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The Method of Medical-Ecological Monitoring of Public Health and Environmentally Hazardous Areas

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Abstract

The main subject of the study of the ecological and medical zoning method is the complex state of the autonomic nervous system (ANS) of the child's organism and the analysis of the processes affecting it. The ANS performs adaptational trophic function - the regulation of the metabolism regarding the conditions of the environment. The analysis of possible ecological problems of the territory and its degree of ecological disturbance can be made due to the received data set on the state of functional health of the children's population of a certain territory and the averaged information on the deviation of the autonomic nervous system. In order to assess the disturbance of the territory, the relative value of the breach of vegetative homeostasis, which is defined as a percentage, is of particular importance. Various organs and systems of the body are known to be associated with certain areas of the skin called acupuncture points. With the appearance of the smallest deviations in the systems of the body and organs, they react at the stage of functional disorders long before the occurrence of organic changes at the expense of meridional bonds. Measuring the electrosurgical resistance in certain acupuncture points you can detect changes in the body still at the stage of

functional disorders. For researches, the method of “biogalvanization” of 24 symmetrical representative active functional zones (12 on the arms and 12 on the legs), which reflect the functional activity of the sympathetic and parasympathetic nervous system has been used. This allows to record changes in the activity of sites of the ANS and to obtain systematic data that are subject to further complex analysis. The given method is unique and allows to conduct ecological analysis of the territory with the help of the target group of organisms - a person; method is non-invasive and low-cost, which allows conducting surveys of different age and sex groups and obtaining data with a minimum statistical error.

Keywords: sympathetic activity; parasympathetic activity; autonomic nervous system; vegetative homeostasis; ecological

Introduction. The problems of preserving the ecosystem and the biosphere as a whole has become more urgent considering the profound transformation of the natural environment, which is carried out under the influence of anthropogenic influence, which in its scale went to the planetary level, but by force and speed ahead of the influence of natural factors [1, 2, 3]. The determination of biologically significant anthropogenic loads based on the reactions of living organisms and their groups is associated with bioindication. Such signs determine the suitability of bioindication for environmental research, expertise, prediction of behaviour, condition and development of ecosystems. Bioindication has several advantages over instrumental methods. It is distinguished by high efficiency, does not require high costs and allows to characterize the state of the environment over a long period of time. Environmental factors fairly strictly determine which organisms can live in this place, and which can not. Given this, we can use the inverse regularity and judge the physical environment of the organism that lives in it [4].

There are a number of bioindication methods of territories. Bioindication involves assessing the state of the environment with the help of living objects [5]. Living objects are usually cells, organisms, populations, communities. Their help can be evaluated as abiotic factors (temperature, humidity, acidity, salinity, content of pollutants, etc.), as well as biotic (the vitality of organisms, their populations and groups) [6].

The term "bioindication" is more often used in European scientific literature, though in the American oneit is usually replaced by a similar content in the name "ecotoxicology".

Bioindication is based on the observation of the composition and number of species-indicators.

The method of bioindication is based on the selective biological accumulation of substances from the environment by organisms of plants and animals. The anthropogenic pollution of the soil and ponds with heavy metals, radionuclides and some organochlorine derivatives are considered to be the most dangerous for biotic communities since the accumulation of these substances in the living organisms (both the whole organism and its individual parts) violates normal metabolism, affects biochemical, cytological and physiological processes and generally worsens the condition and reproducibility of the population [7].

There are many ways of researching the human body and identifying certain environmental impacts on it. Most methods are indirect but mediated [8]. For example, the study of chemicals concentrations and doses of physical influences in the human environment. The maximum permissible concentration (MPC), maximum permissible dose (MPD), levels or doses are usually calculated using lethal doses (LD) of certain factors on the tested organisms, rats, mice, chickens, rabbits, etc. Usually, the boundary effects of the direction on the human body are calculated, and therefore do not reveal the objective impact of environmental factors on humans.

The most qualitative and accurate identification of environmental impacts can only be directed directly to a person, still this is impossible with the use of the "concept of MPC". For a thorough study of the impact of polluted and disturbed environments on humans, one should conduct a detailed study of all possible human health parameters: biochemical blood tests, changes in blood pressure, temperature, genetic effects, general well-being of a person, etc [9].

Environmental pollutants are found in all human bio substrates (blood, urine, breast milk, hair, teeth, bones, and exhaled air).

The greatest danger to child health is the chemical contaminants that cause mutagenicity, teratogenicity and carcinogenicity [10]. In this case, the impact of biosphere chemical contaminants on the body is extremely multifaceted and requires an integrated assessment (the individuality of toxic effects is impossible) [11].

