

Federal Service for Supervision of Consumer Rights Protection and Human Well-Being  
Russian Academy of Sciences, Preventive Medicine Section of the Department of Medical Sciences  
Federal Budgetary Institution of Science Federal Scientific Center for Medical and Preventive Risk  
Management Technologies  
of the Federal Service for Supervision of Consumer Rights and Human Well-being Protection  
Department of the Federal Service for Supervision of Consumer Protection and Human Well-being  
in the Perm Territory  
Federal State Budgetary Educational Institution of Higher Education Perm State  
Medical University named after Academician E.A. Wagner  
of the Ministry of Health of the Russian Federation

*PARTICIPANTS:*  
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*National Institute for Food Control, Hanoi (SRV)*

**HEALTH RISK ANALYSIS – 2022**  
**Fundamental and Applied Aspects of Ensuring Sanitary**  
**and Epidemiological Well-being of the Population**  
**AND RISE-2022 MEETING ON ENVIRONMENTAL HEALTH**

Dedicated to the 100th anniversary  
of the Sanitary and Epidemiological Service of Russia

Proceedings  
XII All-Russian Scientific and Practical Conference with International Participants

(Perm, May 18–20, 2022)

*Edited by Professor A.Yu. Popova,*  
*Academician of the RAS N.V. Zaitseva*

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Materials of the 12th All-Russian Scientific and Practical Conference with International Participants "Health Risk Analysis – 2022" including an international RISE-2022 session on Environment and Health. The materials summarize the scientific and practical experience and cover fundamental and applied issues of sanitary and epidemiological well-being of the population of the Russian Federation. This year the conference is held under the auspices of the 100th anniversary of the Sanitary and Epidemiological Service of Russia.

The conference materials contain legal and relevant methodological aspects of health risk analysis in ensuring sanitary and epidemiological well-being, introduce Russian and international experience, and reveal sanitary and medical demographic problems of the regions at the present stage, including during the pandemic of a novel coronavirus infection, contain the results of the development of scientific and methodological approaches to control and supervisory measures in as part of the development of a risk-based model, with the introduction of remote and contactless forms of supervision.

The works of domestic and foreign scientists summarize the experience of risk assessment in hygienic and epidemiological studies (occupational hygiene, hygiene of children and adolescents, et al.). Several articles provide examples of the implementation of national projects "Ecology", "Demography", "Housing and Urban Environment", and "General Cleaning", highlighting the problems and prospects of risk-oriented oversight in the digital transformation of society. The articles offer methodological approaches to mathematical modeling of systems and processes, prevention of health disorders associated with heterogeneous risk factors.

Numerous articles highlight issues related to the assessment of the impact of physical and biological factors in the conditions of intensive development of large cities and industrial agglomerations. A special section is dedicated to the best practices of hygienic assessment and analysis of health risks, improvement of social and hygienic monitoring, chemical-analytical and IT and software support of the activities of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being. Overall, the conference materials contain the results of research and methodological developments relevant to the practical activities of the service in carrying out hygienic analysis, investigations, studies, and examinations. The experience of different territories can be used to solve a number of tasks at the regional and municipal levels in the field of ensuring the sanitary and epidemiological well-being of the population and consumer protection.

The materials are intended for specialists of the bodies and institutions of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being, research institutions, educational institutions of higher education in the medical and preventive field, students, graduate students, doctors and specialists involved in the related fields of science and practice.

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**To the organizers and participants  
of the 12th All-Russian Scientific and Practical Internet Conference  
with International Participants  
"HEALTH RISK ANALYSIS – 2022.  
Fundamental and Applied Aspects of Ensuring  
Sanitary and Epidemiological Well-Being of the Population"**

Dear Colleagues!

I want to welcome the organizers and participants of the 12th All-Russian Scientific and Practical Internet Conference with international participants "HEALTH RISK ANALYSIS – 2022" on behalf of the Federal Service for Supervision of Consumer Rights and Human Well-Being Protection.

This year the conference is held under the auspices of the 100th anniversary of the Sanitary and Epidemiological Service of Russia. The conference participants will focus on discussing the best historical practices of the country's Sanitary Service and their modern application and development based on advanced scientific achievements.

In the challenging sanitary and epidemiological situation associated with the pandemic of a novel coronavirus infection, the strategic directions of the activities of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being remain the development of science-based methods of analysis and forecasting of the sanitary and epidemiological state of territories, social and hygienic monitoring, prevention of consequences of the adverse impact of chemical, physical and biological factors (including infectious diseases) on public health, containment and prevention of sanitary and epidemiological hazards to the population. The course of counteracting the novel coronavirus infection demonstrated the advantages of the Russian approaches to organizing sanitary and epidemiological services and conducting anti-epidemic measures, the foundations of which were laid one hundred years ago. A new stage in the development of the sanitary and epidemiological supervision system was the development of the "Sanitary Shield" of Russia, an integrated system for counteracting infections.

Particular attention is paid to implementing measures of national and federal projects to improve the quality of life of Russia's population and increase healthy life expectancy. The exchange of experience on national projects and replication of the best practices to all regions of the country is one of the essential tasks of the conference as a meeting of experts.

Developing a unified federal supervision system to protect consumer rights and human well-being, the digitalization of all areas of the Service, and an integrated system of data and operational situation analysis using modern information technologies is an equally important area of exchange of ideas and best practices.

The development and strengthening of cooperation of the Federal Service for Supervision of Consumer Rights and Human Well-Being Protection with the specialized foreign agencies and international scientific organizations working on sanitary and epidemiological well-being of the population and protection of public health are highly relevant.

The essential task is to attract talented young people to the sphere of science and state-of-the-art technologies and increase the professional community's participation in implementing the Strategy of Scientific and Technological Development of the Russian Federation. The competition of works of young scientists and specialists of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being is one of the steps toward solving this problem.

I am confident that the conference will provide an exciting and in-depth review of the announced topics and offer a constructive exchange of views. I wish the conference organizers and participants productive cooperation and new achievements.

Head of the Federal Service for Supervision  
of Consumer Rights and Human Well-Being Protection  
Chief Sanitary Physician of the Russian Federation



A.Yu. Popova



## Section I

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**Actual problems of sanitary and epidemiological well-being and analysis of public health risks**





## **ENVIRONMENTAL HEALTH AND MEDICINE CHALLENGES IN THE ARCTIC AND SUB-ARCTIC\***

**\*within the framework of the RISE-2022 meeting  
on environmental health**

**J. Reis, P.S. Spencer**

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Climate change is a major global concern nowadays and a greatest challenge the mankind has to face. Some regions are more affected by it, especially sensitive ones; the Arctic and Sub-arctic fall into this category. The report “Environmental health and medicine challenges in the Arctic and Sub-arctic” covers multiple important issues associated with climatic change and its devastating influence on the fragile ecosystems in these regions. It focuses on geographical peculiarities and major environmental challenges including water and surface warming, ice melting, weather changes. Major health issues covered in the report concern some historical aspects but greater attention is paid to contemporary challenges such as contamination of food, spread of communicable diseases caused by global warming and release of extremely dangerous viruses from permafrost due to its thawing. Unfortunately, some of the outlined concerns are being ignored and it creates global threats. It is important to remember that climate knows no national borders and what is happening in the Arctic should be a global concern for the whole mankind.

**Keywords:** Arctic region, climate, health.

## **INFLUENCE EXERTED BY GLOBAL CLIMATE CHANGE IN THE ARCTIC ZONE AND PROBABLE HEALTH OUTCOMES\***

**\*within the framework of the RISE-2022 meeting  
on environmental health**

**N.V. Zaitseva, S.V. Kleyn, M.V. Glukhikh**

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Perm, Russia

At present, given the intensive land development in the Arctic and Sub-arctic regions in the RF, it is vital to estimate influence exerted by weather and climate on public health under global climate change. According to multiple reports issued by Russian and international organizations, the most serious and widely spread risks for natural, managed and human systems are to be expected exactly in these regions. In Russia, most regions are located in zones with relatively harsh climate. Average monthly temperatures and precipitations were examined in dynamics over a period from 2010 to 2019 on the analyzed territories in RF regions located in the Arctic and Sub-arctic climatic zones. It was established that average monthly temperatures in July grew on average by 3.4 % over the analyzed period (within a range from 0.3 to 5.9 %); average precipitations also grew in both July and January (15.1 and 13.0 %

accordingly). In all the analyzed RF regions located in the Arctic and Sub-arctic zones, average monthly temperatures in July and January grew on average by 1.2 ° and 1.9 °C accordingly against average long-term levels. We derived differentiated estimates of emergent influence exerted on LEB by weather and climate on the analyzed territories with arctic and sub-arctic climate. Climate-induced losses in LEB vary from 164 days in Yakutia to 349 days in Chukotka. Losses in LEB caused by weather and climate equal 191.7 days on average in the country. We established that combined exposure to weather and climatic factors in the Arctic and Sub-arctic zones produced rather variable effects on LEB in 2010–2019. Such negative effects as a decline in LEB were detected in Magadan region, the Nenets Autonomous Area, Chukotka, and the Yamal Nenets Autonomous Area (-254; -211; -109 and -8 days accordingly). Positive effects were detected in Yakutia where LEB grew by 111 days.

**Keywords:** Arctic, climate in Russia, climate change, life expectancy at birth, neural networks.

## **EXAMINING INDICATORS OF NEGATIVE OUTCOMES IN CHILDREN UNDER COMBINED EXPOSURE TO AEROGENIC CHEMICAL FACTORS AND ADVERSE CLIMATIC ONES\***

**\*within the framework of the RISE-2022 meeting  
on environmental health**

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Perm, Russia

Chemical pollution levels are high (more than 5.0 average daily MPC) in some RF regions exposed to extreme climatic factors. Combined exposure to different factors can produce a wider range of negative effects and cause graver negative health outcomes in exposed population. This is especially true for children. The existing adverse conditions make it necessary to perform more profound examinations of changes in homeostasis indicators that reflect negative responses from target organs.

Our goal was to establish negative health outcomes in children under combined exposure to aerogenic chemical factors and adverse climatic ones. To do that, we examined biochemical indicators that reflected the functional state of critical organs and systems; we also analyzed data on actual diseases diagnosed in children as per results produced by a complex profound medical examination.

We examined children aged 3–6 years who lived under long-term combined exposure to chemical and adverse climatic factors. We established changes in biochemical and general clinical indicators showing that certain negative outcomes were developing in them. These outcomes included tension of the thyroid function, a developing inflammatory process, a risk of early vascular disorders, deteriorating endogenous vasomotion in myocardial tissues and poorer neuroendocrine regulation. These established negative outcomes were confirmed by elevated frequency (up to 5.6 times) of associated respiratory diseases, lymphoproliferative processes in the nasopharynx and chronic non-specific diseases, functional disorders of the nervous, endocrine and circulatory systems. It is advisable to use these established indicators of negative effects within health monitoring. They can also be useful for developing more effective medical and preventive activities for children living under combined exposure to adverse (extreme) climatic factors and high levels of chemical pollution in ambient air.

**Keywords:** aerogenic chemical factors, climatic factors, combined exposure, negative outcomes.

## ISSUES WITH RESEARCH IN THE FIELD OF NEURODEGENERATIVE DISEASE AND ENVIRONMENTAL FACTORS\*

**\*within the framework of the RISE-2022 meeting  
on environmental health**

**Ch. Zjukovskaja**

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This overview of neurodegenerative disease in the world in relation to environmental factors has exposed a number of issues. Diseases such as Alzheimer's, Parkinson's, Huntington's, multiple sclerosis and amyotrophic lateral sclerosis were of interest in this particular overview. Particle matter (PM), metal, pesticide and other exposures have shown great associations with neurodegenerative disease exacerbation and occurrence. There have also been a good number of both human and animal studies, which demonstrate that DNA methylation as well as the gut biome are affected by exposure. Undeniably, ultrafine particles can penetrate the body through mucosal tissue, respiratory, gastrointestinal systems, placenta and the blood brain barrier thereby reaching the central nervous system as well as affecting DNA methylation, but time and duration of exposure is no less important. Understanding how both genetic and environmental factors interact simultaneously is the direction that research needs to take in order to cohesively combine all findings in the field.

**Keywords:** neurodegenerative disease, genetic factors, environmental factors.

## THE ISSUE OF SELECTING A SOURCE OF INFORMATION ON VULNERABLE BODIES AND SYSTEMS IN THE RISK ASSESSMENT PROCEDURE. PERFORMING COMPARATIVE CALCULATIONS OF NON-CARCINOGENIC RISK

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In the process of conducting a public health risk assessment, information on critical organs and systems and harmful effects is summarised. Information on critical organs and systems is used

to characterize the non-carcinogenic risk. The question of selection remains with the specialist performing the risk assessment.

This study assesses the risk to public health from emissions to the ambient air of a physical facility. Non-carcinogenic risks have been calculated based on different sources of information, and the values for critical organs and systems have been summarised. <sup>1</sup>The lowest risk values for critical organs and systems were obtained using the risk assessment guideline. The results obtained using the federal register were significantly different. In the process of updating the guidelines, it is necessary to examine the problem and decide on the selection of a source of information on critical organs and systems.

**Keywords:** risk assessment, non-carcinogenic risk, atmospheric air, summation, critical organs and systems, hazard quotient (HQ).

## SCIENTIFIC AND METHODOLOGICAL ASPECTS OF PUBLIC HEALTH RISK ASSESSMENT AND MANAGEMENT IN THE ZONE IMPACTED BY RAILROAD TRANSPORT

Yu.N. Kaskov<sup>1</sup>, V.A. Loginova<sup>1</sup>,  
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For the purpose of implementation of the "Concept of development of social and hygienic monitoring system in the Russian Federation for the period until 2030" the study proposes: modules of socio-hygienic monitoring and risk management in the bodies of the Russian Federal State Agency for Health and Consumer Rights on railroad transport, stages of socio-hygienic monitoring on railroad transport and transport infrastructure facilities, levels of social and hygienic monitoring system on railroad transport with regard to vertically-oriented management.

**Keywords:** risk assessment, railroad transport, social and hygienic monitoring.

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<sup>1</sup> P 2.1.10.1920-04. Guidelines for assessing the risk to public health when exposed to chemicals polluting the environment. *CODE: electronic fund of legal and regulatory documents*. Available at: <https://docs.cntd.ru/document/1200037399> (accessed: 02.13.22).

## THE PROBLEMS OF ANALYSIS, FORECASTING, AND RANKING OF CHEMICAL HEALTH HAZARDS (SCIENTIFIC LITERATURE REVIEW)

S.V. Kleyn, S.A. Vekovshinina, N.V. Nikiforova,  
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The article presents the results of a review of domestic and foreign experience (scientific literature) on the problems of analysis, forecasting and ranking of chemical health hazards and the results of a systematic analysis of the methods of solving the studied problems existing in world practice. The problems identified provide an opportunity for discussion and the search for a solution to eliminate them.

**Keywords:** chemical health hazard, analysis, forecasting, ranking.

## OCCUPATIONAL APTITUDE EXAMINATION UNDER THE NEW REGULATORY FRAMEWORK

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The professional aptitude examination is conducted by medical organizations licensed to conduct preliminary and periodic examinations (PME) and professional aptitude examinations to determine whether the employee's health status and ability to perform certain types of work is appropriate. An employee may be recognized by a medical commission as unfit for certain types of work (to have restrictions on specific production factors and types of work) or unfit to work in their profession. The medical commission may recommend that an employee undergo an additional examination at the Occupational Medicine and / or Occupational Pathology Center. The basis for referral for examination of professional aptitude to the Occupational Medicine and / or Occupational Pathology Center are complicated cases in terms of diagnosis or the presence of disagreement. The study includes the analysis of 384 cases of occupational aptitude examinations in the Center of Occupational Medicine and Occupational Pathology of the Federal Scientific Center for Medical and Preventive Health Risk Management Technologies since 01.04.2021 based on the results of preliminary and periodic medical examinations carried out by medical organizations of Perm Territory. The study revealed that the reason for referral to the Center for Occupational Medicine and Occupational Pathology for occupational fitness examination was mainly diagnostic problems with first detected clinical symptoms at the stage of periodic medical examination, as well as clarification of the diagnosis (stage/degree of disease, presence of complications).

**Keywords:** professional aptitude examination, medical examinations, medical and social expertise.

## **METHODOLOGICAL APPROACHES TO THE USE OF DATA FROM THE REGIONAL SOCIO-HYGIENIC MONITORING FUND TO MAKE MANAGERIAL DECISIONS AIMED AT REDUCING PUBLIC HEALTH RISKS**

**O.O. Sinitsyna, V.V. Turbinsky, A.V. Khan**

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There is a growing need for prompt and timely information on environmental and health indicators to make effective priority management decisions, develop and adjust systems of preventive and diagnostic measures and determine priorities for the management of sanitary and epidemiological well-being.

The research materials included data from the regional fund for social and hygienic monitoring (habitat, medical and demographic indicators, population health and information about the socio-economic state of the territory, management decisions taken).

The study used standard statistical parameters as methods of data analysis: Kolmogorov-Smirnov test for normality of data distribution using SPSS, calculation of mean and standard error of mean, and 95 % percentile.

The authors have developed approaches to the use of data from regional information funds of socio-hygienic monitoring for management decisions, including optimization of the layout of monitoring points, the choice of priority pollutants and the frequency of control.

**Keywords:** social and hygienic monitoring, regional information fund, management decisions.

## **MODERN METHODOLOGICAL SUPPORT OF ATMOSPHERIC AIR CONTROL**

**T.S. Ulanova, T.D. Karnazhitskaya,  
E.V. Stenno, G.A. Veikhman**

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The article considers the methodological techniques used in the determination of toxic organic and inorganic compounds in atmospheric air for practical instrumental studies used in atmospheric air quality studies. The high sensitivity and selectivity of the determination of phthalates in atmospheric air with a lower limit of  $0.002 \text{ mg/m}^3$  and a maximum error of no more than 35 % was achieved by using a mass spectrometric detector in combination with high-

performance liquid chromatography in combination with optimal sampling conditions. For the analysis of acrolein in atmospheric air at a level of 15 ng/m<sup>3</sup> and above, the authors used the method of its transfer from a highly volatile to a non-volatile state as a result of a derivatization reaction at the sampling stage and analysis of an acrolein derivative by high-performance liquid chromatography with fluorimetric detection. The method of mass spectrometry with inductively coupled plasma, characterized by high accuracy, selectivity, sensitivity in combination with different methods of preparation depending on the research task, was used for the determination of priority chemical elements in atmospheric air at the level of 1 ng/m<sup>3</sup> and above.

The developed methods for the determination of toxic organic compounds and elements in atmospheric air were used in the study of air quality to assess the risk to public health.

**Keywords:** atmospheric air, mass spectrometry, quantitative chemical analysis.

## **CONTRIBUTION OF THE NIZHNY NOVGOROD RESEARCH INSTITUTE OF HYGIENE AND OCCUPATIONAL PATHOLOGY TO THE WORK OF THE SANITARY AND EPIDEMIOLOGICAL SERVICE OF RUSSIA**

**I.A. Umnyagina, S.A. Kolesov, I.V. Fedotova,  
V.V. Troshin, M.A. Pozdnyakova**

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The article gives a historical sketch of the origin, formation, main directions and results of the work of the Nizhny Novgorod Research Institute of Hygiene and Occupational Pathology of the Russian Federal State Agency for Health and Consumer Rights.

**Keywords:** Nizhny Novgorod Research Institute of Hygiene and Occupational Pathology.





## Section II

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**Theory and practice of assessing, forecasting, and managing health risks, including in the context of a coronavirus pandemic**



## PECULIARITIES OF REGULATORY T-LYMPHOCYTE EXPRESSION IN PERIPHERAL BLOOD OF CHILDREN WITH AUTONOMIC NERVOUS SYSTEM DYSFUNCTION UNDER CONDITIONS OF HIGH TECHNOGENIC LOAD

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This study describes the immune status of 236 children aged 4–10 years living in the territory of Central Siberia with a high man-made load (Irkutsk Region), including 189 children with functional disorders of the autonomic nervous system (ANS) (study group) and 47 conventionally healthy children (control group). The aim of this work was to study the expression of CD127 on regulatory T-lymphocytes in the peripheral blood of children with vegetative vascular disorders permanently residing in the technogenic burdened territory of the district center of the Irkutsk Region. The authors studied the parameters of cellular immunity and neuroendocrine system by flow cytometry and by enzyme immunoassay, and also evaluated the changes in IgG content specific to aluminum by allergen-sorbent testing. The results of the study of the immune status of preschool and primary school children with disorders of the autonomic nervous system allowed to establish overexpression of the relative content of CD3<sup>hi</sup> CD25<sup>hi</sup> and CD3<sup>hi</sup> CD25<sup>hi</sup> CD127<sup>low</sup> T-lymphocytes, specific IgG to aluminum, as well as a deficiency in the content of serotonin mediator.

