HOW DO CORRELATIONS BETWEEN PHYSIOLOGICAL PARAMETERS DEPEND ON THE INFLUENCE OF DIFFERENT SYSTEMS OF STRESS FACTORS?

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ABSTRACT. The comparison of populations according to the level of correlation of physiological parameters could be observed as one of the methods of assessing population anthropogenous strain. Approach based on it to the study of adapting populations was called correlation adaptometry. The goal of this paper, thus, was to investigate the process of rehabilitation of oncological patients after surgical intervention and to compare if with adaptation processes at Extreme North. For these purposes the method of correlation adaptometry was applied. We compared the dynamics of anthropoecological stress and statistics of physiological parameters of two groups of people. Those, who have come to Norilsk to serve in the Army and oncological patients, having gone through the surgical intervention, i. e. we deal with two different systems of factors affecting organism: the conditions of Extreme North and aftersurgical rehabilitation of oncological patients.

On the basis of our research we can come to the conclusions:

- Method of correlation adaptometry can be used when analysing the aftersurgical period of oncologic patients.
- With the help of the method of correlation adaptometry analysing aftersurgical rehabilitation of oncologic patients there were elicited the following regularities: days of maximum (the 4-th, 6-th) and minimum (the 5-th, 7-th, 12-th) of correlation of physiological parameters in the organism.
- There was proved correspondence with the increase of the weight of correlation graph and decrease of the stress in the organism of an individual under the influence of synergistic system of factors.

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Introduction

Due to the anthropogenous pollution of environment by technogeneous and biogeneous factors some plants and animals populations are being found disappeared. That inevitably causes vital changes in living organisms and acute form of diseases. As a result the structure of diseases and mortality rate has been changed radically in the past years. Infectious diseases with the exception of some virus diseases have been found relegated to the background while myocardial ischemia, cancer, hypertension, mental diseases are getting more widespread [5].

The possibility of human being existence in constantly changeable environment is provided by organism adaptability. In the view of physiology adaptation is the process of maintenance such functional condition of homeostatic systems and organism in general that would provide is preservation, development, capacity for work and maximum length of human life in nonadequate condition of environment.

There are many researchers and medical men nowadays who are getting aware of the necessity of elaborating methods of assessing organism reactions upon environmental factors influence. Thus there's a search for universal indicators of early unfavourable consequences of extremal influences.

It was stated that under conditions of increased adaptation loadings the level of parameters of correlation reflects the degree of adaptation. With the increase of anthropoecological stress, the correlative connections between physiological parameters are being reinforced. Adaptation leads to the reduction of number of connections with high correlation coefficients [2, 3, 6].

The comparison of populations according to the level of correlation of physiological parameters could be observed as one of the methods of assessing population anthropogenous strain. Approach based on it to the study of adapting populations was called correlation adaptometry [3].

Through, at present, great practical material on adaptation has been accumulated, the theoretical aspects of adaptation under pathological conditions are still lightly developed. There is practically no data of adaptation process peculiarities

within pre- and after clinical disease periods. The investigation of adaptation process variability under therapeutic and operative pressure (influence) is being insufficient as will. The problem of adaptation arouses much interest in theoretical biology and medicine.

The goal of that paper, thus, was to investigate the process of rehabilitation of oncological patients after surgical intervention and to compare if with adaptation processes at Extreme North. For that purposes the method of correlation adaptometry was applied. We compared the dynamics of anthropoecological stress and statistics of physiological parameters of two groups of people. Those, who have come to Norilsk to serve in the Army and oncological patients, having gone through the surgical intervention, i.e. that we used two different system of factors, affecting organism: the conditions of Extreme North and aftersurgical rehabilitation of oncological patients.

Liebig's and Synergistic system of factors

The method of correlation adaptometry rests on optimum principle, that is closely connected with Liebig's principle. Monofactorial theories, that are getting widespread in ecologic investigations, are primarily based on Liebig's law of minimum. According to these theories, survival and reproduction are limited as a rule by one or a small number of factors [6].

Under examination of human being populations, monofactoriality corresponds to the situation, when members of population organisms are being regulated by common extreme factors. As a result of adaptation the role of extremal factors diminish and they become equivalent to the others, the significance of which for different members of population is different.

Though if is not always the factors lagging behind the optimum that affect the population negatively. The cases of synergistic effect of the factors, of their mutual amplification are not rare [6]. Within the group of mutually reinforcing factors, the Liebig's principle doesn't hold as the effects of mutual reinforcement result in the general case in the

significance of all factors. Synergism is, for instance, observed under combined effect of ionized radiation and hyperthermy on normal and tumour calls and tissues [1].

They distinguish two mutually complementary extreme situations: Liebig's factors systems, for which in occasional combination phenotype-environment Liebig's principle is performed and synergistic groups of factors, for which in occasional combination phenotype-environment all mutually reinforcing factors are significant. Adaptation to Liebig's factors systems results in polyfactoriality; adaptation to synergistic group of factors - in monofactoriality [6].

Thus, the variety of different possible systems of factors (the Liebig's and synergistic ones are extreme possibilities) gets us down to number one question: what are the real systems of factors, describing environment effect on organism? The problem is that we could hardly define what particular system of factors affects living organism.

Materials and Methods of Investigation

There were examined men aged 18-25, that came to Norilsk from different country regions and groups of people, being sick with carcinoma of stomach and gullet cancer of III clinical group and lung carcinoma of III and IV clinical groups, that came from different regions of Krasnoyarsk territory to have an operation at Krasnoyarsk Oncological Clinic.

According to adaptation potentialities the adapting population, having come to Extreme North, was divided into following groups: 1) almost healthy; 2) having frustrations of adaptation process (diseases of respiratory tract and etc.). The environment influence, affecting that particular group of people belongs to Liebig's system of factors, where the main "pressing" factor is sun activity.

The group of factors, affecting oncological patients in the period of aftersurgical rehabilitation could be considered as synergistic. All - round influence of pathological factors, depending on disease and individualities of patient's organism, on the one hand, and operation trauma, on the other, causes the development of a certain condition. It is characterized by

appropriate functional derangements and opposed to them defense reactions, aimed at homeostasis recovery. It may be assumed, then, that such factors, influencing organism, as malignant tumour and surgical intervention are being mutually reinforced.

Within each group of examined people, the following indices gotten by total blood count were analyzed:

1) erythrocytes
2) hemoglobin
3) leukocytes
4) eosinophils
5) nuclear segment
6) nuclear bacillus
7) lymphocytes
8) monocytes

Blood system is one of the most dynamic systems, rather quickly responding to any organism mutation with the chance of form elements structure and their functional activity. Therefore, by means of blood count we could follow adaptation reactions, going on in living organism under one or an other unfavourable factors influence and, thus, study the process of adaptation.

