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SIMULATION OF ADVERSE FACTORS OF MINING PRODUCTION INFLUENCE ON STOMATOLOGICAL HEALTH OF MINING WORKERS

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Abstract

Mathematical modeling of the unfavorable mining factors influence with the help of basic dental indices such as CPITN, PMA, KPU has been carried out. The relationship of these indices with the adverse effect of mining on the dental health of miners was has been established. It has been revealed that with accumulation of job seniority, paraclinical indices negatively change significantly.

Key words: mathematical modeling, dental indices, mining production.

To estimate the prevalence and intensity of periodontal tissue disease, a working group of WHO specialists proposed an index of the " need for treatment of periodontal diseases – CPITN". The latter is recommended to use when carrying out epidemiological studies of the oral cavity in population [1].

Currently, the scope of the index has expanded, and it is used for the planning and effectiveness evaluation of programs for the prevention of dental diseases, as well as calculating the necessary number of medical personnel. In addition, in clinical dentistry, the CPITN index is used to monitor periodontal tissues condition in individual patients [2, 3].

Based on this, we can conclude that the CPITN index is a screening test, both at the population and individual levels.

However, it should be noted that this index registers only those clinical signs that may undergo reverse development, namely inflammatory processes in periodontal tissues, which are indirectly judged by bleeding, the presence of dental deposits, etc. CPITN does not reflect irreversible clinical and morphological changes in the peri-toothed tissues, such as: recession of the gum, mobility of the teeth, loss of epithelial attachment. CPITN index also does not reflect the activity of the pathological process and can not be used to plan individual specific clinical treatment in patients with various forms of periodontitis.

At the same time, we can not but note the main advantages of CPITN index use in clinical dentistry, such as: simplicity, speed of its definition, informative value and the possibility of comparing the dynamic result of clinical prophylactic measures.

In clinical dentistry, a capillary-marginal alveolar index (PMA) is used to assess the severity of gingivitis, and subsequently to record the therapeutic process dynamics. Various modifications of this index are suggested, but in clinic Parma's modification (1960) of PMA index is more often adopted [4].

Clinical evaluation of teeth hard tissues, defects of the dentition is carried out using CFE index, which characterizes the need for dental care and where C-caries, F-fillings, E-extracted teeth.

Objective: By means of reliable dental research methods conduct mathematical analysis and trace the connection of miners dental diseases, performance status and the influence of unfavorable factors of the production environment.

Object of the study. The miners with performance status have been examined. 95 of them had dusty bronchitis; 65 - vibration disease; combined pathology - dust bronchitis + vibration disease had 96 persons, and 130 individuals not related to mining. Age groups were compiled in accordance with WHO recommendations.

In the mathematical treatment of paraclinical indices, we did not take into account the production experience of the miners [5, 6].

The study of dental status in individuals with general pathology was conducted at the Institute of Industrial Medicine of the Ukrainian Academy of Medical Sciences.

As the volume of the investigated samples is much larger than 30 (the critical number), it is possible to use analysis methods for large samples. The mathematical analysis was carried out with the help of programs written by the authors in the VBA language (Visual Basic for Applications) in the Microsoft Excell 2007 environment.

The results obtained their discussion. As the dispersion analysis should be applied when it is established that the distribution of the effective characteristic is normal, the hypothesis of asymmetry distribution and kurtosis parameters normality was used.

Asymmetry is an indicator reflecting the degree of asymmetry in the curve of the differential function of the experimental distribution in comparison with the differential function of the normal distribution. The kurtosis is an indicator that reflects the elevation of the curve of the differential function of the experimental distribution in comparison with the differential function of the normal distribution.

The value of asymmetry (A) and kurtosis (E) was calculated as follows:

Selective A and E are random variables. Their variances are equal.

If “u”, is much more, the distribution is considered normal.

Next, for each sample, the sample size n_x, the sample expectations m_x, the sample variances D_x were determined.

The analysis of the initial data made it possible to unambiguously establish the normality of the distribution of the parameters under investigation (Table 1).

Table 1.

Distribution of paraclinical indices according to the mathematical meaning

	CPINT	**PMA**	**CFE**
Mathematical expectation, m_x	2.31	38.54	14.62
Deviation (D_x)	1.06	369.58	38.67
Asymmetry (A)	-0.65	-0.26	0.87
Excess (E)	-0.32	-0.59	1.20
A-D (A)	0.28	0.11	0.50
E-D (E)	-0.91	-0.64	-0.02

First of all, variance comparisons were performed, because the task of comparing mathematical expectations is solved differently depending on whether the variances are different or the same.

