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Monitoring of the Visual System of Students in the Southern Region of Kazakhstan and the Implementation of the Results in the Methods of Teaching Biology

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Abstract: The deterioration of the health of the visual system of students, registered in modern conditions in the Republic of Kazakhstan, indicates the need to introduce constant monitoring of the health of the visual system of the younger generation living in poor environmental conditions. However, studies on monitoring the growth of eye diseases in students of the southern regions of Kazakhstan, which are necessary for conducting appropriate monitoring, are currently lacking. In this regard, the goal was set to conduct a study among students of biological specialties, as future teachers of biology, on the knowledge of the problems of the visual system as a basis for the subsequent introduction of a methodology to improve the dynamics of growth of eye diseases in students into the course of Human Physiology. Monitoring of the visual system of students, consisting of a questionnaire and a medical examination, revealed the attitude of students to their health and the main pathologies of the organ of vision.

Keyword: Visual System, Eye Diseases, Overview, Methodology, Eye Exercises

1. Introduction

One of the key factors in the development of society is the health status of the country's residents. The problem of public health is given sufficient attention in long-term programs adopted by the government of the Republic of Kazakhstan in the field of health care. So, if the development strategy of the Republic of Kazakhstan "Kazakhstan-2030" defines the preservation of health and ensuring the well-being of citizens as one of the main long-term priorities, then the Strategy "Kazakhstan-2050"[1] specifies the priority areas for the development of health care, which include preventive medicine and information -explanatory work with the population. So one of the priority tasks of the country's health care and education system is the preservation and strengthening of the health of students in educational institutions of the country. However, in recent years, especially the transition to distance learning, there has been a tendency of visual impairment among students, which is associated with the influence of socio-economic, climatic-geographical, ethno-national, environmental and other factors[2] (Facchini F., Fiori G.,2008, Dyer S. M., Gomersall J. S.,2017, Wheaton A. G.,2016).

A special role in solving this problem belongs to higher education, where the formation of the personality takes place. However, according to official figures[3], secondary and high schools are the environment in which the health problems of the younger generation are initiated and aggravated. So, during the time of study at a Kazakh school, the number of students with scoliosis, visual impairment and posture is increasing. If at the age of 6-7 years 8.2% of children have diseases of the eye and its appendages, then at the age of 14-17 years - 70.3%, the number of students with scoliosis increases from 5.7% to 34%. Therefore, the organization of the prevention system in educational institutions is of great importance for the preservation and development of the health of students (Rouse H.,2019, Lee S. M., 2019).

Monitoring the health of all participants in the educational space can play a significant role in addressing these issues[4]. In the early years of the educational

[1] https://www.akorda.kz/ru/official_documents/strategies_and_programs

[2] Analysis of the current situation. Morbidity of children in the Republic of Kazakhstan (according to the data of professional examinations). - URL: http://balaombudsman.kz/wp-content/uploads/2018/04 (date accessed: 12.06.2019)

[3] Children of Kazakhstan: statistical collection. - Astana, 2017 .-- 122 p. URL: https://www.unicef.org

[4] Aizman R.I., Aizman N.I., Zakharenkov V.V., Iashvili M.V., Levina I.L. et al. Comprehensive assessment of the state of health and development of children. M. Company ASTSh, 2006. 166 p.

process, student receives about half of the information related to his future professional activity. Moreover, most of it is passed through the visual analyzer. The increase in the volume of load on the visual analyzer, according to doctors, is one of the main causes of dysfunction of the organ of vision. This is evidenced by the works of a number of scientists, for example, in his research dissertation A.S. Grachev referring to the works of E.V. Fazleeva (Fazleeva E.V.,2009), E.N. Kopeikina (Kopeikina E.N., 2010) and M.D. Bogoeva (Bogoeva M.D., 2011) indicates that the number of students of the first course with various pathologies of the visual analyzer annually increases by 3-5% (Grachev A.S. 2013).

Based on the results of studies carried out by scientists from the Scientific and Educational Center for Physical Culture and Health Technologies (SEC PHT) of the Belgorod State National Research University among 1-3 year students, A.S. Grachev states that a violation of the functions of the visual analyzer is observed in about 13.4% (Kopeykina E.N., 2010). He carried out a comparative analysis of the data obtained with the data for the 2008-2009 academic year, in which 8.9% of students with impaired vision were recorded.

As stated by other researchers, the following picture is presented. So, according to preventive examinations for the period 2007-2012, represented by E.A. Kalabugina, 36% of students of a technical university were diagnosed with eye diseases (Kalabugina E.A. 2013).