For data processing the standard statistics methods of mean, error of mean and dispersion computation were used. Then, the analysis of pair correlation coefficients for each indices took place.

Degree of connectivity of indexes was testified with the help of the correlation graph. This correlation graph is calculated as the sum of correspondent coefficients of pair correlation:

$$G = \sum_{|r_{ij}| \geq \alpha} r_{ij} ,$$

where r_{ij} – true coefficient of correlation between i– and j–indexes, magnitude of coefficients ≥ 0.5.

For estimating dynamics of anthropoecological stress during the period of shot-term adaptation to conditions of the Extreme North the carried out researches were based on the total blood count which were made on the day of arrival at the North as well as at the 5-th, 10-th, 15-th days, in a month, in a month and a half, etc. Blood count of oncological patients were testified before surgical intervention and on the 1-12 days of it.

Results of Research

As the result of medicine researches it was notified that after operative intervention the quantity of tumor cells in blood increases during some period of time, and in 7-10 days dramatically decreases. It means that the active protective strength of organism is really exist and really defeats these cells.

Physiological development of system postaggressive reaction (PAR) conforms to the clinical picture of different stages of aftersurgical period. It means the period since the end of surgical intervention up till total recovery of ability to work. There are nearest aftersurgical period (since the 1-st day up till 5-7 days) which corresponds to transition phase of postaggressive reaction; early aftersurgical period (from 7-9 days till 2-3 weeks) and far aftersurgical period. In our work we outlined nearest and early aftersurgical period.

The first 3-5 days are accompanied by rapid increase in power inputs of organism because of hyperventilation, increase in blood circulation, work of liver and kidneys which create physiological defense mechanisms. 5-7-th days are transition ones, which are different by decrease in intensity of catabolic and step by step increase in anabolic processes and total tissue metabolism.

Analysis of changes of correlation of physiological parameters during the period of aftersurgical rehabilitation of people suffering from lung cancer of III and IV clinical groups and gullet and stomach cancer of the III clinical group allows us to find out the regularity of changes in function of organism during the period of surgical disease and to reveal the terms of decline of patient's condition and as the result he needs additional attention and may be additional review.

After correlation adaptometry there have been found that for oncologic patients with lung cancer of III and IV clinical groups, carcinoma of the stomach and gullet of the III clinical group the weight of correlation graph increases on the 4-th and 6-th days and decreases on the 5-th and 7-th days after operation (Fig. 1).

On the 7-th day there is an increase in weight of

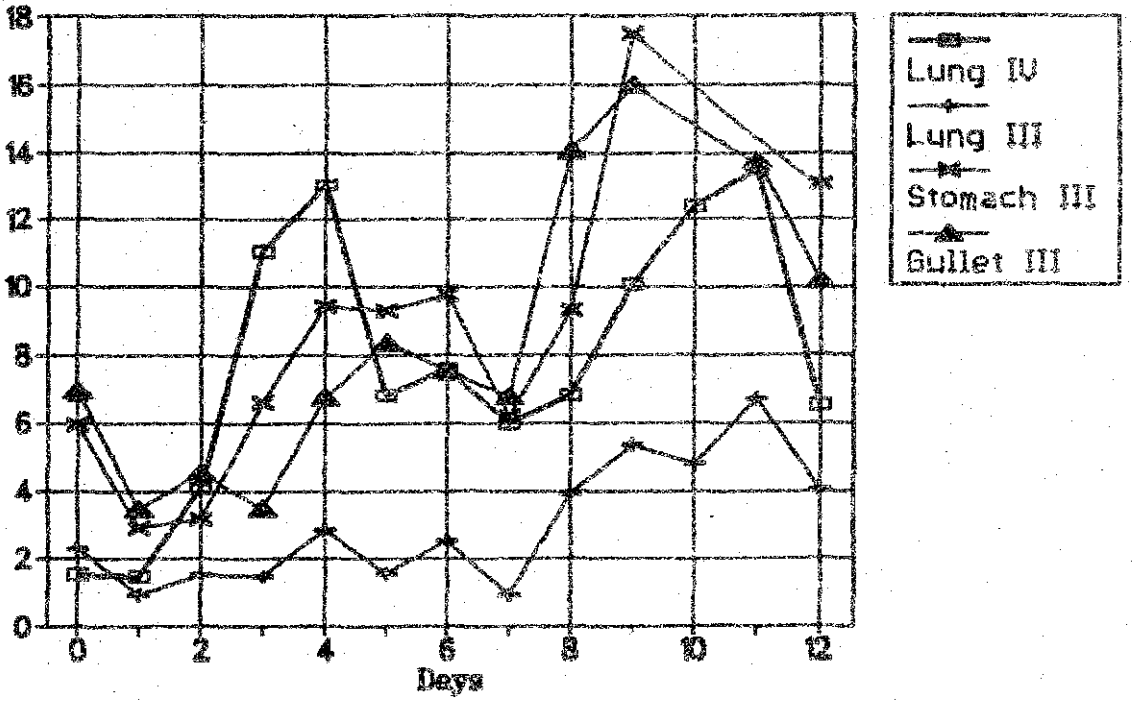

Fig. 1 Dynamics of Correlation of Physiological Parameters during the period of aftersurgical rehabilitation

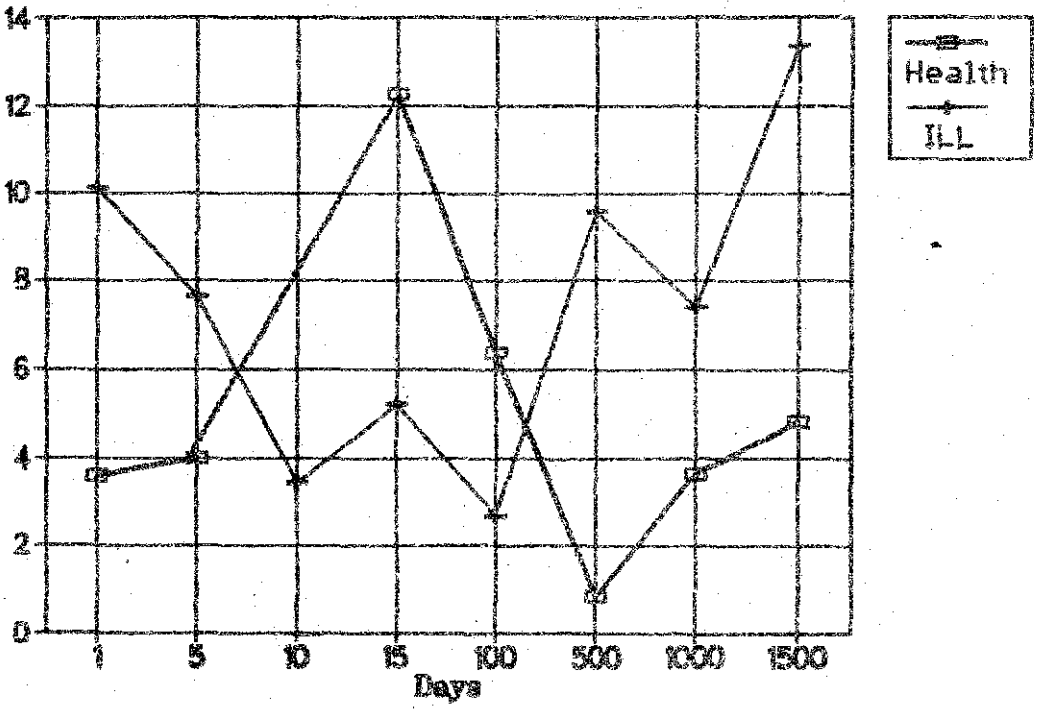

Fig. 2 Dynamics of Correlation of Physiological Parameters during the period of adaptation to the conditions of Extreme North