**Keywords:** regulatory cells, children, autonomic nervous system, habitat.

## DEVELOPMENT OF A TECHNIQUE FOR SIMULTANEOUS DETERMINATION OF CAROTENOIDS (β-CAROTENE, LUTEIN, ZEAXANTHIN) AND VITAMIN E IN DIETARY SUPPLEMENTS BY HPLC METHOD

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S.I. Voitenko, L.L. Belysheva

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The study involved the development of the method for the simultaneous determination of beta-carotene, lutein, zeaxanthin, and vitamin E content in dietary supplements. The method is based on alkaline hydrolysis of the product, extraction, purification of extracts and simultaneous

quantitative determination using high-performance liquid chromatography (HPLC) with a diode-matrix detector. HPLC separation was conducted on a reverse phase column C18 (HyperClone ODS (C18) 120 A, 250 x 4.0 mm, 5.0  $\mu$ m). A mixture of acetonitrile: 0.06 % NaOH solution in methanol was used as eluent. Elution was performed in gradient mode. LOQ for carotenoids was 0.2 mg/kg, and for vitamin E – 2.0 mg/kg.

**Keywords:** beta-carotene, lutein, zeaxanthin, vitamin E, HPLC, dietary supplements.

## MAIN RESULTS OF THE EXPERIMENTAL TOXICOLOGICAL EVALUATION OF THE PECTIN-SILVER NANOCOMPOSITE

**V.M. Vasilkevich, R.V. Bogdanov, V.Yu. Zinovkina**

Republican Unitary Enterprise Scientific and Practical Center for Hygiene, Minsk, Republic of Belarus

The aim of the research was to study the peculiarities of biological action and evaluation of toxicity of the pectin-silver nanocomposite synthesized in accordance with the green chemistry principles to substantiate the possibility of its safe use as an antimicrobial component in human and veterinary medicine. The authors present the main results of the experimental studies in the scope of the primary toxicological evaluation of the pectin-silver nanocomposite, suggesting the nanocomposite as a promising nanomaterial for use in human and veterinary medicine.

**Keywords:** nanocomposite, nanoparticles, silver, pectin, toxicity.

## RISK OF HEALTH IMPAIRMENT DUE TO INHALATION OF A TRANSFLUTHRIN-BASED INSECTICIDAL AGENT

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Transfluthrin (CAS No. 118712-89-3) is one of the active substances of insecticidal agents from the group of highly volatile pyrethroids. Transfluthrin is recommended in medical disinsection for the control of flying bloodsucking insects, flies, and moths, often in liquid form and in the form of electric fumigator pads. A series of experiments on white rats were conducted to identify the risk of organismal disorders during inhalation exposure to the insecticidal agent based on transfluthrin in the form of a liquid used with an electric fumigator. The authors studied a single inhalation effect. To do this, the animals were placed in chambers (0.5 m<sup>3</sup> in volume) with the electric fumigator turned on during 40 to 1,160 minutes. During chronic inhalation exposure, the animals from the moment of birth were placed in chambers with an electric fumigator turned on, which operated from 6 to 1440

(24-hour) minutes a day for 5 months. At a single inhalation exposure, a violation of the functional state of the nervous system was revealed. At chronic exposure there were revealed changes in the functional state of the nervous system, liver and an increase in the number of eosinophils.

**Keywords:** transferrin, toxicity, liver, nervous system, electric fumigator, white rats.

## **METHODOLOGICAL APPROACHES TO THE DETERMINATION OF TOXIC ELEMENT CONCENTRATIONS IN MODEL ENVIRONMENTS SIMULATING FOOD PRODUCTS CONTACTING BIODEGRADABLE PACKAGING**

**I.V. Drebenkova, A.A. Kuzovkova**

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The aim of this study is to develop methodological approaches to the determination of micro concentrations of lead (Pb), zinc (Zn), arsenic (As), chromium (Cr), cadmium (Cd), titanium (Ti), aluminum (Al), barium (Ba), copper (Cu), iron (Fe), tin (Sn), nickel (Ni), molybdenum (Mo), selenium (Se) in model media simulating food products in contact with biodegradable packaging based on atomic emission spectrometry with inductively coupled plasma (AES – ICP). The study involved the use of an atomic emission spectrometer equipped with 2 types of spray atomizers - pneumatic and ultrasonic. The subject of the study were the detection limits of the above elements in aqueous media (distilled and deionized water), as well as in model media based on organic acids (3 % lactic acid; 3 % acetic acid; 2 % citric acid). The study demonstrates the feasibility of using an atomic emission spectrometer with an ultrasonic spray atomizer to significantly reduce the detection limits and determine almost all of the studied chemical elements in aqueous and model media, except for cadmium and arsenic.

**Keywords:** toxic elements, model media, biodegradable packaging, AES – ICP.

## **THE POTENTIAL OF USING EXPERIMENTAL MODELS OF ANIMAL PATHOLOGY IN ASSESSING THE BIOLOGICAL EFFECTS OF CHEMICALS FOR THE PURPOSE OF HYGIENIC REGULATION**

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The study represents the biological effects of model chemical indicators (barium and mineralization) at different levels of exposure on experimental models of pathology (spontaneous

arterial hypertension and experimental gentamicin-induced nephropathy) compared with studies conducted on healthy animals allowed to confirm the working hypothesis of greater susceptibility and sensitivity of pathology models to toxic effects of chemicals (considering the targets of their biological effects) in comparison with the classical model. The obtained results made it possible to substantiate recommendations on the expediency of using experimental models of animal pathology in assessing the biological effects of chemicals of natural origin in order to increase the reliability of their hygienic regulation, taking into account sensitive population groups.

**Keywords:** experimental models of pathology, nephropathy, animals with spontaneous hypertension, risk assessment, sensitive population groups, methodological approaches, barium, mineralization.

## RESPIRATORY MORBIDITY DURING THE COVID-19 PANDEMIC: ADDITIONAL RISKS IN INDUSTRIAL CENTERS OF THE IRKUTSK REGION

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Studies of the relationship between respiratory morbidity, especially during the COVID-19 pandemic, and atmospheric air pollution are attracting increasing attention, but most existing studies have a high degree of variability in results.

The purpose of the work is to conduct a comparative assessment of the incidence of respiratory diseases of the population of industrial centers of the Irkutsk region during the COVID-19 pandemic. Using the example of the Irkutsk region and individual industrial centers, the authors of the study conducted a comparative assessment of changes in respiratory morbidity, nosological structure in the period 2017–2019 and 2020–2021. Morbidity during the pandemic increased in the group of adolescents by 7 %, in the group of adults – by 1.6 times, in the group of retired persons – by 1.8 times. In the group of children aged 0–14 years, the primary morbidity dropped significantly: 1,469.7 cases per 1,000 children in the reference period vs. 1,345.0 ‰ in 2020–2021. On average in Irkutsk region the statistically significant risks were characteristic of the following groups: retired individuals, RR = 1.8 (1.4–2.3); adult population over 18 years old, RR = 1.6 (1.38–1.99); and adolescent population, RR = 1.1 (1.03–1.11). The maximum risk levels were registered for the population of Shelekhov: in adolescents RR = 1.7 (1.51–1.82), in adults RR = 2.2 (1.93–2.61). In the cities of Bratsk and Angarsk, the risk levels were slightly lower. In children of the age group 0–14 years, both in all the cities under consideration and in the Irkutsk region as a whole, the values of RR ≤ 1.

Therefore, the results of the study confirm the need to optimize the work of public healthcare institutions and to strengthen preventive measures in the cities with a high level of atmospheric air pollution.

**Keywords:** morbidity, respiratory diseases, COVID-19, pollution, atmospheric air.

# ON THE ISSUE OF ESTABLISHING THE LIMITING LEVEL OF THE CONTENT OF ANTIBACTERIAL DRUGS IN FOOD OF ANIMAL ORIGIN ON THE EXAMPLE OF THE TETRACYCLINE GROUP

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Antibacterial drugs used in agriculture can have toxic negative effects and lead to the formation of resistant strains of microorganisms, which requires sanitary and hygienic control by the governments. Toxicological, pharmacological, and microbiological effects are taken into account when establishing safe levels of antibiotic residues in food products.

However, in different countries, differential approaches to the level of their safe content are used, with the application of a toxicological or microbiological acceptable daily intake, which may lead to underestimation of negative effects. Thus, it is advisable to use a unified approach to the development of hygienic standards for the content of residual amounts of antibacterial drugs in food products.

When justifying the standards, it is necessary to take into account the basic principles of assessing the risk to public health, assess the toxic effect on the human body, the effect on its intestinal flora (the formation of an imbalance of microflora) and the likelihood of the formation of resistant strains of pathogenic microorganisms with the establishment of toxicological and microbiological acceptable daily intake (ADI). The smallest of them will be accepted as limiting and will be used for further calculation of the hygienic standard (MRL) of the content of residual amounts of antibiotics in food products. As an example of differences in the establishment of MRL for residual amounts of veterinary drugs in food products of animal origin, antibacterial drugs of the tetracycline group can act.

So, for tetracycline, a toxicological ADI was established at the level of 250 mg/kg of body weight. At the same time, for the entire group of tetracyclines, a number of studies have established a single microbiological ADI at the level of 3 µg/kg of body weight. It is advisable to use this ADI value as a limiting one for establishing the MRL of tetracycline content in food products, since it ensures safety from the point of view of the formation of toxicological and microbiological negative effects. Thus, taking into account all types of negative effects allows determining the safest value limiting ADI and MRL.

**Keywords:** antibacterial drugs, food products, rationing, limiting ADI, MRL.

## CURRENT ASPECTS OF THE STUDY OF STANDARDS AND QUALITY OF LIVING OF MEDICAL STUDENTS DURING THE PANDEMIC

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The object of the study were students of the Federal State Publicly Funded Institution of Higher Education South Ural State Medical University of the Ministry of Health of the Russian Federation aged 18–24. The purpose of the study was to analyze the quality of life, mental health, and physical condition of medical students during the pandemic. Sociological, analytical, and statistical methods of research were used in the study. The interview was conducted according to the SF-36 questionnaire "SF-36 Health Status Survey." It was an anonymous online questionnaire corresponding to the questionnaire developed by the authors. The study found out high levels of physical health among students in the age group of 18–20 years. 24.5 % of all respondents had poor physical health and had difficulty with any degree of physical exertion. When analyzing the indicators of the nervous and mental condition, 47.1 % of the students noted that they experience frequent depressive moods, a sense of restlessness, anxiety, the prevalence of negative emotions. In the second age group (21–24 years old) the number of students with good physical condition was slightly lower – 71.5 %, with 55.9 % of students reporting regular good mood and 50.9 % of respondents indicating unfavorable health status. 48.5 % of respondents noted the presence of chronic diseases of the gastrointestinal tract, due to having only two meals a day (26.5 % of respondents) and consumption of fast food 2–3 times a week (63.3 % of respondents). According to the results of the survey, more than half of the respondents (52.9 %) got COVID-19, while 88.2 % were vaccinated. Respondents noted that the incurred disease affected their eating habits (16.1 %), which was reflected in a prolonged (2–3 months or more) distortion of taste and absence of smell. Comprehensive preventive measures aimed at improving the quality and lifestyle of medical students were developed and proposed based on the results obtained.

**Keywords:** physical condition, mental health, quality of life, lifestyle, novel coronavirus infection, medical students.



## COMPARATIVE CHARACTERISTICS OF THE MULTI-MEDIATED CARCINOGENIC RISK TO ADOLESCENT HEALTH IN KAZAN

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The main purpose of the study was to compare the carcinogenic risk to the health of adolescents and adults from exposure to chemical pollutants in multi-mediated intake (from drinking water, soil, atmospheric air, food). The results demonstrated high level of total carcinogenic individual risk in the studied territories of the city in adolescents and adults in the 2nd zone (0.00426 and 0.00298, respectively). The magnitude of the total carcinogenic risk (TCR) in the studied territories with a complex multi-mediated intake of chemicals in adolescents and adults corresponded to an alarming level of risk ( $1,0 \cdot 10^{-3}$ – $1,1 \cdot 10^{-4}$ ). Chloroform and lead made the main contribution to the carcinogenic risk in all zones. The highest level of carcinogenic risk was registered in all the studied zones at the level of the 95th percentile for adolescent health.

**Keywords:** carcinogenic risk, health, adolescents, adult population, chemicals.

## DEVELOPMENT OF METHODS TO ASSESS THE EFFECTIVENESS OF TARGETED MEASURES TO REDUCE HEALTH DAMAGE TO THE POPULATION OF PERM TERRITORY

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The relevance of the study stems from the need to achieve the targets set by the national and regional programs: indicators of life expectancy, mortality from cardiovascular diseases and cancer. This paper is focused on developing topical approaches for research and analysis of health damage risks and a comprehensive assessment of the effectiveness of targeted measures to reduce mortality from cardiovascular diseases and cancer (including malignant tumors) in Perm Territory. The article considers the solution of the direct problem in the triple system "medical practice – morbidity – mortality", which involves forecasting changes in morbidity and mortality when the

health care system indicators change. Modeling of cause-effect relationships is based on methods of mathematical statistics (correlation and regression analysis and factor analysis) with subsequent examination of the obtained results for biological plausibility. The proposed methods make it possible to obtain estimates of health losses and identify priorities in the context of: municipalities of Perm Territory, sex and age structure of the population, disease subclasses, degrees of disease severity, and the focus of the health care system (prevention, diagnosis, treatment). The greatest effectiveness was observed in the areas with the highest mortality rates; in these areas there were reserves for reducing the number of deaths due to prevention and diagnosis of diseases. The potential ultimate attainability of life expectancy in Perm Territory due to the activities of the health care system aimed at the prevention and diagnosis of cardiovascular diseases and cancer may reach 73.1 years in the short term and more than 80 years in the long term. The methods and research results presented in the article will be used in practical activities to achieve the targets of territorial programs and to select the optimal program of measures to reduce the mortality of the Perm Territory population.

**Keywords:** healthcare system effectiveness, cardiovascular diseases, cancer, mathematical modeling, mortality, morbidity, limit of health damage management.

## EXPERIENCE IN THE DETECTION OF COVID-19 PATHOGEN GENETIC MATERIAL IN ENVIRONMENTAL SAMPLES IN AMUR REGION

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One of the ways of SARS-CoV-2 transmission is the contact route, which is realized through direct contact with an infected person as well as through surfaces and objects contaminated with the virus. In order to determine the fact of contamination of environmental objects with SARS-CoV-2 virus, the authors conducted studies to identify the genetic material of the pathogen in samples taken from the external environment. The studies were conducted in accordance with MR 3.1.0196-20. 3.1. Prevention of infectious diseases. Detection of the COVID-19 pathogen in environmental samples. Methodological recommendations (approved by the Chief Sanitary Physician of the Russian Federation on 23.06.2020).

**Keywords:** COVID-19, identification of SARS-CoV-2 pathogen in the genetic material of the environmental samples.

# ANALYTICAL ASSESSMENT OF ATMOSPHERIC AIR POLLUTION AND ITS DETRIMENTAL IMPACT ON PUBLIC HEALTH

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A radical reduction in the level of air pollution in the city of Chelyabinsk, which has a high level of air pollution and is included in the list of 12 industrial centers, where the "Clean Air" federal project is being implemented, is a national task of developing a comfortable and safe living environment. In this regard, laboratory monitoring of the state of atmospheric air pollution is conducted on the territory of populated areas on a daily basis.

The authors analyzed the results of the assessment of atmospheric air quality in the city of Chelyabinsk for 2017–2021, obtained by the Center for Hygiene and Epidemiology for the Chelyabinsk region, and identified the main target bodies and hazard classes of pollutants with the highest percentage of samples exceeding maximum allowable concentrations, and established cause-effect relationships of detrimental effects on public health.

A total of 115,414 atmospheric air samples were collected and tested to monitor the content of more than 40 pollutants in the city from 2017 to 2021, with up to 4.04 % of samples exceeding the maximum allowable concentrations recorded as part of social and hygienic monitoring.

The main chemicals that exceed the hygienic standards, affect the target organs (respiratory tract, hematopoietic organs, bone marrow, central nervous system, peripheral nervous system, spinal marrow, skin, mucous membranes of the eyes, etc.).

In 2021, activities were carried out to reduce emissions of pollutants within the framework of the project "Clean Air" in order to drastically reduce emissions of pollutants into the air and provide favorable living conditions in the city of Chelyabinsk.

**Keywords:** atmospheric air, maximum allowable concentrations, target organs, hazard classes, aerogenic effects, measures to reduce emissions of pollutants into the atmospheric air.

## FORECASTING OF HEALTH HAZARDS CAUSED BY NON-COMPLIANCE WITH FOOD SAFETY REQUIREMENTS, TAKING INTO ACCOUNT CHANGES IN CONSUMPTION VOLUMES FOR THE PERIOD UP TO 2024

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The article presents the results of a study on forecasting the risks of health disorders of the population of the Russian Federation caused by non-compliance with food safety requirements, taking into account changes in consumption volumes. The study determines public health hazards in 2019 and for the period up to 2024. The authors identified groups of food products, which, according to the forecast, will create the highest levels of risk of violation: "Culinary products produced according to non-traditional technology," "Biologically active food additives," and "Canned foods, imported."

**Keywords:** safety, food products, health hazards, risk forecast, consumption volumes.

## CORRELATION OF THE RISK DYNAMICS OF IXODIC TICK INFESTATIONS WITH THE ABUNDANCE OF SMALL MAMMALS

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The incidence of tick-borne viral encephalitis and other tick-borne infections correlates with the incidence of ixodic tick bites. It is obvious that the number of reported cases of tick bites is proportional to the economic and recreational activity of the population in the endemic territory and the number of hungry ticks. In turn, the amount of ixodic ticks depends on the abundance of the main feeders for blood-feeding stages, with some lag associated with the parameters of the life cycle: molting, diapause and pronounced seasonality in the continental boreal climate.

The purpose of the work was to analyze the factors and synthesize a formalized/parameterized statistical model for describing and predicting the risks of the population of the Sverdlovsk Region to be attacked by ixodic ticks.

The authors used a number of linear (by parameters) regression models to describe the dynamics and forecast the number of victims of tick bites in the Sverdlovsk Region. The adequacy of the description of the observed dynamics was evaluated using a multimodel inference apparatus. The long-term dynamics of the number of victims of tick bites in the Sverdlovsk Region was characterized by the presence of a high-amplitude slow, long-wave oscillation (decade, with a quasi-period of about 10 years) and a short 2–3-year cycle. The first could be a reflection of the climatic rhythmicity and trend in the socio-economic situation, and the second was due to biotic factors.

The use of logit regression model demonstrates that the number of small mammals in the previous year and the beginning of the current season of ixodic tick activity can serve as a proactive predictor of the risk for the population to be attacked by the ticks.

The predicted values of the obtained statistical model satisfactorily describe and correspond to the initial time series of chances/probabilities of ixodic tick attacks.

**Keywords:** ixodic ticks, small mammals affected by tick bites, population dynamics, odds ratio, time series.

## ASSESSMENT OF THE RISK TO PUBLIC HEALTH FROM EXPOSURE TO TRAFFIC NOISE IN MOSCOW

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The study covers the methodological approaches used in assessing the risk to public health from exposure to traffic noise in Moscow. The authors of the study noted the importance of conducting a preliminary examination of design acoustic calculations and noise protection measures, as well as analyzing the health status of the population living in the areas under consideration.

**Keywords:** noise, traffic noise, risk assessment, public health.

## STUDY OF ERGONOMIC PROPERTIES OF PERSONAL PROTECTIVE EQUIPMENT AGAINST BIOLOGICAL FACTORS FOR MEDICAL PERSONNEL

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The article presents the results of an assessment of the ergonomic characteristics of personal protective equipment against biological factors used in the pandemic of the new coronavirus infection COVID-19. After 5 hours of work in a full set of personal protective equipment against biological factors in the contagious zone, medical workers participating in the study noted deterioration of health, the occurrence of ailments affecting their ability to work, resulting directly from the ergonomic properties of the personal protective equipment.

**Keywords:** ergonomics, personal protective equipment, COVID-19.

## NEW PROBLEMS OF HEALTHCARE-ASSOCIATED INFECTIONS – MUCORMYCOSIS

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The article presents an analysis of the incidence of mucormycosis in patients based on the otorhinolaryngological department of the Moscow State Medical University Clinics of the Ministry of Health of the Russian Federation who had a history of the novel coronavirus infection COVID-19. The study reviews the aspects of the influence of the novel coronavirus infection on the development of mucormycosis, contains a retrospective analysis of incidences of the disease, and evaluates the methods and results of the anti-epidemic measures.

**Keywords:** mucormycosis, novel coronavirus infection, COVID-19, epidemiology, HAI, otorhinolaryngology.

## STRUCTURAL ANALYSIS OF SANITARY AND EPIDEMIOLOGICAL SURVEILLANCE FACILITIES IN THE PERM TERRITORY

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The article presents the results of a structural analysis of sanitary and epidemiological surveillance facilities in the Perm Territory in 2019. The study found that more than 60 % of the facilities within the groups of extremely high, high, significant, medium and moderate risk in the Perm Territory are related to facilities engaged in food production, public catering and food trade and the facilities of social and communal organizations, which is consistent with the Russian facility profile. A considerable part of facilities of significant risk in the Perm Territory is made up by the facilities operated by children and teenage organizations – 23.3 %.

The analysis of the structure of subordinate and inspected facilities revealed that the supervision of more hazardous facilities in Perm Territory was intensified in 2019, which is in line with the principles of the risk-oriented approach.

The analysis of violations of sanitary requirements by supervised facilities showed that the leaders in the number of violations per facility in 2019 in Perm Territory were the facilities operated by children and teenage organizations (6.3 violations per facility) and industrial facilities (4.2 violations per facility), which is a reason to increase the risk level of these facilities and therefore increase the intensity of inspections at these facilities.

