дыхательных движений (частоту, глубину, дыхательный объем) может влиять ряд внешних и внутренних факторов: атмосферное давление, количество кислорода в атмосфере, экологическое состояние окружающей среды, различные патологии организма и др., которые могут стать причиной различных болезней. В группу риска данной проблемы входят жители, в том числе и школьники, регионов, расположенных вблизи экологически неблагоприятной среды, особенно в районах открытых рудников. Методом специальных дыхательных упражнений можно снизить этот риск, в частности у школьников средних классов, и предотвратить развитие патологических процессов в организме.

Целью данного исследования являлась проверка влияния этих упражнений на показатели дыхательной системы подростков Варденисского района.