correlation graph. It is an indicator of the fact of the increase of correlation connections between physiological parameters. It proves the medicine researches of protective strength of the organism and corresponds to the end of transition phase of postaggressive reaction.

At the 12-th day there is a decrease of the weight of correlation graph. It could be explained as the end of early period and the beginning of remote artersurgical period for the patients, in other words transition from one phase of postaggressive reaction to another.

As it was mentioned, adaptation of a man to the Extreme North and aftersurgical rehabilitation of cancer patients are connected with two different factor systems: the first one - to Liebig's system of factors, the second one - to synergistic. That's why we can suggest that the biological active conditions of organisms which are in these systems are different.

In Liebig's system of factors adaptation resources of the organism struggle with limiting factor. Organism become "similar" in the sense that they react (each may be in its own way) to it especially. It results in increase of correlation physiological parameters and can be noted when studying the process of adaptation of a man to Extreme North.

When studying aftersurgical rehabilitation of cancer patients it was noted synergistic in the disease factors and surgical intervention. They strengthen each other influence on the organism. Adaptation resources go into "different directions". It results in decrease of correlation physiological parameters and noted when studying dynamics of weight of correlation graph in all groups under research.

When adaptation of a man in Liebig's system of factors influencing organism increase in correlation between physiological parameters corresponds to increase in stress of the organism. And in synergistic system of factors everything is v. v. When decreasing in correlation of physiological parameters increases stress of the organism. That is why for oncologic patients days of minimum weight of correlation graph can be critical days when a patient need additional medical attention. And those day are - 5-th and 7-th days after surgical intervention.

Further more there was made a research of dynamics of dispersion of physiological parameters. It showed common regularities of oncological patients. As it is showed at Fig. 3, 5, 7 graphs of dispersion of parameters of cancer patients blood have their maximums on the 5-th and 7-th days and minimums on the 4-th and 6-th days after surgical intervention.

Comparing graphs of weight of correlation graph and dispersion it could be noted that during the period of aftersurgical rehabilitation (synergistic system of factors), when the factors of cancer and surgical intervention, influencing organism reinforce each other, dispersion dynamics of physiological parameters is retroactive to the dynamics of the weight of correlation graph.

Analysis of anthropological stress in the period of adaptation of a man to the condition of the Extreme North expressed that almost healthy people during their 1-st month of stay there have got an increase in correlation of physiological parameters, it means that the organism stress increases and then decreases. Those people who have frustrations in the process of adaptation v. v. anthropological stress decreases at first and a month later starts increasing (Fig. 2). The same dynamics was showed by dispersion of physiological parameters of the organism which were got after total blood count (Fig. 4, 6, 8). So, during the process of adaptation in Liebig's system of factors anthropological stress and dispersion of physiological parameters are in dependence.

Analysis of Validity of Calculations

As it was noted method of correlation adaptometry allows to analyse population in the process of changes in environmental factors, find out situations when adaptation stress of the population dramatically increases, estimate the degree of organisms stress on different stages of pathological process, describe dynamics of population stress in the process of adaptation (new ecological and climate conditions, operative disease), etc. Usage of index of weight of correlation graph in the researches proves existing theories about process of acclimatization, adaptation and aftersurgical rehabilitation.

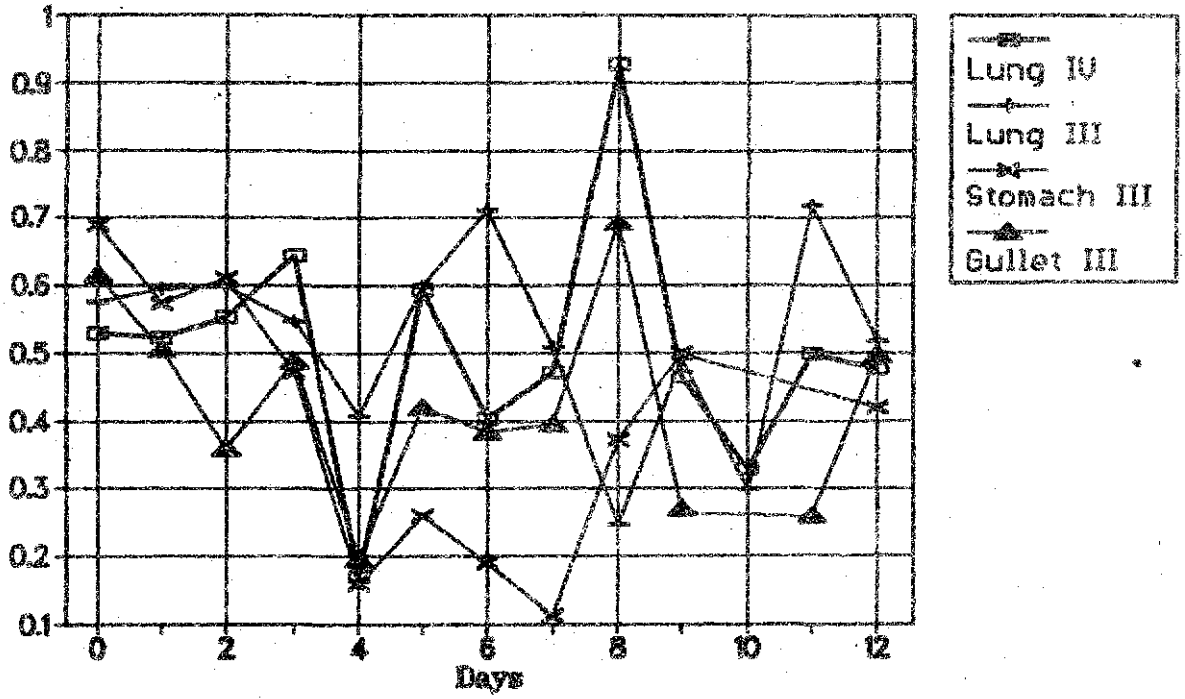

Fig. 3 Changes in dispersion of erythrocytes during the period of aftersurgical rehabilitation