The variance was compared using Fisher’s distribution (F-test).

F-test returns the two-way probability that the difference between the variances of the arguments "sample 1" and "sample 2" is not significant. This function allows to determine whether two samples have different variances.

Since the general variances are comparable (the o-hypothesis for the variances $D_x = D_y$ is valid), then to test the o-hypothesis for the mathematical expectations $m_x = m_y$, Student's t-criterion (the TTEST function) may be used.

The TTEST function makes it possible to determine the probability that two samples are taken from general populations that have the same mean (Tables 2, 3).

Table 2

Distribution of variances among paraclinical indices

groups	CPITN	PMA	CFE
1-2	0.26	0.03	<0.01
1-3	<0.01	<0.01	<0.01
1-4	<0.01	0.04	0.02
2-3	<0.01	<0.01	<0.01
2-4	<0.01	<0.01	0.25
3-4	0.62	<0.01	<0.01

Table 3

The probability of main entity among paraclinical indices determination

Groups	CPINT	PMA	CFE
1-2	<0.01	<0.01	<0.01
1-3	<0.01	<0.01	0.13
1-4	<0.01	<0.01	<0.01
2-3	0.23	<0.01	<0.01
2-4	0.82	0.80	0.18
3-4	<0.01	<0.01	<0.01

Changing the initial data for each group of the subjects surveyed into a graphic representation and comparing paraclinical parameters, we obtained the following initial data:

I group (control). Persons not connected with mining production (n =130).

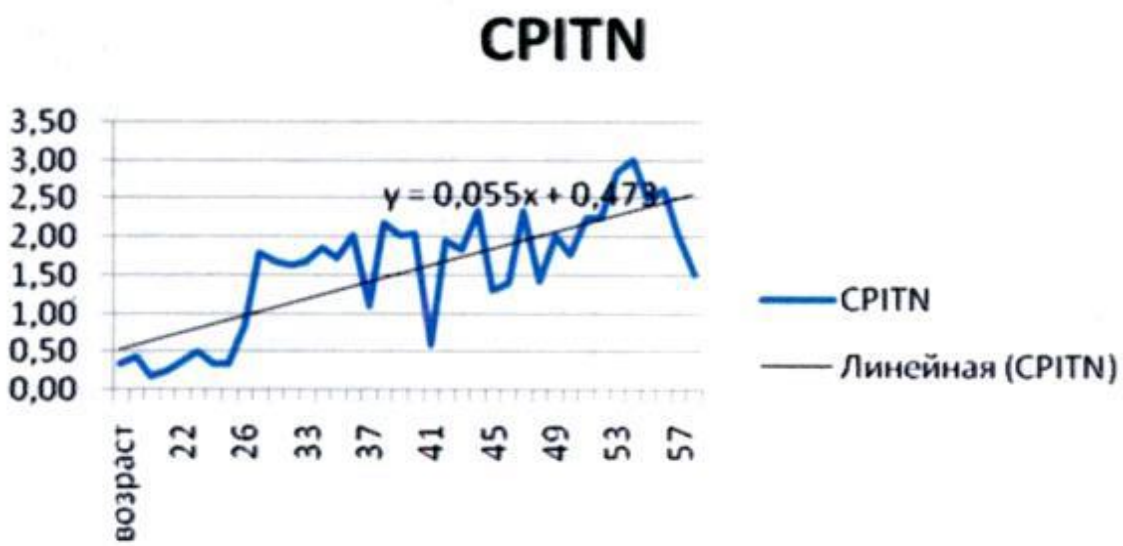

Fig. 1. Graphical distribution of the CPITN index in I (control) group.