**Keywords:** risk-oriented approach, sanitary and epidemiological surveillance, facility under surveillance, risk of health hazard, type of activity.

## STUDY OF BIOACCUMULATION AND TOXIC EFFECTS OF NANOPARTICLES OF MOLYBDENUM (VI) OXIDE DURING REPEATED ORAL INTAKE IN COMPARISON WITH ITS MICROSIZED COUNTERPART

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Due to the toxic properties of molybdenum (VI) oxide nanoparticles ( $\text{MoO}_3$  nanoparticles), it is important to conduct an in-depth study of the effects of this nanomaterial on the body in different exposure pathways. The aim of the study is to investigate the bioaccumulation and toxic effects of  $\text{MoO}_3$  nanoparticles when administered repeatedly orally in comparison with

microparticles of its chemical analogue ( $\text{MoO}_3$  microparticles). The particle size was determined by scanning electron microscopy. Repeated oral exposure was conducted on rats according to the scheme proposed by Lim and co-authors. One day after the last exposure, samples of heart, lung, liver, kidney, brain and blood tissue were taken for molybdenum concentration and histological examination. In terms of size, the tested sample of  $\text{MoO}_3$  is a nanomaterial. At the exposure of  $\text{MoO}_3$  nanoparticles, an increase of molybdenum concentration relative to the control level was recorded in the heart, lungs, liver, kidneys, brain and blood by 12.10 to 361.75 times; at the exposure of  $\text{MoO}_3$  microparticles - in the same list of organs and tissues by 9.67 to 114.75 times. The concentration of molybdenum in the studied organs and tissues when exposed to  $\text{MoO}_3$  nanoparticles was 2.59 to 9.27 times higher compared to the exposure to  $\text{MoO}_3$  microparticles. Microvesicular steatosis of hepatocytes was established in the liver of rats exposed to  $\text{MoO}_3$  nanoparticles and microparticles. When exposed only to  $\text{MoO}_3$  nanoparticles, pathomorphological changes in lung tissues in the form of inflammation of interstitium, bronchi and vessels, hyperplasia of lymphoid tissue, hemorrhagic infarcts were observed. According to the findings of this study,  $\text{MoO}_3$  nanoparticles exhibited a more pronounced degree of bioaccumulation and toxic effects compared to  $\text{MoO}_3$  microparticles.

**Keywords:** molybdenum (VI) oxide, nanoparticles, oral exposure, toxicity.

## NUTRITION STRUCTURE AND ASSESSMENT OF NON-CARCINOGENIC RISK TO THE HEALTH OF CHILDREN OF THE FIRST YEAR OF LIFE

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The study of the structure of nutrition in children during their first year of life remains relevant in terms of assessing the possible intake of foreign substances with supplementary foods and calculating the non-carcinogenic risk to the health of the child population. The aim of the study was to investigate the structure of children's nutrition in the first year of life and hygienic assessment of the possible intake of chemicals. 600 mothers were interviewed in various health facilities. The authors analyzed the content of heavy metals in infant foods according to the Federal Information Fund of Social and Hygienic Monitoring of the Russian Federation and calculated the non-carcinogenic health risk to children in the first year of life. Assessment of feeding patterns revealed that 37.3 % of children in the first year of life were breastfed, while the rest were fed either mixed nutrition or formula feeding. At the age of 4–6 months, 74.7 % of mothers introduce complementary foods and more often use fruit and vegetable products, cereal and canned meat and cereal products. These products also have the highest levels of heavy metals (lead, cadmium, arsenic, mercury). Calculations of exposures and hazard ratios ( $\text{HQ}_{\text{med}}$ ) based on the median content of heavy metals in foods for children in the first year of life given different types of feeding revealed the following: for infants receiving breastfeeding or mixed feeding,  $\text{HQ}_{\text{med}}$  in foods remained under



one, which does not require more in-depth research. And for the children who received formula feeding, with an increase of age,  $HQ_{med}$  increased, as well, and the indicators exceeded one ( $HQ_{med}Pb = 1.1$ ;  $HQ_{med}Cd = 1.37$ ;  $HQ_{med}As = 1.39$ ), which required a more in-depth assessment, as it may lead to the accumulation of heavy metals in the body and adversely affect health, increasing the potential risk of developing various diseases.

**Keywords:** baby food, heavy metals, non-carcinogenic risk.

## EPIDEMIOLOGICAL FEATURES OF MALARIA IN THE WORLD AND IN THE RUSSIAN FEDERATION DURING THE COVID-19 PANDEMIC

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The article presents the results of the analysis of the malaria situation in the world and the Russian Federation in the period of 2019–2021 during the COVID-19 pandemic.

**Keywords:** malaria, imported cases of malaria, COVID-19, mortality.

## INFORMATION ENVIRONMENT AS A RISK FACTOR FOR THE DEVELOPMENT OF NUTRITION-RELATED NON-INFECTIOUS DISEASES

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A high prevalence of behavioral risk factors, including unhealthy diet and low physical activity, which are associated with the leading metabolic determinants of the discussed group of diseases, contributes to the development of non-infectious diseases. The STEPS 2020 survey found a low consumption of fruits and vegetables among the country's population – 78.2 % of respondents had less than five servings a day, while 44.3 % always or often consumed processed foods with high salt content. The proportion of overweight and obese adults reached 53 % (in total).

The information environment, including labeling and various food promotion strategies, is socially deterministic and greatly influences the food preferences of consumers, including those of children. Therefore, the study of individual qualitative and quantitative characteristics of this social factor appears relevant.

Assessment of legislative requirements for food labeling and advertising revealed that specific elements that contribute to reducing the risk of nutrition-dependent diseases require a clearer regulation.

**Keywords:** food products, social factors, product promotion, labeling, health risk, non-infectious diseases.

## ANALYSIS AND CHARACTERIZATION OF HEALTH RISKS OF THE POPULATION LIVING IN THE AREAS OF THE SEAPORTS OF THE LENINGRAD REGION FROM ATMOSPHERIC AIR POLLUTION

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The towns of Vysotsk, Primorsk, Vyborg and the rural settlements of Ust-Luga of the Leningrad Region are located on the shore of the Gulf of Finland and are characterized by intensive development of transport and logistics infrastructure for the transshipment of liquefied natural gas, petroleum products and bulk cargo. In the course of the study the authors used the methodology of public health risk assessment, as well as the recommendations of the US Environmental Protection Agency. The values of chronic carcinogenic and non-carcinogenic health risks associated with the activities of industrial enterprises in the territory of Primorsk and Ust-Luga rural settlement correspond to acceptable values. In Vyborg, despite the fact that hygienic standards for pollutants in the ambient air were not exceeded, the values of carcinogenic and non-carcinogenic risks were unacceptably high. The main contribution to the formation of unacceptable carcinogenic risk was made by nickel and benzene; non-carcinogenic risk – cadmium, manganese, copper, nickel, lead, sulfur dioxide and xylene. In Vysotsk, the levels of carcinogenic risk corresponded to an acceptable level, while the data on the magnitude of chronic non-carcinogenic risk were contradictory. In Vyborg, it was recommended to add carcinogenic factors to the atmospheric air-monitoring program and increase the number of studies, to conduct an in-depth study of the impact of atmospheric air on public health, and it was recommended that local authorities take management decisions to reduce emissions of pollutants by priority enterprises.

**Keywords:** atmospheric air, pollutants, public health risk assessment, social and hygienic monitoring, seaports, Leningrad Region.

## SUBSTANTIATION OF A SET OF QUANTITATIVE CRITERIA FOR THE ASSESSMENT OF NON-CARCINOGENIC RISK TO PUBLIC HEALTH IN CHRONIC INTAKE OF BENZENE WITH ATMOSPHERIC AIR

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The study proposed a set of quantitative criteria for assessing the non-carcinogenic health risk associated with inhalation exposure to benzene, including reference benzene concentration (RfC=0.005 mg/m<sup>3</sup>, critical organs and systems – blood system and immune system), and additional quantitative criteria for its effects on individual organs and systems (additional RfC liver = 0.007 mg/m<sup>3</sup>, additional RfC development = 0.012 mg/m<sup>3</sup>). These criteria can be used as parameters during the procedure for assessing the risk to public health in chronic inhalation intake of benzene, including in conditions of multicomponent increased exposure.

**Keywords:** benzene, reference concentration, non-carcinogenic risk, atmospheric air.

## STUDY OF TOXICITY OF PHENOLIC COMPOUNDS AGAINST CELL CULTURE IN THE IN VITRO SYSTEM

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The study involved the influence of natural phenolic flavonoids 5,7,3',4'-tetrahydroxyflavone (luteolin) and 3,5,7,3',4'-pentahydroxyflavone (quercetin) on the phagocytic activity of the granulocytic lineage of white blood. The results of the studies revealed the presence of changes in the phagocytosis system in vitro, which manifested as a significant decrease in phenol-induced phagocytic activity, in relation to the spontaneous level (a decrease of 1.25–1.6 times). The presented experimental results obtained in the in vitro system allowed the authors to assess the contribution of phenolic compounds of natural origin to the regulatory mechanisms of the immune system.

**Keywords:** 5,7,3,4-tetrahydroxyflavone, 3,5,7,3,4-pentahydroxyflavone, phagocytosis.



## Section III

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**Risk-oriented sanitary and epidemiological surveillance: methodological development, application experience, new forms in the context of digital transformation of society**



## PECULIARITIES OF WORKPLACE ENVIRONMENT FACTORS MONITORING AT COPPER-SULFIDE ORE MINING ENTERPRISES

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The relevance of this work was dictated by the need to improve the system of industrial control over workplace conditions in the units of copper-sulfide ore mining and processing enterprises in accordance with the new requirements set forth in Sanitary Regulations 2.2.3670-20 Sanitary and Epidemiological Requirements for Workplace Conditions.

The study defines a list of indicators for conducting industrial control over workplace conditions for each subdivision of a mining enterprise, taking into account the specifics of the technological process, the equipment used, the technological operations performed on the basis of previously conducted studies and the measurements of working environment factors (special assessment of workplace conditions, industrial control) and inhouse research.

The industrial factors in the subdivisions of the mining and processing enterprise representing a potential hazard to workers and subject to control were chemical and physical factors (noise, vibration, aerosols of mainly fibrogenic effect (dust of copper-sulfide ore, limestone, cement), ambient air temperature, humidity, air speed, thermal radiation, ionizing radiation, ultrasound, infrasound and light).

Implementation of the program in the field of safe workplace environment will allow the employers to identify the main industrial risk factors, develop and implement timely measures to improve workplace conditions in order to reduce the health risks for the employees.

**Keywords:** workplace conditions, hazardous industrial factors, production control, mining, processing, copper sulfide ores.

## SCREENING METHOD FOR ADULTERANTS IN DIETARY SUPPLEMENTS BY LIQUID CHROMATOGRAPHY COUPLED WITH A HIGH-RESOLUTION MASS SPECTROMETER (LC – HRMS)

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Adulterants in supplements have always been a matter of concern in unknown screening. Basically, all pharmaceutical substances have the potential to be illegally mixed into dietary supple-

ments. According to the recent Food Drug Administration documents, there were three major groups that could be mentioned as sexual enhancements (phosphodiesterase type-5 inhibitor (PDE-5i), hormone...), weight loss (sibutramine and its derivatives, phenolphthalein...), and exercise enhancements (dopamine, glucocorticoid, non-steroidal anti-inflammatory drugs (NSAIDs)). Otherwise, there were also other pharmaceutical groups such as regulating blood sugar, regulating the heart, reducing cough, sedating, reducing pain, reducing allergies, and increasing appetite, which could be used as adulterants. They were often mixed without warning on the label. On the other hand, they could be modified to derivatives, which had the same or enhanced effects and unknown side effects. Being sold over-the-counter, they had many potential health risks for consumers. The liquid chromatography coupled high-resolution tandem mass spectrometer could solve this problem with its application: identifying both known and unknown substances. The method validation met AOAC requirements and accredited ISO/IEC 17025 accreditation. The results of surveillance analysis in 2021 detected 25 adulterants on 518 dietary supplements in different dosage forms. This result contributed to providing data for regulators and warnings to consumers.

**Keywords:** Adulterants, supplements, LC – HRMS, targeted screening, food safety.

## SELECTION OF INDICATORS FOR EVALUATION OF THE EFFECTIVENESS AND PERFORMANCE OF SUPERVISION OVER FOOD PRODUCTS

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Until 2021, the objects of control and supervisory activities were economic entities and their activities. Most of the indicators of effectiveness and performance of the Federal Service for Supervision of Consumer Rights Protection and Human Welfare have been developed on the basis of the data of the objects of supervision. The introduction of food products as an object of supervision in 2021, made it necessary to develop the indicators of the effectiveness and performance of this supervision. According to the analysis of existing legislation, all key performance indicators of sanitary and epidemiological supervision for all objects of supervision characterize the prevention of harm (damage) to health from exposure to microbiological and parasitic agents, while supervision, in addition to the above listed factors, covers a wide range of human exposures, such as chemical impurities, working conditions, training, etc. Some of the approved indicators characterize the effectiveness of activities undertaken in relation to the objects of supervision – parameters of natural environmental objects (air, water, soil, subsoil), but the list does not include food products.

Based on the analysis of the already developed indicators of effectiveness and performance of the Federal Service for Supervision of Consumer Rights Protection and Human Welfare, the following types of indicators for assessing the effectiveness of food safety control are proposed: class B2 (25 indicators such as the number of samples of products that do not meet sanitary and epidemiological requirements, identified during control and supervisory measures using laboratory research methods, etc.), B3 (7 indicators such as the total number of samples of products tested in laboratory conditions, etc.), B4 (1 indicator – the amount of financial resources allocated in the



reporting period from budgets of all levels for performing laboratory analyses of product quality and safety).

**Keywords:** supervision, effectiveness and performance, key indicators, indicative figures, food products

## EVALUATION OF BENZENE CONTENT IN FOOD PRODUCTS CONTAINING BENZOATE SALTS AND ASCORBIC ACID

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Benzoates and ascorbic acid are widely used as preservatives and antioxidants in foods. Benzoate salts and ascorbic acid have been approved by the FDA as safe and are allowed to be added to foods at concentrations up to 0.1 and 0.2 %, respectively. In addition, some foods themselves also contain ascorbic acid or benzoic acid, such as cranberries, which have a benzoic acid content of 4.1–478.4 mg/kg. In 1993, Gardner and Lawrence found that benzene is formed from benzoate and ascorbic acid. Benzoate is decarboxylated by free hydroxyl radicals to form benzene in a low pH media, high temperature and the catalysis of some transition metal ions. Soft drinks, chili sauce or fruit jam are products that are often added with benzoate salts, ascorbic acid, and these products often have acidic pH, so there is a risk of benzene formation during the processing and storage. The International Agency for Research on Cancer (IARC) has classified benzene as group 1, a group of human carcinogens. Currently, no regulatory limit has been established for benzene in food or beverage products. The limit of benzene in water is regulated by World Health Organization is 10µg/L, the US Environmental Protection Agency is 5 µg/L and the European is 1µg/L.

The aim of this study was to evaluate the benzene content in food samples using gas chromatography-mass spectrometry (GC-MS) method. The method was optimized and validated for limit of detection and limit of quantitation were 0.05 and 0.15 µg/kg, respectively, recovery ranged from 86.6 to 110.9 % and repeatability of 4.0 to 7.2 %. The method was applied to evaluate benzene content in 120 food samples sold in Vietnam including beverage, fruit juice, nectar, jam, ketchup, chili sauce. The results showed that benzene was detected in 27.5 % (33/120) of samples. 26/120 samples contained benzene with content in the range of 0.05–1.0 µg/kg/L including 7/40 fruit juice and nectar samples; 7/40 beverage samples; 4/15 jam samples; 3/10 ketchup samples and 5/15 chili sauce samples. Benzene was detected in 5/120 samples with content of 1–10 µg/kg/L, including 2/40 beverage samples; 2/15 ketchup samples and 1/15 chili sauce samples. 2/15 chili sauce samples contained benzene with content in the range of 15.2–109.7 µg/kg. Most of the samples contained benzene detected in products claiming sodium benzoate or in some products of unknown origin.

**Keywords:** food products, benzoate salts, ascorbic acid, chromatography-mass spectrometry (GC-MS) method.

## IMPROVEMENT OF METHODOLOGICAL APPROACHES TO THE APPLICATION OF MODEL ENVIRONMENTS IN TESTING FOOD ALUMINUM FOIL

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The relevance of the study is determined by the wide distribution of food aluminum foil in the consumer market and its active use in domestic conditions. At the same time, food foil can serve as a source of aluminum intake into the human body, while the safety of aluminum for health during its chronic consumption has not been sufficiently studied. In this regard, it is relevant to study the conformity of the methods and model environments used for testing the whole food packaging with the tasks of testing aluminum foil. The purpose of the study is to improve methodological approaches to the use of model media in testing food grade aluminum foil.

The study used the method of study and critical analysis of domestic and foreign regulatory framework, as well as relevant scientific sources regarding methodological approaches to the study of aluminum content in food and model environments during the testing of food aluminum foil. The authors conducted an experiment to study the levels of aluminum content in the model media and directly in the food during the testing of food aluminum foil.

The study revealed that the regulated model environments and methods do not fully account for the peculiarities of the use of food aluminum foil in the domestic environment. It is advisable to develop a special methodology for testing aluminum foil for household purposes with a description of temperature and time modes and conditions for simulating the process of baking food.

**Keywords:** food grade aluminum foil; model environments.

## Section IV

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**Sanitary and epidemiological problems of the regions.  
The best practices of hygienic assessment and analysis of health risks in the framework of the national projects "Ecology", "Demography", "Housing and urban environment", "General cleaning"**



## EXPERIENCE IN DETECTING UNDECLARED PESTICIDES AND ANTIBIOTICS IN THE SOUTHERN FEDERAL DISTRICT AND THE NORTH CAUCASIAN FEDERAL DISTRICT OF THE RUSSIAN FEDERATION

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The object of the study was the analysis of food products sampled on the territory of the Southern Federal District and the North Caucasian Federal District for undeclared substances. The purpose of the study was to generalize the experience of identifying undeclared substances, to develop proposals for ensuring the safety of food products consumed. The methods used were gas chromatography with mass spectrometric detection and high-performance liquid chromatography with mass spectrometric detection. The present study analyzed the results of laboratory tests of food products for undeclared substances, gave suggestions to the content of expert opinions on the results of detection of undeclared substances in food products, established possible reasons for the presence in circulation of food products containing undeclared pesticides, and made suggestions to ensure the safety of products in circulation.

**Keywords:** undeclared antibiotics, pesticides, monitoring, demography.

## HEAVY METALS CONTENT IN FOOD PRODUCTS AVAILABLE ON THE MARKET OF THE REPUBLIC OF BELARUS IN 2020–2021

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The study contained the assessment of the levels of heavy metals in various types of food products available on the market of the Republic of Belarus in 2020–2021. The study focused on the retrospective data on the content of lead, cadmium, arsenic and mercury in food products obtained for the period from January 2020 to December 2021. The methods used in the course of the study were inductively coupled plasma atomic emission spectrometry (AES-ICP) and flameless atomic absorption spectrometry.

**Keywords:** toxic elements, food products, acceptable levels.

## DETERMINATION OF SUCRALOSE AND ASPARTAME SWEETENERS IN FOOD PRODUCTS AND DIETARY SUPPLEMENTS BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY WITH REFRACTIC INDEX DETECTION

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The study contained the development of a methodology for the simultaneous determination of aspartame and sucralose sweeteners in food products and dietary supplements. The method was based on the extraction of sweeteners with water, purification of extracts and quantitative determination of analytes by high-performance liquid chromatography with refractive index detection. HPLC separation was conducted on a reverse phase column C18 (Hypersil ODS 250 × 4.6 mm, 5.0 μm). A mixture of water: methanol (3:1 vol. %) was used as eluent. LOQ for sucralose and aspartame was 20 mg/kg.

**Keywords:** sucralose, aspartame, HPLC, refractive index detection, food products, dietary supplements.

## SPECTRAL METHODS FOR THE ANALYSIS OF TRACE ELEMENTS IN BIOLOGICAL OBJECTS

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The study examines the most common methods of atomic spectroscopy to determine trace elements in biological objects such as blood and urine. The authors consider sample preparation of biological material for atomic absorption, atomic emission, and mass-spectral methods. The article examines the important criteria for selecting the best method for a particular application. The study contains the description of PerkinElmer AAnalyst 400 spectrometer, which was used to determine the iron content in biological material.

**Keywords:** trace elements, atomic spectroscopy, biological objects.

## THE INFLUENCE OF SOCIAL STRESS FACTORS ON THE LIFE EXPECTANCY OF THE POPULATION OF THE RUSSIAN FEDERATION

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Increasing the life expectancy of the population remains a priority of the government's policy. The study found that over the period of 2010–2020 there was an improvement in several indicators of social stress, such as the number of reported crimes (–23.9 %), the Gini coefficient (–3.6 %), the share of consolidated budgets for social policy (21.0 %). The study revealed that during the period of 2010–2019, the influence of the socio-demographic indicators amounted to 462 days, the private influence of indicators of social stress amounted to +42 days. According to the forecast, the impact of these indicators will reach +36 days by 2024, in the case of achieving the best values among the regions of the Russian Federation, the potential impact will be +65 days. The study demonstrates variability of the influence of social stress factors under different background conditions of environmental factors.