Among the reasons leading to dysfunction of the visual analyzer is work with electronic devices (computer, cell phone, tablet), as a result of which increases the likelihood of a number of pathologies of the visual analyzer, musculoskeletal system, gastrointestinal tract (Zhukembaeva A.M.,2016). G.I. Shvedov, analyzing the influence of a computer on human health, states that more than 90% of computer users complain of burning and pain in the eye area, feeling of sand under the eyelids, blurred vision, etc. (Vlasova E.M.,2011). This condition is described in the literature as computer visual syndrome, which occurs in 70% of users, the first signs of which are: a feeling of eye fatigue, the manifestation of frequent blinking, a feeling of heaviness in the eyes, redness (Smagulov N.K.,2013). Then there is lacrimation, increased photosensitivity, double image may create, headaches appear. Pain in the eye sockets and forehead may be experienced, when moving the eyes, blurred vision, slow focus, rapid fatigue with visual stress (for example, when reading texts). The reason for these phenomena is the features of visual work with electronic devices (Shvedov G.I.,2008).

The above information is also supplemented by experimental data. So, scientists from Bashkortostan conducted a study, which recorded the emergence of various signs of fatigue of the visual analyzer of students after 30 minutes of working at the computer (Futyma E.,2002).

In another study involving 959 schoolchildren aged 7-17 years it was found that almost all schoolchildren spend from one to six hours at the computer every day (Zhukembaeva A.M.,2016), which significantly exceeds the allowable time. At the same time, the time spent at the computer for students can be twice as much.

A number of publications raise the problem of the clinical manifestation of "dry eye syndrome", which is common in patients of mature and elderly age, in young people, as well as in children and adolescents. With dry eye syndrome, the person reading from the screen blinks less often, which means that the cornea is not sufficiently moisturized. The main symptoms of DES are eye pain, gritty feeling in eyelids, burning, itching, and photophobia (Isakova E.V.,2011).

In the studies of some scientists, data are provided that, in addition to working at a computer, also multi-media learning technologies perform a load on the visual analyzer. An experimental study dedicated to the study of the influence of multi-media teaching technologies on the condition of the visual analyzer in students showed that a longer and more intense workload for students falls on classroom work at the university compared to classes at home (63 and 37%, respectively) (Kamenskaya E.N.,2016).

Currently, there are a number of approaches to monitoring and the list of morphological and functional indicators of the body, which are used to assess the physical and mental health of students. Thus, the World Health Organization has developed various programs HEAT (Health Equity Assessment Toolkit), HEAT Plus, which allow displaying the obtained data and summary indicators in an interactive and customizable form that facilitate interpretation and reporting in relation to various health indicators (Hosseinpoor A. R.,2016).

In order to prevent eye diseases among the population of Kazakhstan, a number of important documents have been developed. So, according to the Messages of the first President of the Republic of Kazakhstan "Kazakhstani way-2050: Common goal, common interests, common future" and "Nurlyzhol - the way to the future", as well as the WHO Global Plan for 2014-2019. "Universal access to eye health", the Kazakh Research Institute of Eye Diseases proposed a strategy for the development of the ophthalmological service of the Republic of

Kazakhstan for 2016-2020 within the framework of the new State Health Development Program "Salamatty Kazakhstan" 2016-2020 [5] (Botabekova T.K.,2014). One of the crisis regions, as defined by UNESCO, is the Aral Sea region. An important problem in applied physiology is the study of human life and performance in extreme conditions, since the systematic excess in recent years of permissible anthropogenic loads on the environment has led to the emergence of global environmental problems. The Kyzylorda region is distinguished by a peculiar climatic peculiarity, in which dust storms prevail up to 200 days a year. In recent years, extensive material has been accumulated concerning the level of morbidity among its inhabitants and evidence of its significant increase (Ibadullaeva S.Zh.,1998).

Despite the complex of monitoring studies carried out, it should be noted that a systematic study of the functional indicators of the visual analyzer in the universities of Kyzylorda was not carried out. The lack of information on the influence of physiological and social factors on the state of students' vision complicates the current and long-term planning of measures to prevent their morbidity and form a healthy lifestyle, which determined the relevance, purpose and objectives of the study.

We set a goal to monitor the functional indicators of the visual system of students in the city of Kyzylorda and the introduction of scientific and methodological developments in the course of human physiology.

The research tasks are also formed: monitoring the functional indicators of the visual system in students, identifying the dynamics of the growth of eye diseases; creation of a structural-meaningful model of the formation of students' scientific knowledge of functional indicators of the visual system; development and testing of a methodology for the formation of students' scientific knowledge of functional indicators of the visual system in the educational process of human physiology.

