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Стаття надійшла 15.09.2022 р.

DOI 10 26724/2079-8334-2023-3-85-41-47

UDC 616.314–002:(616.311.2–002+616.314.17-008.6)]-053.81:613.2:311.21

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STATISTICAL STUDY OF THE INFLUENCE OF FOOD PRODUCTS ON THE OCCURRENCE OF CARIES AND PERIODONTITIS IN PERSONS AGED 18–22 YEARS

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The article presents the results of the study on the food products influence on caries and periodontal processes using statistical methods. The information base of the study was the data obtained by surveying dental students aged 18–22 years of the medical university. Mainly, consumption of dairy products, vegetables and fruits, meat, bread, and sweets were considered as factors. The quantitative characteristic of nutrition was taken as the number of food consumption times during the week. The hypothesis that the amount of food consumption affects the state of the periodontium and the number of carious teeth in a person has been confirmed. As a result of determining the relevant dependencies, a significant influence of two food products groups – dairy and vegetables and fruits – was revealed. Directly, the dependences have a non-linear (quadratic) form, and accordingly, the optimal intervals of the products consumption are established, since both insufficient and excessive use of them negatively affects the condition of the teeth and gums. A two-factor linear statistical dependence was built to estimate the total effect of two types of food products. Regarding other products, no significant relationships were found between their use and the oral cavity condition. The conclusions of the article present the main results of the performed studies and directions for further research.

Key words: caries, periodontal disease, food products, statistical dependence, impact assessment, optimal consumption

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СТАТИСТИЧНЕ ДОСЛІДЖЕННЯ ВПЛИВУ ПРОДУКТІВ ХАРЧУВАННЯ НА ВИНИКНЕННЯ КАРІЕСУ ТА ПАРОДОНТИТУ У ОСІБ ВІКОМ 18–22 РОКІВ

В статті подані результати дослідження впливу харчових продуктів на процеси карієсу та пародонту з застосуванням статистичних методів. Інформаційною базою дослідження послужили дані, які отримані шляхом анкетування студентів-стоматологів віком 18–22 роки медичного університету. В основному як фактори розглядалось вживання молочних продуктів, овочів і фруктів, м'яса, хліба, солодощів. За кількісну характеристику харчування приймалась кількість разів споживання продуктів протягом тижня. Підтверджено гіпотезу, що кількість споживання продуктів впливає на стан пародонту та кількість карієсних зубів у особи. В результаті визначення відповідних залежностей виявлено суттєвий вплив двох груп харчових продуктів – молочних та овочів і фруктів. Безпосередньо залежності мають нелінійний (квадратичний) вигляд і відповідно встановлено оптимальні інтервали обсягів споживання продуктів, оскільки як недостатнє, так і надлишкове їх вживання негативно впливає на стан зубів і ясен. Побудована двофакторна лінійна статистична залежність, яка дає можливість оцінити сумарну дію двох видів продуктів харчування. Стосовно інших продуктів, то суттєвих взаємозв'язків між їх вживанням та станом ротової порожнини не виявлено.

Ключові слова: карієс, пародонт, продукти харчування, статистична залежність, оцінка впливу, оптимальне споживання.

The study is a fragment of the research project “Development and improvement of methods of diagnosis, prevention and treatment of periodontal diseases, caries and its complications”, state registration No. 0120U002139.

Rational nutrition is an integral part of a healthy human lifestyle [1, 2] and plays a significant role in the prevention of major dental diseases (tooth caries, gingivitis, periodontitis, etc.) [10, 11]. This influence of rational nutrition is expressed in the aspect of the teeth formation, resistant to the influence of adverse factors, such as, for example, the cariogenic effect of simple carbohydrates, the insufficient amount of necessary trace elements and vitamins, etc.[4–6].

Currently, scientists do not have a single opinion about the impact of nutrition on dental [3]. and periodontal diseases Thus, some clinicians adhere to the theory of dental diseases (in particular, periodontal disease), which assigns a key role to nutritional deficiencies and imbalances, although previous studies seem not to have proven this point of view [7–9].

