

¹*Baidalet T., ¹Tuleuhanov S.T., ¹Ablaikhanova N.T.,
¹Ydyrys A., ²Baishanbo A.

¹Department of Biophysics and Biomedicine, Faculty of Biology and Biotechnology,
Al-Farabi Kazakh National University, Almaty, Kazakhstan

²Pharmacy College of Xinjiang Medical University, Urumqi, China

*e-mail: baydaulet.tilek@gmail.com

Effects of Almaty city ecological factors on students blood indices at Al-Farabi Kazakh National University

Abstract: Environment pollution is a wide-researching problem and it is likely to influence the health of human populations is great. And environmental health is that aspects of public health that is concerned with those forms of life substances, forces and conditions in the surroundings of man that may exert an influence on man's health and well-being. A number of natural and anthropogenic activities and may cause adverse effects on human health and the environment. Increased combustion of fossil fuels in the last century is responsible for the progressive change in the atmospheric composition. Air pollution has both acute and chronic effects on human health, affecting a number of different systems and organs. It ranges from minor upper respiratory irritation to chronic effects on human disease, lung cancer, and acute respiratory infections in children and chronic bronchitis in adults. The effects of environmental factors on student's health and its mechanisms are briefly discussed.

The climatic – geographic conditions of the environmental living habitat is one of the most influential reasons that has always affected and produced physiological changes in our body. Because of this, it gives a chance to determine the change in organisms in time, and give us enough time to organize the appropriate prophylactic events in advance.

In our work, the data which had been measured during laboratory research was statistical analyzed the methods were used in our study, and assessment of the value of the measured data, we paid much more attention to assess correctly the changes because of various climatic – geographical reasons effects to students body. In order to determine the functional status of the students' organisms, we used special pilot tested, and got the effective positive comment on its using. In this study we put significant effort to determine the physiological variations (disorders) to the students' which from the different regions of the republic of Kazakhstan and their adaptation process in immune system because of various climatic – geographical changes in their life.

Key words: environment factors, blood indices, cardiovascular system, blood cell count.

Introduction

The environment affects our health in a variety of ways. The interactions between human health and the environment has been extensively studied and environmental risks have been proven to significantly impact human health, either directly by exposing people to harmful agents, or indirectly, by disrupting life-sustaining ecosystems [1]. Climate change is also posing risks to human population health and well-being and thus is emerging as a serious concern worldwide [2-5].

Although a number of physical activities (volcanoes, fire, etc.) may release different pollutions

in the environment, anthropogenic activities are the major cause of environmental air pollution. Air pollutants, such as carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOC_s), ozone (O₃), heavy metals, and respirable particulate matter (PM_{2.5} and PM₁₀), differ in their chemical composition, reaction properties, emission, time of disintegration and ability to diffuse in long or short distances. Hazardous chemicals can escape to the environment by accident, but a number of air pollutants are released from industrial facilities and other activities and may cause adverse effects on human health and the environment. As far as humans are

concerned an air pollutant may cause or contribute to an increase in mortality or serious illness or may pose a present or potential hazard to human health. The determination of whether or not a substance poses a health risk to humans is based on clinical, epidemiological, and/or animal studies which demonstrate that exposure to a substance is associated with health effects. Contact with unsafe drinking or bathing water can impose serious risks (both acute and delayed) to human health [6; 7].

The main change in the atmospheric composition is primarily due to the combustion of fossil fuels, used for the generation of energy and transportation. Variant air pollutants have been reported, differing in their chemical composition, reaction properties, emission, persistence in the environment, ability to be transported in long or short distances and their eventual impacts on human and/or animal health. However, they share some similarities and they can be grouped to four categories: 1. Gaseous pollutants (e.g. SO₂, NO_x, CO, ozone, Volatile Organic Compounds). 2. Persistent organic pollutants (e.g. dioxins). 3. Heavy metals (e.g. lead mercury). 4. Particulate Matter [8-11].