2. Methods

In the course of the research, theoretical and empirical methods were used. The analysis of the philosophical, psychological, pedagogical and methodological literature served as the basis for the theoretical construction of the study. Empirical research methods allowed us to generalize domestic and foreign

[5] Botabekova T.K., Aubakirova A.S., Doshakanova A.B. The place of the ophthalmological service in the concept of health care development in the Republic of Kazakhstan for 2016-2020 // Ophthalmological journal of Kazakhstan.-2014.-№3,4 (46) .- P.5-12.

experience on the problem of the formation of students' scientific knowledge of functional indicators of the visual system. Mathematical processing of the research results based on elemental analysis was based on a survey, conducted among students and teachers regarding the educational process and the content of physiological concepts.

The study was conducted in stages from 2018 to 2021. At the first stage (2018 - 2019), the study, generalization and systematization of scientific information on the research problem in the philosophical, psychological, pedagogical, methodological literature on biology was carried out, as well as the monitoring of the functional parameters of the visual system was developed and carried out. At the second stage (2019 - 2020), a stating experiment was carried out, its results were evaluated and analyzed, an experimental methodology was developed and experimental training of students was carried out. At the third stage (2020 - 2021), the results of the experiment were processed. To solve the set tasks, research was carried out in which 252 students took part: 1-4 courses of the Kyzylorda State University named after Korkyt Ata and Bolashak University from (of which 78 are boys and 174 are girls).

As part of the monitoring of the visual system of students, the attitude of students to their health and determination of the causes of eye disease according to the questionnaire was studied, as well as the visual system of students was examined on the basis of a student clinic in Kyzylorda. Eyesight examinations were carried out on the same individuals in the fall and spring semesters of the 2018-2019 academic year. We analyzed the following parameters: uncorrected visual acuity, corrected visual acuity using standard Sivtsev-Golovin tables for distance and near.

The survey was carried out in the morning (from 8 am to 12 pm). Visual acuity was studied monocularly using the optotypes of the Sivtsev table, placed in the Roth apparatus, from a distance of 5 meters. If the tenth row of the table is visible, visual acuity corresponds to 1.0. If the subject does not see the first line of the table, then it is revealed from what distance the first line is visible when approaching the table and visual acuity is calculated using the Snellen formula: V = d / D, where V is visual acuity, d is the distance of the subject from the table, D - the distance from which the normal eye should clearly see the given line (Grigorovich M.S.,2009).

When detecting refractive errors in students, the subjective correction was determined monocularly. For this purpose, trial lenses from the optical set were

placed in a test frame. The optical power of the lens, which provides the most complete correction of ametropia, corresponds to the clinical refraction of the eye.

3. Results and Discussion

Analysis of the results of the questionnaire on the question "Do you have vision problems?" demonstrated the following indicators: according to the students themselves, 117 students have vision problems, which is 46.42%, 135 respondents (53.57%) do not experience difficulties (Figure 1).

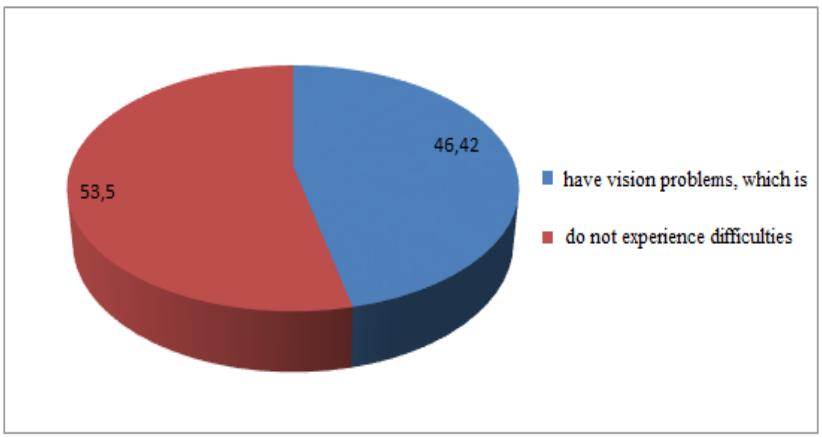

Fig. 1- Students' answers to the question about vision problems

When analyzing the students' answers to the next question "Have you observed a difficulty?" it turned out that 39 students had difficulty reading (15.47%), 51 students when working at a computer (20.25%), 27 students when watching TV (10.71%). 53.57% of the interviewed students never observed vision problems (Figure 2).