Most of the opinions and study results regarding the effect of nutrition on periodontal tissues and teeth boil down to the following [1, 10]:

- there are no nutrient deficiencies that can cause gingivitis or periodontal disease by themselves;
- there are nutrient deficiencies that lead to changes in the oral cavity (changes in the mucous skin, gums, and bone tissue);
- it is theoretically predicted that a person with a nutritional deficiency is less protected from a bacterial disease than a person who receives adequate nutrition;
- modern studies have shown the effect of nutrition on inflammatory processes in the body, which, in their turn, have an effect on the periodontium. Evidence suggests that foods rich in antioxidants are beneficial, while foods with high level of refined carbohydrates promote inflammation [10–11].

As you can see, there is no consensus. At the same time, the influence of many other factors on the oral cavity condition can be considered indisputably proven. These are factors such as gastrointestinal tract diseases, diabetes, leukemia, endocrine disorders, osteoporosis, the patient's age, the use of certain medications, etc. [4, 9].

Considering the above, the relevance of this work is determined by the need to reveal the influence of food products on the processes of caries formation and periodontal diseases in young people (aged 18–22 years) according to experimental data. This method of research has its advantages and disadvantages. The advantages include the fact that there is no need to carry out a specially organized laboratory type study, which is quite toilful and expensive. The use of a regular questionnaire among students does not require significant human resources and material costs.

The influence of food products in the real regime of their consumption is directly investigated, which permits to develop recommendations of a practical nature regarding the amount and structure of nutrition. Focusing on young people permits to assess the impact of nutrition in the period when chronic diseases have not yet been acquired, that is, inactive are negative age factors that could distort study results and would require a much larger array of information.

The negative aspects of the study include the fact that the individual components effect of food products, for example, calcium and vitamin D, which are considered to be the basic building blocks of dental tissues, is not considered. But this is a separate direction of research and experiments.

The purpose of the study was to set ourselves the task of obtaining quantitative relationships related to nutrition and the condition of teeth and periodontium.

Materials and methods. In the research process the statistical methods were mainly used. Thus, with the aim of obtaining a mass of primary information, a statistical observation was performed by means of a written questionnaire, the survey of respondents with participation of medical students. After the formation of the relevant sample of primary data, they were systematized and compiled using the method of statistical grouping to form homogeneous groups of data, grouped by essential features, and later they were presented in the form of graphs and tables.

A separate direction of the application of statistical methods was the determination of probabilistic cause-and-effect relationships between the studied factors. The main aim of probabilistic relationships is that for a specific value of an independent parameter, the dependent parameter changes in some range of values. If we talk directly about the analytical relationships, then the statistical dependence determines the average value of the dependent parameter. As a rule, the so-called method of least squares is used to find statistical dependencies, which later would allow predicting the behavior of dependent variables through regression. Its essence is that the root mean square deviation of the actual values from the estimated values is minimized. For this purpose, a specific form of analytical relationship between factors is chosen, in which unknown constant coefficients are present. As a result, with the involvement of statistical data, the values of these coefficients are found, which provide the minimum mean square deviation of the actual data of the function from its calculated values. The use of the method of least squares makes it possible to obtain conclusions about the closeness of the detected dependencies, as well as statistical estimates and the values of the calculated coefficients. According to the purpose of the study, we used both linear and non-linear one-factor statistical relationships, as well as relationships on two factors, to identify dependencies between such parameters as the amount of consumption of certain types of products over time and indicators characterizing the condition of the teeth and periodontium. In the research process, Microsoft Excel software was used for computer calculations,

which made it possible to analyze a large amount of data and obtain relevant relationships. At the same time, there is a need to also apply certain elements of functional analysis, in particular, for the purpose of developing recommendations of an applied nature.

Results of the study and their discussion. The source of primary information was questionnaire data on the diet in a group of dental students numbering 204 persons aged 18–22 years who independently entered the necessary data. The questionnaire consisted of three parts. The first part included surveys on the consumption of certain types of food and beverages, as well as sports and smoking factors. The second part of the questionnaire contains questions and answers about hygienic habits related to oral care (brushing teeth, toothpaste types, etc.). The third part of the questionnaire is called “dental examination card” and is aimed at diagnosing the state of the teeth and periodontium.

A sample of the completed fragment of the first part of the questionnaire is presented in Table 1.