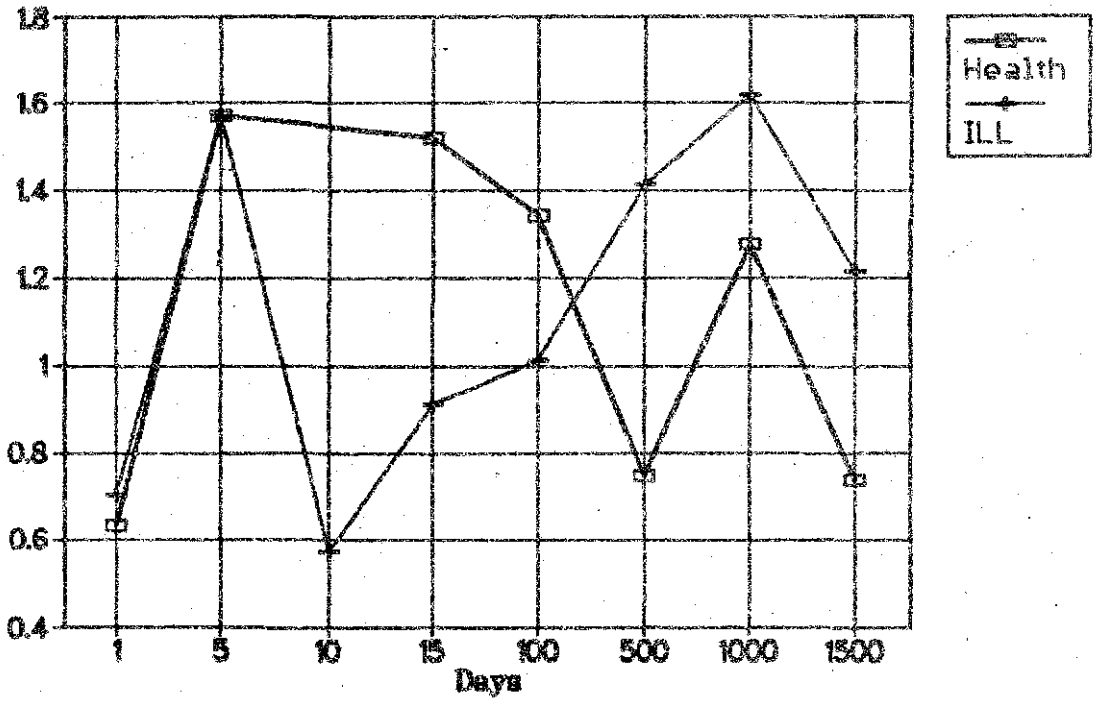

Fig. 4 Changes in dispersion of erythrocytes during the period of adaptation to the conditions of Extreme North

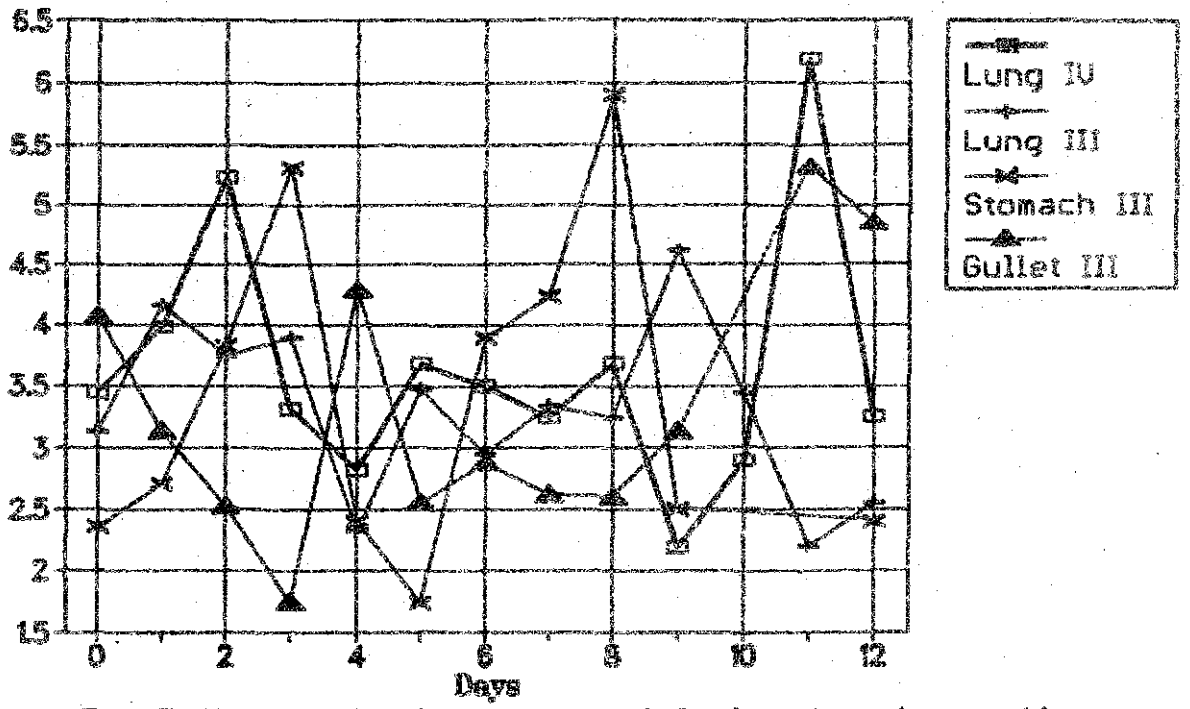

Fig. 5 Changes in dispersion of leukocytes during the period of aftersurgical rehabilitation