**Keywords:** environment, social stress factors, life expectancy, neural networks, time series analysis.

## DYNAMICS OF MORBIDITY AND MORTALITY FROM MALIGNANT NEOPLASMS IN THE REPUBLIC OF BASHKORTOSTAN IN 2017–2021

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The article presents statistical and epidemiological data on the incidence of malignant neoplasms in different population groups of the Republic of Bashkortostan, along with mortality due to changes in the quality of the human environment.

**Keywords:** malignant neoplasms, morbidity, susceptibility to disease, mortality, factors of the human environment.

## MODIFICATION OF PHAGOCYtic ACTIVITY OF NEUTROPHIL GRANULOCYTES BY PHENOLIC COMPOUNDS OF NATURAL ORIGIN ON THE EXAMPLE OF 5,7,3,4-TETRAHYDROXYFLAVONE

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Environmental degradation as a result of high frequency of anthropogenic and anthropogenic processes has a negative impact on the adaptive capacity of the organism, which may contribute to the formation of diseases in the pathogenesis of which imbalances in the indicators of innate immunity is dominant. The study examined the effect of 5,7,3',4'-tetrahydroxyflavone on the phagocytic activity of neutrophil granulocytes in an *in vitro* model. Using tests based on the registration of absorption of phagocytosis objects, it was found that 5,7,3,4-tetrahydroxyflavone at a concentration of 0.5 mg/ml in experimental samples statistically significantly ( $p=0.021-0.012$ ) reduced the percentage of phagocytosis by 10 % and the absorption activity of professional phagocytes by 40 %. Therefore, the immunomodulatory effect found in 5,7,3,4-tetrahydroxyflavone on innate immunity indicators suggested a promising further study of the effect of natural flavonoids on the functional activity of immunocompetent cells (neutrophils).

**Keywords:** 5,7,3,4-tetrahydroxyflavone, innate immunity, neutrophil, phagocytosis.

## ASSESSMENT OF EXPOSURE WITH COMPLEX INTAKE OF BARIUM INTO THE BODY IN THE REPUBLIC OF BELARUS

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The study focused on the content of barium in water sources and drinking water in the Republic of Belarus, determined the republican and territorial distribution (content levels), and contained calculations of exposure levels for different population groups. The authors studied barium content in food products and its consumption levels using an adapted frequency method, which allowed identifying the groups of products with the highest barium content (baked goods, cereals and confectionery products, products with the highest barium content – Brazil nuts, breakfast cereals, roasted peanuts,



pecan nuts, soybeans, basil, laminaria). About a quarter of the studied product samples contained barium below the limit of detection. In a realistic scenario, vegetables, cereals, pasta, and baked goods made the greatest contribution to the alimentary exposure. The average daily intake with food according to the main scenarios (1–4) did not exceed the reference doses for barium with oral intake. Assessment of total barium exposure with drinking water and nutrition (5 scenarios for alimentary exposure, 7 scenarios for drinking water exposure and 35 combinations thereof) made it possible to determine the levels and priority sources of exposure. The specific contribution of water to total daily barium intake for models 1–2 of alimentary exposure (a realistic scenario) and its concentration in water at the median level was 40–42 % with barium concentrations in water 95P – 75–76 %.

**Keywords:** drinking water, exposure assessment, barium, complex intake.

## ON THE DEVELOPMENT OF THE DEMOGRAPHIC SITUATION IN THE ULYANOVSK REGION AS OF JANUARY 1, 2021

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The article deals with one of the most pressing problems of the present time – the demographic situation. The study contains the comparison of the previously predicted values of demographic indicators for the Ulyanovsk Region with the actual data against the background of the pandemic of a novel coronavirus infection (COVID-19). The study covers the natural growth and the natural decline of the population.

**Keywords:** mortality, natural population changes, Ulyanovsk Region.

## INNOVATIVE TECHNOLOGY FOR DISINFECTION OF PERSONAL PROTECTIVE EQUIPMENT BASED ON GENERATION OF AEROSOLS CONTAINING OXYGEN-ACTIVE COMPOUNDS FOLLOWED BY PLASMA TREATMENT

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The study involved the analysis of the dynamics of the size and taxonomic composition of the microbial population of personal protective equipment used by the personnel of medical institutions for 2 hours, and the phenotypic features of the extracted isolates to assess the aggression potential complex. The study identified the largest taxonomic units with a pronounced aggression potential.

The authors developed the design of an experiment to simulate microbial contamination on carriers, a laboratory technology for decontamination of personal protective equipment under aggravated conditions, and conducted a quantitative assessment of its effectiveness.

**Keywords:** microbial contamination, personal protective equipment, disinfection, aerosols, modeling.

## **ANALYSIS OF OCCUPATIONAL RISKS IN THE SYSTEM OF PRESERVING LABOR LONGEVITY**

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The modern approach to preserving the health of the working population involves a shift from reactive responding to workers' illnesses, to preventive management of the health damage risks. The development and implementation of a multifactorial occupational risk management system should become the basis for preserving the life and health of employees in the course of their work.

The authors conducted a study of the state of working conditions and the working environment, socio-demographic status, assessment of the professional health of 2,187 employees of the largest mining and metallurgical enterprise.

Health risk groups of different occupational groups were formed along with the development of preventive measures programs.

The authors scientifically substantiated the algorithm of assessment and management of occupational health risks of the employees, included in the risk management system of the enterprise, with modules on optimization of working conditions, correction of risk factors, medical and preventive measures.

**Keywords:** occupational risks, risk management, risk assessment and management algorithm.

## **SOME PROBLEMS OF ESTABLISHING BOUNDARIES OF SANITARY PROTECTION ZONES IN THE CONTEXT OF URBAN PLANNING RESTRICTIONS**

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The sanitary protection zone by its purpose is a barrier that provides a standard level of air quality in places of residence of the population. The article covers the problems of establishing the boundaries of sanitary protection zones (SPZ) in the context of urban planning restrictions. The paper highlights the issues of limiting the land plots included in the boundaries of the SPZ, possible

solutions to reduce the boundaries of the SPZ, approaches to the formation of programs for field studies of atmospheric air quality.

**Keywords:** sanitary protection zone, sanitary classification, impact factors, regulated territory, economic entities, field studies.

## THYROID DISEASE PREVALENCE FOR THE PERIOD OF 2015–2020 IN CHILDREN LIVING IN PERM TERRITORY

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Thyroid diseases occupy one of the leading places in the structure of general endocrine pathology. The study contains the analysis of the frequency and dynamics of the prevalence of thyroid diseases for the period of 2015–2020 in children of the Perm Territory living in the areas with different levels of sanitary and hygienic well-being of the habitat according to official statistics. According to the Federal State Statistics Service data, the range of fluctuations in the prevalence of thyroid diseases in the Perm Territory areas was 1.4–19.4 %, hypothyrosis due to iodine deficiency – 0.29–15.3 %, asymptomatic hypothyrosis associated with iodine deficiency – 0.29–4.77 %, thyroidenitis – 0.26–2.37 %. The dynamics of general and primary prevalence of thyroid diseases and some nosological forms of thyroid pathology associated with iodine deficiency were found to be multidirectional, and the multiplicity of differences in the prevalence of thyreopathies, depending on the territory, reached 52.8 times.

**Keywords:** thyroid diseases; general morbidity; primary morbidity; children; Perm Territory.

## STUDY OF BENZO(A)PYRENE CONTENT IN THE BLOOD OF CHILDREN AND ADULTS LIVING IN DIFFERENT CONDITIONS OF ANTHROPOGENIC IMPACT

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The paper presents the results of the analysis of benzo(a)pyrene in the blood of children and adults living in the territory of Eastern Siberia in the zone of industrial emissions (study group) and outside of the zone of industrial emissions (control group). In the study group, benzo(a)pyrene in the blood was detected in 16.0 % of the examined children and in 18.1 % of the examined adults with an average concentration in children ( $0.0078 \pm 0.0019$ ) mcg/dm<sup>3</sup>, in adults ( $0.0089 \pm 0.0021$ )

mcg/dm<sup>3</sup>. The content of benzo(a)pyrene in the blood of children and adults of the study group was found to be 1.7 times higher as compared to the control group.

**Keywords:** benzo(a)pyrene, blood, high-performance liquid chromatography, fluorimetric detector.

## QUANTITATIVE CHARACTERIZATION OF EXPOSURE TO AIR POLLUTION TO ASSESS PUBLIC HEALTH RISK DURING THE IMPLEMENTATION OF THE "CLEAN AIR" FEDERAL PROGRAM

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The article covers the problems of quantitative characterization of exposure to assess acute and chronic risks to public health.

The authors analyzed the results of the exposure for the four cities participating in the "Clean Air" federal program, analyzed the problems that arose and the ways to solve them.

The study examined the features of obtaining concentrations of substances based on monitoring and modeling with the use of the "Ecolog-Gorod" unified software for calculating atmospheric pollution. A disadvantage of the "Ecolog" software series is the inability to calculate concentrations with adequate application of the criteria of acute risks. The study proposed an approximate method for obtaining 1-hour concentrations from maximum-dose measurements of the "Ecolog" software, which is based on Haber's rule.

The use of summary calculations on the total emissions of various groups of sources made it possible to take into account their contribution to atmospheric air pollution as fully as possible when assessing the exposure.

The number of priority substances in the cities varied from 43 to 58, and the number of calculated concentrations according to the "Ecolog-Gorod" unified software for each substance was from 7,881 to 21,105. The calculations for one city took several dozen hours to complete.

At that, in the cities there was an exceeding of the discrepancy between the results of monitoring and computer modeling allowed by the consolidated calculations. One of the reasons was the use of the "Ecolog" software to calculate concentrations of average values of meteorological parameters from meteorological data over the past few years. The weather conditions at the time of measurement of natural concentrations could significantly differ from average weather conditions. Another reason could be that the calculations were made without taking into account the multi-story buildings in the cities. The values of in-situ and calculated concentrations used in health risk assessments were also affected by the sensitivity of the methods used to determine substances in atmospheric air, incomplete accounting of emission sources due to the lack of the necessary information about their parameters, and a number of other reasons.

**Keywords:** exposure assessment, 1-hour and average annual concentrations, "Ecolog-Gorod" unified software for calculating atmospheric pollution, Haber's rule, health risk.

## ESTABLISHMENT OF BIOMARKERS OF ADVERSE EFFECTS ON THE CARDIOVASCULAR SYSTEM IN CHILDREN WITH ELEVATED ALUMINUM AND FLUORIDE ION CONCENTRATION IN URINE

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The search for molecular indicators of adverse effects the altered level of expression of which allows determining the features of molecular and cellular mechanisms of the pathogenesis of a number of non-infectious diseases, including cardiovascular diseases, when simultaneously exposed to chemicals, is of particular importance nowadays. The authors conducted a biochemical study of indices reflecting the state of the cardiovascular system in children with increased aluminum and fluoride-ion content in urine to establish biomarkers of negative effects of the cardiovascular system. We conducted a proteomic study of blood plasma in children, modeling cause-and-effect relationships. Long-term combined aerogenic exposure to aluminum and fluorine compounds in low average daily doses (0.0005 mg/(kg·day) and 0.002 mg/(kg·day)) causes elevated (relative to non-exposed children) concentrations of aluminum (2.8 times) and fluoride ion (1.2 times) in the urine of exposed children. The study identified elevated levels of the studied chemicals in the urine of children with significant changes in biochemical (decreased apolipoprotein A1 and HDL cholesterol, increased serum triglycerides) and proteomic protein markers (increased Kelch-like protein 4, apolipoprotein CII, serum amyloid protein A1, reduced apolipoprotein A1), characterizing the development of adverse effects on the cardiovascular system. The results of the study proved a causal relationship between elevated levels of Kelch-like protein 4, decreased HDL cholesterol, apolipoprotein A1, and urinary aluminum, and fluoride ion concentrations with concurrent exposure to the substances. Changes in the relative volume of protein spots including Kelch-like protein 4 and apolipoprotein A-1 are prognostically significant for the development of cellular-molecular mechanisms of involvement of the transformed proteomic profile in the development of negative effects. When Kelch-like protein 4 is expressed, these effects are characterized by sequential closure of potassium- and calcium-dependent endothelocyte ion channels, impaired electrolyte transport, reduced lumen and increased vascular resistance. When apolipoprotein A1 production is decreased, the reverse cholesterol transport from the cells is impaired.

**Keywords:** aluminum and fluoride ion in urine, proteomic profile of blood plasma, cardiovascular system, Kelch-like protein 4, apolipoprotein A-1.

## **ANALYSIS OF TASTES AND HABITS OF STUDENTS IN GENERAL EDUCATIONAL INSTITUTIONS IN THE AMUR REGION, CONDUCTED WITHIN THE FRAMEWORK OF THE NATIONAL DEMOGRAPHY PROJECT**

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In 2021, the authors conducted a study to assess the nutrition of school students in the Amur Region. The survey covered three groups of respondents: heads of educational organizations ( $n = 58$ ), catering organizers (operators) ( $n = 9$ ), students of educational organizations and their parents ( $n = 864$ , including the students of "grades 1–4" – 331 people, "grades 5–9" – 296 people, "grades 10–11" – 237 people). The studies corresponded to the methodological recommendations MR 2.3.0237-21. 2.3. Food hygiene. Preparation and monitoring of the nutritional status of students in general education organizations (approved by the Chief Sanitary Physician of the Russian Federation on 12.03.2021). The study established that it is necessary to develop road maps at the regional level to improve the organization of child nutrition, providing for the mandatory implementation of the principles of healthy eating in the family and at school, as well as measures aimed at reducing the risks of disorders in child growth and development, including excess body weight and obesity caused by the nutritional factor.

**Keywords:** health, nutrition, schoolchildren, Demography, Amur Region.

## **ASSESSMENT OF THE IMPACT OF THE EPO-TEK 330 COMPOUND POLYMER ON THE HEALTH OF EMPLOYEES IN THE FIBER-OPTIC INDUSTRY**

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The technological process of modern polymer composites production can have a polytropic effect on the worker's physical condition. One of the main factors of negative impact is EPO-TEK

330 compound – a unique composite material created on the basis of low-molecular-weight organosilicon oligomers. Its impact on the human organism is still understudied. *Objective:* to assess the impact of the EPO-TEK 330 polymer compound components on the health of fiber-optic production workers. *Materials and methods:* 83 employees of fiber-optic production were examined. The study group consisted of 47 people with a professional exposure of the studied chemical factor. The average length of service was  $4.1 \pm 2.8$  years, the average age was  $29.3 \pm 3.4$  years. The control group consisted of 35 people, having the same professions, with no professional exposure to the studied chemical factor, an average length of service of  $4.7 \pm 2.4$  years, an average age of  $31.2 \pm 4.1$  years. The groups were comparable by gender, age, length of service, and social status. Study: survey, analysis of medical documentation; chemical-analytical methods of research (blood and urine mass spectrometry, chromatography-mass spectrometry of the EPO-TEK 330 polymer sample and the air in the working zone); laboratory studies (hematological, biochemical, enzyme immunoassay); genetic analysis; clinical and functional examination; statistical analysis of the obtained results.

The structure of pathology in the study group was represented by respiratory diseases (33.33 %), the presence of professional stigmas. Laboratory indicators: increased activity of metabolic markers, atopic nature of the immune response, increased level of specific immunoglobulins Ig G to the EPO-TEK 330 compound (0.86 U/ml). Genetic analysis: 14.8 % of cases (mutant allele) demonstrating the probability of developing immune disorders, 11 % of cases – predisposition to violations of the detoxification processes of phase I.

Deviations of laboratory parameters, in combination with skin stigmas, together with a genetically impaired detoxification mechanism, were considered as early criteria for the diagnosis of respiratory and skin diseases in workers under conditions of occupational exposure to polymers.

**Keywords:** polymer composite, respiratory and skin diseases, risk assessment, health disorders.

## ON THE STAGES OF IMPLEMENTING HEALTH RISK ASSESSMENT METHODOLOGY IN THE REPUBLIC OF BURYATIA

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The article presents the historical path of a step-by-step implementation of the methodology of public health risk assessment from the impact of environmental factors of different nature in the activities of the Department of the Federal Service for Supervision of Consumer Rights and Human Well-Being Protection in the Republic of Buryatia. The paper also provides the results of the implemented risk management measures.

**Keywords:** health risk, risk assessment, health damage assessment.

## ON THE CHOICE OF PRIORITY SUBSTANCES FOR ESTIMATING EMISSIONS FROM SEWAGE SLUDGE INCINERATION PLANTS

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The present study is dedicated to determining the composition of contaminants emissions generated by burning sewage sludge in a fluidized bed of inert material (sand with a particle size of 5–1 mm), the qualitative and quantitative volume of which is obtained using modern methods of laboratory research, including SPME/GC-MC. The research program was developed based on the analysis of domestic and foreign scientific works devoted to the study of the environmental impact of sewage sludge incineration plants, technologies of sewage sludge neutralization. The program included the determination of pollutants characteristic of the technology, as well as the study of samples of unknown composition of emissions. The results of laboratory tests of samples of unknown composition showed that the maximum concentrations were observed for the following chemical compounds: dioxins – 2,3,7,8-trichlorophosphazodichlorophosphonyl, 1,2,3,4,8-pentachlordibenzofuran, 2,3,4,7,8-pentachlordibenzofuran, 1,2,3,4,7,8-hexachlorodibenzofuran; polynuclear aromatic hydrocarbons – acenaphthylene, acenaphthene, fluorene, phenanthrene, fluorantene, pyrene; metals – mercury, chromium, nickel, lead; carbonyl compounds - acetaldehyde, acetone; highly volatile and volatile organic compounds – carbonyl sulfide, dichloromethane, toluene, xylene, ethylene, butene-1, trans-pentane, cyclopentane; volatile and semi-volatile compounds – butoxyethoxyethyl acetate, formaldehyde, C<sub>12</sub>–C<sub>19</sub> alkanes.

**Keywords:** sewage sludge, sewage sludge incineration, chemical composition of industrial emissions.

## ORGANIZATION OF ECOLOGICAL MONITORING IN AN INDUSTRIAL CITY TODAY. STATUS AND PROBLEMS

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The article is devoted to the analysis of the existing environmental monitoring system at the regional (Rostov Region) and municipal (Taganrog city) levels. The authors assessed the current state of organization of environmental monitoring, identified the main problems



concerning interagency cooperation, including information and analytical with the system of social and hygienic monitoring in the field of dynamic observation of environmental quality and safety parameters on the example of atmospheric air. The study revealed insufficient level of interdepartmental interaction, which determined the high relevance of the development of measures to optimize it in the implementation of the Concept of the development of the system of social and hygienic monitoring in the Russian Federation for the period up to 2030. The study proposed a number of promising directions for improving environmental monitoring, including the unified scheme of atmospheric air monitoring being developed, which provided for close interdepartmental interaction within the framework of four functional units.

**Keywords:** environmental monitoring; socio-hygienic monitoring; anthropogenic load; atmospheric pollution; information and analytical support; geographical information systems.

## CURRENT STATE OF THE PROBLEM OF POLLUTION OF NATURAL WATER RESOURCES WITH PHARMACEUTICAL DRUGS AND THEIR METABOLITES

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The wide availability of various classes of pharmaceutical drugs in the Russian Federation results in their increased consumption for medical purposes and, as a consequence, the likelihood of their release into the environment. The unchanged residues of pharmaceutical drugs and their biologically active derivatives, being in the environment, can cause a potential risk to public health. The article studies the problem of the growing uncontrolled presence of pharmaceutical residues and their metabolites in the environment. The article presents the primary results of studies on the level and structure of pollution of the aquatic environment due to wastewater flow into it from the sewage system of an industrial city in the south of the Russian Federation. The research was conducted in city of Taganrog located in the Rostov Region with a population of about 250 thousand people. The authors analyzed data on the use of various pharmaceutical agents in the inpatient departments of three major medical and preventive health institutions of the city in 2021 under the conditions of a novel coronavirus infection. The study included the assessment of the potential for certain pharmaceutical drugs and their metabolites to enter the Taganrog Bay of the Azov Sea with effluents due to physical and physiological excretions of the hospitalized patients. The article considers the prospects of organizing a dynamic observation of the xenobiotic profile of water bodies as one of the areas of social and hygienic monitoring with further assessment of the public health risks caused by pharmaceutical drug residues and their derivatives.

**Keywords:** xenobiotic profile; pharmaceutical drugs; wastewater; pollution of water bodies; social and hygienic monitoring; risk factors.

## SELECTION OF CONTROL POINTS FOR ELECTROMAGNETIC FIELDS IN THE RADIO FREQUENCY RANGE

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The increase in the number of base stations in the territory of dense urban areas, constant modernization of base station equipment, leads to an increase in the volume of measurements of electromagnetic fields generated by cellular base stations. The number of base stations that are built at extremely close distances from residential multi-storey apartment buildings is on the rise. The danger of this arrangement of antennas lies in the frontal (frontal) and minor lobes of electromagnetic radiation, which, due to their proximity to the residential buildings, can have a negative impact on public health. One of the tasks when conducting measurements is the choice of control points of electromagnetic fields created by cellular base stations. The article examines the criteria for selecting control points for electromagnetic fields based on a visual assessment of the location of antennas of cellular base stations. The authors of the study defined the criteria for selecting the points for controlling electromagnetic fields by the example of a survey of the area around cellular base stations located in the city of Perm.