Table 1

Type of food products and their consumption by one person

Name of food product	Food consumption per week				
	every day	every 2–3 days	once per week	once per month	rarely or never
yellow cheese				+	
white cheese			+		
melted cheese					+
milk, yogurt, kefir		+			
meat products	+				
fish		+			
fresh vegetables	+				
fresh fruits	+				
fancy cakes; pies			+		
brown rye-bread		+			
white bread	+				
sweets, candies			+		
chocolate			+		
apple juice		+			
orange juice		+			
mineral water	+				
coffee	+				
alcohol				+	
black tea	+				
vitamin C					+
Do you do your morning exercises?	+				
Do you smoke?					+

On the basis of tabular data for each person, it can be determined how many times a week he consumes this or that product. To perform statistical assessments, students are divided into groups with appropriate intervals. An example of such group formation according to the frequency of dairy products consumption is given below in Table 2. Table 1 includes the following types of dairy products: yellow cheese, white cheese, milk, yoghurt, kefir.

Table 2

Division of persons into groups according to the consumption of dairy products

groups of students as to consumption of dairy products	number of persons	percentage to total number (%)
0–3 times per week	39	19.1
3–6 times per week	66	32.4
6–9 times per week	38	18.6
9–12 times per week	38	18.6
12–15 times per week	7	03.5
15–18 times and more	16	07.8
Total	204	100

A graphic illustration of the data in Table 2 is given in Fig. 1.

Since the purpose is to study the processes of dental caries formation in the selected group of students, they were grouped by the number of teeth with caries. The relevant visual diagram is shown in Fig. 2

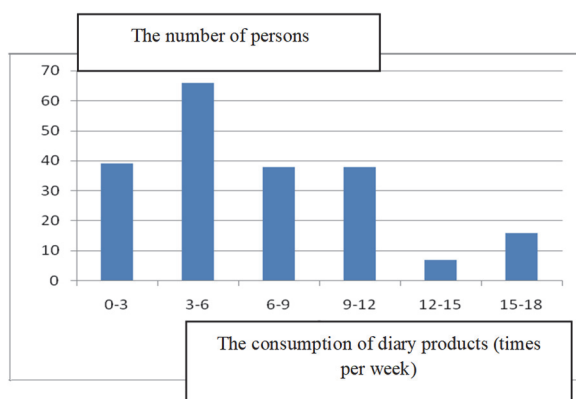


Fig.1. Diagram of students' division according to the consumption of dairy products

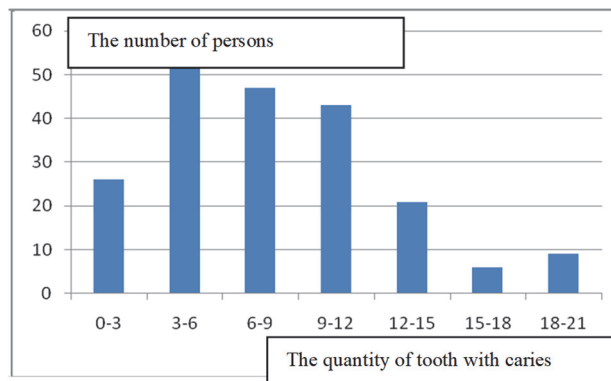


Fig. 2. Diagram of students' division according to the carious teeth

According to the obtained data, the least number of carious teeth (0–3) is observed in 12.8 % of students from among the rest in the group. The largest number of carious teeth (18–21 affected teeth) is in 4.4 % of students. In general, as conclusion, it follows that a very small part of students, despite their age, have healthy teeth. A similar analysis may be performed towards the consumption of other food products. The presence of variability in the amount of food consumption and the degree of dental disease is a prerequisite for setting the task of establishing the relationship between nutrition and diseases of the oral cavity.

In this field, male and female persons were studied separately.

Let's consider the results of studying the quantitative dependence of caries on the consumption of dairy products in a subgroup of boys. The total number of times of consuming dairy products (yellow cheese, cottage cheese, milk, yogurt, kefir) per week was taken as factor characteristic (x). The number of teeth with caries per person was taken as the outcome measure (y).

As the previous analysis showed, here it is advisable to use quadratic polynomial dependence to describe the relationship.

Using statistical methods (in particular, the method of least squares), the following dependence was obtained:

$$Y = 9.412 - 0.955x + 0.053x^2$$

This dependence is characterized by the presence of a minimum region concerning the number of teeth with caries. Moreover, this area is within the limits of the actual consumption of dairy products. The minimum number of carious teeth is reached at $x=9.01$ (milk consumption 9 times a week) and makes $y=5.11$ (teeth). Deviation in one direction or another in milk consumption leads to an increase in the number of diseased teeth.