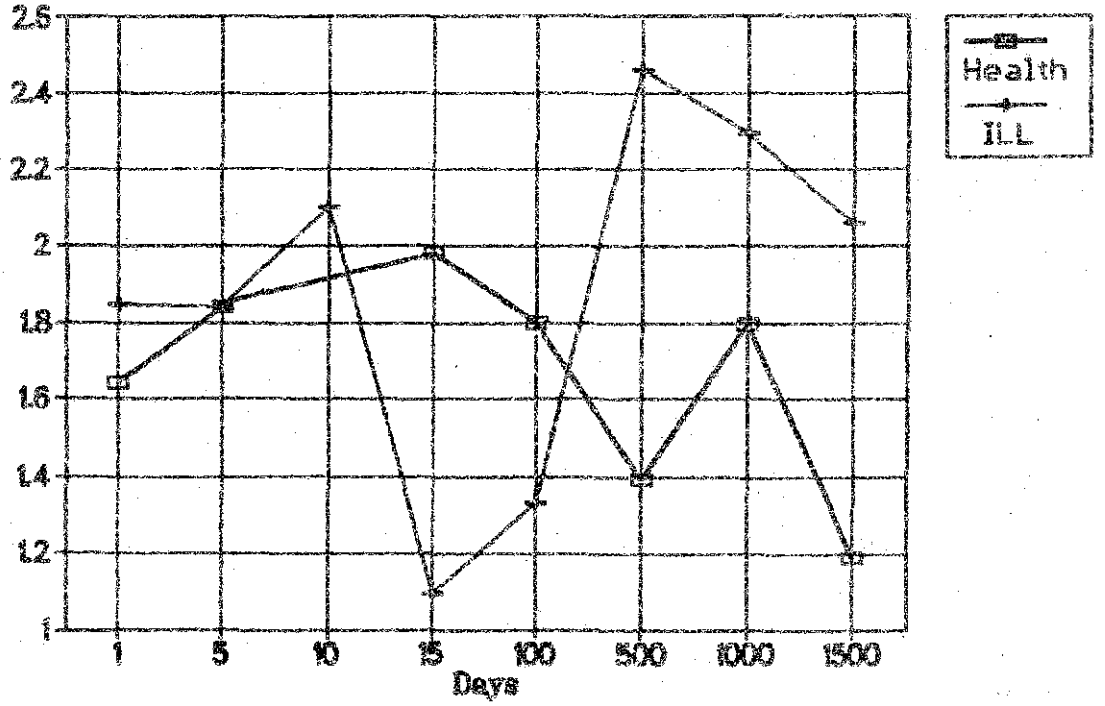

Fig. 6 Changes in dispersion of leukocytes during the period of adaptation to the conditions of Extreme North

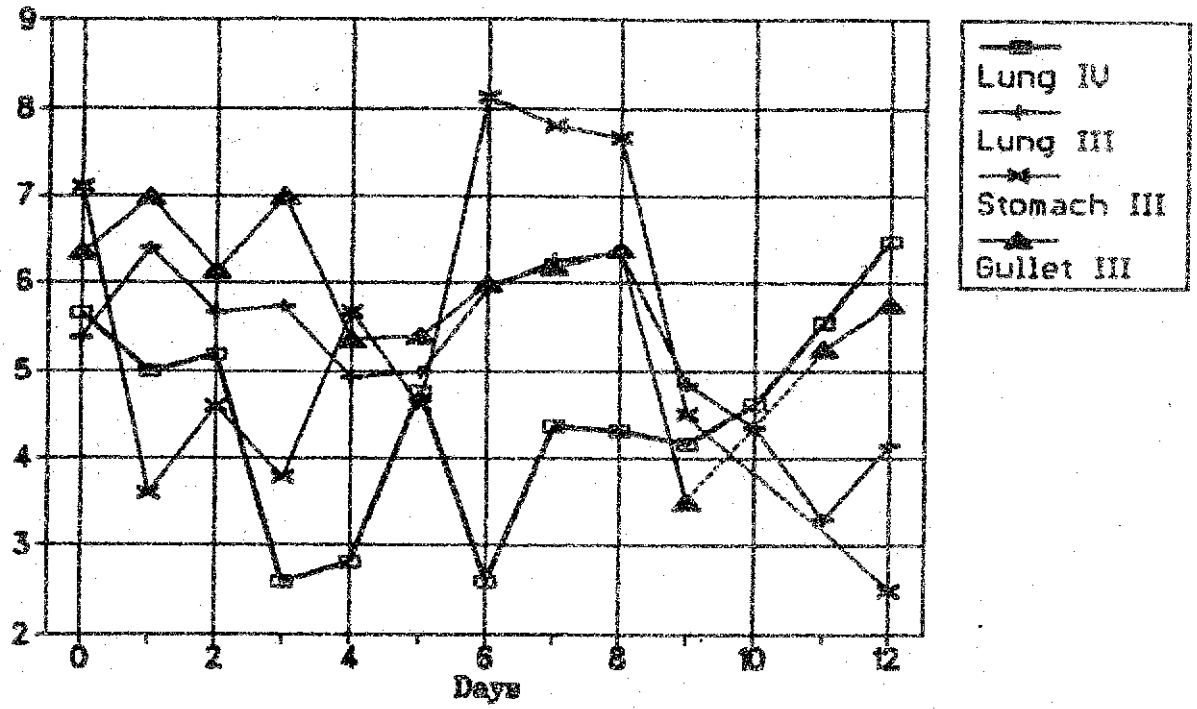

Fig. 7 Changes in dispersion of nuclear segment during the period of aftersurgical rehabilitation

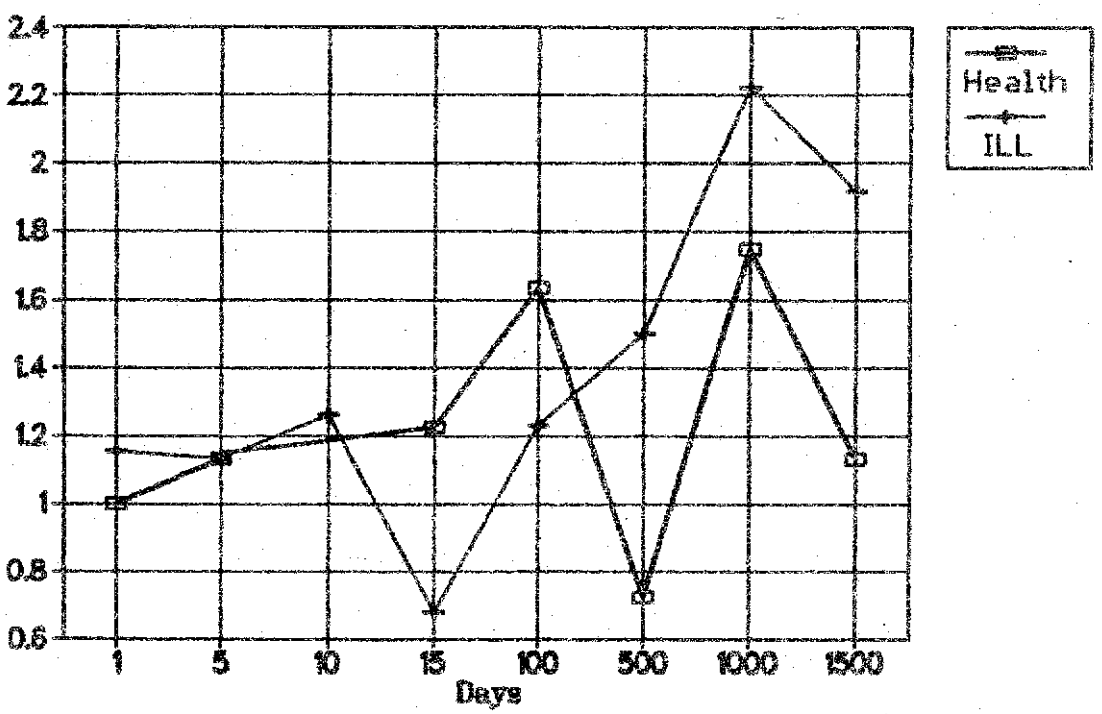

Fig. 8 Changes in dispersion of nuclear segment during the period of adaptation to the conditions of Extreme North

Work with figure indexes always brings to the problem of validity of obtained results. Studying process of population adaptation to the conditions of Extreme North and surgical disease there was made calculation of validity of weight of correlation graph (G). For this purpose there was measured dependence of G from the quantity of examined people in the group (N). Calculations were made for the largest group of oncological patients (lung cancer of III and IV clinic groups) before and after surgical intervention and for the group of people arrived at the North in one year and one and half years.