**Keywords:** electromagnetic fields, cellular base station, visual assessment, control point.

## PECULIARITIES OF COBALT DETERMINATION IN BLOOD BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY

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The article presents the results of development of methodological techniques for the determination of cobalt in whole blood samples using inductively coupled plasma mass spectrometry (ICP-MS). The article presents the setup parameters of the Agilent 7900 quadrupole mass spectrometer with inductively coupled plasma and the instrument operation parameters for interference suppression, and substantiates the optimal scheme of sample preparation by acid dissolution during heating in a thermal unit to reduce the matrix effect, the choice of the optimal element as an internal standard. The accuracy of the results was confirmed by analysis of SERONORM TM Whole Blood L1 and L2 samples with validated values.

**Keywords:** inductively coupled plasma mass spectrometry (ICP-MS), reaction-collision cell, internal standard, cobalt, blood.

## TOXICOLOGICAL AND HYGIENIC ASSESSMENT OF EXTRACTS FROM POLYLACTIDE FILM SAMPLES USING *TETRAHYMENA PYRIFORMIS* TEST OBJECT

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Poly lactides are currently recognized as the most promising alternative to synthetic polymers as they represent a condensation product of lactic acid obtained by fermentation from renewable plant sources. Creation and use of such biopolymers contributes to the transition to a closed-cycle economy model, which is a high priority in the national economic development. Another advantage of polylactide is its ease of processing without harming the environment. However, pure biopolymer has a number of disadvantages, such as brittleness and gas permeability, which are mitigated by using special synthetic additives, fillers, or through copolymerization with other polymers. Thus, products made of such materials used in contact with food products can be a source of a variety of chemical compounds that can migrate into the contacting environment and cause adverse effects on the body when they come into contact with food. Therefore, the direct interaction of extracts from the studied sample of polylactide with a living organism will make it possible to evaluate the complex effect of migrated potential toxicants. The laboratory population of single-celled organisms *Tetrahymena pyriformis* has a number of advantages due to its similarity to warm-blooded animals in terms of nutrient requirements and the nature of their metabolism, as well as due to the level of its exploration. The study included toxicological and hygienic assessment of water extracts from a sample of polylactide film using *Tetrahymena pyriformis* as a test object. The results of the experiments suggested that there was no detrimental effect of the studied extracts on the population of single-celled organisms. Visual assessment of the state of *Tetrahymena pyriformis* population cultivated in media containing the studied aqueous extracts did not reveal any visible morphological and functional changes compared to control group. The adaptive potential increased to 42 % in relation to control group indicated the presence of organic compounds in the studied extracts (for example, lactic acid oligomers or lactates) with a stimulating effect on the generative function of the population.

**Keywords:** materials coming in contact with food products, packaging, safety, polymer materials, polylactides, *Tetrahymena pyriformis*.

## **SOME RESULTS OF THE IMPLEMENTATION OF THE "CLEAN AIR" FEDERAL PROJECT IN NOVOKUZNETSK**

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The environmental protection measures implemented by enterprises provide a positive trend in reducing emissions of pollutants into the air by reducing the average annual concentrations of a number of pollutants. However, the risk levels of exposure to some critical organs and systems remain high, which indicates the occurrence of adverse effects on the health of the population of Novokuznetsk.

**Keywords:** comprehensive plan, risk assessment, social and hygienic monitoring, non-carcinogenic hazard indices.

## **ASSESSMENT OF THE EFFECTIVENESS OF SANITARY AND HYGIENIC MEASURES AIMED AT ENSURING THE QUALITY OF ATMOSPHERIC AIR AND PREVENTING THE RISK TO PUBLIC HEALTH IN CITIES WITH PARTICULARLY HIGH LEVELS OF POLLUTION (CASE STUDY OF BRATSK)**

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In cities of intensive industrial development with a very high level of atmospheric air pollution, it is relevant to assess the effectiveness of a set of measures aimed at reducing hygiene problems. The purpose of this study was to evaluate the effectiveness of sanitary and hygienic measures aimed at ensuring the quality of atmospheric air and preventing the risk to public health (case study of Bratsk). The effectiveness of the measures conducted in the

period of 2018–2020 was assessed by hygienic indicators and criteria of atmospheric air quality, as well as the health of the population from the highest risk area. The study established positive dynamics of the quality and condition of atmospheric air in places of permanent residence of the population, both in general by reducing the specific weight of samples that do not meet hygienic standards (by 80.5 %) and by the content of individual pollutants. The concentrations of hydrogen fluoride, solid fluorides, phenol, suspended solids, benzo(a)pyrene, nitrogen dioxide, formaldehyde) included in the list of priority air pollutants in Bratsk and related to the economic activities of specific enterprises for the production of aluminum, wood processing and pulp and paper products decreased by 15–72.2 %. The study revealed a reduction in the incidence of upper respiratory tract diseases, diseases of the musculoskeletal system, vegetative disorders, gastroduodenal dysfunction (by 15.0–100 %) associated with exposure to priority substances in children from the highest risk area. The content of toxic substances such as benzo(a)pyrene, o-, m-, p-xylenes, benzene, toluene, ethylbenzene, phenol in blood decreased by 33.3 times; the content of aluminum in the urine, which was on the list of priority substances, decreased by 3.5 times. Prevented damage to the health of the child population from the highest risk area for 2020 was about 2,111 cases of diseases. Prevented GDP losses amounted to 29.9 million rubles.

**Keywords:** effectiveness of measures, atmospheric air quality, prevented damage, biomonitoring, morbidity of the population.

## BIOINFORMATIC ANALYSIS OF PROTEINS USING DATABASES (LITERATURE REVIEW)

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The number of protein sequences has increased significantly in recent years, leading to the creation of proteomics databases. A variety of protein-related databases, query tools, and software tools have been developed to structure information for the analysis of biological annotations of proteins and their sequences, as well as structural, functional, and evolutionary analyses in the context of the biology of signaling pathways. The obtained data on protein bioinformatic analysis should be used to suggest hypotheses of the development of pathological processes at the molecular level.

**Keywords:** proteins, databases, bioinformatics, proteomic profile.

## **SUBSTANTIATION OF EXPERIMENTAL STUDY OF TETRACYCLINE ANTIBIOTICS TAKING INTO ACCOUNT ALIMENTARY EXPOSURE**

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Modeling and exposure assessment are integral to quantifying risk. The approaches used to assess exposure to residual amounts of antibiotics contained in food products are similar to those used to assess exposure to chemical contaminants and combine data on the presence (concentration) of residual amounts of the specified contaminants in food and the average daily intake of the relevant products. Carrying out the experiment according to the proposed scheme makes it possible to evaluate individual biological effects, including the effect on the intestinal microbiota of residual amounts of tetracycline antibiotics equivalent to the calculated values of alimentary exposure, as well as the maximum allowable levels adopted in the Republic of Belarus and the Eurasian Economic Union, in international standards Codex Alimentarius. The object of research was a scheme for conducting an experimental study of the alimentary effects of tetracyclines. The study demonstrates the feasibility of selecting actual and theoretical doses for the experimental study of residual amounts of tetracycline antibiotics, taking into account the alimentary exposure, which justified the study design.

**Keywords:** tetracyclines, risk assessment, alimentary exposure, experimental model.

## **STUDY OF THE CONTENT OF PHENOL AND ITS DERIVATIVES IN THE BLOOD OF CHILDREN LIVING IN THE ZONE OF INFLUENCE OF INDUSTRIAL EMISSIONS**

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The paper presents the results of the analysis of phenol and its derivatives (hydroquinone, pyrocatechin) in the blood of children living in the zone of influence of emissions from metallurgical enterprise (group No. 1) and oil production enterprise (group No. 2). The study included the analysis of chemical compounds in biological media (blood) by high-performance liquid chromatography using diffusion solid-phase extraction to extract

analytes. Phenol in the blood was detected in 100 % of the examined children in the studied groups. The average group concentration ( $M \pm m$ ) of phenol in the blood of study group No. 1 was  $(0.009 \pm 0.003)$  mg/dm<sup>3</sup>, for hydroquinone –  $(0.171 \pm 0.053)$  mg/dm<sup>3</sup> and pyrocatechin –  $(0.060 \pm 0.033)$  mg/dm<sup>3</sup>. The average group concentration ( $M \pm m$ ) of phenol in the blood of group No. 2 was  $(0.006 \pm 0.002)$  mg/dm<sup>3</sup>, for hydroquinone –  $(0.122 \pm 0.026)$  mg/dm<sup>3</sup> and pyrocatechin –  $(0.050 \pm 0.020)$  mg/dm<sup>3</sup>. There were no significant differences in the content of phenol, hydroquinone and pyrocatechin in the blood of the children of group No. 1 in relation to group No. 2 ( $p > 0.05$ ).

**Keywords:** phenol, hydroquinone, pyrocatechin, blood, children's population, high-performance liquid chromatography.

## STUDY AND EVALUATION OF BIOCHEMICAL AND HEMATOLOGICAL BLOOD PARAMETERS OF RATS DURING REPEATED INHALATION EXPOSURE TO MOLYBDENUM (VI) OXIDE NANOPARTICLES AND MICROPARTICLES

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Due to the expansion of the range of application of molybdenum (VI) oxide nanoparticles (MoO<sub>3</sub> nanoparticles) the risk of pathological changes in health caused by the adverse effects of this nanomaterial increases, which makes research aimed at studying the toxicity of MoO<sub>3</sub> nanoparticles in different exposure pathways relevant. This study examined the biochemical and hematological parameters of the blood of rats under repeated inhalation exposure to MoO<sub>3</sub> nanoparticles compared to microparticles. The identified changes in blood parameters indicated the likely development of abnormalities in the structure and/or function of the liver and kidney tissues when exposed to both nanoparticles and microparticles of MoO<sub>3</sub>. A more pronounced character of changes and a larger list of altered blood parameters in rats exposed to the nanomaterial indicate a greater degree of toxicity of MoO<sub>3</sub> nanoparticles compared to particles of its microsized chemical counterpart.

**Keywords:** molybdenum (VI) oxide, nanoparticles, inhalation exposure, toxicity, blood parameters.

## ASSESSMENT OF HEALTH RISK ASSOCIATED WITH CONSUMPTION OF DRINKING WATER FROM GROUNDWATER SOURCES IN PRIOZERSKY DISTRICT OF LENINGRAD REGION

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Priozersky district covers an area of 3,597 km<sup>2</sup> and is located in the northern part of the Karelian Isthmus, on the western shore of Lake Ladoga. The water supply of many settlements of the district is largely based on the use of groundwater. The study analyzed the results of laboratory tests of drinking water quality of aquifers used, carried out within the framework of industrial control and socio-hygienic monitoring, research work on water quality assessment of the studied aquifers, literary sources on the assessment of drinking water quality. The authors conducted a hygienic assessment of water quality and health risk assessment in 23 settlements of Priozersky district of Leningrad Oblast when consuming water from ground water sources. The methods of examination, evaluation, and system analysis were applied. During the course of the study it was established that the water supply was based on the Archean-Proterozoic, Vendian, and Quaternary sediments. The research resulted in clarification of the list of substances with concentrations exceeding 1 MPC, and identification of substances of hazard classes 1 and 2 with concentrations exceeding 0.1 MPC, as well as substances of hazard classes 3 and 4 exceeding 0.5 MPC, which should be included in production control programs. Recommendations on improving the systems of industrial control and socio-hygienic monitoring of the quality of water from groundwater sources were provided, as well as an assessment of the health risk of the population consuming water associated with specific aquifers.

**Keywords:** groundwater, drinking water quality, Priozersky district, public health risk assessment.



## DETERMINATION OF FINE FRACTIONS OF SUSPENDED PARTICLES IN ATMOSPHERIC AIR AT THE BORDER OF THE SANITARY PROTECTION ZONE OF A PHARMACEUTICAL ENTERPRISE

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The article presents the research of determining the maximum single and average daily concentrations of fine particles of PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>4</sub> PM<sub>10</sub>, and TSP in the atmospheric air at the border of the sanitary protection zone of one of the enterprises of the industrial pharmaceutical cluster. The measurements were conducted using the DustTrak aerosol analyzer mod. 8533.

The authors of the study analyzed the percentage of each fraction of suspended particles in the total amount of dust and estimated the contribution of the studied fine fractions to atmospheric air pollution.

The study found no exceedances of the maximum permissible single maximum concentrations of the PM<sub>2.5</sub> and PM<sub>10</sub> fine particles. The value of the average daily concentration of PM<sub>10</sub> was recorded at the level of daily average MPC.

**Keywords:** fine fractions, atmospheric air, pharmaceutical industry, sanitary protection zone, maximum permissible concentration (MPC).

## HYGIENIC ASSESSMENT OF THE EFFECTIVENESS OF USING THE BEST AVAILABLE TECHNOLOGIES (ON THE EXAMPLE OF WASTE MANAGEMENT FACILITIES)

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The unfavorable situation with environmental pollution and public health in the regions of Russia, combined with the inefficiency or insufficiency of environmental protection measures (which is often explained by economic and technical reasons), requires urgent changes and the development of new approaches of state regulation. One of the ways to change the situation may be the transition of industry to the principles of the best available technologies (BAT) using modern

resource- and energy-saving innovations. The object of the study was the application of BAT at waste management facilities.

The study analyzed the methodologies of development, implementation, application of BAT at enterprises, together with an assessment of the effectiveness of the policy in the field of BAT application at industrial facilities and the effectiveness of their use to reduce the negative impact on public health on the territory of the Russian Federation. The study also covered legislative and legal norms on the introduction of BAT in the territory of the Russian Federation. The authors examined the procedures for the introduction of BAT, representing a set of economically feasible and technically feasible technological, technical and managerial solutions, the use of which allows achieving high environmental and resource efficiency of production and ensuring a reliable level of environmental protection. The study contains generalized data, indicating that the transition to BAT involves the development of technological regulation in the field of environmental protection. The article presents analysis of the effectiveness of the policy in the field of definition and implementation of BAT in the Russian Federation.

**Keywords:** the best available technologies (BAT), BAT reference directories, legislative and legal norms and procedures for the introduction of BAT, effectiveness of BAT introduction.

## FOOD SAFETY IN THE REPUBLIC OF TATARSTAN: CONTROL AND RISK ASSESSMENT OF DDT RESIDUES IN MAJOR PRODUCT GROUPS

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Information about residual quantities of dichlorodiphenyltrichloroethane (DDT) in food products and the diet is important for health risk assessment in the Republic of Tatarstan. The authors of the study analyzed the dietary intake of children aged 3–6 years in Kazan using the time-weighted method, and estimated the non-carcinogenic health risk associated with DDT intake from major food groups. Exposure and non-carcinogenic risk of residual amounts of DDT in food was calculated for 2014–2018 based on the median and 95-th Perc based on the results of laboratory tests by Federal State Budgetary Institution Center of Hygiene and Epidemiology in the Republic of Tatarstan in accordance with the regulatory documents. The estimated daily intake (EDI) for all DDT compounds for children was at the 95th perc level of 0.0023 mg/kg/day, which was 2 times higher than the recommended acceptable daily intake (ADI) established by FAO/WHO. According to SanPiN 1.2.3685-21, the values obtained amounted for 27.5 and 90.2 % of the acceptable daily intake (ADI) established for children (0.0025 mg/kg).

Intake with food is the main route of exposure to DDT for children in Kazan.

**Keywords:** DDT, exposure, food products, children, non-carcinogenic risk

## DEPENDENCE OF CHANGES IN CHEMICAL SUBSTANCES CONCENTRATION IN THE BLOOD DEPENDING ON THE CONSUMED FOOD COMPONENTS

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The proximity of residential areas to industrial facilities can increase the risk of developing various diseases, and reduce the quality of life and life expectancy of the population. Nutritional optimization can serve as an approach to protect the population from the negative effects of anthropogenic environmental factors. A study of the nutrition of the residents of unfavorable regions is necessary to develop recommendations aimed at reducing the incidence of diseases at the population level. The authors conducted direct questioning of the students of secondary schools to assess the daily nutrition intake of the children in the study area. The developed questionnaire made it possible to obtain information on the daily nutrition, and the cooking method for a number of products, which let the authors obtain the most reliable information on the macronutrients and micronutrients consumption with food. Together with the questionnaire, concentration of chemicals in the blood of the respondents was determined. The construction of logistic regression models made it possible to determine the correlation between the level of biologically significant substances entering the body with food and the concentration of chemicals in the blood. The study resulted in models describing the correlation between a decrease in the concentration of certain chemicals in biological fluids and an increase in important nutritional components in the diet, including B group vitamins, vitamins C and A, dietary fiber, etc.

Adjusting the diet can reduce the concentration of harmful chemicals in the blood.

**Keywords:** nutrition, questionnaire, mathematical modeling, health, chemicals.

## STUDY OF THE AIR HEATING PROCESS IN THE HUMAN NASAL CAVITY DURING BREATHING

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Within the framework of creating a multilevel model of the accumulation of functional disorders in the human body under the influence of environmental factors, a sub-model of the meso-level of respiratory system is being developed. This article is devoted to the study of the process of air heating in the human nasal cavity, forming part of the respiratory system model

under development. Using numerical simulation, the authors obtained characteristics of the nonstationary flow of inhaled air, characteristics of temperature distribution in the nasal cavity at different time points, and estimated air heating at different temperatures of inhaled air. The obtained results can be used in modeling the occurrence and development of respiratory diseases associated with the temperature factor. The considered approaches can be applied to solve the problems of assessing the health hazard of the population from climatic factors of the living environment.

**Keywords:** mathematical modeling, human respiratory system, nasal cavity, air heating, temperature.

## Section V

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### **Risk analysis in occupational health**



## **ASSESSMENT OF OCCUPATIONAL HEALTH RISKS IN TERMS OF WORKING CONDITIONS, OCCUPATIONAL MORBIDITY AND INJURIES**

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The study revealed differences in indicators of the state of working conditions, occupational morbidity, and injuries characteristic of certain sectors of the economy of the Republic of Bashkortostan for 2019–2020.

To assess the occupational health risks of workers the authors selected five production facilities of organic synthesis petrochemical complex, part of the manufacturing sector of the economy.

A methodological approach to the assessment of occupational risk based on the integral index was developed at five production facilities of organic synthesis belonging to the largest petrochemical complex of Russia: ethylbenzene styrene, ethylene-propylene, butanol, 2-ethylhexanol, phthalic anhydride, heptyl.

The analysis made it possible to rank the studied productions according to the degree of risk of health disorders, depending on specific indicators, which included working conditions, occupational morbidity, and injuries.

The highest risk according to the integral indicator was noted in the production of heptyl and ethylbenzene-styrene, followed by the production of organic alcohols, ethylene-propylene, and phthalic anhydride. The suggested methodology for assessing occupational risk by an integral indicator is proposed for wide testing in other sectors of the economy.

**Keywords:** risk, health, workers, working conditions, occupational morbidity, injuries.

## **HEALTH AND WORKING LONGEVITY MOTIVATION PATTERNS IN PRE-RETIREMENT AND RETIREMENT AGE WORKERS OF HAZARDOUS INDUSTRIES**

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In today's society, there is an increase in the proportion of older people and a trend toward deterioration in public health. Socio-economic conditions, biological characteristics, behavior and lifestyle, as well as the production environment shape the health of the working-age population. The health of an employee has a direct impact on their working longevity. Negative motivation patterns should give way to modern methods of motivation.

Objective: to determine the main patterns of motivation for health and working longevity in the employees of hazardous industries of pre-retirement and retirement age.

Materials and methods. The authors conducted the study based on industrial enterprises of Perm Territory in the period of 2018–2020. The employees filled out questionnaires (342 questionnaires were processed in total). The respondents were divided into 2 groups: employees of pre-retirement and retirement age<sup>1</sup> in the study group and young workers in the control group. The employees filled out a questionnaire compiled using generally accepted methods

The results showed that in both groups of respondents, external positive motivation is the main one, and internal motivation is low. In the study group, 61.2 % of the employees have a low health status.

The study found that the employees of pre-retirement and retirement age lack a pronounced internal motivational focus on the preservation of health. Health has a low status in the hierarchy of values; the attitude to diseases is non-constructive. In the control group, the motivation for success was also expressed with a non-constructive attitude to diseases.

In modern socio-economic conditions, it is advisable to talk about health-forming technologies aimed at creating intrinsic motivation of the employee to health and working longevity. The preservation of health is possible only if an employee has a conscious positive internal motivation. In the absence of positive patterns, the health-preserving technologies cannot be effective.

Conclusions. Health for employees of both groups had a low status in the hierarchy of values, the attitude to diseases was non-constructive; there was no pronounced internal motivational focus on health preservation.

The main positive patterns for health motivation and work longevity for workers of pre-retirement and retirement age were job stability, job satisfaction; negative patterns were lack of interest in life and the fear of losing the job.