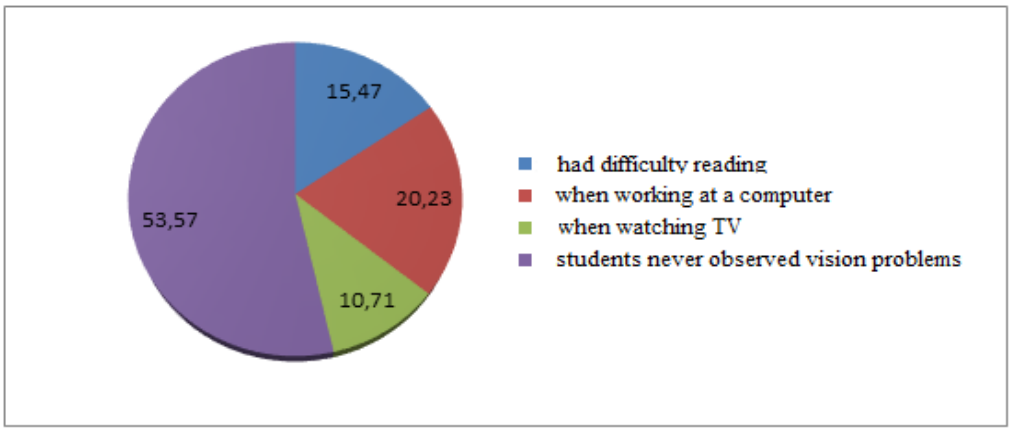

Fig. 2- Answers of students to the question about visual impairment

When analyzing students' answers to the question "How much time do you spend at the computer a day?" it was revealed that 22 (8.73%) students spend from 1 to 3 hours, from 3 to 5 hours - 91 students (36.11%), 139 students (55.15%) spend more than 5 hours at the computer (figure 3).

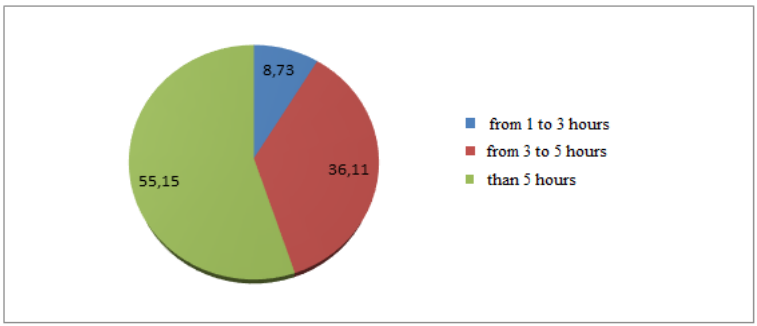

Fig. 3- Computer usage by students

To the next question "How long do you use your mobile phone?" 94 surveyed students (37.3%) answered that they use a mobile phone all day, 158 students (62.69%) even at night. Nobody indicated the option “I rarely use it” (Figure 4).

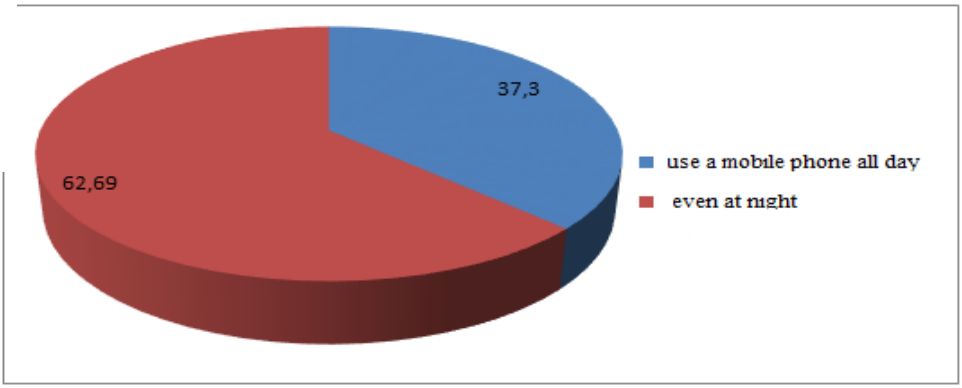

Fig. 4- Mobile phone use by students

Information on the time of visiting social networks shown as bellow: up to 3 hours a day - 35 students (13.88%), up to 5 hours - 73 students (28.96%), 144 students (57.14%) over 5 hours (Figure 5).

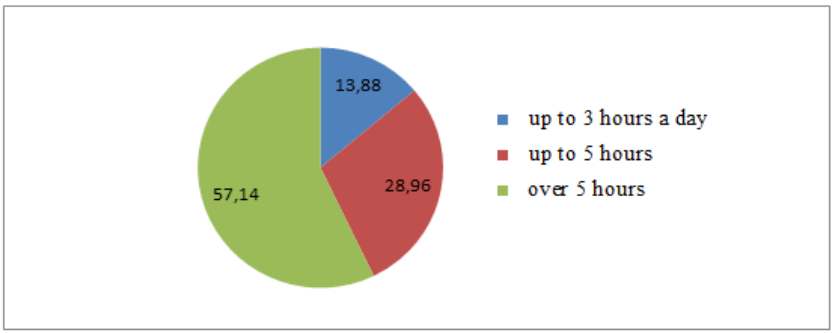

Fig. 5- Visiting social networks

When analyzing the respondents' answers, it was revealed that 82 students (32.53%) observe hygiene of vision, 113 do not comply (44.84%), 57 students (22.61%) found it difficult to answer (Figure 6).