Sample	Period	Quantity people in the group
Lung cancer III	before/after surgical intervention	100
Lung cancer IV	before/after surgical intervention	60
Arrived at North	1 year/1.5 years	60

Out of these samples there were formed random groups of 10, 15, 30 and 45 people. There was calculated the weight of correlation graph G_{ij} for each group, where i=10, 15, 30, 45 and j-quantity of groups in sample. Mean G_i and standard deviation σ_i were calculated for the received results of G_{ij}. On Fig. 9-14 plot of σ_i and mean G_i versus quantity of group in the sample. For G_{100} - Lung cancer III and G_{60} - Lung cancer IV and people arrived at the region of Extreme North is σ_i=0.

Analysing graphics Gi for oncologic patient (Fig. 9, 11) it could be see that increased stress during before surgical intervention period in comparison with aftersurgical, remains independently of quantity of examined people in the group (n). If you look at the graph of dependence of G_i for those arrived at the Extreme North (Fig. 13) you can see that when n=15 there is a deviation of $G_{1\ year}$ from $G_{1.5\ years}$. And for oncological patients v. v., when n=15 graph G draw together before and after surgical intervention.

So, proceeding out of the conducted researches, to avoid obliteration of differences between G_1 and G_2, we can recommend to make groups for examining more then 15 when using method of correlation adaptometry.