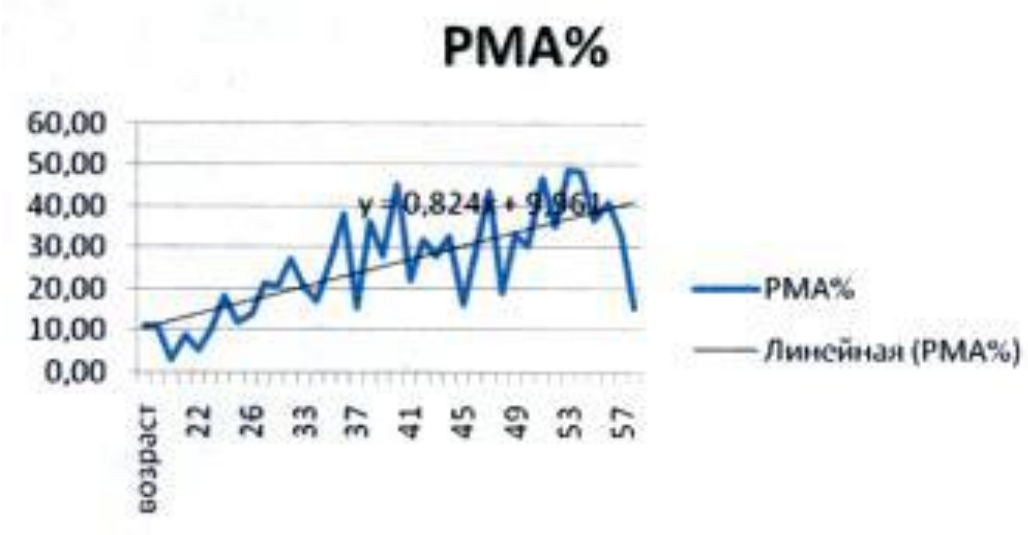

Fig. 2. Graphic distribution of PMA index in I (control)group.

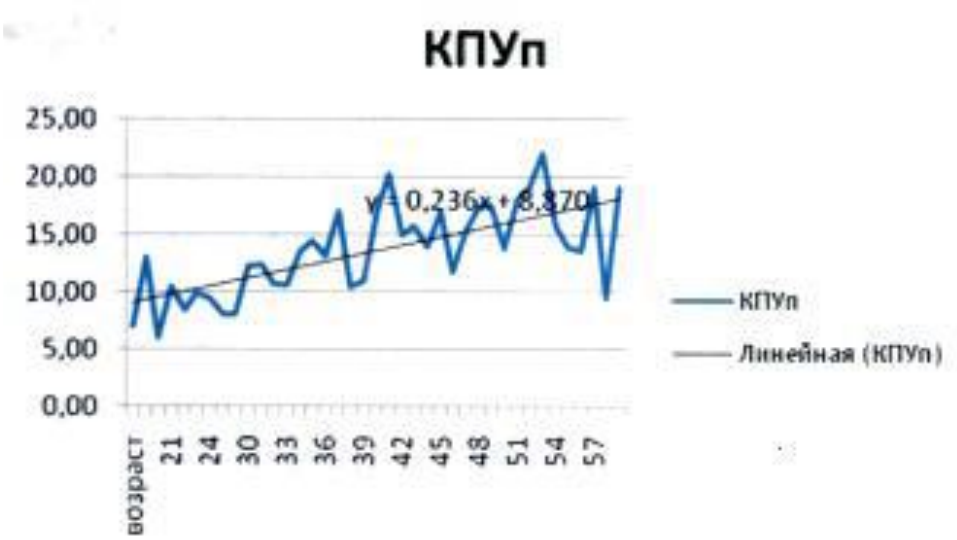

Fig. 3. Graphical distribution of the CFE index in I (control) group.

With age there is the "linear" increase in CPITN, PMA and CFE indices (Fig. 1, 2, 3), which is comparable with the literature data on the problem under study.

Under the same conditions we marked a dynamic "linear" decrease in the parameters of the PMA index (Fig. 4), increase in CFE (Fig. 5), and a relatively stable CPITN index (Fig. 6).