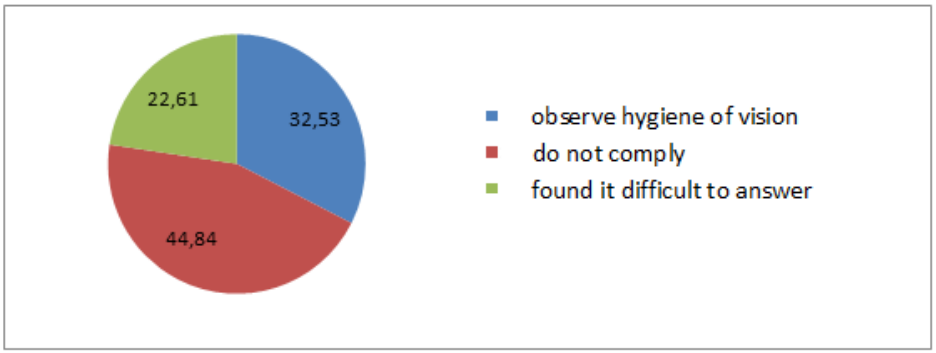

Fig. 6 - Observance of eye hygiene

When questioning, it turned out that 93 students (36.90%) have ever consulted an ophthalmologist, 63.09% (159 students) of the respondents have never consulted a doctor (Figure 7).

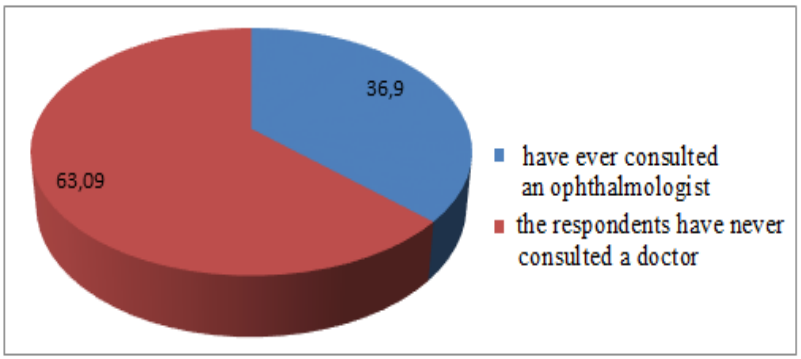

Fig. 7- Seeing an ophthalmologist

To the question "Are your eyes sensitive to cigarette smoke, smog, conditioned air?" of the respondents, 47 students (18.65%) answered positively,

69 students (27.38%) answered negatively, 116 students (46.03%) found it difficult to answer (Figure 8).

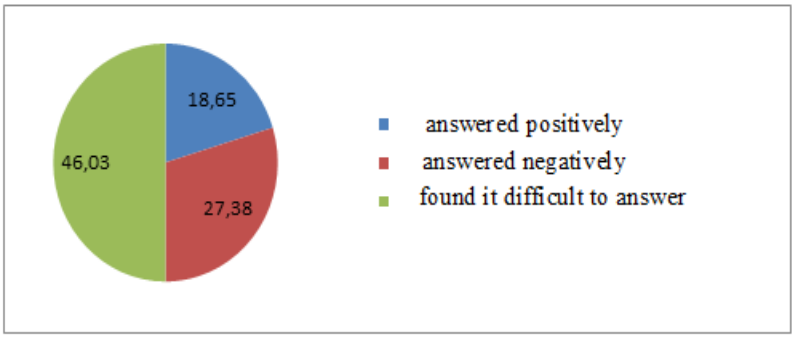

Fig. 8 - Determination of eye sensitivity

To the question "Do your eyes turn red and irritated in the evening?" 14.28% of the respondents (36 students) answered positively, 132 students (52.38%) sometimes have this phenomenon, 84 students (33.33%) do not have this phenomenon (Figure 9).