Thus, if dairy products are not consumed at all ($x=0$), 9.4 units of teeth with caries should be expected. The effect of having a certain negative effect from excessive compared to optimal consumption of dairy products turned out to be rather unexpected. At the interval of maximum consumption of dairy products (15–18 times a week), the number of teeth with caries is on average 6.4 units instead of 5.1 units in the optimal version.

It should be noted that according to the actual data, the mean consumption of dairy products by boys is $x_{\text{mean}}=9.26$, and the number of diseased teeth is $x_{\text{mean}}=6.18$, and the number of diseased teeth $y_{\text{mean}}=6.18$. We should also note that from the point of view of statistics, the relationship between the factors is quite significant, since the correlation index is: $R=0.30$.

Thus, it can be assumed that, on average, the actual consumption of dairy products by the studied group of persons is within optimal limits. But reducing the consumption of dairy products significantly affects the increase in the number of diseased teeth (compared to the optimal consumption within the limits of an increase in diseased teeth by 80 %). Note that a certain part of persons in the studied group consumes a relatively small amount of dairy products, and due to this, their teeth are damaged by caries.

There is also some negative impact from excessive consumption of dairy products. But this influence within the actual consumption interval is not significant. Thus, with a 50% increase in the consumption of dairy products, the number of diseased teeth will be equal to the mean: $y_{\text{mean}} = 6.43$.

The second field was the study of the influence of fruit and vegetable consumption on caries in boys. The revealed statistical dependence is as follows:

$$Y = 9.906 - 1.08x + 0.057x^2$$

Graphic illustrations of this dependence are presented in Figs. 3, 4.

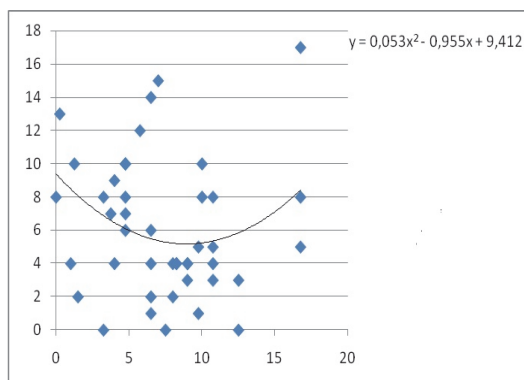


Fig. 3. Dependence of the number of teeth with caries on the consumption of dairy products (in the subgroup of boys).

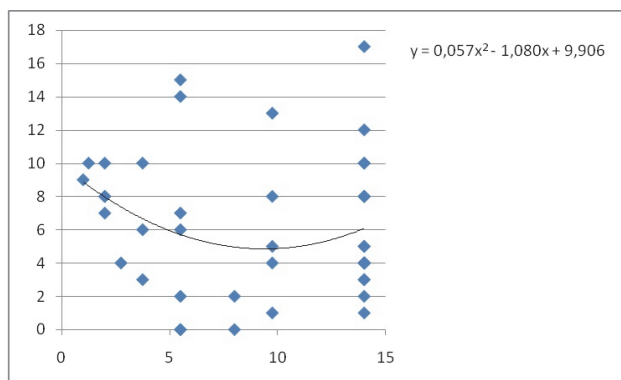


Fig. 4. Dependence of carious teeth on the consumption of fruit and vegetables (in the subgroup of boys)

As in the case of dairy products, this dependence also has optimal consumption limits. Minimum caries is achieved with the consumption of vegetables and fruits 9.5 times a week. A comparison of the graphs for both types of products shows that the deviation in the consumption of vegetables and fruits from the optimal level has a smaller effect on the change in the number of diseased teeth.

The found effect of the amount of consuming dairy products and vegetables on caries, which is expressed by one-factor dependences, indicates the need to determine such an effect with the help of two-factor dependence (as the occurrence of carious teeth is determined by the simultaneous consumption of dairy products and vegetables). This task is complicated due to the non-linearity of the both factors' influence on caries. Certain results can be achieved by constructing dependencies in a linear form within the limits of changing the values of the factors within the limits that do not exceed their optimal values. This means that the values of the factors located to the right of the minimum point in fig. 3 and fig. 4 are excluded from the calculation.

The application of appropriate statistical methods permits obtaining the following two-factor correlation dependence:

$$Y = 9.3637 - 0.3797 x_1 - 0.1241 x_2, \text{ where}$$

X_1 – the number of times per week dairy products are consumed;

X_2 - the number of times of vegetables and fruits consumption per week.