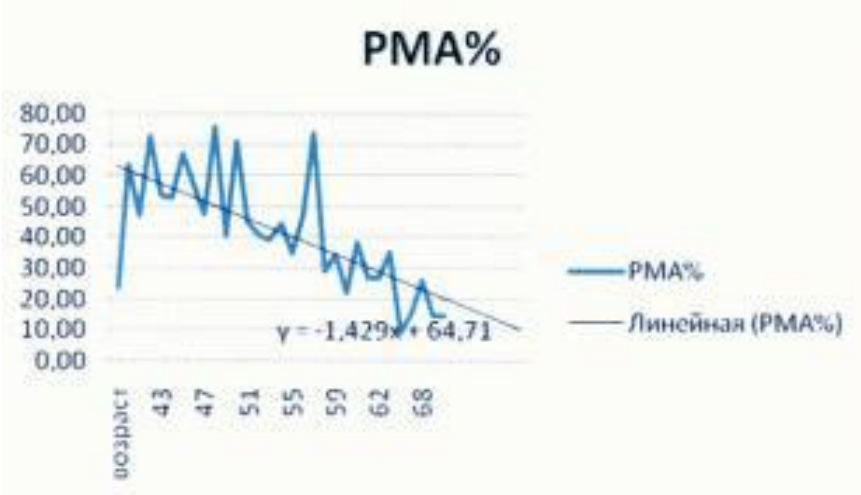

Fig. 4. Graphical distribution of PMA index in the II (dust) group.

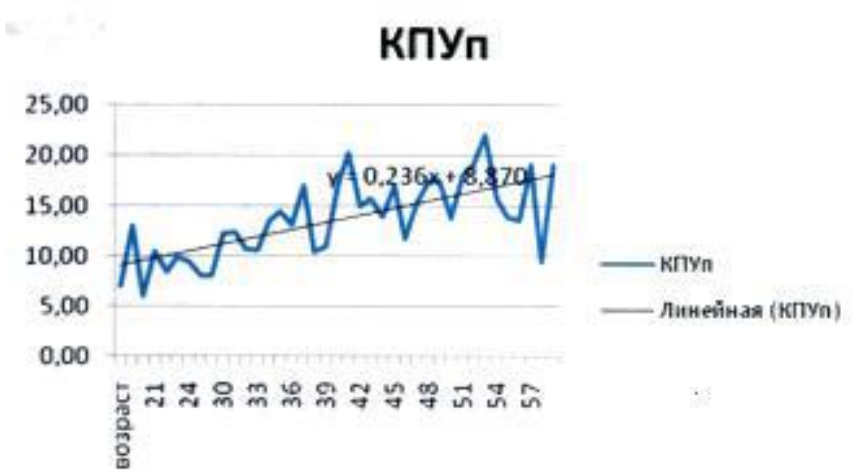

Fig. 5. Graphical distribution of the CPMU index in II (dust) group.

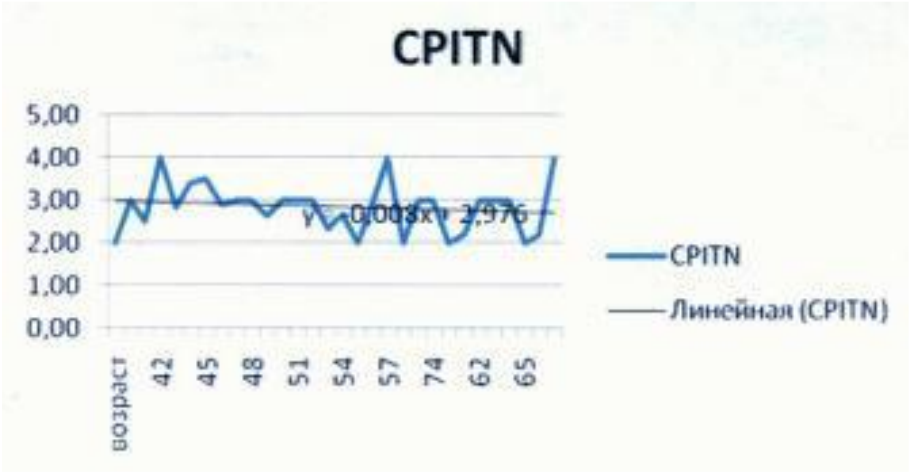

Fig. 6. Graphical distribution of the CPITN index in II (dust) group.

At the same age parameters, we note an insignificant increase in CFE (Fig. 7), a decrease in PMA (Fig. 8) and CPITN indexes (Fig. 9).

IV group (miners with combined general pathology (dust bronchitis + vibration disease), n= 96).

With decrease of PMA (Fig. 10) and CPITN (Fig. 11) indexes, we note a dynamic linear increase in the CFE index (Fig. 12) in the age aspect.