An unpredictable set of pollutants (chemical, physical, biological, anthropogenic and informational) causes "integral environmental pressure" (IEP) on nature and man. Therefore, the functional health of the children's population should become the center of attention in modern conditions [12].

In general, the correlation between different (all) types of environmental impacts and human health violations in certain areas is extremely difficult, although it is an urgent task.

The functional health of certain age groups of the children's population should be in the center of attention, which becomes the "bioindicator" of the regional socio-ecological state.

"Functional health" implies the ability to adapt the organism to changing conditions of the external and internal environment. Today there is an understanding of adaptive dependence on the dynamic constancy of functionally vegetative homeostasis [13].

For this purpose, functional-vegetative diagnostics (FVD) of the children's population by the method of V. Makats is offered to be used since it allows to reveal indicators of variance of vegetative levels acting as integral bioindicators of internal homeostasis [14]. On this basis, an integral characteristic of the ecological state is formed and the levels (zones) of its ecological pressure are determined. The health of the children's population more objectively reflects the ecological changes of the territory, since children have neither occupational illnesses nor bad habits, they are fed by higher quality food, which allows to obtain more accurate information directly about the environmental impacts on the health of the population. Therefore, the study of the functional health of the children's population with the further analysis of medical and environmental impacts of the environment is an extremely urgent task [15, 16].

Materials and methods of the research. The essence of the bio-diagnostic method and bioindication of territories through the analysis of functional health of the population.

For researches, the method of “biogalvanization” of 24 symmetrical representative active functional zones (12 on the arms and 12 on the legs), which reflect the functional activity of the sympathetic and parasympathetic nervous system has been used. This allows to record changes in the activity of sites of the autonomic nervous system and to obtain systematic data that are subject to further complex analysis. The peculiarity of this method and device is the ability to record the activity of the VNS points of organs and systems of the body, in particular, the lungs (LU), the large (LI) and the small intestine (SI), the stomach (ST), the spleen and the pancreas (SP), Heart (HT), kidney (KI), bladder (BL), liver (LR), and the state lymphatic system (TE) separately. The symbols used correspond to the international classification of functional-vegetative systems (acupuncture channels). The obtained data are compared with the norm and it is concluded about the degree of deviation from it and the level of disturbance of functional health [13, 14].

The method of bio-diagnostics and devices for its implementation are officially authorized by the Ministry of Health of Ukraine "New medical technology and new methods of diagnosis" (minutes No. 5 dated December 25, 1991, No. 1.08-01 dated January 11, 1994)

and the Academic Council Ministry of Health of Ukraine (Duct No. 1.08-01 dated January 11, 1994).

Features of the device VITA 01 M:

1. external energy sources are not used for the device functioning;

2. the voltage in the closed circle does not exceed the levels of the membrane potentials (0,03 - 0,6 V);

3. due to the compactness and ergonomics of the device, it can be used for both stationary and expeditionary research.

The conducting of the experiment itself is carried out in the following stages [13, 14]:

1. preparation of the device VITA-01-M for diagnostics of functional and vegetative balance of the organism;

2. localization of representative and biologically active zones (BAZ), partially represented in Table 1;

Table 1

Representative active zones used for functional and vegetative diagnostics

Active zones	Topography of representative BAZ
H-1 (LU-9) Lungs	On the lumbar skin of the radial-wrist joint from the radius of the radial artery
H-2 (PC-7) Pericardium	In the middle of the lumbar fold of the radial wrist, between the muscle tendons
H-3 (HT-7) Heart	In the depression between petiolate and elbow bones on the lumbar spine of the radial wrist
H-4 (SI-4) Small intestine	On the inner (elbow) edge of the wrist in the gap between the base V of the kneecap and the wrists
H-5 (TE-4) Three heaters	On the back of the radial wrist in the depression between the tendons of the extensor of the fingers and the V finger
H-6 (LI-5) Large intestine	On the ray edge of the wrist, between the tendons of the thumb extensors
F-1 (SP-3) Spleen	On the medial side of the foot, in the depression behind and below the head I mold
F-2 (LR-3) Liver	On the back surface of the foot, in the narrowest place between the I and II molds
F-3 (KI-3) Kidneys	In the depression in the middle of the distance between the heel (Achilles) tendons and the medial tibia
F-4 (BL-65) Bladder	On the lateral side of the foot, in the depression behind and below the head of the V mold
F-5 (GB-40) Gall bladder	Side and bottom of the lateral side of the fibula, in the depression of the external side of the tendon of a long finger extensor
F-6 (ST-42) Stomach	At the very high part of the back of the feet between the joints II and III of the wedge bones and the II-III molds