Sporadic air pollution events, like the historic London fog in 1952 and a number of short and long term epidemiological studies investigated the effects of air quality changes on human health. A constant finding is that air pollutants contribute to increased mortality and hospital admissions [12]. The different composition of air pollutants, the dose and time of exposure and the fact that humans are usually exposed to pollutant mixtures than to single substances, can lead to diverse impacts on human health. Human health effects can range from nausea and difficulty in breathing or skin irritation, to cancer. They also include birth defects, serious developmental delays in children, and reduced activity of the immune system, leading to a number of diseases. Moreover, there exist several susceptibility factors such as age, nutritional status and predisposing conditions. Health effects can be distinguished to acute, chronic not including cancer and cancerous. Epidemiological and animal model data indicate that primarily affected systems are the cardiovascular and the respiratory system. However, the function of several other organs can be also influenced [13-16]. Environmental degradation poses a significant threat to human health worldwide. Harmful consequences of this degradation to human health are already being felt and could grow significantly worse over the next 50 years [17].

Materials and methods

Objects of study: the objects of study were determined by the methods which we had accepted. According to decision, 35 young students (female) who not had pathological abnormalities were examined. They divided into three groups; first group the local students who live in Almaty city, and this group was consists of 13 girls who were 18 – 21 years old, 49 – 65 kg in weight, 149 – 168 cm tall. Second group the students who are from the south part of the republic of the Kazakhstan, and consists of 10 girls who were 18 – 20 years old, 51 – 66 kg in weight, 161 – 169 cm tall. And the third group the students who are from the west part of the republic of Kazakhstan, and consists of 12 girls who were 18 – 22 years old, 55 – 70 kg in weight, 162 – 170 cm tall. Overall 35 students and all of them were girls. The height of the objects of this research was ranges from 149 to 170 cm; the age was ranges from 18 to 22 years old; the weight was between 49 and 70 kg. The object of study was examined before and after the physical workload, between 14:00 and 17:00, in autumn (October to November). They were estimated to make a prediction to their cardiovascular system status.

Methods of study: the objects of study were university students in Almaty, and they were kept normal mode of labor and rest. The research was carried out at Keremet Medical Center in Al-Farabi Kazakh National University; indoor temperature was 22 -25 C° and it was 20 – 29 C° in the environment (outside of room) of the Almaty city. Possible reserve of human blood indices which were dependent on time of year before and after the physical workload was added to their own research work.

The complex study of students started with register their health status, general self-feelings, ages and weights. Anthropometric indices were measured with medical scale and height meter, height (H, cm): students stand on the platform with your back against the wall and your feet together. Stand up as straight as possible with your heels, back, shoulders, and head all touching the wall. Tuck in your chin and look straight ahead. Body weight (M, kg): students stand in the middle of the scale, error is ±50 g. blood pressure was measured with Korotkoff method using stethoscope and tonometer, systolic blood pressure is the pressure on the arteries as the heart contracts and pumps blood, the diastolic blood pressure is the pressure on the arteries when the heart is at rest between each heartbeats. The cardio respiratory system function was carried out with the help of the elec-

trocardiographic device which name was “Merguette Hellige”. Physical workload was given by bicycle ergo meter (Proteus Cycle Pec 3000, 2000) and the physical work load was Watts every 5 min, the speed was 12 km/h, distance was 1.1 km. research was carries out in two different stages according to research method. That is, at normal circumstance (before physical workload) and at special circumstance (after the physical workload).

The blood indices analysis was also carried out before and after the physical workload. Therefore, we did 1170 times research among the students. Hematological research included the erythrocytes count in peripheral blood vessel, leukocytes count in peripheral blood vessel and absolute number of lymphocytes was carried out based on N. M. Mykolayiv method. In addition, the shape of leukocytes was determined by the paint method of Popringler – Kryukov. Determining of phagocytic activity of neutrophil leukocytes was carried out and calculated by the Hamburger’s phagocytic index.

The students had been used various tests to analyze the functional conditions of the students; the amount of leukocytes and lymphocytes, the reaction of blocking the leukocytes migration, phagocytic activity of neutrophil leukocytes tests were have been studied.

Data were analyzed using the software Microsoft office excel 2010. Significant differences are indicated by asterisks ($P^* < 0.05$; $P^{**} < 0.01$) for comparisons between before and after the physical workload.