**Keywords:** health, work longevity, pattern, motivation

## **AUTONOMIC DYSFUNCTION AS A PREDICTOR OF ARTERIAL HYPERTENSION IN WORKERS IN HAZARDOUS WORKING CONDITIONS**

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When producing oil by thermal mining method, chemical, physical production factors, underground work, physical strain, shift work schedule, as well as social risk factors have a negative impact on employee's health. Reduction of individual functional reserves of certain systems, gradually leads to a redistribution of functional reserves of the body, and then to their reduction, which manifests itself in the initial fatigue and impairment of work capacity. The health risk is mainly associated with pathological changes in the cardiovascular and nervous systems. The purpose of the study was to assess the role of vegetative disorders in the formation of arterial hypertension in workers in hazardous working conditions (on the example of enterprises producing oil by the thermal shack method). Materials and methods: the study examined 21 well purge operators engaged in oil

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<sup>1</sup> According to the classification of the World Health Organization, adopted in 2014, the age from 25 to 44 years is considered young.



extraction by the thermal mining method. Control group 1 included 15 employees of the administrative subdivision with a professional history of underground work for 3 to 23 years before the identification of medical contraindications to this type of work; the people in this group worked on the surface from 1 to 15 years. Control group 2 consisted of 23 office workers whose work activity has never been associated with exposure to harmful production factors. The authors used hygienic, sociological, clinical, laboratory and functional research methods. Results: All examined persons in the study group had signs of disorders of the autonomic nervous system of varying degrees of severity. Administrative workers with an occupational history of underground work, in addition to vegetative disorders had verified Arterial hypertension in 40 % of all cases. Workers engaged in thermal oil extraction revealed signs of oxidative stress, high atherogenicity index and signs of morphological changes in the vascular wall, which contributed to the development of arterial hypertension. The authors of the study used the results of modeling the evolution of risk, taking into account both the increase in risk, as a result of occupational factors, and the magnitude of background risk, over a lifetime, to calculate a reduced index of health risk for workers due to responses from the cardiovascular and central nervous systems.

**Keywords:** autonomic dysfunction, predictor, arterial hypertension, hazardous working conditions, thermal extraction.

## EFFECT AND SENSITIVITY MARKERS AS INDICATORS OF HEALTH DISORDERS IN WORKERS, REVEALING THE FORMATION OF WORK-RELATED PATHOLOGY ASSOCIATED WITH ONCOPROLIFERATIVE CONDITIONS (USING LEAD AND FORMALDEHYDE AS EXAMPLES)

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In the framework of the study the authors conducted an examination of the employees of a non-ferrous metallurgy enterprise in Perm Territory who are exposed to chemical harmful production factors. The working conditions of the examined workers at their workplaces were evaluated as hazardous with working conditions class 3.1–3.3. according to the Guidelines R 2.2.2006-05. We propose to use the following indicators, markers of the effect and sensitivity of the conditions of exposure to chemical factors of the industrial environment, including contamination of biological media with metals (lead), formaldehyde, having mutagenic and carcinogenic effects, leading to the formation of oncoproliferative conditions: activation phenotypes of CD25+, CD95+ cell differentiation clusters, TNFR receptor, transcription factor p53 and Bcl-2 anti-apoptotic factor, Annexin V negative and positive cells, CD3+HLA-DR+; IgG and IgE specific to haptens; fetal proteins – CEA, NSE Gene polymorphisms: *MMP9*rs17576 matrix metalloproteinase gene, *TP53* rs1042522 transcription factor p53 gene, *TP53* rs4961 adducin gene.

The developed and scientifically substantiated algorithm for the identification of immune regulation markers and candidate gene polymorphisms in workers reflects the early manifestations of the formation of occupationally conditioned pathology associated with oncoproliferative conditions under adjuvant hapten-induced immune control modification (using formaldehyde and lead as examples).

**Keywords:** effect marker, sensitivity marker, lead, formaldehyde, oncoproliferation.

## RISK FACTORS FOR PROFESSIONAL BURNOUT IN SOCIAL WORKERS

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The problem of professional risks in social work remains relevant in modern conditions. Regular stressful situations in the process of complex social interaction with clients, personal insecurity and other moral and psychological factors have a negative impact on the health of social workers.

In order to determine the risk factors of professional burnout of social workers, we conducted a study of working conditions, clinical-functional and psychological examination of 147 social workers (social workers of the patronage service, social workers of hospices, and specialists of the social service system) with the identification of the main risk factors of health disorders.

The study revealed the main groups of diseases, risk factors of professional burnout development. The authors developed a system of preventive measures, including sanitary and hygienic, medical and psychological programs aimed at preserving the health of social service workers.

**Keywords:** occupational risks, social workers, health disorders, prevention.

## CARDIOVASCULAR RISK FACTORS IN UNDERGROUND MINING WORKERS

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The widespread use of mine mining in Russia determines the high relevance of preserving labor resources in this industry, preventing occupational and production-related morbidity, reducing cases of temporary and permanent disability. Mining is characterized by the impact on

workers of a number of non-specific harmful (hazardous) factors: industrial noise, general and localized vibration, hard labor, heating or cooling microclimate, low light conditions.

The aim of the work was to study the prevalence of arterial hypertension among underground miners, its clinical features and changes in the complex of biochemical risk factors for cardiovascular complications.

The study group consisted of 98 employees of the following specializations: sinker, miner, drill rig operator, scraper winch operator, borehole driller. The control group (working in conditions outside the influence of the studied production factors) consisted of 75 employees – managers and specialists of the administrative and managerial personnel of the enterprise. All surveyed employees of the study and control groups were men. The workers were examined by a cardiologist. Laboratory tests were conducted: high-sensitivity CRP, lipid hydroperoxide, uric acid. The spectrum of blood lipids, stress hormones (adrenaline, cortisol) was studied.

In the group of underground miners, the study established a significant prevalence of cases of arterial hypertension (31.3 % in the study group and 17.2 % of the examined in the control group,  $p=0.042$ ), and determined its clinical features. Laboratory tests in a group of miners revealed the presence of a number of paraclinical syndromes: systemic inflammation and immune activation syndrome, lipid metabolism disorder syndrome, oxidative stress syndrome, hormonal profile disorder. The clinical and paraclinical peculiarities revealed in the study suggest grounds for further development of targeted preventive programs for this category of mining workers.

**Keywords:** underground mining, industrial pathology, arterial hypertension.

## OCCUPATIONAL MORBIDITY IN THE PERM TERRITORY

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The study presents the results of the analysis of occupational morbidity and its structure in Perm Territory for 2011–2021. The authors identified the leading working conditions affecting the development of occupational diseases. The study noted a downward trend in the proportion of respiratory diseases, and an increase in the proportion of musculoskeletal diseases, and vibration pathology. The authors have determined that workers with more than 31 years of work experience in the presence of a hazardous production factor were at the highest risk of occupational disease development.

**Keywords:** occupational morbidity, working conditions, hazardous production factors.

## STUDY OF BONE MINERAL DENSITY IN WORKERS OF PROFESSIONS SUBJECT TO VIBRATION HAZARDS

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Vibration sickness is one of the most common occupational pathologies in various industries, which affects many body systems, including the musculoskeletal system. In the literature, there is evidence of an increased risk of osteopenic syndrome in workers exposed to prolonged exposure to industrial local and general vibration. Bone mineral density (BMD) was assessed using X-ray and ultrasound densitometry to evaluate the presence of osteopenic syndrome in workers with vibration hazardous occupations. The study included 48 workers with grade I–II vibration disease due to exposure to general vibration ( $n = 25$ , average age –  $52.3 \pm 0.41$  years, professional experience –  $21.5 \pm 1.5$  years) and combined exposure to local and general vibration ( $n = 23$ , average age –  $53.4 \pm 0.5$  years, professional experience –  $19.6 \pm 2.1$  years). A comparative assessment of the frequency of detection of reduced BMD was carried out according to X-ray and ultrasound osteodensitometry examination. The frequency of detection of reduced BMD according to ultrasound densitometric examination was lower compared to X-ray densitometry and amounted to 20.8–29.2 % in different study areas.

**Keywords:** local vibration, general vibration, decrease in bone mineral density, osteopenic syndrome, vibration disease.

## THE INFLUENCE OF INDUSTRIAL ALLERGENS ON HOMEOSTASIS INDICATORS OF THE WORKERS

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The rapid development of the chemical industry, the introduction of new complex chemical compounds entail an increase in the number of workers who have industrial contact with various irritants and allergens. As a consequence, earlier identification of the adverse effects of harmful factors on the health of workers is of paramount importance. This study examined the changes that occur in the body of electroplating workers depending on the duration of contact with nickel aerosols.

202 workers of the electroplating workshop and 64 people of the control group were examined. Clinical and laboratory studies were performed according to standard methods.

With an increase in work experience, the workers demonstrated a 1.6–1.8-fold increase in the activity of neutrophil acid and alkaline phosphatase and a 1.7–2-fold decrease in the activity of neutrophil myeloperoxidase and catalase in relation to control indicators. In 28–53 % of electroplating workers, the phagocytic activity of leukocytes and the reaction of inhibition of

leukocyte migration increased. A suppression of the T-cell component of the immune response was noted, immunoglobulin IgG, IgA levels were sharply reduced by 1.4–3 times and immunoglobulin IgM, IgE and CIC-complex levels were increased by 1.4–1.8 times. The study detected an increase in the production of pro- and anti-inflammatory cytokines (IL-1 $\beta$ , TNF- $\alpha$ , IL-4) by 1.5–3.5 times. The relationship between the concentration of nickel in urine and changes in the parameters of CFn ( $r = 0.87$ ), MPn ( $r = -0.84$ ), RTML ( $r = 0.75$ ), IgA ( $r = -0.72$ ); IL-1 $\beta$ , IL-4, IdE, ( $r = 0.62$ – $0.71$ ), confirmed the priority effect of nickel compounds on the detected changes. The revealed health disorders of workers can contribute to the development of immunodeficiency, allergic and autoimmune conditions underlying occupational and work-related diseases.

The data of the conducted studies served as a basis for the development of preventive measures aimed at preserving the health of electroplating workers.

**Keywords:** working conditions, electroplating, nickel, antioxidant status, immunoreactivity.

## OCCUPATIONAL HEALTH RISK OF EMPLOYEES DEPENDING ON THE LEVELS OF EXPOSURE TO HAZARDOUS INDUSTRIAL FACTORS AND THE EARLY SYMPTOMS OF DISEASE

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The study covers the results of a special assessment of working conditions of employees engaged in open-pit mining. The assessment revealed that the working conditions in the main occupations corresponded to Hazard Class 3. Taking into account the impact of complex production factors (vibration, intensity and severity of the work process); the overall assessment of working conditions corresponds to Class 3 of grade 2–3, which determines a high level of occupational risk of health damage.

The study established a high level of prevalence and a high relative risk of developing chronic general somatic diseases of the musculoskeletal system and connective tissue, circulatory system, and endocrine system in workers due to the impact of a complex of unfavorable production factors. The specified indicators increased with the increase in the length of service under hazardous working conditions.

The authors developed diagnostic criteria for detecting early signs of lumbosacral musculoskeletal syndrome associated with physical overload and functional overstrain of individual organs and systems.

The calculation of the total risk of fatal cardiovascular diseases in workers showed a shift from medium to high and very high, depending on the characteristics of working conditions and work experience.

The data obtained form the basis for the development of proposals for the creation of a system for monitoring the health of the employees engaged in hazardous working conditions and priority measures for the preservation of their health.

**Keywords:** occupational risk, industrial factors, health status.

## MARKERS OF METABOLIC DISORDERS IN MINING INDUSTRY WORKERS

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Using modern diagnostic methods, the features of the formation of metabolic disorders in 261 workers of the mining industry were studied. The study revealed that the combined effect of production factors (dustiness, noise, vibration, intensity and heaviness of labor, cooling microclimate) lead to the formation of metabolic insufficiency, which was accompanied by changes in lipid, carbohydrate metabolism and hormonal profile, developing 2.5 times more often than in the workers with acceptable working conditions. The revealed changes in homeostasis indicators should be considered as a single neuroimmunoendocrine reaction leading to the development of occupational and general somatic diseases.

**Keywords:** mining enterprises, production factors, working conditions, metabolic disorders, homeostasis indicators.

## PECULIARITIES OF FORMATION OF METABOLIC DISORDERS UNDER COMBINED INFLUENCE OF PRODUCTION FACTORS OF UNDERGROUND CHROME ORE MINING

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The purpose of the study was to explore the peculiarities of the formation of work-related metabolic disorders in the workers of an underground chrome ore mine with the use of modern marker indices.

The authors examined the working conditions, clinical and laboratory status of 236 employees of an underground chrome ore mine.

The study revealed that the extraction of chrome ore by underground mining is conducted in hazardous working conditions (class 3.3–3.4). Under the conditions of combined influence of

production factors of chromium ore underground mining (noise, dust, vibration, intensity and heaviness of labor, cooling microclimate) cardiovascular and endocrine pathology develops 2.8–3.3 times more often than in persons with acceptable working conditions. The metabolic disorders were characterized by more frequent (by 1.4 times) detection of abdominal obesity and a 1.2–1.4-fold increase of metabolic indices (lipid accumulation factor, LAP and visceral obesity index, VAI), compared to comparison group ( $p=0.001–0.048$ ).

Prevention of cardiovascular diseases, including in workers employed in chrome ore mining, should include the calculation of early markers of metabolic disorders – VAI and LAP indices – as part of medical examinations.

**Keywords:** chromium mining, miners, metabolic disorders, obesity, marker indicators, lipid accumulation coefficient, visceral obesity index, periodic medical examinations.

## COMPARATIVE ASSESSMENT OF THE A PRIORI RISK OF HEALTH DISORDERS AT OIL INDUSTRY ENTERPRISES IN DIFFERENT CLIMATIC ZONES

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One of the leading industries in the Russian Federation is oil production and refining, employing a significant number of the working-age population. Employees at the enterprises of this industry are exposed to a complex of factors of the working environment, including the cooling meteorological effects of open industrial sites. The climatic conditions of work at open industrial sites are of particular importance in assessing the risk of health disorders from exposure to cooling meteorological factors.

The authors conducted a comparative assessment of the total a priori risk in the workplaces for operators and machinists of technological installations and repair mechanics of two companies located in different climatic zones.

The study revealed that the risk values of health disorders of the employees working in the open area during the cold period of the year in the II climatic zone with the increase of work experience have statistically significantly higher values of total risk of health disorders ( $p < 0,05$ ), compared to the employees of the PO KINEF LLC company located in the III climatic zone (provided there are no differences in the time of presence in the open area during the 40-hour work week in the compared professional groups,  $p > 0,05$ ).

**Keywords:** work in an open area, oil production, cooling meteorological factors, assessment of the risk of health disorders, a priori risk.

## MARKERS OF RISK OF CARDIOVASCULAR SYSTEM DISORDERS IN BUS DRIVERS UNDER CONDITIONS OF CHRONIC WORK STRESS

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The aim of the work was to assess the impact of neuropsychiatric and physical stress associated with professional activity on the functional state and adaptive capabilities of the body, the risk of developing cardiovascular diseases (CVD) in a group of bus drivers.

The study presents the results of a comprehensive examination of 56 trained drivers of passenger vehicles using methods of heart rate variability (HRV), determination of erythrocyte activity of superoxide dismutase (SOD), bioelements in serum – zinc and copper, and in toxicant - formaldehyde (FA).

A significant part of drivers had modifiable and unmodified risk factors for CVD and an increase in cardiovascular risk (CVD) with an increase in length of service ( $r = 0.56$ ;  $p = 0.00001$ ). The study revealed reliable correlations between CVD and HRV parameters, and adaptive risk, and significant correlations between the studied parameters and elevated blood pressure (BP). The study revealed inverse correlation between the values of blood pressure and the activity of the antioxidant enzyme – erythrocyte SOD ( $r = -0.371$ ;  $r = -0.264$ ;  $p < 0.05$ ), and reliable dependences on the concentration of copper in serum ( $r = 0.473$ ;  $r = 0.305$ ;  $p < 0.05$ ), FA in blood ( $r = 0.463$ ;  $p = 0.04$ ).

The detected markers can be used for the purpose of effective monitoring and correction of the functional state of the body under the influence of industrial stress factors.

**Keywords:** stress, drivers, cardiovascular risk, adaptive risk; heart rate variability, superoxide dismutase, copper, zinc, formaldehyde.

## STATUS AND PROSPECTS OF THE ANALYSIS OF THE ATTRIBUTIVE RISK OF HEARING LOSS FROM NOISE IN THE WORKPLACE

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The study focused on the risk of hearing loss from occupational noise exposure. The study was aimed at analyzing the attributive risk of hearing loss when exposed to various levels of noise,



taking into account gender, age, and length of exposure to develop adequate preventive measures. An expert-analytical study was conducted, and the attributive risk of hearing loss was calculated. The authors used a calculation method for determining hearing thresholds based on the model of the third revision of the ISO 1999 standard, taking into account sex, age, duration of exposure to noise, which was developed by the authors and implemented as linked MS Excel tables, including calculation factors, formulas for calculating changes in hearing thresholds with age and exposure to noise in different percentiles of the male and female population, criteria values and calculation results in numerical and chart forms. The conducted research scientifically substantiated the priority application of attributive risk (in comparison with relative risk, etc.) as the most adequate indicator of the probability of hearing loss development, considering not only age-related changes in hearing function, but also noise exposure. The authors have tested a mathematical model based on ISO 7029 and ISO 1990 standards to calculate the group attributive risk of hearing loss in the population. The developed calculation technology makes it possible to calculate the group attributive risk of hearing loss in almost real time. The optimal criterion of the state of the auditory function for assessing the attributive risk of hearing loss under the influence of noise is scientifically substantiated – the average value of the hearing threshold at audiometric frequencies of 0.5, 1.0, 2.0 and 3.0 kHz is equal to 30 dB. Attributive risk was used to substantiate hygienic criteria and classify working conditions according to noise. Promising areas of research on risk management have been proposed.

**Keywords:** attributive risk, audiometric frequencies, hearing thresholds, hearing loss criteria, mathematical model, calculation technology.

## RISK OF COGNITIVE DYSFUNCTION IN OIL PRODUCTION WORKERS DEPENDING ON THE LENGTH OF SERVICE

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The purpose of the study is to study the dynamics of indicators of the state of cognitive functions of employees of an oil-producing enterprise, depending on the length of service under hazardous production factors.

The authors evaluated the state of cognitive functions in 292 oil and gas production operators exposed to the hazardous factors of the working environment (industrial noise, heavy labor, aromatic hydrocarbons, hydrogen sulfide, and unfavorable microclimate). The control group consisted of 65 employees of the enterprise administration. All surveyed were men aged 20–65 years, divided by length of service into subgroups: I – less than 10 years of experience; II – 10–20 years; III – more than 20 years, comparable in average age ( $p > 0.05$ ). The exclusion criterion was

the presence of diseases of the nervous system leading to cognitive deficits<sup>1</sup>. The authors conducted a psychological examination using the "NS-Psychotest" computer complex ("Exclusion of concepts" tests, "Image memory", "Numerical square"). To analyze the nature of the dependence of cognitive impairment on the length of work experience in the study and control groups, the authors calculated the relative risk and its 95 % confidence interval (the results are presented in the form – RR (95 % CI), and conducted a one-factor linear regression analysis of the dependence on work experience separately for each indicator of the studied cognitive functions.

The indicators of cognitive flexibility, imaginative memory, and attention were 1.3–1.6 times lower for oil and gas production operators than for people working in acceptable working conditions. With an increase in the length of service up to 10 years or more, the risk of developing cognitive impairments in employees increases by more than 5 times, and the frequency of registration of low values of memory, attention, and analytical activity increases by 2–3 times. Based on the calculation of the relative risk, the study established the relationship between the development of cognitive impairment and work experience. The use of a set of psychological tests characterizing the state of memory, attention, and cognitive flexibility during periodic medical examinations of oil and gas production department operators allows diagnosing cognitive dysfunction at an early stage and identifying persons with its minimal manifestations for subsequent in-depth examination, preventive measures, and addressing expertise issues.

**Keywords:** cognitive functions, numerical and figurative memory, attention, cognitive flexibility, cognitive deficit, psychological testing, oil industry, industry-induced pathology, harmful production factors, work experience.

## A RISK-BASED ASSESSMENT OF THE SOCIAL, ECONOMIC, AND BEHAVIORAL CHARACTERISTICS OF THE WORKING POPULATION'S LIFESTYLE

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The common framework proposes to divide human health risks into 4 groups: lifestyle factors (occupation, unhealthy habits, socio-economic indicators), environmental factors, hereditary factors, and the quality of health care. In occupational health science, occupational health risks are separated from risks associated with the lifestyle characteristics – economic, social and behavioural.

The purpose of this study is to assess the social, economic, and behavioural characteristics of the lifestyle of the working population using the health risk criterion.

During the study, a total of 344 people who underwent compulsory periodic medical check-ups were examined. The following lifestyle characteristics were studied: economic situation, mental exertion, sleep, leisure time, physical activity, and smoking. Criteria were used to assess the risks of chronic fatigue, deteriorating health and long-term diseases during the year, hypertension, and respiratory diseases. The influence of lifestyle characteristics on the risk of health disorders

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<sup>1</sup> Shapar V.B., Timchenko A.V., Shvydchenko V.N. Sh23 Practical psychology. Tools. – Rostov-on-Don: Phoenix publishing house, 2002. – 688 p.

was assessed by the value of the regression coefficient, characterizing their connection with the risk of health disorders.

The risks (frequency) of health disorders of employees with various criteria for their assessment have been established. The greatest risks of chronic fatigue syndrome occurrence, health deterioration over the year and prolonged illnesses are associated with the mental strain of workers and their economic situation. Mental strain and lack of leisure time increase the risk of hypertension by 5 and 7 %, respectively.