3. preparation of diagnostic electrodes DE and AE: base electrode acceptor of electrons (AE) - a plate of special alloy, pre-coated with an oxide film (5x7 cm); diagnostic electrodes (DE - electron donors) in the form of a silvered vapor, which are disassembled in 1 cm diamonds and wrapped with foam Arubber gaskets;

4. fixation with a special pass through a wet pad (moistened with warm water or physiological solution) AE in the umbilical region (central mesogastric area (0-zone) with a tensile of average density to create stable test conditions. The latter are moistened with warm water. During testing DE at a right angle with a slight pressure (at the touch of a touch), simultaneously contact each pair of symmetric BAZs (left-right on each limb) for 1-4 seconds until stable values are obtained. Through each three contacts with BAZs electrodes are repeatedly wetted in a previously prepared solution.

NB H1-H6 representing biologically active zones (BAZ) on the hands, and F1-F6 - on the legs.

The data presented in Table 1 reveals only 12 key points that are important for the study of the major groups of the human organs, although the complete list of points contains over 200 active zones.

Results and Discussion. The main subject of the study of the ecological and medical zoning method is the complex state of the autonomic (vegetative) nervous system (VNS) of the child's organism and the analysis of the processes affecting it.

Indicators of the autonomic (vegetative) nervous system regulate all internal processes of an organism. There are functions of internal organs and systems, glands, blood and lymphatic vessels, smooth and partially transversely banded muscles, sensory organs. They provide the homeostasis of an organism, that is the relative dynamic constancy of the internal environment and the stability of its basic physiological functions (blood circulation, respiration, digestion, thermoregulation, metabolism, selection, reproduction, etc.). In addition, the autonomic nervous system performs adaptational trophic function - the regulation of the metabolism regarding the conditions of the environment.

There is a number of methods for studying individual indicators of the state of the autonomic nervous system. In particular, the method of orthostatic test, cardiointervalography, dermography, the method of heart-to-heart reflex, galvanic reflex, etc. All of them are reduced to procedures or actions that allow characterizing the tone of sympathetic and parasympathetic innervation of a particular organ or system and do not reflect the vegetative state of the whole organism.

Till the recent days, vegetative anamnesis with the usage of questionnaire tables has been generally accepted as the means of integral evaluation of vegetative homeostasis. At the same time, historically preserved detached evaluation of sympathetic and parasympathetic reactions of the basic divisions of vegetative nervous system (VNS) contradicts contemporary ideas of their functional-dependent composition. Additionally, the complexity of the study of over-segmental and segmental levels of vegetative regulation restricts necessary information for clinicians. It is also necessary to remember about the heterogeneity of sympathetic and parasympathetic reactions, nonlinearity of parameters of vegetative status during the change of activity of one of the divisions of VNS and their dependency on a range of regulating factors. At the same time, it has been defined, that the indications of instrumental examination of VNS characterize only separate mechanisms of vegetative regulation.

Thus, table methods of vegetative diagnostics are subjective, though instrumental ones reflect the functional state of separate subsystems of VNS and separate mechanisms of vegetative regulations. That is why, in order to see the full picture, we need enormous, simultaneous and complex researches, during which, separate indications lose features of system evaluation of general vegetative homeostasis (VH).

Various organs and systems of the body are known to be associated with certain areas of the skin called acupuncture points. With the appearance of the smallest deviations in the systems of the body and organs, they react at the stage of functional disorders long before the occurrence of organic changes at the expense of meridional bonds. Such a reaction at acupuncture points is manifested in the form of a change in the magnitude of their magnetic field, temperature, electrical resistance, the rate of biochemical reactions, cellular composition in them as well as their size. Measuring the electrosurgical resistance in certain acupuncture points you can detect changes in the body still at the stage of functional disorders.

Each power system and body associated with its group of acupuncture points, among which there are so-called representative points (zones) that carry the maximum of reliable information about their system.

The analysis of possible ecological problems of the territory and its degree of ecological disturbance can be made due to the received data set on the state of functional health of the children's population of a certain territory and the averaged information on the deviation of the autonomic nervous system.

The data from the statistical observations of 18,650 children of different sex and age groups were used in order to determine of the normal values of vegetative states and

deviations from the norm. The analysis was not based on the absolute values of the indices, but the relative correlation of the total sympathetic and parasympathetic activity of the VNS.

Table 2

Gives the basic diagnostic norms of the functional state of individual systems

FVS	M, μA	min, μA	max, μA	FVS	M, μA	min, μA	max, μA
LU	10.1	7.3	12.9	BL	9.3	5.9	12.7
LI	7.8	5.3	10.2	KI	7.6	5.5	9.7
ST	7.7	5.0	10.3	PC	8.6	6.3	10.9
SP	9.5	6.1	13.1	TE	7.4	4.4	10.6
HT	9.3	5.4	13.1	GB	6.2	3.7	8.6
SI	9.0	7.0	11.0	LR	7.5	4.8	10.2

The array of experimental data is compared with the norms of the functional state after which the normative index of vegetative homeostasis is calculated for k-V (zone of FC - functional compensation zone).