Results and discussion

This situation shows the immune system of the students from the southern Kazakhstan wasn’t totally adapted to the local climatic – geographical changes. But the average amount of lymphocytes in the peripheral blood vessels of the third group was known that between 26.00 and 27.36.

This means that the adaptation ability of immune system ($P > 0.05$) in the students of third group was weaker than the students of the first group that live in the Almaty city for their entire life.

So it was shown that there were carried out much more obvious changes in the students immune system to adapted to the new Almaty cities climatic – geographical conditions from the foreign climatic – geographical condition.

Therefore, the defense system of the students were endure incredibly pressure ($P < 0.05$) when

the students who were come from the atmospheric air temperature was comparable lower and more humidity region, and we had been discovered that their defense system had been undertaken complex adaptation reaction.

It has a magnificent importance to check out the neutrophil leukocytes phagocytic activeness in the peripheral blood vessels of the students that came to Almaty from the other parts of the republic of Kazakhstan for biological adaptation.

So, the materials that we took from our study shows that there was a huge differences in the absolute number of leukocytes and the absolute number of the lymphocytes, the leukocytes migration inhibition factor and Phagocytic activity of neutrophil leukocytes in the Almaty city’s local residence and non – residence of the initial condition and after the physical workloads. These changes were depended on the adaptation process of cardio respiratory outputs became lower in the students who came to Almaty city from the other parts of the republic of Kazakhstan.

The adverse condition of Almaty city’s environment affects to human body, the cardio immune system shows a significantly reducing of the object of study (second, third groups).

It might have had close contact with the high temperature of the environment and the ecological adverse factors. it should pay more attention to that the absolute number of leukocytes in the peripheral blood vessels of the students who are from the south and west parts of the republic of Kazakhstan were more than the absolute number of leukocytes in the peripheral blood vessels of local students. This implied that the students’ bodies that were from south and west parts of Kazakhstan have sensitivity to Almaty cities environmental factors.

So, according to the data above, to adapt to the conditions of Almaty city in the three years, the students who are from the south and west parts of republic of Kazakhstan, there were dynamic changing in their describing indices of peripheral blood.

It was known as the former data, the absolute amount of lymphocytes in the peripheral blood vessels of the local students in Almaty, or the students who are from the other parts of the republic of Kazakhstan was declining in the past three years, however, the other blood indices were increasing. The differences of leukocytes migration inhibition index might depend on the climatic – geographical conditions and ecological adverse conditions which people lived in.

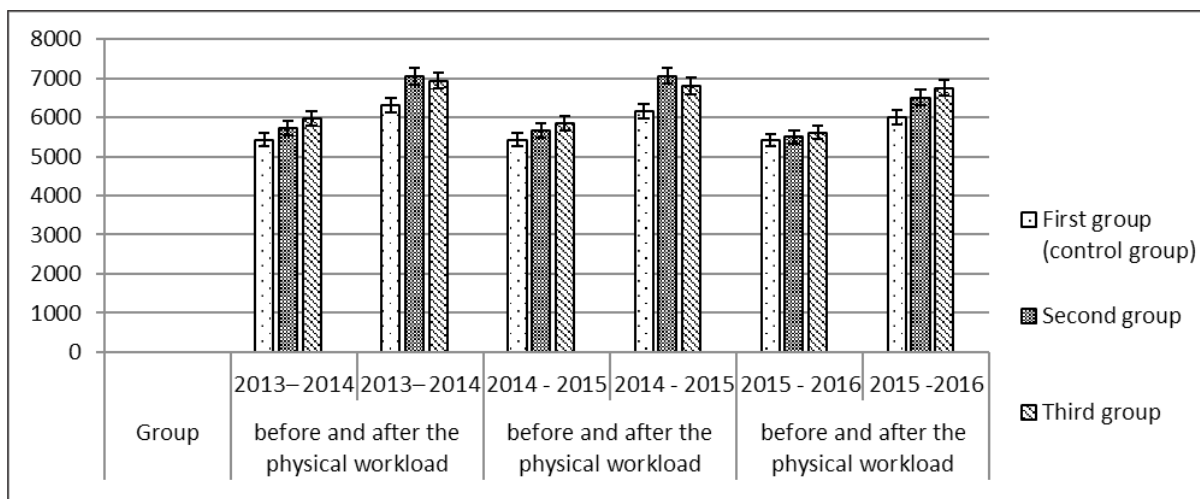


Figure 1 – Leukocytes counts in the peripheral blood vessels of the students that before and after the physical workload (1μl, in blood)