**Conclusions.** Lifestyle characteristics such as "daily mental strain" and "dissatisfaction with one's economic situation" have the greatest impact on the health risk indicators (chronic fatigue syndrome, deteriorating health and prolonged illnesses during the year). Mental stress increases the risks of hypertension and chronic respiratory diseases. Lack of leisure time significantly increases the risk of chronic fatigue and the risk of hypertension. Intensive smoking significantly increases the risks of hypertension and respiratory diseases. Lack of sleep increases the likelihood of deterioration of health during the year.

**Keywords:** health risks, lifestyle, mental strain, economic situation, leisure time, sleep, physical activity.

## QUANTITATIVE CARDIOVASCULAR INDICES ASSOCIATED WITH THE RISK OF OCCUPATIONAL SENSORINEURAL HEARING LOSS

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The aim of the study was to establish quantitative cardiovascular indices associated with the risk of occupational sensorineural hearing loss (SNHL).

Two hundred and fifty employees of mining enterprises exposed to noise exceeding the MPL were surveyed. The surveyed workers were divided into two groups. The first group consisted of 100 workers with an established diagnosis of SNHL, the second group consisted of 150 workers with no hearing loss. We assessed cardiovascular system indices by 24-hour blood pressure monitoring with assessment of arterial stiffness and by duplex scanning of extra and intracranial cerebral vessels.

The risk of SNHL was found to be associated with significantly higher values of mean daily systolic and diastolic blood pressure (DSBP and DDBP), vascular wall stiffness indices (pulse wave velocity, stiffness index, augmentation index). Ultrasound duplex scanning of extra and intracranial cerebral vessels revealed decreased peak systolic blood flow velocity (up to 30–35 cm/s) against the background of increased peripheral resistance index (up to 0.95 o.u.), indicating hypoperfusion condition of cerebral blood flow in 35 % of the first group workers. Hyperkinetic type of hemodynamics with pronounced angiospasm was significantly more frequent in the first group (30 % of cases versus 12 % in the second group ( $p < 0.05$ )).

A moderate degree of correlation was established between the risk of developing SNHL and indicators of the cardiovascular system: indicators of arterial rigidity (pulse wave velocity, rigidity index and augmentation index) ( $r = 0.40–0.47$ ), peak systolic blood flow rate ( $r = -0.41$ ),

thickness of the intima-media complex ( $r = 0.48$ ). The degree of influence of 24-hour blood pressure monitoring indicators (DSBP and DDBP, hypertensive indices of systolic and diastolic blood pressure time) was lower ( $r = 0.31-0.33$ ).

Quantitative clinical and functional cardiovascular system indices are important and can be used in the algorithm of evaluation of the complex effect of industrial and individual extraaural factors determining the risk of SNHL development.

**Keywords:** professional sensorineural hearing loss, extraaural risk factors, 24-hour monitoring of blood pressure, peak systolic blood flow rate, thickness of intima-media complex, vascular wall rigidity.

## OCCUPATIONAL PATHOLOGY IN THE METALLURGICAL INDUSTRY OF THE MURMANSK REGION (2000–2020)

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Employees of metallurgical enterprises in the Arctic are at an increased risk of developing occupational diseases.

The authors studied the data of the Murmansk Regional Register of Occupational Diseases for 2000–2020: 1,216 occupational diseases were diagnosed for the first time in 626 employees of metallurgical enterprises, which accounted for 24.4 and 24.6 % of all cases registered in the Murmansk region. Almost all occupational diseases (1,174 cases or 96.5 %) were detected in the workers of the copper-nickel industry (606 people or 96.8 %). The aluminum industry accounted for only 42 (3.5 %) diseases in 20 (3.2 %) workers. The peculiarities of occupational pathology in metallurgical production during the last year of the study were the following: increase in the number of nosological forms of diseases detected in one employee, increase in the length of work experience at the time of detection of occupational disease, increase in the share of musculoskeletal system diseases in the structure of occupational pathology and decrease in the share of malignant neoplasms. The annual share of occupational diseases of employees of metallurgical enterprises in the structure of regional occupational pathology varied significantly but had a long-term upward trend.

The obtained data can be used to improve the methods of prevention of occupational pathology in workers of metallurgical enterprises of the Murmansk region.

**Keywords:** occupational pathology, metallurgical industry, Murmansk region.

## FATAL ACCIDENTS IN THE DRIVER'S WORKPLACE

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The problem of preserving the health of drivers of motor vehicles is relevant, since this profession occupies a leading position in the number of accidents in the workplace, both due to injuries and as a result of general diseases. Severe injuries sustained by drivers as a result of workplace injuries lead to temporary or permanent disability, and high mortality. In addition, the authors note that professional drivers are significantly at risk of developing cardiovascular diseases and, as a result, sudden death.

The authors analyzed the materials of the investigation of fatal accidents at the workplace of drivers from 2016 to 2020 at enterprises and organizations of the Republic of Bashkortostan, recognized during the investigation as work-related (injuries) and non-work-related (due to general diseases), in order to study the circumstances and causes of fatal accidents that occurred at the workplace of the driver and to develop activities to prevent them.

A total of 77 accidents occurred at enterprises and organizations of the Republic of Bashkortostan with professional drivers in 2016–2020. Most of the drivers died at the age of 50–59 years. Violations of traffic rules were the cause of accidents in 48.5%. Natural death of professional drivers in 98% of cases occurred from diseases of the circulatory system. According to the Labor Conditions Assessment System, 81.0 percent of the drivers complied with Class 2.

The authors proposed measures, the implementation of which will reduce the risk of fatal accidents in the driver's workplace.

**Keywords:** accident, professional drivers, sudden death, work injury.

## USE OF PROBABILISTIC METHODS WHEN CATEGORIZING OCCUPATIONAL RISK

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While physical factors play the leading role in the formation of occupational pathology, the urgency of developing measures aimed at preserving the health of workers, in particular those employed in the extractive industry, is becoming increasingly relevant. The article presents a

calculation of the levels of personal occupational risk caused by the development of sensorineural hearing loss for oil industry workers. Certain risk categories were clarified using the theory of fuzzy sets in order to identify employees characterized by the greatest probability of increasing the risk category in the event of continued employment.

**Keywords:** occupational risk, noise, occupational diseases, probabilistic assessment.

## PECULIARITIES OF IMMUNE REGULATION IN EMPLOYEES OF A MINING ENTERPRISE UNDER CONDITIONS OF EXCESSIVE CONTAMINATION OF THE BIOLOGICAL MEDIA WITH FORMALDEHYDE

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The paper studies the peculiarities of immune regulation, both its cellular and humoral links, for the tasks of diagnosing early health disorders in workers associated with excessive contamination of biological media with formaldehyde. The study group included 157 people aged  $43.2 \pm 1.3$  years working under hazardous working conditions at a mining enterprise. The control group included 78 patients aged  $44.5 \pm 1.2$  years, working in the administrative part of the enterprise. According to the results of chemical and analytical studies, there was an excess of the acceptable level of formaldehyde in the blood both in the study group and in the control group. There were significant deviations in the system of humoral and cellular immunity in the form of a decrease in phagocytic activity, an increase in the content of serum immunoglobulins, the level of general and specific sensitization, increased expression of killer CD16+CD56+ and activation CD25+ and CD95+ lymphocytes. The study revealed an imbalance of the cytokine profile in the form of IL-1 $\beta$  hyperproduction and TNF suppression. The study also established impaired regulation of adaptive potential: deficiency of serum serotonin levels and overexpression of cortisol. A set of indicative figures (formaldehyde-specific IgE, the level of expression of killer and apoptotic membrane receptors, cytokine profile of IL-1 $\beta$  and TNF alpha, serotonin and cortisol imbalance) can be considered as a marker for the early diagnosis of immunoregulation disorders in the formation of production-related pathology in mining workers in conditions of excessive contamination of the biological media with formaldehyde.

**Keywords:** mining, blood contamination with formaldehyde, sensitization, immune regulation.

## ANALYSIS OF FATAL ACCIDENTS AT ENTERPRISES AND INSTITUTIONS IN THE REPUBLIC OF BASHKORTOSTAN IN 2019–2020

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Deaths in the workplace are on the rise all over the world. According to various sources, from one to two million people die every year. The relevance of this problem necessitates an analysis of workplace deaths, as well as the development of a set of measures aimed at preventing them.

In order to study the risk factors and causes of fatal accidents at the workplace, recognized in the investigation as both work-related and non-work-related, and to develop a science-based program for their prevention, we analyzed the materials of the investigation of fatal accidents at enterprises and institutions in the Republic of Bashkortostan for the period of 2019–2020, which, according to the labor legislation of the Russian Federation, qualified as both work-related and non-work-related. The analysis was conducted for individual types of economic activity with the calculation of relative indicators (per 1000 employees).

It was found that during the observation period, 219 deaths were registered at the workplace, and the structure of deaths was dominated by non-work-related deaths (from a general disease), compared to work-related deaths (from injuries). The total number of fatal accidents in 2019–2020 at enterprises and institutions of the Republic of Bashkortostan was: due to injuries in 2019 – 0.030 per 1000 employees, in 2020 – 0.023 per 1000 employees; from general diseases in 2019 – 0.036 per 1000 employees, in 2020 – 0.033 per 1000 employees.

The largest proportion of deaths due to injuries in the workplace was noted in construction companies – 25.9 %, manufacturing enterprises – 20.0 %; due to sudden death in the workplace from general diseases – in manufacturing – 22.1 %, transportation and storage – 19.5 %.

**Keywords:** accident, fatal accident, workplace, enterprises, institutions.

## QUANTITATIVE ASSESSMENT OF OCCUPATIONAL RISK CAUSED BY THE INTENSITY OF THE LABOR PROCESS

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The article presents methodological approaches to the assessment of occupational health risk caused by the intensity of the labor process, taking into account the characteristics of certain types of workload. The assessment algorithm involves the following steps: hazard identification, collection of information on the level of the active factor (exposure assessment), health assessment, calculation of group risk, as well as determining its acceptability. In the course of validation conducted on a group of employees of an oil production enterprise, the study revealed an unacceptable risk of gastric and duodenal ulcer disease development due to sensory strain, and the risk of atherosclerosis development due to sensory strain and work mode impact. The integral risk of developing atherosclerosis associated with exposure to two detailed types of strain was  $14.9 \times 10^{-2}$ . Furthermore, the contribution of work-related strain to the development of atherosclerosis was more significant (66 %) than that of the sensory strain (34 %). The results of the risk assessment can be used as the basis for effective preventive health-saving measures.

**Keywords:** risk assessment, methodological approaches, labor process intensity, quantitative assessment.

## DYNAMICS OF MAXIMUM LUNG VENTILATION IN OFFICE WORKERS AFTER A PHYSICAL EXERCISE TEST

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Office workers nowadays usually have to spend most of the day in a sedentary position, which in turn leads to a decrease in the respiratory volume of the lungs when the body needs more oxygen. The authors studied the dynamics of respiratory system indices by maximum ventilation of the lungs in office workers before and after the physical exercise test, using a Schiller SP-1 spirograph with a SP-20 sensor. The physical exercise test was a Martinet test, which included 20 squats during 30 seconds. In the study group, after performing the test, the maximum ventilation of the lungs and the respiratory rate significantly increased, and then after



three minutes of recovery decreased below the initial level. The average respiratory volume, on the contrary, decreased significantly after the test, but increased after three minutes of recovery. The increase in average respiratory volume and maximum ventilation of the lungs after physical activity indicated a positive effect of motor activity on respiratory function. Thus, short-term physical activity improves lung ventilation. Periodic short-term physical activity can be recommended to office workers to improve ventilation of the pulmonary tract by stimulating respiratory function.

**Keywords:** spirometry, maximum lung ventilation, respiratory volume, physical exercise test.



## Section VI

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**Modern methods of diagnosis, correction and prevention of health disorders associated with risk factors of the external environment, labor, educational process, lifestyle, socio-economic conditions**



## PREVALENCE OF PRIMARY NON-INFECTIOUS DISEASES IN VEGETABLE GROWERS WITH DIFFERENT LEVELS OF ADAPTIVE STRESS

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Currently, the "Total Worker Health" paradigm is shifting towards a comprehensive assessment of occupational and non-work-related cardiometabolic risk factors and reducing their burden. The authors used the previously developed methodology to conduct a comparative assessment of the prevalence of primary non-infectious diseases in vegetable growers of protected ground with different levels of adaptive stress. When ranking the examined according to the degree of adaptability, 25.58 % of workers revealed a state of eustress (subgroup I), 56.59 % – stress compensation (subgroup II), 17.83 % – risk of distress development (subgroup III). The differences in age and professional experience of the vegetable growers in the selected subgroups were statistically significant only in relation to the age of workers of subgroup III, which was on average 11.6 % lower than that of the vegetable growers of the eustress subgroup. At the same time, the correlations of adaptive stress values with both age and work experience factors corresponded to very weak connections, which indicated an insignificant contribution of working conditions to the risk of distress development. At the same time, the analysis of the primary diagnosis of arterial hypertension (AH) and obesity in vegetable growers revealed a direct relationship between the prevalence of these nosologies and the level of adaptive stress. Thus, among the workers of the eustress subgroup, hypertension compared with subgroups II and III was detected more often by 2.03 and 7.73 times, respectively, and the prevalence of obesity among people in a state of stress compensation and the risk of distress development was exceeded relative to subgroup I by 2.74 and 3.62 times, respectively.

In this regard, a relatively large proportion of people at risk of distress with a combined high prevalence of hypertension and obesity identified among the examined vegetable growers could be mediated by non-professional factors, including workload at home, which required further study and should be taken into account when developing individual recommendations for improving the workers' health.

**Keywords:** vegetable growers, adaptive stress, primary non-infectious morbidity.

## EFFECTIVENESS OF THE COMPLEX OF RECREATIONAL MEASURES IN WORKERS WITH DISORDERS OF PITUITARY GONADAL SYSTEM EXPOSED TO VIBRATION HAZARDS

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Despite a variety of materials on the pathogenesis of the disease, the functional state of neuroreflective mechanisms of regulation and adaptive capabilities of the pituitary-gonadal system in patients with vibration pathology remains one of the most urgent matters. The authors examined 211 workers of occupations involving vibration hazards at mining and metallurgical enterprises in the Far North and selected three groups – two main groups and a control group, comparable by age and length of service. The control group (63 people) included patients who had not been exposed to industrial vibration and did not have clinical manifestations of occupational disease from exposure to the vibration factor. The study of the hormonal status of workers in occupations with hazardous exposure to vibration served as the basis for the development of a complex of health-improving measures, including the earlier detection of clinical and biochemical markers of acquired androgen deficiency syndrome, the formation of risk groups at the preclinical stage of the disease, comprehensive hygiene and therapeutic and preventive measures with the use of antioxidant medication.

**Keywords:** vibration disease, markers of acquired androgen deficiency, a complex of hygiene, therapeutic, and preventive measures, antioxidant drug.

## EFFECTIVENESS OF HEALTH PRESERVATION HABITS DEVELOPMENT IN STUDENTS OF EDUCATIONAL ORGANIZATIONS UNDER DIFFERENT SYSTEMS OF HEALTHY LIFESTYLE DEVELOPMENT

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The study focused on the system of healthy lifestyle habits development in students in the conditions of the educational process, and the adolescent morbidity for the period of 2015–2021. The authors studied the role of systematic formation of a healthy lifestyle of students in the conditions of educational organizations in rural areas in the formation of adolescent health. The objects of observation were the systems of healthy lifestyle development in educational organizations located in two neighboring districts, the unit of observation was a school student. The study used traditional statistical, socio-hygienic and epidemiological methods for evaluating the effectiveness of healthy lifestyle development, and health studies.

The model of a continuous education system for the formation of a healthy lifestyle development included hygienic education of teachers, parents, and the development of healthy lifestyle habits in students with the involvement of medical workers and community representatives. The introduction of a system of continuous education on the formation of healthy lifestyle habits into the educational process of students in the experimental schools in school years 2008–2009, and its successful further maintenance contributed to the fact that the proportion of adolescents with healthy behavior skills in the experimental schools exceeded the proportion of such adolescents studying in the schools of the reference area. The development of healthy lifestyle of students in the experimental schools, in contrast to the reference schools, was accompanied by a decrease in the morbidity of adolescents in a few years after the introduction of the new system of lifestyles development in the area.

**Keywords:** system of continuous education for the development of a healthy lifestyle, adolescents, morbidity.

## MEDICAL AND SOCIAL EFFECTIVENESS OF THE INNOVATIVE SYSTEM OF FORMING A CULTURE OF HEALTHY AND SAFE LIFESTYLE IN STUDENTS OF RURAL EDUCATIONAL ORGANIZATIONS

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The object of the study was the system of forming a culture of healthy and safe lifestyle in students and the morbidity of adolescents for the period from 2015 to 2021. The purpose of the study is to study the influence of the system of forming a healthy lifestyle in students of rural educational institutions on the health of adolescents. The objects of observation were the systems of healthy lifestyle development in educational institutions located in two neighboring districts. The unit of observation was a school student. The study used traditional statistical, socio-hygienic and epidemiological methods for evaluating the effectiveness of healthy lifestyle development, and health studies.

The model of an innovative educational system for fostering a culture of healthy and safe lifestyle among students as part of the Federal State Educational Standard for Basic Gen-

eral Education included hygiene education for teaching staff, parents, and the formation of healthy lifestyle skills in students with the involvement of medical professionals and community representatives. The introduction of a system of continuous education on the formation of healthy lifestyle habits into the educational process of students in the experimental schools in school years 2008–2009, and its successful further maintenance contributed to the fact that the proportion of adolescents with healthy behavior skills in the experimental schools exceeded the proportion of such adolescents studying in the schools of the reference area. The level of formation of a healthy lifestyle culture among adolescents of experimental schools in many components of lifestyle is also higher than in the reference schools – 78–86 points and 54–70 points, respectively.

Several years after the introduction of an innovative system for the development of a healthy lifestyle in the district, compared with 2015, there was a significant decrease in the level of primary morbidity in the treatment of adolescents in 2021 by 21.16 %, total morbidity by 19.9 % ( $p < 0.05$ ).

**Keywords:** innovative education system for the development of a healthy lifestyle, adolescents, morbidity.

## ASSESSMENT OF THE IMMUNE STATUS OF PRESCHOOL CHILDREN LIVING UNDER THE INFLUENCE OF EXTERNAL ENVIRONMENTAL CHEMICAL FACTORS IN A LARGE INDUSTRIAL CITY OF THE WESTERN URALS

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The fast paced technogenic development of the environment determines the need to study the adverse effects of environmental factors on the health of the population. In this case, it is pre-school children who are most sensitive to changes in the quality of the environment. The work is devoted to the study of the peculiarities of the immunological indicators of preschool children living in a large industrial city of the Western Urals. The results of the studies show reliable changes in the indicators of innate cellular immunity: an increase in absolute phagocytosis in relation to the norm ( $p < 0.05$ ), with the prevalence of phagocytosis activity indicator in children of the study group reaching 57.7 %. At the same time, the immune status of preschool children was characterized by deficiency of immunoglobulins M and A, as well as hyperproduction of immunoglobulin G and hypersensitization to man-made haptens according to specific IgG to benzene, lead, phenol and IgE to manganese, nickel and formaldehyde relative to the control group ( $p < 0.05$ ).



The revealed signs of inhibition of cellular immunity with the development of processes of increased specific sensitivity to benzene, lead, phenol, manganese, nickel and formaldehyde indicate the adverse effects of the formation of immunodeficiency and autoallergic processes associated with exposure to chemical factors of the environment.

**Keywords:** immune status, preschool children, specific sensitization, environmental chemical factors.

## DEVELOPMENT OF FUNCTIONAL DISORDERS IN THE PROCESS OF PERFORMING JOB DUTIES IN MINING INDUSTRY WORKERS

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Optimal work and rest schedule is a prerequisite for an efficient and safe production process.

The purpose of the work is to assess the functional indicators and cognitive functions of workers in various shift modes, which differ in the duration of the work shift and inter-shift periods.

To conduct the research, two study groups were formed, which differed from each other in the duration of working cycles and inter-shift periods. Comparative analysis of the results of neuropsychological testing was carried out; analysis of hemodynamics of workers as an indicator of the functional state of the cardiovascular system; mathematical and statistical processing of the data was obtained.

Analysis of the blood pressure and heart rate dynamics demonstrated that the functional indices (blood pressure and heart rate) remained within the permissible physiological values during the whole period of observation only on the 2nd day of the work cycle. Pronounced blood pressure lability is a risk factor for the development of arterial hypertension; the tendency to increase blood pressure and heart rate is observed with a working cycle duration of more than 3 working days in a row.

With the shift work schedules in use today, rest between shifts and days off do not fully compensate for fatigue and longer periods of rest are required.

**Keywords:** occupational risk, functional disorders, work schedule, mining industry.

## ASSESSMENT OF THE SENSITIVITY OF DONOR PERIPHERAL BLOOD LYMPHOCYTES TO THE DAMAGING EFFECTS OF THIRAM

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The study of individual body sensitivity to adverse environmental factors is of particular interest from the point of view of professional selection and personalized medicine. A large body of data has now been accumulated showing that some pesticides from previous generations or their mixtures can cause damage to hereditary structures. Contact fungicide thiram (tetramethylthiuram disulfide), the genotoxicity of which has been proven in several *in vitro* and *in vivo* studies, was used as a model compound to study the susceptibility of human somatic cells to the action of xenobiotics in the *in vitro* system.