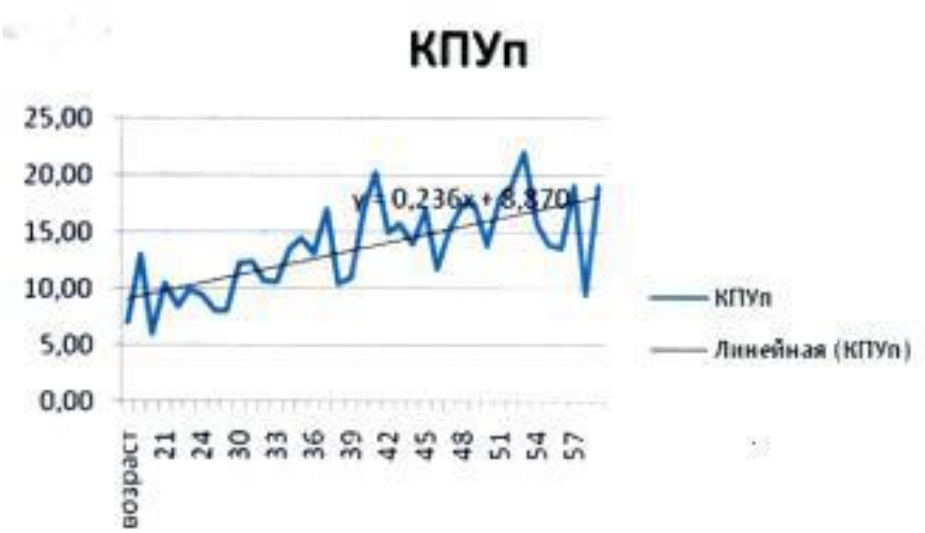

Fig. 7. Graphic distribution of the CFE index in III (vibration disease).

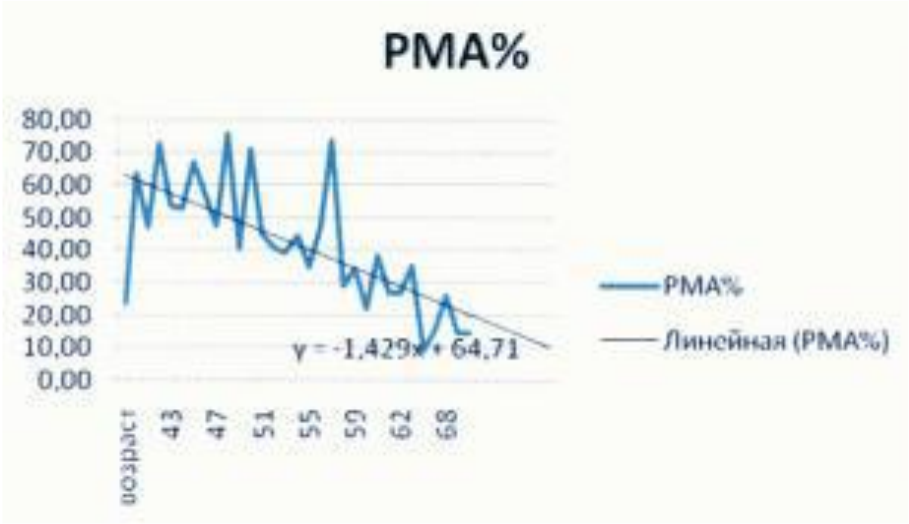

Fig. 8. Graphic distribution of PMA index in III (vibration disease).

Fig. 9. Graphic distribution of CPITN index in III (vibration disease).

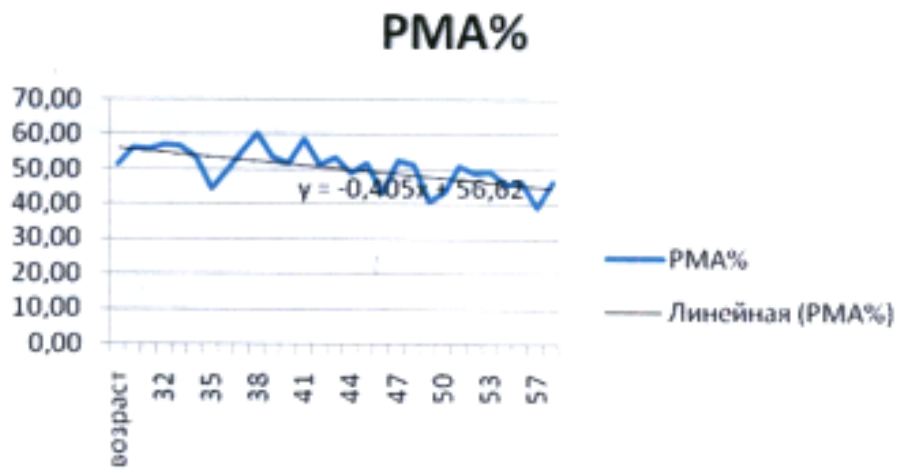

Fig. 10. Graphic distribution PMA index in IV (dust bronchitis + vibration disease).