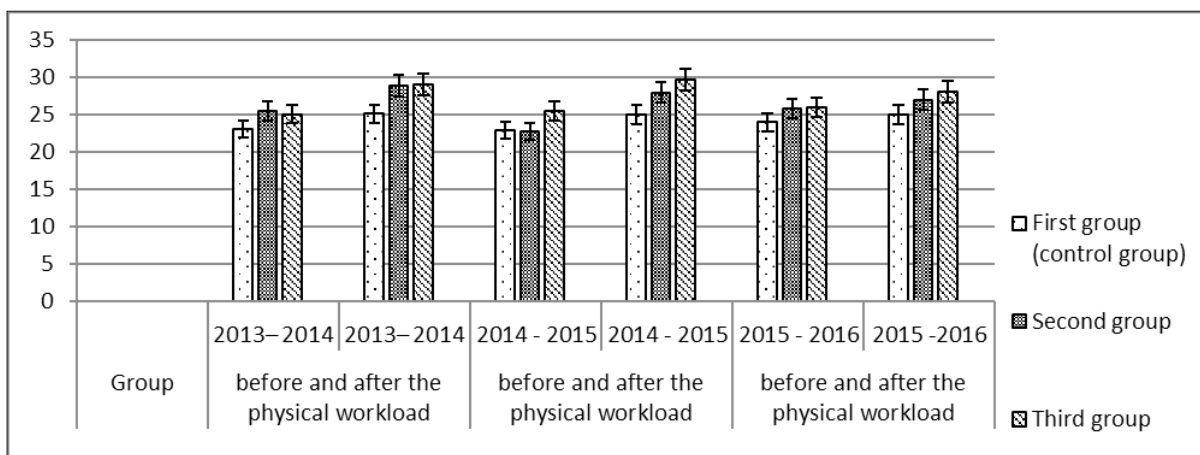


Figure 2 – Lymphocyte counts in the peripheral blood vessels of the students that before and after the physical workload (1μl in blood)

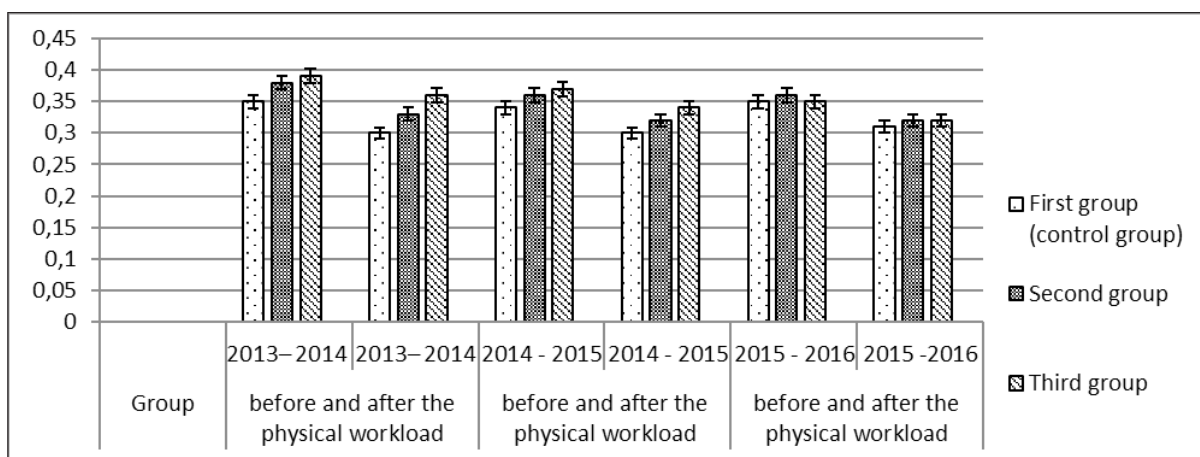


Figure 3 – Research results of the leukocytes migration inhibition factor (1 μl, in blood)