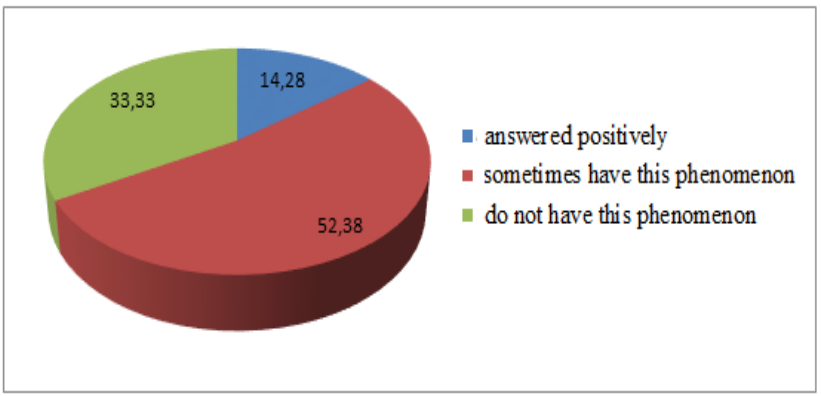

Fig. 9 - Determination of redness and irritation of the eyes in the evening

39 students of all the respondents, (15.47%) heard about the dry eye syndrome, 127 students (50.39%) are not familiar with this term, 86 students (34.12%) found it difficult to answer (Figure 10).

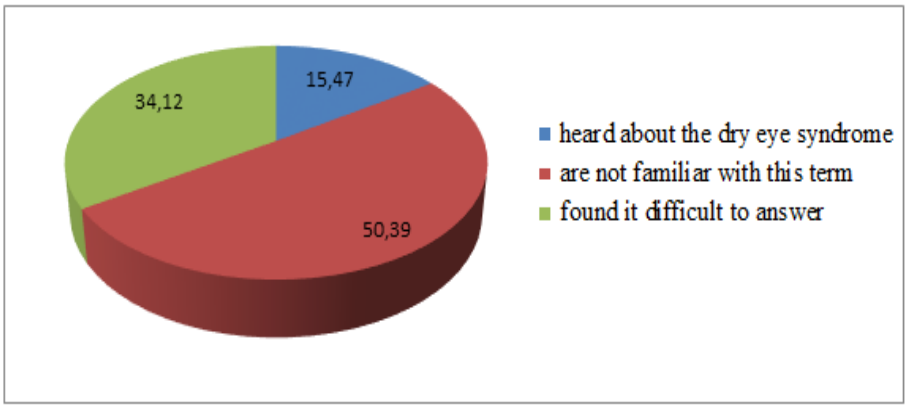

Fig. 10 - Determination of awareness of dry eye syndrome

When analyzing the answer to the question "What do you know about eye exercises?" it turned out that 137 students (54.36%) know about them, 69 students (27.38%) do not know about them, 45 students (17.85%) find it difficult to answer (Figure 11).

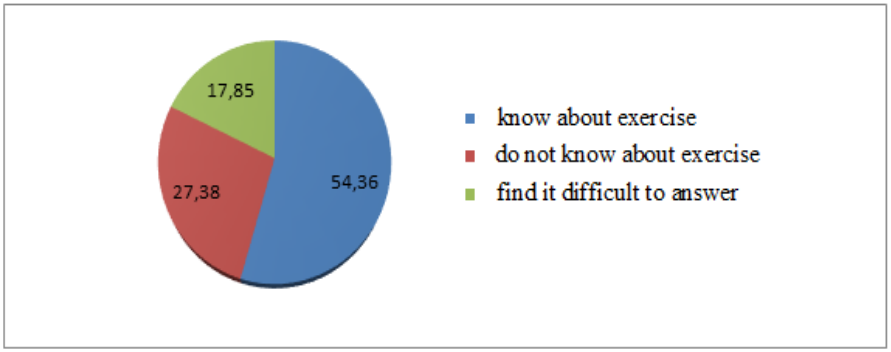

Fig. 11- Eye exercise awareness

Only 16 students of all the respondents (6.34%) devote 0.5-1 hour of time for eye exercises per week, 207 students (82.14%) do not, 29 students (11.50%) found it difficult to answer (Figure 12).

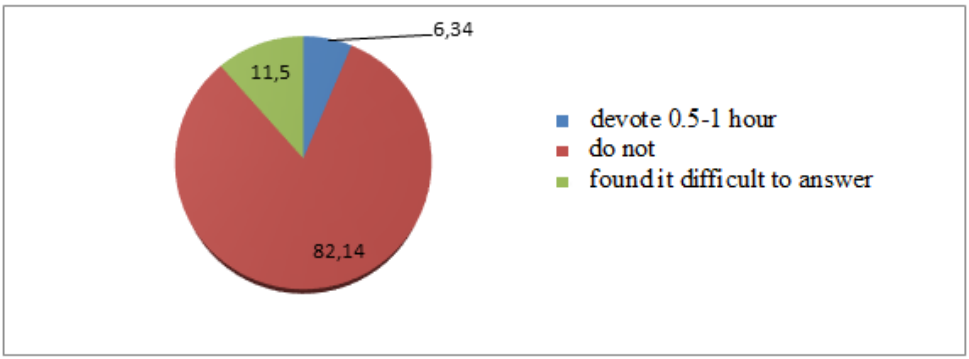

Fig. 12- Eye training per week

Summing up the results of the questionnaire conducted among students, we summarize that the attitude of students to their health leaves much to be desired. The next monitoring step was to determine the distance vision acuity without correction and with full spectacle correction using the Sivtsev-Golovin table and a set of trial spectacle lenses. During the examination, it was initially revealed that of all examined 114 students (42.23%) were healthy, 138 students (54.76%) have various eye diseases (Figure 13).