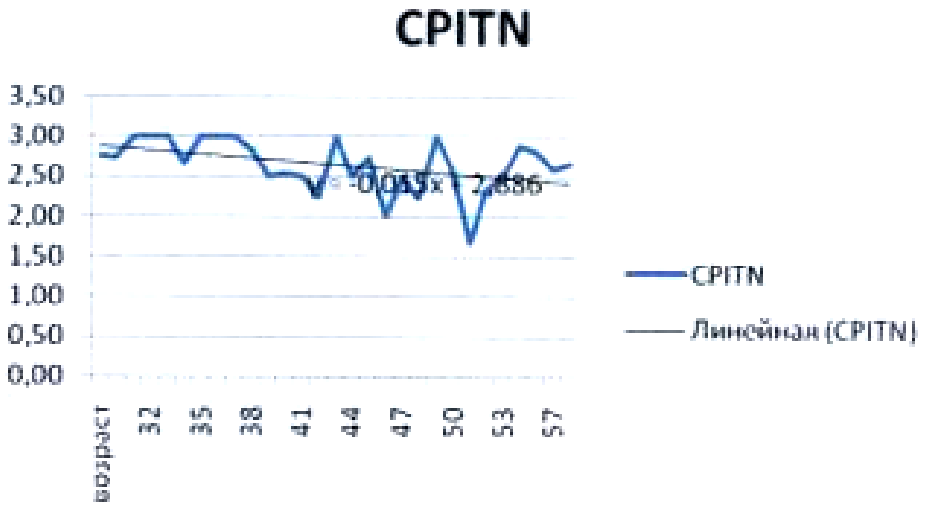

Fig. 11. Graphic distribution of CPITN index in IV group (dust bronchitis + vibration disease)

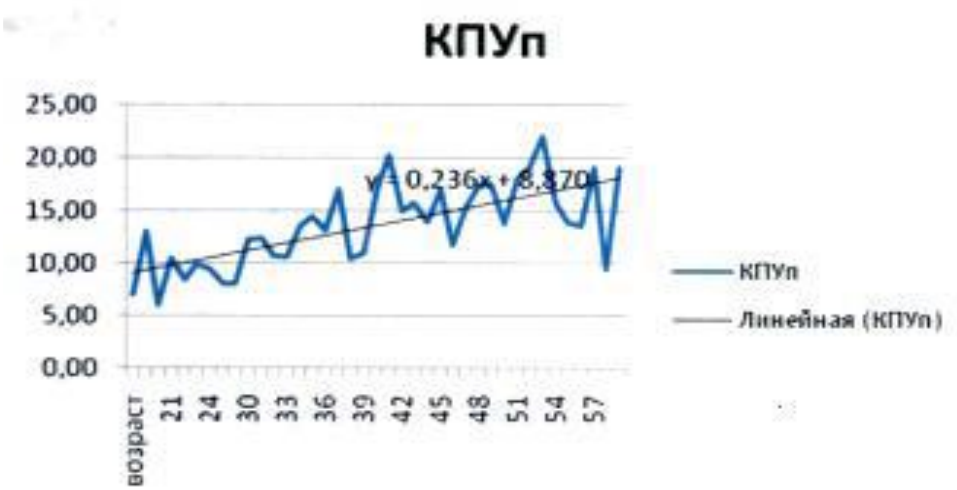

Fig. 12. Graphic distribution of CFE index in IV group (dust bronchitis + vibration disease).

Thus, in terms of mathematical analysis of paraclinical indicators reflecting the dental morbidity in miners with general pathology and persons not related to mining, the following conclusions can be drawn:

1. The distribution of the mathematical parameters of CPITN, PMA and CFE is subject to the normal distribution law.

2. The average value and variance of the parameters of CPITN, PMA and CFE are significantly different for each of the four groups, which indicates the influence of general somatic pathology on the index indicators of the oral cavity, periodontal tissues and severity of gingivitis.

The trend lines of the CPITN, PMA and CFE parameters allow us to conclude that with age, the condition of the oral cavity in groups with general diseases worsens much faster than in the control group (persons not related to the mining industry).

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