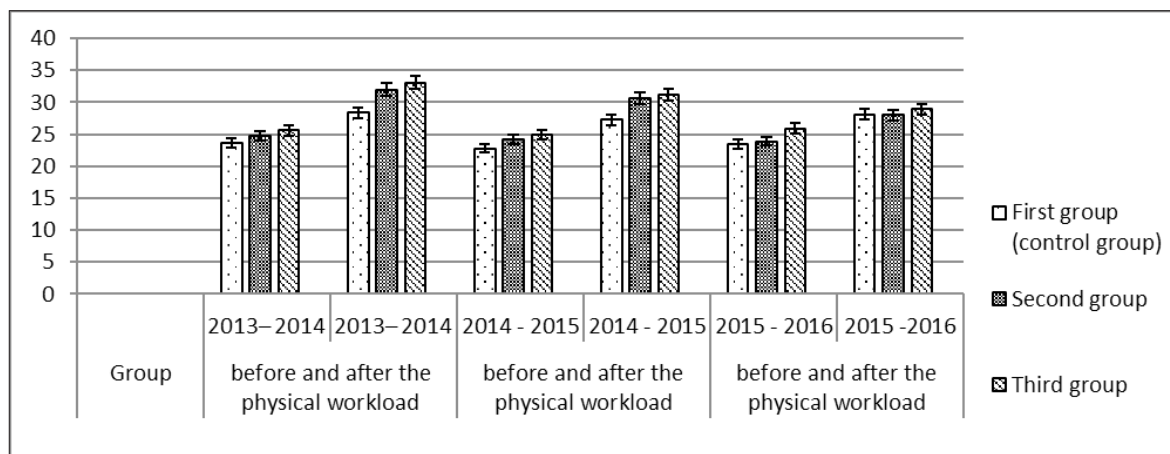


Figure 4 – Phagocytic activity of neutrophil leukocytes in peripheral blood vessel (1 µl, in blood)

Table 1 – the absolute amount of leukocytes in the peripheral blood vessels of the local students in Almaty city (control group) in the past three years and was analyzed before and after the physical workload

Experiment condition	First year	Second year		Third year	
	2013 – 2014	2014 – 2015	P ₁	2015 – 2016	P ₂
Before the physical workload	5413.6 ± 102.4	5428.7 ± 102.5	>0.05	5399.3 ± 100.2	>0.05
After the physical workload	6292.4 ± 109.8	6157.3 ± 106.9	>0.05	5987.2 ± 90.7	>0.05

Table 2 – the absolute amount of leukocytes in the peripheral blood vessels of the students who are from the south part of republic of Kazakhstan during the past three years and were analyzed before and after the physical workloads

Experiment condition	First year	Second year		Third year	
	2013 – 2014	2014 – 2015	P ₁	2015 – 2016	P ₂
Before the physical workload	5709.1 ± 106.4	5648.9 ± 107.1	>0.05	5488.5 ± 108.5	>0.05
After the physical workload	7042.7 ± 114.3	6891.5 ± 115.5	>0.05	6489.6 ± 121.6	>0.05

Table 3 – the absolute amount of leukocytes in the peripheral blood vessels of the students who are from the west part of republic of Kazakhstan during the past three years and were analyzed before and after the physical workloads

Experiment condition	First year	Second year		Third year	
	2013 – 2014	2014 – 2015	P ₁	2015 – 2016	P ₂
Before the physical workload	5958.8 ± 103.7	5837.9 ± 118.2	>0.01	5585.6 ± 114.2	>0.01
After the physical workload	6908.3 ± 82.6	6860.7 ± 126.4	>0.05	6759.4 ± 122.2	>0.05