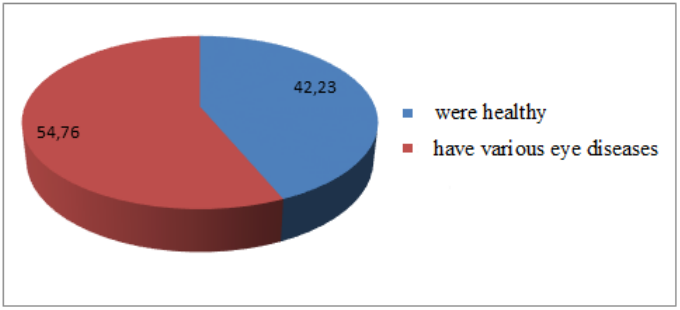

Fig. 13-Determination of the disease rate of the visual analyzer among students

Further, we determined the main eye diseases common among the examined students, the results of which are shown in Table 1. The percentage of the incidence of diseases was calculated from the total number of detected eye pathologies.

Table 1. Identification of types of diseases of the visual analyzer among students

Number of students with eye diseases	Number of students with visual impairments				
	Myopia	Spasm of accommodation	Hyper metropia	Myopia with astigmatism	Dry eye syndrome
138	41	7	1	7	82
%	29,71	5,07	0,72	5,07	59,42

Among the pathologies identified, diseases such as dry eye syndrome and myopia prevailed, a detailed analysis of which is presented in Table 2.

Table 2. Determination of the degree of myopia in students

Myopia	Low myopia	Moderate myopia	High myopia
к-во:	28	13	-
в %:	68,29	31,70	-

A detailed examination revealed that the predominant pathology is low myopia, which was found in 68.29% of students during the first examination. Moderate myopia is less pronounced (31.70% of students), high myopia was not found. To correct diseases of the visual analyzer, we proposed a set of eye exercises, described above, for three months. For the prevention and correction of eye diseases, from the set of exercises proposed by S.A. Marchuk, we recommended general developmental and specifically directed exercises for use.

General developmental exercises performed in combination with eye movements

Methodical instructions: during the exercises, do not turn or tilt your head (except for exercise 3); movements are performed at a slow pace in combination with eye movements. 1) Raise your hands forward - upward, and then lower

forward downward, watch the movement of your hands with your eyes; 2) Hands forward, hands into the lock outward. Press your palms to your chest, then return to the starting position. The eyes follow the hands; 3) Standing: legs apart, hands on hips. Circular movements of the head. With the eyes, we describe a circle simultaneously with the movement of the head; 4) Standing, arms forward - outward. Crossed movements of the hands. Eyes alternately follow the right, then the left hand; 5) Standing or sitting. Shifting any object from one hand to the other, follow the object with your eyes; 6) Standing or sitting, arms forward, fingers apart. Squeezing fingers into fists, eyes with an effort to close, fingers to unclench - eyes open; 7) Standing with legs apart. Rocking the whole body, stepping from one leg to the other. The eyes look into the distance without strain; 8) Standing, Look only forward. Head turns to the right, then to the left. Look at an object at a distance of more than three meters. As general developmental games, it is possible to recommend throwing balls to a goal, table tennis, badminton, tennis. In addition to these games, it is useful to transfer a volleyball, basketball or soccer ball.

Exercises for the prevention of visual impairment according to the method of A.L. Sirotyuk. Methodical instructions: all exercises are performed from the initial position while sitting or standing; breathing is arbitrary; after each exercise, let your eyes rest by closing them for 2 - 3 s. 1) "Shooting with eyes" left and right, up and down 6 times; 2) With your eyes, draw 6 circles clockwise and 6 circles counterclockwise; 3) Using your eyes, write the numbers from 0 to 9; 4) Use your eyes to write your first and last name; 5) With your eyes write the day, month and month of your birth; 6) Draw the springs for the eyes; 7) For the eyes draw 6 horizontal eights and 6 vertical eights; 8) With the eyes, draw 6 triangles clockwise, then 6 triangles counterclockwise; 9) Closing the left eye, write odd numbers from 1 to 9 with the right. Closing the right eye, write the odd numbers from 2 to 10 with the left; 10) Draw geometric shapes (circle, square, and triangle) with the eyes first clockwise, then counterclockwise (Marchuk S.A., 2004).