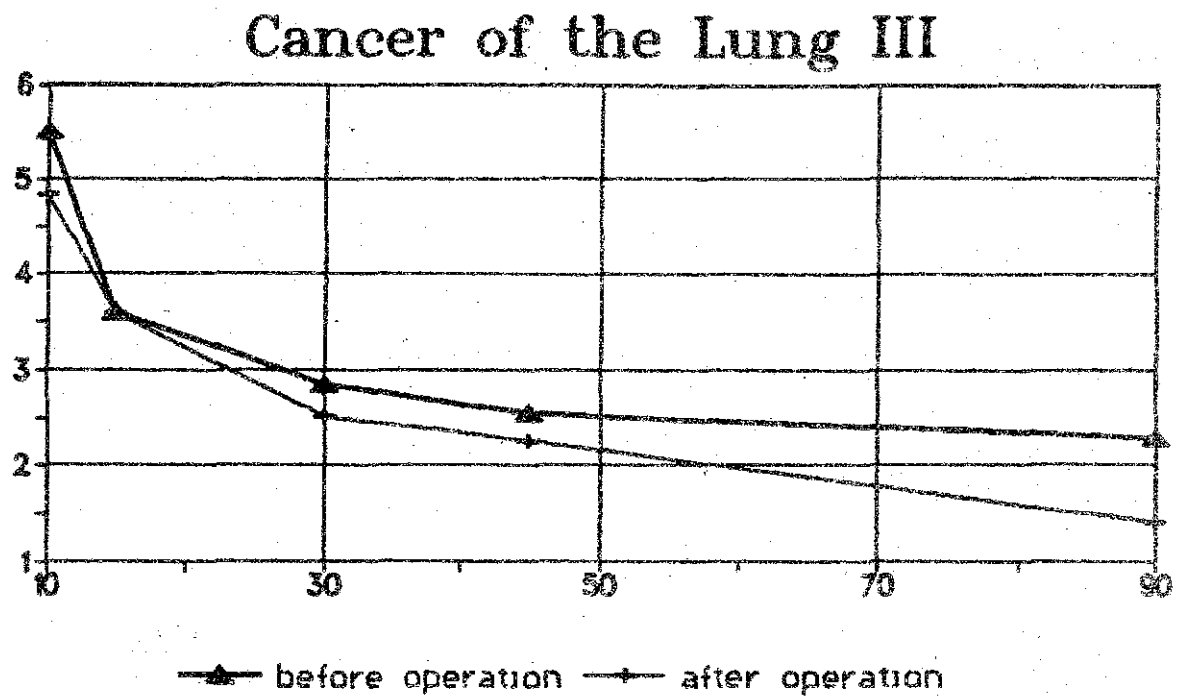

Fig. 9 Plot of Mean weight of correlation graph versus volume of sample

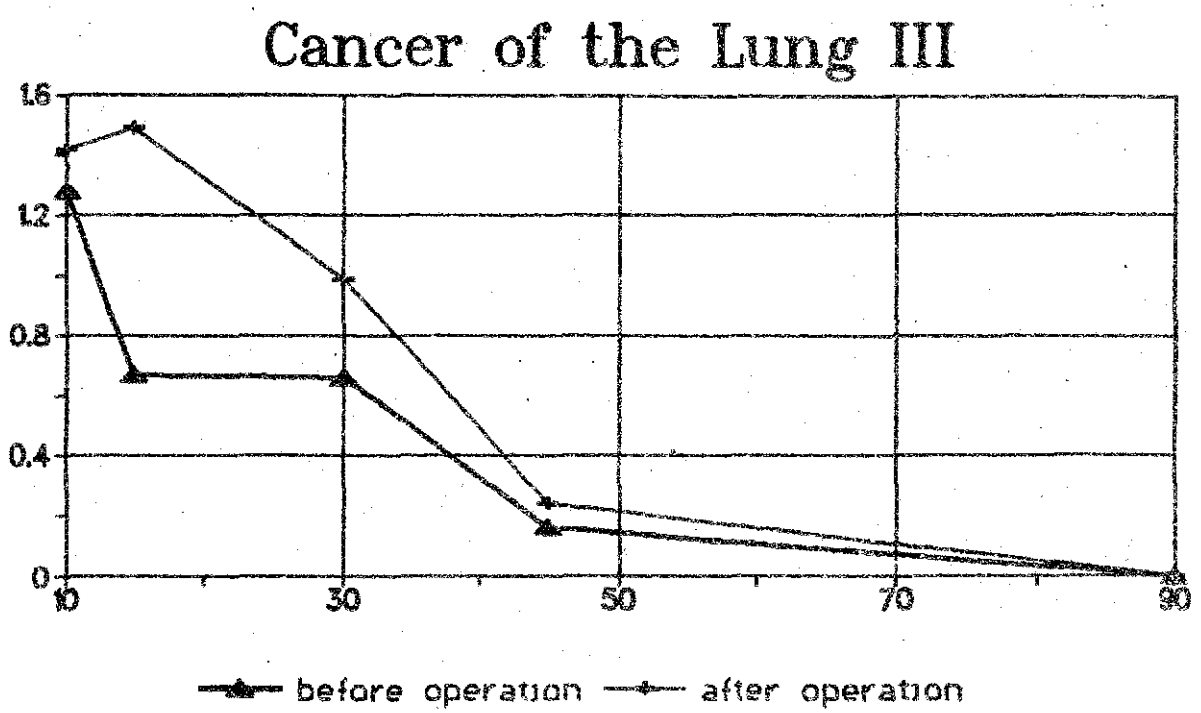

Fig. 10 Plot of dispersion of weight of correlation graph

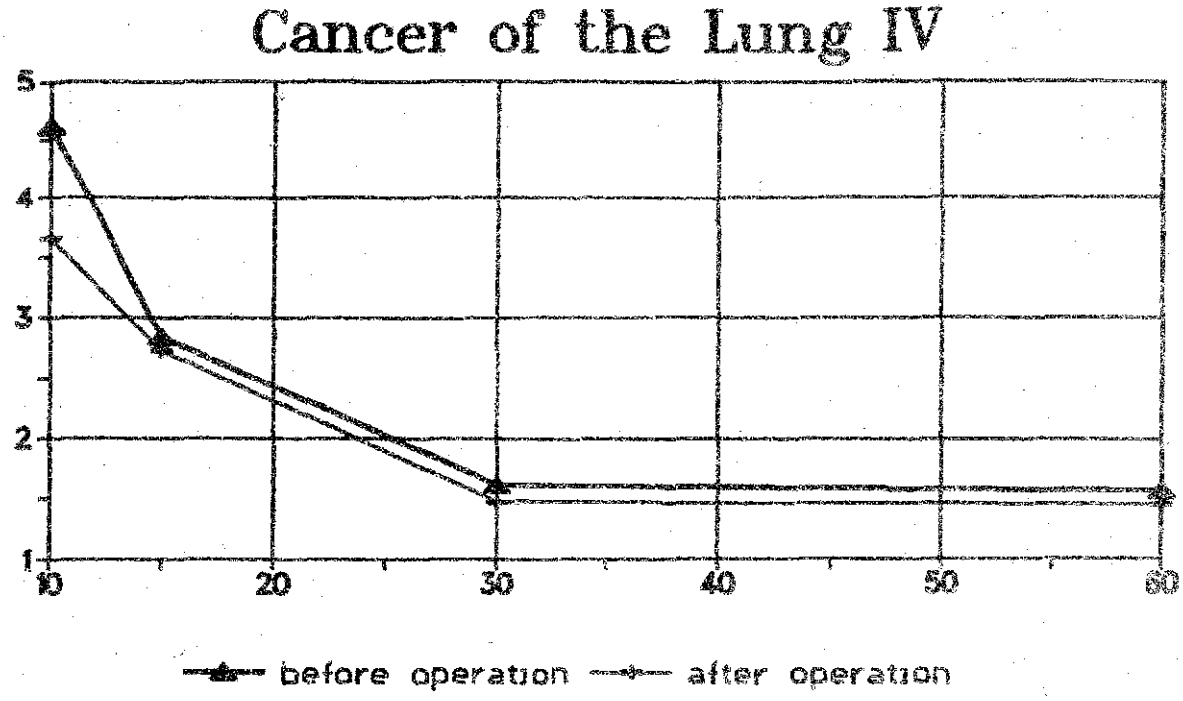

Fig. 11 Plot of Mean weight of correlation graph versus volume of sample

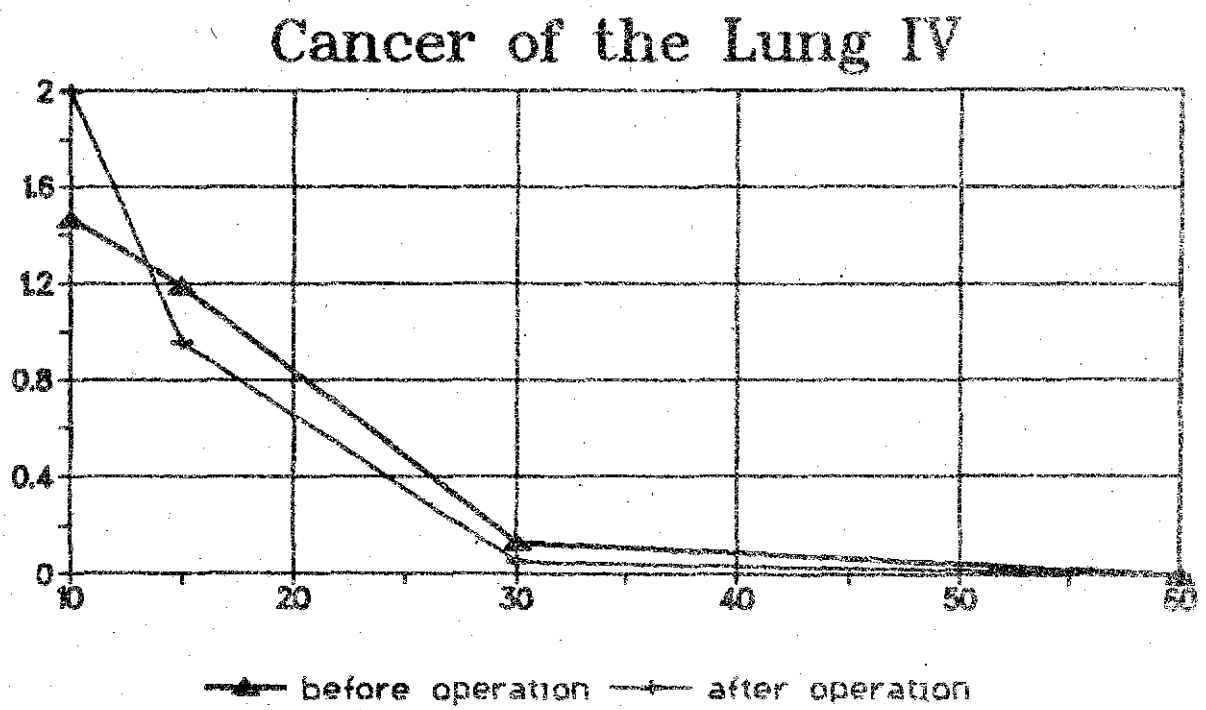

Fig. 12 Plot of dispersion of weight of correlation graph

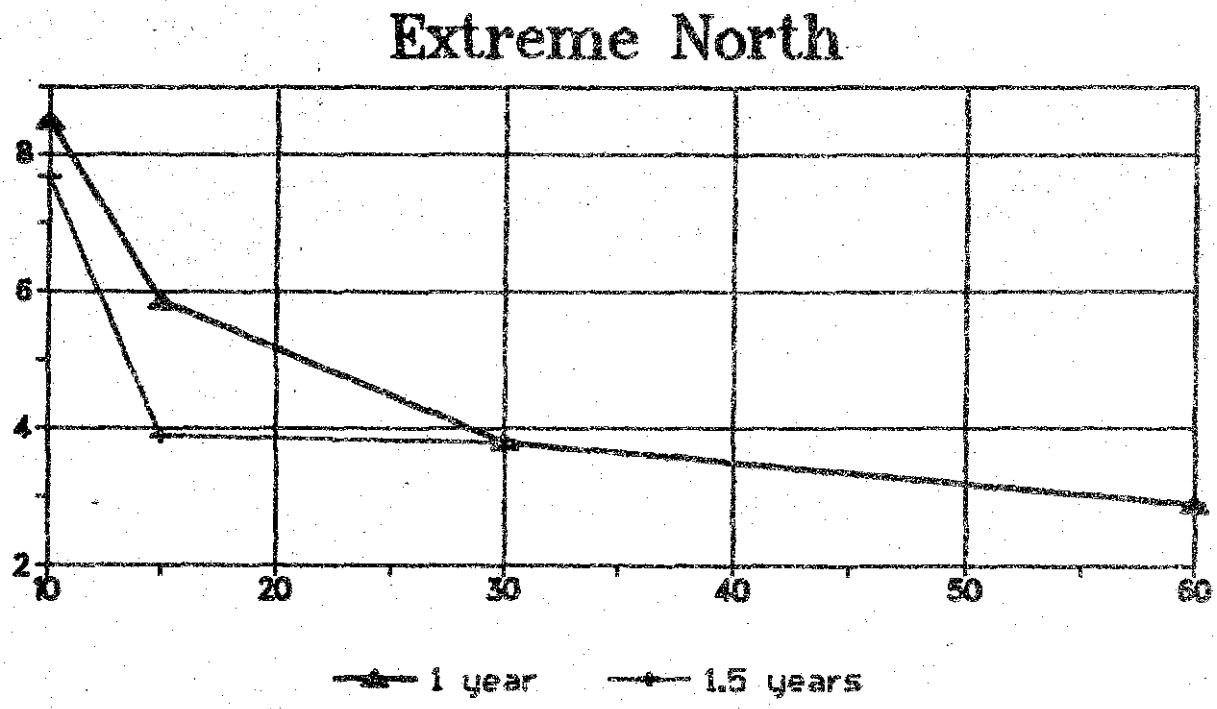

Fig. 13 Plot of Mean weight of correlation graph versus volume of sample

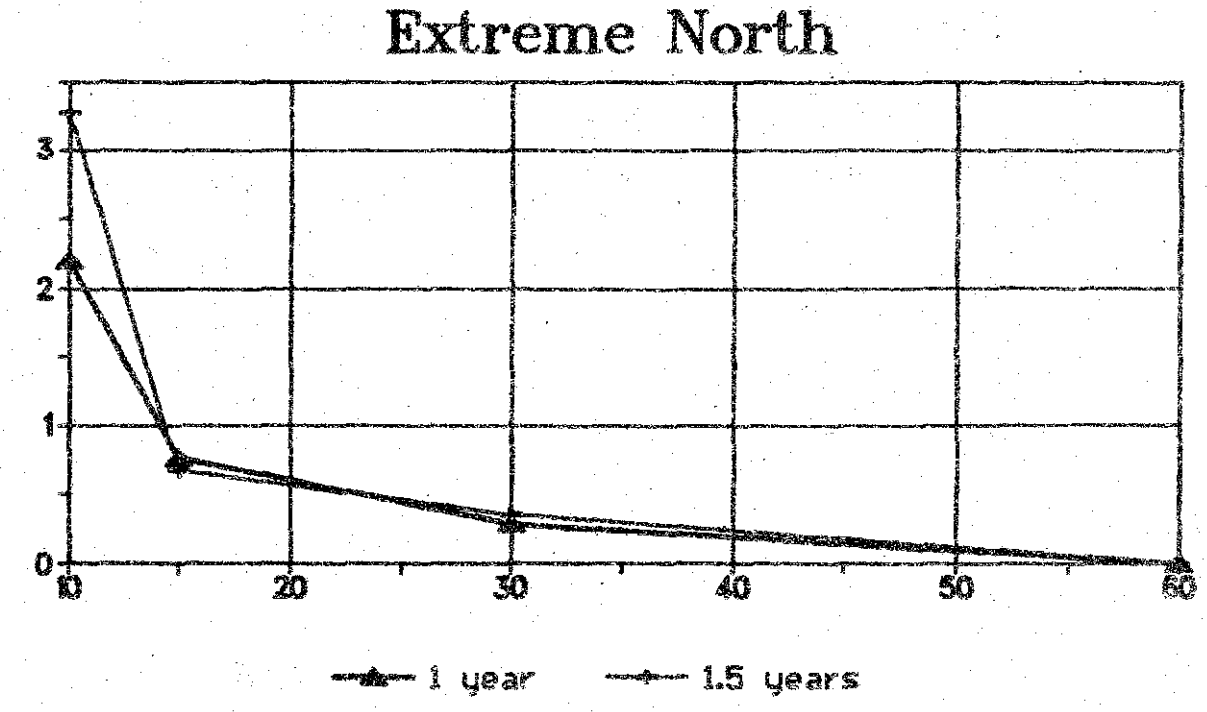

Fig. 14 Plot of dispersion of weight of correlation graph

Conclusion

On the basis of our research on eftersurgical rehabilitation of people suffering from lung cancer of the III, IV clinical groups and carcinoma of the stomach and gullet of the III clinical group we can come to the conclision:

1. Method of correlation adaptometry can be used when analysing of aftersurgical period of oncologic patients.

2. With the help of the method of correlation adaptometry analysing aftersurgical rehabilitation of oncologic patients there were elicited the following regularities: days of maximum (the 4-th, 6-th) and minimum (the 5-th, 7-th, 12-th) of correlation of physiological parameters in the organism.

3. There was proved correspondence with the increase of the weight of correlation graph and decrease of the stress in the organism of a man under the influence of synergistic system of factors.

4. On the basis of correlation adaptometry and data processing there was elicited that in the synergistic system of factors when increasing the weight of correlation graph (G) dispersion (σ) physiological parameters decreases and v. v. when decreasing the weight of correlation graph dispersion of physiological parameters increases. In the Liebig's system of factors when increasing the weight of correlation graph dispersion of physiological parameters increases; and when G decreases dispersion of physiological parameters decreases.

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