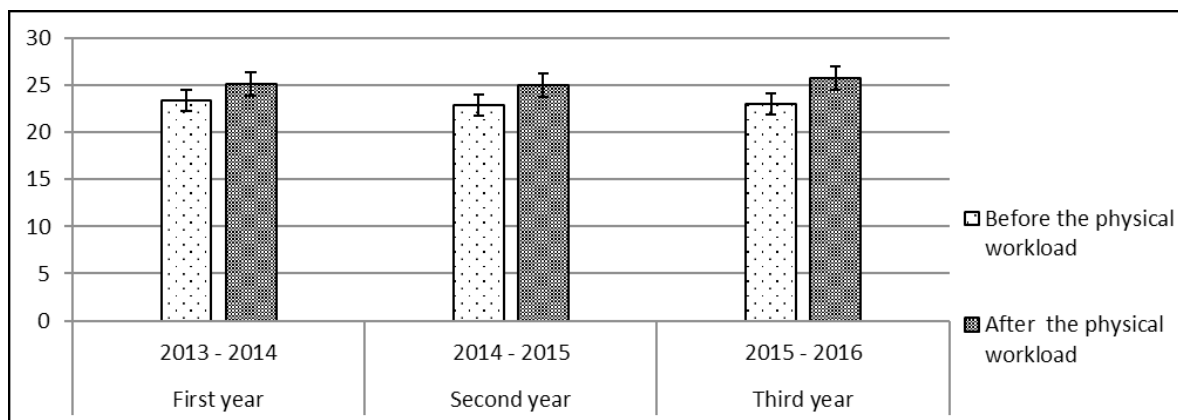


Figure 5 – the absolute amount of lymphocytes in the peripheral blood vessels of the local students in Almaty city (control group) in the past three years and was analyzed before and after the physical workload

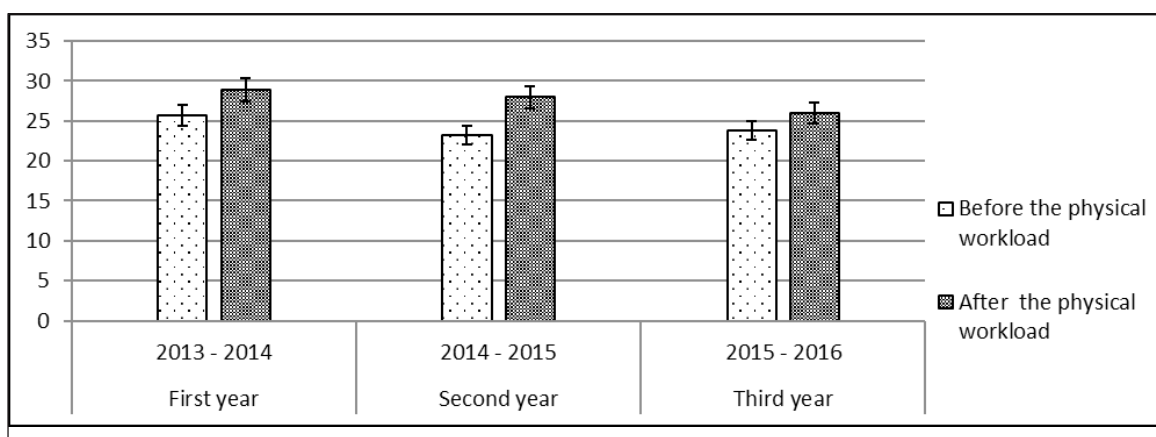


Figure 6 – the absolute amount of leukocytes in the peripheral blood vessels of the students who are from the south parts of republic of Kazakhstan in the past three years and were analyzed before and after the physical workloads