Re-examination of the student contingent revealed a slight improvement in the indicators of the visual analyzer. So the number of healthy students increased by 10.94%, and the number of students with various eye diseases decreased by 7.94%. A comparative analysis of the survey is shown in Figure 14.

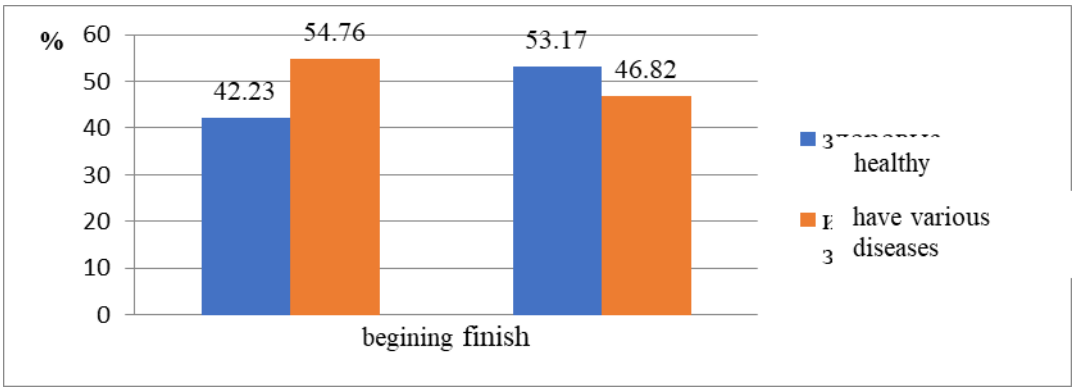

Fig. 14 - Comparative analysis of the survey (%)

In a detailed analysis, the following picture of diseases of the visual analyzer is observed: emmetropia, myopia of various degrees, astigmatism of various types (table 3).

Table 3. Identification of types of diseases of the visual analyzer among students

Number of students with eye diseases	Number of students with visual impairments				
	Myopia	Spasm of accommodation	Hypermetropia	Myopia with astigmatism	Dry eye syndrome
115	35	7	1	4	68
%	32,20	5,93	0,84	3,38	57,62

Comparing the initial data with those obtained from the same individuals after 3 months of performing visual exercises, it was revealed that low myopia remains the prevailing refractive error, but there is a slight decrease. At the same time, the indicators of the moderate degree of myopia did not change. The assessment of the dynamics of uncorrected visual acuity in myopia was carried out in terms of the number of cases of its increase, decrease or absence of changes (table 4).

Table 4. Change in uncorrected visual acuity for 3 months with myopia

	Start		End		Decrease incidence	Increase incidence	No change
	Number	%	Number	%			
Low myopia	28	68,29	22	62,855 3,65	6/14,63	-	-
Moderate myopia	13	31,70	13	31, 70	-	-	-
High myopia	-	-	-	-	-	-	-

The main tendency for those examined in the dynamics of eye disease is a slight change in uncorrected visual acuity, in particular, an increase in the percentage of a low degree and a decrease in the percentage of an moderate degree of myopia, which indicates a favorable effect of visual exercises on the dynamics of diseases of myopia in students' eyes. One of the positive indicators of the influence of visual exercises on the "Dry eye syndrome" was a decrease in the percentage of students' morbidity from their total number in the surveyed period from 32.5% to 26.5%, which is also an indicator of the positive effect of a set of visual exercises on the functional indicators of the visual analyzer.

4. Conclusion

The visual analyzer is a set of protective, optical, receptor and nervous structures that perceive and analyze light stimuli. The condition of the visual system is part of the health of the individual. Student health refers to objective indicators and a subjective feeling of a complex state and harmony, characterized by good health, social well-being and high performance. Monitoring of the visual system of students, consisting of a questionnaire and a medical examination, revealed the attitude of students to their health and the main pathologies of the organ of vision. Among the pathologies identified, diseases such as dry eye syndrome and myopia among students prevailed. Summing up the results of the survey conducted among students, we summarize that the attitude of students towards their health leaves much to be desired. The use of a set of general developmental and specifically directed exercises in order to correct visual diseases has led to an improvement in dynamics. Along with this, this event contributed to the optimization of the student's working day, since this type of exercise was performed independently by students at a convenient time. One of the positive aspects of these exercises was a decrease in the incidence of myopia

and Dry eye syndrome. Further, during the conducted studies, a slight decrease in the percentage of the average degree of eye myopia was proved, which an evidence of the effective outcome of exercise is also.

As a result of the research, we developed and introduced into the educational process an electronic textbook on human physiology for students of biology, in which we added a section on the physiology of sensory systems, where there is a description of eye diseases, the exercises we recommended to improve the dynamics of reducing eye diseases and a teaching aid with practical work on the physiology of sensory systems.

5. References

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