At the same time, the correlation coefficient is quite significant ($R=0.4$).

Negative coefficients for variables x_1 and x_2 indicate that an increase in the weekly consumption of the two studied products to a certain limit causes a decrease in the number of teeth with caries. It should also be noted that the coefficient at x_1 is almost three times greater than the similar coefficient at x_2 . This means that the consumption of dairy products has a greater impact on the condition of the teeth than the consumption of vegetables and fruits. When such consumption is equal ($x_1=x_2=x$), the dependence takes the following form:

$$Y = 9.3637 - 0.5x.$$

In a quantitative interpretation, this means that when you increase the consumption of these two types of products twice a week, the number of carious teeth decreases by 1 unit. Let's compare two options for consuming products. In the first of them, we assume that vegetables, fruits and dairy products are rarely consumed – approximately once a week ($x=1$). Then the mean number of teeth with caries will be approximately 9 units.

In the second option (when the consumption of dairy products, vegetables and fruits is 9 times a week), the number of teeth with caries will already be less than 5 units. The difference between these two options is 4 units. In other words, these two factors can almost halve the mean number of diseased teeth. Of course, we are talking about taking into account the action of only two nutritional factors.

It should not be ruled out that a number of other factors, including non-food factors, also affect the body. Identifying the quantitative impact of these factors is a very difficult task and requires larger-scale research and experimental work.

The identified dependencies are important from the point of view of developing effective nutritional recommendations and available in terms of practical use. Certain statistical assessments were also carried out regarding the periodontal condition of boys.

3 types of periodontal condition were considered: healthy (code 0), bleeding gums (code 1), stones (code 2). The following structure of these types of diseases is observed: 45.5 % – healthy periodontium; 31.8 % – have signs of bleeding; 22.7 % – have stones. The combination of stones and bleeding at the same time is very rare.

Regarding food consumption, the following situation can be observed:

1) those persons with healthy periodontium consumed dairy products on average 9.66 times a week; vegetables and fruits – 10.08 times a week;

2) those individuals with signs of bleeding gums consumed dairy products an average of 5.54 times a week (significantly less compared to the first group), and vegetables and fruits – 7.86 times (also significantly less than healthy people);

3) those individuals with tartar consumed dairy products an average of 8.92 times a week, and fruits and vegetables 9.8 times a week, respectively, i.e. comparable to the healthy group.

From the obtained results of the study, it can be concluded that there is an influence of the consumption of dairy products and vegetables and fruits on the state of the periodontium.

A similar approach was used to study the effect of food products on the state of teeth in a group of girls.

The mean value of consuming dairy products by girls is: mean = 6.45, and the mean number of teeth with caries is mean = 7.98. Compared to boys ($h_{\text{mean}}=9.26$), the mean consumption of dairy products is significantly lower (by 30 %), and the number of diseased teeth is by 24 % higher on average.

The finding of correlations between the number of products consumed and indices of the teeth state permitted to conclude that, in general, the influence of the number of products consumed is weaker than in men. This is confirmed, for example, by the found values of the correlation indices ($R_f = 0.15$; $R_{ch} = 0.30$), calculated to assess the relationship between the number of diseased teeth and milk consumption for the group of women (R_f) and for the group of men (R_{ch}).

Determining the impact of food products on the teeth condition in the human body is of great scientific and practical importance for medicine in general, dentistry in particular, and as a consequence for human health. In addition to theoretical considerations, carrying out special experiments, the regularities of this influence can be studied by organizing the observation of real data collection processes and processing the obtained information using statistical methods.

Since there are quite a lot of food products, this multifactoriality complicates the analysis and interpretation of the results.[2, 4]. Because of this, it is advisable to form separate groups of products, considering that they are close in their action and their total value is important. In the conducted research, dairy products [7, 8], vegetables and fruits, meat products, etc. are included in such groups.

Since obtaining the weight and quality characteristics of products is quite time-consuming, the equivalent of their volume is the number of times of consumption during the week. This was the argument-factor that is connected with the indices of the teeth condition. For example, the index that characterizes the number of carious teeth in a person's oral cavity is quite characteristic.

Statistical methods determine the corresponding dependencies between quantitative variables, particularly the so-called method of least squares. This method also assesses the closeness of the relationship between factors, which expresses the essence of these factors' influence on the resulting characteristic (correlation coefficient).