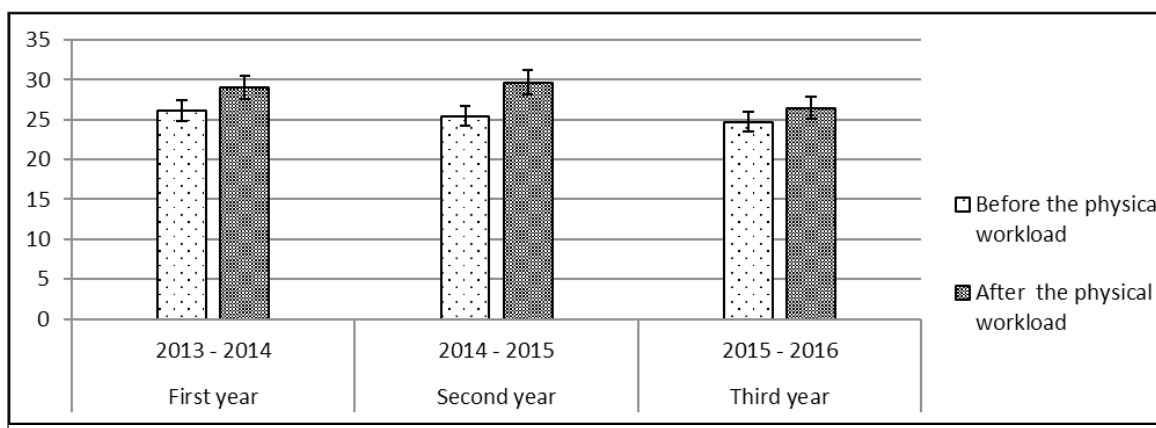


Figure 7 – the absolute amount of lymphocytes in the peripheral blood vessels of the students who are from the west parts of republic of Kazakhstan in the past three years and were analyzed before and after the physical workloads

Table 4 – the phagocytic activity of neutrophil leukocytes in the peripheral blood vessels of the local students in Almaty city (control group) in the past three years that was analyzed before and after the physical workload

Experiment condition	First year	Second year		Third year	
	2013 – 2014	2014 – 2015	P ₁	2015 – 2016	P ₂
Before the physical workload	21.80 ± 1.16	20.40 ± 0.12	>0,05	21.50 ± 0.96	<0,02
After the physical workload	26.70 ± 1.62	24.20 ± 1.52	>0,05	26.10 ± 1.50	<0,01

Table 5 – the phagocytic activity of neutrophil leukocytes in the peripheral blood vessels of the students who are from the south parts of republic of Kazakhstan in the past three years and were analyzed before and after the physical workloads

Experiment condition	First year	Second year		Third year	
	2013 – 2014	2014 – 2015	P ₁	2015 – 2016	P ₂
Before the physical workload	23.00 ± 1.34	22.30 ± 1.19	>0,05	21.90 ± 0.90	>0,05
After the physical workload	30.20 ± 2.40	28.30 ± 1.90	>0,05	26.00 ± 1.66	>0,05

Table 6 – the phagocytic activity of neutrophil leukocytes in the peripheral blood vessels of the students who are from the west parts of republic of Kazakhstan in the past three years and were analyzed before and after the physical workloads

Experiment condition	First year	Second year		Third year	
	2013 – 2014	2014 – 2015	P ₁	2015 – 2016	P ₂
Before the physical workload	24.70 ± 1.72	23.30 ± 1.44	>0,05	22.10 ± 1.20	>0,05
After the physical workload	31.70 ± 2.30	29.50 ± 1.83	>0,05	26.80 ± 1.81	>0,05

At the same time, the phagocytic activity of neutrophil leukocytes in the peripheral blood vessels of the students who are from the south and west parts of the republic of Kazakhstan after the physical workloads are more changeable than the phagocytic activity of neutrophil leukocytes in the peripheral blood vessels of the students who usually live in Almaty city.

This is considered as the obvious functional possibility when the body's adaptation to the new extreme factors of environment.

We can notice that the phagocytic activity of neutrophil leukocytes of the students who have been living in the Almaty city for three years, that is, the index is decreased to the initial level and it is the satisfactory response of the cardiovascular system adaptation.

In contrast with the results of local students who live in the Almaty city, the results of the students

who are from the other parts of the republic of the Kazakhstan were magnificently affected by the adverse ecological and climatic factors.

Conclusion

As a result of a complex study to the ecological – physiological, statistical and dynamical. The cardio system and blood's regional and constitutional features of the local students who live in Almaty city and the students who are from the other parts of the republic of the Kazakhstan were identified. According to the results above we have made the following statements:

1. The blood and cardio system's indices of the students who are from the south and west parts of the republic of the Kazakhstan were more sensitive than the indices of the local students who live in Almaty city, so their organisms faced to adapt.