The values can possibly be considered to be perfect if they recognize the equilibrium zone and the deviation in the area of parasympathetic activity or sympathetic activity indicates a deviation of functional health.

The vegetative coefficient of deviation (k-V) is used to determine the numerical value of the deviation. It is done with the use of the formula (1):

$$k\text{-}V = \sum X(SA) / \sum X(PSA), \quad (1)$$

where: $\sum X(SA)$ – the amount of diagnostic indicators that have a value higher than M;

$\sum X(PSA)$ – the sum of diagnostic indicators that have values lower than M;

M - diagnostic standard for a specific active zone, μA;

X - measured value of the activity of a specific active zone, μA.

Vegetative coefficients (k-V) indicate the systemic ratio of "sympathetic / parasympathetic" activity.

Accordingly, when values of the deviation from the norm are more than one, sympathetic activity will be observed and, with values less than one, the parasympathetic activity takes place (Table 3).

For functional-ecological expertise (estimation) of settlements, indicators of vegetative dispersion (scattering of vegetative levels) are used (Yermishev O., 2017).

Table 3

Normative indices of vegetative homeostasis (vegetative dispersion) in k-V magnitude

Parasympathetic Activity (PSA)		Vegetative homeostasis			Sympathetic Activity (SA)	
considerable	expressed	FC zone PSA	Equillibrium zone	FC zone SA	expressed	considerable
0,75 ≤	0,76-0,86	0,87-0,94	0,95-1,05	1,06-1,13	1,14-1,25	1,26 ≥

Note: FC zone is a zone of functional compensation.

It is impossible to judge the ecological situation in the region according to individual indicators of the rejection of vegetative homeostasis. However, according to the group indicators (which are obtained by a large number of people), it is possible to draw conclusions regarding the level of environmental disturbance of the territories. To do this, Table 4 should be used. To determine the total percentage of homeostasis disturbances in the studied children in a particular territory is taken into account.

Table 4

The dependence of the functional ecological disturbance of the territory on the state of averaged deviations of the autonomic nervous system

Estimation of the tension (voltage) of the functional and ecological situation in the region	Number of violations of vegetative homeostasis in children (in%):		
	PSA zone	VE zone	SA zone
The zone of relative functional and environmental	15	70	15
Zone of increased functional and ecological attention	25	50	25
Zone with signs of functional and environmental voltage development	30	50	20
Zone with signs of the development of functional and environmental disaster	45	40	15
Functional and ecological disaster zone	65	25	10
Functional protection voltage zone - FVP	10	25	65

Note: PA - parasympathetic activity; VE - vegetative equilibrium; SA - sympathetic activity.

Practically, the type of complex deviation of functional health (sympathetic or parasympathetic) does not matter. In order to assess the disturbance of the territory, the relative value of the breach of vegetative homeostasis, which is defined as a percentage, is of particular importance.

The use of the data obtained to construct contamination maps and further analysis. For the effective use and analysis of the functional health data of the population of a certain territory, it is necessary to use the geographical binding of each case of the study.

It is difficult to deny the fact that the overwhelming majority of information on diseases has a geographic aspect and therefore it can be spatially analyzed and visualized in the form of maps, diagrams, graphs and drawings. There are powerful tools for effective analysis and visualization of spatial information such as geographic information systems (GIS) that not only allow the creation of electronic maps based on high-level databases but also by means of a comprehensive analysis of available spatial information solve problems of varying complexity.

These maps can be used to draw data on the definition of functional health and mapping of complex environmental pollution.

The mapping method can be used for in-depth analysis of various environmental parameters, which may include the condition of forest plantations, hunting teriophane, etc.

Conclusions

1. The given method is unique and allows to conduct ecological analysis of the territory with the help of the target group of organisms - a person.

2. The research method is non-invasive and low-cost, which allows conducting surveys of different age and sex groups and obtaining data with a minimum statistical error.

3. The given method does not consider such subjective indicators for different people as the MPC (maximum permissible concentration), MPD (maximum permissible dose), and therefore assesses the environmental impact on each subject objectively in its ability to withstand anthropogenic influences.

4. The given method is extremely promising in bioindication of territories contaminated with radionuclides, chemical means of plant protection, territories with contaminated objects of the hydrosphere and atmosphere, it allows to evaluate the total impact of all negative environmental factors on human health.

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