The obtained statistical dependences between the number of dairy products, vegetables and fruits consumed per week and the number of carious teeth were quite characteristic. According to this dependence, consuming milk products in a certain volume range determines the minimum number of carious teeth. Beyond this interval, i.e., in the variant of consumption less or more compared to their optimum, leads to an increase in dental caries. Very important is the conclusion regarding the possible negative impact of an excess amount of food products [2, 4].

The developed two-factor dependence is also of significant importance. After all, different products are consumed at the same time and even to some extent are interchangeable. Constant coefficients for variables in this dependence have a negative sign. This means that increasing the consumption of both types of products up to a certain limit leads to a decrease in the number of teeth with caries. It is worth noting that the coefficients for the variables differ by three times and that dairy products have a stronger influence [5, 6].

Some general conclusions regarding the influence of other factors are as follows. A similar statistical analysis of the effect on the teeth condition and periodontium of such factors as the consumption of meat, bread, sweets, as well as various types of drinks showed that such an effect is not observed within the studied “doses” of consumption. This also applies to such factors as smoking, sports and oral hygiene. This can be largely explained by the young age of the studied persons.

Conclusion

The performed study showed that observing the real situation in regards to nutrition influence on caries and periodontium is a sufficiently efficient method to establish the regularities of these processes. Appropriate quantitative interrelations can be established by means of statistical analysis methods. The obtained results present scientific interest, have practical significance as well as display the fields of further research in stomatology.

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Стаття надійшла 15.07.2022 р.

DOI 10.26724/2079-8334-2023-3-85-47-51

UDC 617.713-002.6

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EFFECTIVENESS OF OZONE THERAPY IN THE TREATMENT OF HERPETIC UVEITIS

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The purpose of the study was to learn the impact of ozone therapy on the outcomes of treatment in patients with herpetic uveitis. 80 patients (80 eyes involved) with herpetic uveitis were treated. The resorption of the infiltration of the choroid in the main group (40 patients – 40 eyes), was treated with ozone therapy in combination with conventional treatment terms of resorption of infiltration of the choroid were completed earlier than the compared group (40 patients – 40 eyes), which was treated with the preparation based on a combination of highly active enzymes of plant and animal origin combined with conventional treatment (respectively, 19.4 ± 0.2 and 25.1 ± 0.3 ; $p < 0.05$). The duration of treatment in main group was shorter than in the control group (respectively, 21.1 ± 0.3 and 26.8 ± 0.5 ; $p < 0.05$). The main group, which was treated with ozone therapy, showed a higher therapeutic effect in comparison to the control group of patients, who obtained tablets of preparation based on a combination of highly active enzymes of plant and animal origin, the results were statistically significant.

Key words: ozone therapy; herpetic uveitis; treatment.

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ЕФЕКТИВНІСТЬ ОЗОНОТЕРАПІЇ ПРИ ЛІКУВАННІ ГЕРПЕТИЧНОГО УВЕЇТУ

Метою дослідження було вивчити вплив озонотерапії на результати лікування хворих на герпетичний увеїт. Проведено лікування 80 пацієнтів (залучено 80 очей) із герпетичним увеїтом. Розсмоктування інфільтрату судинної оболонки в основній групі (40 хворих – 40 очей), що лікувалися озонотерапією в поєднанні з традиційним лікуванням (основна група), показало більш короткі терміни розсмоктування інфільтрату судинної оболонки, ніж у групі порівняння (40 хворих – 40 очей), яких лікували препаратом на основі комбінації високоактивних ферментів рослинного та тваринного походження у поєднанні з традиційним лікуванням (відповідно $19,4 \pm 0,2$ та $25,1 \pm 0,3$; $p < 0,05$). Тривалість лікування в основній групі була коротшою, ніж у контрольній (відповідно $21,1 \pm 0,3$ та $26,8 \pm 0,5$; $p < 0,05$). В основній групі, яка отримувала озонотерапію, відзначений більш високий терапевтичний ефект порівняно з контрольною групою пацієнтів, які отримували таблетки препарату на основі комбінації високоактивних ферментів рослинного та тваринного походження, результати були статистично значущими.

Ключові слова: озонотерапія, герпетичний увеїт, лікування.

Wide spread among the population, the predominant lesion of active age individuals, recurrences, high incidence of visual impairment make uveitis a highly significant social problem, according to some data, the uveitis is one of the causes of blindness and poor vision in 15–30 % of all patients, who have lost their sight [1, 2].