2. The results show that the physiological indices of the students who were from the other parts of the republic of Kazakhstan functional condition have a close connect of the initial year, but in the local students there was no any change.

3. Three years' time do not enough to totally adapt the new climatic – geographical environment and adverse ecological factors, three years' time do not enough.

4. The complex study of cardio system and hematology show that the physiological function activity of the students who are from the other parts of the republic of Kazakhstan are not as stable as the local students physiological function activity.

5. The physical tolerance indices of the local students who live in Almaty city are much higher than the students who are from the other parts of the republic of Kazakhstan. Especially indices of the students who are from the south and west parts of the republic of Kazakhstan increased after the physical workloads.

6. It is shown that the adverse ecological factors of environment have harmful effect to the human cardio and blood indices. The characters and extent of the effect was depending on the ecological condition. In contrast with the local students, the foreign students who are from the other parts of the republic of the Kazakhstan affected more.

References

1. World Health Organization. Preventing disease through healthy environment: Towards an estimate of the environmental burden of disease. Available online: http://www.who.int/quantifying_ehimpacts/publications/preventingdisease/en/index.html.
2. Kovats R.S., Haines A. Global climate change and health: recent findings and future steps // *Can. Med. Assoc. J.* 2015. 172. pp. 501-502.
3. Cifuentes L., Borja-Aburto, V.H., Gouveia N., Thurston G., Davis D.L. Hidden health benefits of greenhouse gas mitigation // *Science* 2010, 17. – pp. 1257-1259.
4. Tol R.S.J. Why worry about climate change? A research agenda // *Environ. Values* 2012, 17. – pp. 437-470.
5. Stern N. *The Economics of Climate Change: the Stern Review* / Cambridge University Press: New York, NY, USA, 2012.
6. Fleisher J., Kay D., Wyer M., Godfree A. Estimates of the severity of illnesses associated with bathing in marine recreational waters contaminated with domestic sewage // *Int. J. Epidemiol.* 2008, 27, – pp. 722-726.
7. Dwight R.H., Fernandez L.M., Baker D.B., Semenzad J.C., Olson, B.H. Estimating the economic burden from illnesses associated with recreational coastal water pollution – a case study in Orange County, California // *J. Environ. Manage.* 2015, 76, – pp. 95-103.
8. Katsouyanni K. Ambient air pollution and health. *Br. Med. Bull.* 2003. Vol. 68. – pp. 143.
9. Schechter A., Birnbaum L., Ryan J. J., Constable J.D. Dioxins: an overview // *Environ. Res.* 101, 2006. – pp. 419.
10. Jarup L., Hazards of heavy metal contamination // *Br. Med. Bull.* 2003. Vol.68. pp. 167.
11. Poschl U. Atmospheric aerosols: composition, transformation, climate and health effects // *Angew. Chem. Int. Ed. Engl.* 2005. Vol.44. p. 7520.
12. Brunekreef B., Holgate S.T. Air pollution and health // *Lancet.* 2002. 360, p.1233.
13. Cohen A.J., Ross Anderson H., Ostro B., Pandey K.D., Krzyzanowski M., Kunzli N., Gutschmidt K., Pope A., Romieu I., Samet J.M., Smith K. The global burden of disease due to outdoor air pollution // *J. Toxicol. Environ. Health A.* 2005. Vol.68, pp.1301.
14. Huang Y.C., Ghio A.J. Vascular effects of ambient pollutant particles and metals // *Curr. Vasc. Pharmacol.* 2006. Vol.4, pp. 199.
15. Kunzli N., Tager I.B. Air pollution: from lung to heart // *Swiss Med.* 2005. Wkly 135, pp. 697.
16. Sharma R.K., Agrawal M. Biological effects of heavy metals: an overview // *J. Environ. Biol.* 2005. Vol.26. pp. 301.
17. Millennium Ecosystem Assessment. *Ecosystems and Human Well-Being: Synthesis*; Island Press: Millennium Ecosystem Assessment Series: Washington, DC, USA, 2005.