The sensitivity of peripheral blood lymphocytes of donors to the DNA-damaging effect of thiram *in vitro* was studied. Human peripheral blood lymphocytes were used as test objects. The assessment of the damaging effect of thiram was carried out in two parallel variants under conditions of metabolic activation (+S9) and without it (-S9) by the DNA comet method in the alkaline version.

Statistically significant effects of exceeding the % DNA index in the tail of comets in the lymphocytes of all donors were observed, which indicates a violation of the integrity of DNA molecules under the action of thiram. The DNA damage in lymphocytes from different donors varied considerably. For the cells of some participants of the study, a statistically significant increase in the DNA damage level under the effect of thiram was detected starting from the concentration of 5 µg/ml. Lymphocytes of the other group of donors were less susceptible; statistically significant effects were noted when exposed to a pesticide in concentrations above 50 µg/ml.

Comparison of the maximum and minimum values of the areas under the curves of the concentration-effect relationship demonstrated a difference of 7.7 (-S9) and 16.0 (+S9) times in the sensitivity of lymphocytes of different donors to the damaging effects of the pesticide.

Thus, the sensitivity of somatic cells of different donors to the genotoxic effect of thiram varies widely.

**Keywords:** thiram, genotoxic effect, lymphocytes, individual sensitivity.

## PECULIARITIES OF STRESS DEVELOPMENT INDICATORS IN ADOLESCENTS

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The health of the younger generation requires particular attention. Enrollment in education is associated with an increase in academic workload, the prevalence of stress and various diseases. The authors conducted a survey of 298 students of Saratov College of Water Transport, Construction and Service. The study investigated the adaptive potential of the circulatory system according to the Baevsky method, the Stress index and body structure indices. 91,6 % of the examined young men and 98 % of the examined young women demonstrated a reduced adaptive potential of the circulatory system. In isolated cases, there was an elevated value of the Stress Index. The study revealed a trend connecting stress indicators with increased body fat mass and decreased levels of active cell mass.

**Keywords:** stress, body structure, adolescents.

## THE USE OF PHYSICAL PARAMETERS OF URINE FACIES TO DIAGNOSE INITIAL REACTIONS TO ADVERSE ENVIRONMENTAL FACTORS

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Facie is a thin film formed when a biological liquid dries on a solid, non-absorbent surface that is inert with respect to the liquid under study. There is a reliable correlation between the morphology of the facies and the composition of the fluid, which allows to consider it for determining clinical diagnosis. The most basic human bodily fluid available for examination is urine. The study revealed the physical parameters of urine facies and formulated the principles of their use for the diagnosis of initial reactions to adverse environmental factors. The objects of the study were urine facies obtained by drying 3  $\mu$ l droplets. The physical parameters of the facies were determined by image analysis. The physical parameters of the facies were compared with the biochemical parameters by calculating the Pearson correlation coefficient. The study revealed that the degree of crystallization of urine facies is an integral characteristic of the renal filtration function and the degree of mineralization is an integral characteristic of the inflamma-

tory reaction, while the degree of crystallization and mineralization of urine facies do not correlate with each other.

**Keywords:** biological fluid, urine, facies, morphology, sedimentary structure

## **IDENTIFICATION OF RISK FACTORS FOR CHRONIC NON-INFECTIOUS DISEASES IN THE PROCESS OF PRENOSOLOGICAL SCREENING**

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The article presents the results of identifying risk factors for chronic non-infectious diseases in the process of conducting a complex of prenosological diagnostics as part of the "Passport of Health" program. The methods used make it possible to identify individual risk factors for the development of major chronic non-infectious diseases with an emphasis on diseases of the circulatory system, which will make it possible to develop an effective strategy for further monitoring and treatment, and the formation of a program of preventive measures.

**Keywords:** prenosological diagnostics, vascular wall stiffness, body mass index, physical activity, smoking.

## **SCIENTIFIC SUBSTANTIATION AND APPLICATION OF EXPOSURE AND EFFECT BIOMARKERS FOR THE TASKS OF ESTABLISHING AND PROVING THE REALIZATION OF THE RISK OF HEALTH DISORDERS IN THE EXPOSED POPULATION**

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The study presents elements of the scientific and methodological rationale for the adequate selection of biomarkers, which provides a systematic evidence-based approach to implementing expert assessments of the results of risk-reversal health disorders. This rationale increases the

accuracy and objectivity of hygienic evaluations, screening, biomonitoring, results of epidemiological and biomedical studies of actual pollution estimates of environmental objects (atmospheric air, drinking water, soil, food), and evidence of exposure. The existing experience and the results of in-house scientific research permitted the application of exposure and effect biomarkers in solving the tasks of establishing the causes and preventing the hazardous effects of environmental factors on human health, including those associated with the results of atmospheric air pollution in the areas of business enterprises' impact and accumulated ecological damage. Exposure markers and effects are also widely used in experimental studies of bioaccumulation and toxic effects of new chemicals, including nanomaterials.

The accumulated scientific and practical experience in using biomarkers allows the researchers to solve the tasks with a high degree of efficiency and offer scientific, methodological, organizational, and practical assistance to the regions of the Russian Federation.

**Keywords:** environmental factors, biomarkers of exposure and effect, cause-and-effect relationships, health damage.

## ADAPTATIONAL COHERENCE OF THE ACTIVITY OF PRO-OXIDANT AND ANTIOXIDANT PROCESSES IN THE HUMAN BODY IN THE CONTEXT OF SEASONAL CHANGES IN THE UV RADIATION INTENSITY IN A METROPOLITAN AREA (NIZHNY NOVGOROD)

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UV radiation as part of solar radiation is necessary for normal functioning of all living organisms, but in excessive exposure is an environmental risk factor, under the influence of which there is damage to organic molecules of biological systems by active oxygen forms, which can lead to the development of oxidative stress, and, in turn, initiate a variety of pathologies. The article assesses adaptive changes in the activity of free radical processes in the human body in normal conditions in response to seasonal changes of UV-radiation intensity in order to develop methods of diagnosis, correction and prevention of human health disorders.

**Keywords:** risk factor, solar radiation, UV-radiation, oxidative stress, TBA-active products, superoxide dismutase, catalase.

## THE INFLUENCE OF CHEMICAL POLLUTION OF THE ENVIRONMENT ON THE HEALTH OF PRESCHOOL CHILDREN IN CITIES WITH A DEVELOPED COPPER SMELTING INDUSTRY OF THE SVERDLOVSK REGION

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The prevalence of lead, cadmium, and arsenic compounds in the environment is very high nowadays due to both man-made and natural sources of intake. Despite the fact that over the past decades, health risk management measures implemented at various levels have made it possible to reduce the levels of contamination of components of the environment in industrialized regions severalfold, this level remains significant, especially in cities with a developed copper-smelting industry. According to the data of social and hygienic monitoring for the Sverdlovsk Region, lead, cadmium and arsenic cause risks to public health in the form of additional cases of diseases and deaths.

The authors evaluated the toxic load according to biomonitoring data, conducted a descriptive analysis of the level of chronic morbidity of children in organized collectives, and performed mathematical modeling by constructing regression decision trees in order to determine the level of lead, cadmium, and arsenic in the biosphere of children living in cities with developed copper-smelting industry. The obtained results of the study indicated an excess of the average regional level of chronic morbidity of children in organized collectives in cities with a developed copper-smelting industry. Mathematical modeling revealed an increase in the content of lead, cadmium and arsenic in environmental components associated with an increase in the concentration of these toxicants in the biological media, and the level of toxic load according to biomonitoring influenced the change in clinical and laboratory parameters. The obtained results were used in the preparation of organizational and methodological documents on the implementation of biomonitoring in the Sverdlovsk Region and in the creation of information materials for hygienic education of the population on the reduction of the toxic load.

**Keywords:** cadmium, lead, arsenic, chronic morbidity, biological monitoring.

## COMPARISON OF THE INCIDENCE OF DISEASES IN OCCUPATIONAL GROUPS ACCORDING TO SURVEY DATA AND MEDICAL EXAMINATION RESULTS

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The doctor-patient relationship is one of the most important issues in modern medical practice today. Patients are not motivated to be upfront with a doctor during periodic medical

examinations (PME) due to the fact that the doctor must inform the employer about the contraindications for continuing the employee's professional activity, and the presence of a disease may be associated with the loss of employment. In an anonymous questionnaire administered by a physician who did not have any influence on the patients' employment, the patients were more open and disclosed more information on their health. As part of PME, 63 school teachers, 40 kindergarten teachers, and 82 vegetable growers were examined and interviewed using the WAI questionnaire. The examination included older age groups due to the fact that, as a rule, they had more chronic diseases, but despite this, it was important for them to continue working. PME revealed a significant discrepancy between the diseases stated by the employees during questioning and the diseases discovered by physicians during the examination. On the one hand, the medical examination revealed new diseases that the patients concealed or were unaware of. On the other hand, there were a large number of conditions that were not identified during the PME, but which the patients experienced and did not articulate to the physicians involved in the examination, because these conditions would affect admission to work in their professions. The method of survey can be used in combination with medical examinations, allowing to identify groups at risk of health disorders in the early stages.

**Keywords:** questioning, survey, periodic medical examination (PME).

## IDENTIFICATION OF PROTEOMIC MARKERS OF ADVERSE EFFECTS ON NEURO-ENDOCRINIC AND IMMUNE SYSTEMS IN CHILDREN WITH ELEVATED ALUMINUM AND FLUORIDE ION CONCENTRATION IN URINE

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Studies aimed at the identification of molecular and cellular changes in homeostasis, the identification of omic-markers for the prediction and early detection of adverse effects on the target organs, as well as for the development of measures to prevent the effects associated with chemical exposure are of particular importance at present. Chemical-analytical and proteomic studies of blood plasma in children with elevated aluminum and fluoride ion concentration in urine and modeling of cause-effect relationships were conducted to identify proteomic markers of negative effects on the neuro-endocrine and immune systems. Proteomic analysis of blood plasma identified about 25 protein spots significantly different in volume and intensity in children of the observation group. The molecular profile of the blood plasma of children with elevated aluminum and fluoride ion content in urine revealed a significant

increase in such protein markers as transthyretin, THO complex subunit 2, and immunoglobulin J chain. The authors established a multifactorial causal relationship between elevated levels of transthyretin, immunoglobulin J chain, and urinary aluminum and fluoride ion concentrations. Indicator omic-markers of predicted negative responses and genes encoding their expression in children with an elevated content of aluminum and fluoride ion in urine are the immunoglobulin J chain (JCHAIN gene), the expression of which determines adaptive rearrangements of the immune response; transthyretin (TTR gene), the expression of which characterizes the inhibition of retinol-mediated neuroprotection mechanism.

**Keywords:** aluminum and fluoride ion in urine, proteomic profile of blood plasma, neuroendocrine and immune systems, transthyretin, THO complex subunit 2, immunoglobulin J chain.

## ASSESSMENT OF NEURODYNAMIC PROPERTIES OF THE NERVOUS SYSTEM OF FIREFIGHTERS DEPENDING ON POLYMORPHIC VARIANTS OF METABOLIC REGULATOR GENES (TFAM, ACTN3, PPARA AND PPARGC1A)

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Elimination of fires of different localization is associated with the exposure to a complex of harmful chemical and physical factors. Toxic combustion products pose the greatest hazard, which may be due to the significant amount of chemicals released during the combustion of construction materials. It should be noted that it is impossible to determine both qualitative and quantitative characteristics of the resulting substances at the time of the fire, and to predict the toxic effect of their effects. A constant component among the products of combustion is carbon monoxide (CO), the toxic effect of which is manifested in organs and tissues that consume a significant amount of oxygen. Posterior neurological disorders have a combined character, and their development is secondary. The aim of the present research was to carry out a neurophysiological assessment of the biological response to exposure to toxic products of combustion in the body of firefighters depending on the polymorphic variants of metabolic regulator genes. The results indicate a reduced level of neurodynamic properties of the nervous system in firefighters with genotypes of metabolic regulator genes associated with low aerobic performance (TFAM Ser/Ser, ACTN3 R/R, PPARA C/C and PPARGC1A Ser/Ser). Considering that the strongest negative changes are determined in carriers of polymorphic variants of metabolic regulator genes associated with a decrease in aerobic performance, it is possible to suggest the importance of long-term exposure to carbon monoxide in the development of these changes.

**Keywords:** firefighters, carbon monoxide, gene polymorphism, metabolism regulator genes.



## ORGANIZING AND CONDUCTING A WELLNESS CAMPAIGN IN THE CONTEXT OF THE ONGOING SPREAD OF A NOVEL CORONAVIRUS INFECTION (COVID-19) IN AMUR REGION

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On March 27, 2020, the first laboratory-confirmed case of a novel coronavirus infection (COVID-19) was registered in Amur Region. During the 2020 recreation season, only four recreational institutions with day care for children held their shifts. In 2021, in the conditions of the ongoing pandemic of a novel coronavirus infection (COVID-19), 287 institutions worked during the recreation season, more than 17,000 children visited the establishments.

The implementation of methodological documents of the Federal Service for Supervision of Consumer Rights Protection and Human Welfare and the strict implementation of these regulations by business entities allowed conducting an effective recreation campaign in 2021, preventing the emergence and spread of infectious diseases among children and adolescents, and among the personnel of recreational facilities.

**Keywords:** recreation campaign, novel coronavirus infection (COVID-19), SARS-CoV-2, Amur Region.

## PECULIARITIES OF THE INDICATORS OF REGULATORY SYSTEMS IN SCHOOLCHILDREN STUDYING UNDER THE INFLUENCE OF PHYSICAL FACTORS OF NON-IONIZING NATURE

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The article presents data on the hygienic assessment of physical factors of non-ionizing nature at two educational institutions in Perm (Gymnasium – study group, School - control group) having different conditions of the educational environment and analyzes the immune and neuroendocrinal status of children studying in these conditions. Studies have demonstrated that the levels of the measured physical factors (light, noise, electromagnetic radiation) do not exceed the standard values, with the exception of the aeroionic composition of the air. Analysis of children's regulatory systems revealed different age-dependent combinations of changes in the expression of a number of CD-receptor lymphocytes, phagocytic activity and humoral immunity indicators, imbalances in markers of cytokine regulation, changes in hormonal background in the study groups. The analysis of logistic regression models allows us to draw a conclusion about the relationship between the features of the status of regulatory systems and the impact of physical factors of a non-ionizing nature.

**Keywords:** physical factors, immune system, neuroendocrine system, schoolchildren.

## IMPROVEMENT OF THERAPEUTIC AND PREVENTIVE MEASURES IN PATIENTS WITH OCCUPATIONAL DORSOPATHIES

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Ninety-seven men with established occupational diseases of the lumbosacral spine were examined. The study established the main neurological syndromes of occupational lumbosacral dorsopathies – pain syndrome and muscle-tonic syndrome. The authors tested the technique of air local cryotherapy on patients with occupational diseases of the spine. The study revealed analgesic and myorelaxant effects of local cryotherapy in neurodegenerative diseases associated with working conditions, which makes it possible to recommend this method in therapeutic and preventive programs.

**Keywords:** therapeutic and preventive programs, occupational dorsopathies, local air cryotherapy, pain syndrome and muscle-tonic syndrome, lumbosacral radiculopathy.

## CHARACTERISTICS OF THE IMMUNE STATUS OF ADOLESCENT BOYS WITH ENDOCRINE SYSTEM PATHOLOGY UNDER CONDITIONS OF BLOOD CONTAMINATION WITH AROMATIC HYDROCARBONS

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The study examined the peculiarities of the immune status of adolescent boys with endocrine pathology under conditions of blood contamination with aromatic hydrocarbons. A comparative analysis of the indicator figures of the observation group in relation to those in the group of schoolchildren with no pathology revealed: an increase in the expression level of specific antibodies to benzene (IgG specific to benzene), inhibition of IgM expression, which was characterized by a reverse reliable relationship with blood contamination with benzene, increased content of proinflammatory cytokines IL-4, IL-6, TNF.

**Keywords:** aromatic hydrocarbons, endocrine system pathology, adolescents, cytokines, immunoglobulins.

## THE STATUS OF POST-VACCINATION IMMUNITY TO DIPHTHERIA IN STUDENTS OF SECONDARY EDUCATIONAL INSTITUTIONS

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Vaccination against diphtheria is the only way to create a favorable epidemic situation. The aim of the study was to assess the state of post-vaccination immunity to diphtheria in students of secondary schools of a large industrial center distinguished by the focus of educational programs.

To study the state of collective immunity to diphtheria, we selected 180 students aged 7–17 years from elementary, middle and senior grades of a gymnasium and a regular secondary school, who had been fully and timely vaccinated and revaccinated with the DPT and Td adsorbed vaccines. Analysis of anti-diphtheria immunity showed a high level in both schools,

where the proportion of seropositive results reached 95–100 %, which proved the high effectiveness of vaccination against diphtheria. The average group level of antibodies in primary grades students of a gymnasium was 1.2 times lower, and the frequency of registration of high titers of antibodies characterizing long-term post-vaccination immunity against diphtheria was 1.5 times less than in a regular secondary school. A significant decrease in the level of antibodies to diphtheria toxoid was shown in students with allergic diseases – the frequency of registration of high titers of antibodies was 1.8 times lower in senior students of a gymnasium compared to the senior students at a regular secondary school. The average group level of antitoxic antibodies in the students of middle grades of a regular secondary school was 1.2 times lower than in the same group of students who do not have any allergic diseases. Gymnasium students with allergic diseases had higher short-term post-vaccination immunity to diphtheria compared to a similar group – the indicators of "short-term" immunity were 1.3 times higher, the frequency of detection of high antibody titers was lower, and the average group antibody index in primary school students with allergies was 1.4 times lower than in the similar group of students in a regular secondary school.

**Keywords:** post-vaccination immunity, diphtheria, students, gymnasium, secondary school, collective immunity.

## PECULIARITIES OF ALLERGIC RHINITIS DEVELOPMENT IN CHILDREN UNDER DIFFERENT CONDITIONS OF COMPLEX AEROGENIC IMPACT OF ANTHROPOGENIC CHEMICALS

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Allergic pathology has a high prevalence in the areas of sanitary and hygienic disadvantages. The purpose of the study was to reveal the peculiarities of allergic rhinitis development in children under different conditions of complex aerogenic influence of anthropogenic chemicals. The authors of the study conducted a clinical examination of 254 children aged 5–14 years with chronic allergic rhinitis residing in an area exposed to airborne pollution by anthropogenic chemicals (study group) and in conditions of relative sanitary and hygienic well-being (control group). The study revealed that the exposed children with chronic allergic rhinitis had elevated blood levels of benzene, toluene, phenol and formaldehyde up to 10.8 times higher than the background levels and control group indicators. Under the conditions of complex aerogenic pollution by anthropogenic chemicals in children, allergic rhinitis in 38.5 % of cases was manifested by pronounced nasal breathing difficulties, caused by increased concentration of phenol in blood and level of average daily content of suspended substances in the atmospheric air. It was accompanied by the development of inflammatory response (CRP highly sensitive), oxidative

stress (lipid hydroperoxide), decreased antioxidant protection (AOS, SOD), due to increased blood concentration of benzene, toluene, phenol, formaldehyde and level of average daily content of suspended particles in the atmospheric air; immune disorders (phagocytic index, Ig G), general sensitization associated with elevated blood concentrations of formaldehyde, phenol, and average daily concentration levels of suspended particles. In 60.7 % of cases, exposed children with allergic rhinitis had pathology of the nervous system: every second child had autonomic dysfunctions, manifested in 22.2 % of cases by sympathicotonic initial vegetative tone, in 63.3 % – hypersympathicotonic vegetative reactivity, due to an increased content of benzene, phenol, formaldehyde in the blood and the level of the average daily content of suspended solids in the atmospheric air.

**Keywords:** children, allergic rhinitis, aromatic hydrocarbons, formaldehyde, suspended solids.

## INCIDENCE OF DIGESTIVE DISEASES IN STUDENTS

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Today, monitoring the health status of students and taking measures to improve it are the priority public health issues. The aim of the study was to conduct a comparative analysis of the incidence of diseases of the digestive system in students in educational institutions of various types. The authors conducted an in-depth clinical examination of 270 children studying at an innovative type of school and 184 students of a regular secondary school. The team analyzed the organization of the educational process in the educational institutions under study, organization of nutrition at school, and evaluated the incidence of diseases of the digestive system among students. The study revealed that the educational process was more intense in the innovative type of school. According to the results of the study, 50 % of upper grade students did not get hot meals. The nutrition of students was unbalanced, associated with insufficient intake of vitamins from food and animal products. The study of the incidence of digestive diseases among students of educational institutions with different intensity of academic workload showed that elementary school students studying in the innovative type of institutions had functional dyspepsia 1.5 times more often, and the risk of developing combined functional disorders in them was 4.2 times higher. The risk of developing a combined chronic and functional pathology was twice as high for students in the middle grades at the innovative type of school as it was for students in the general education system. By the end of training, every fifth graduate of the innovative type of school had a chronic pathology of the digestive tract.

**Keywords:** innovative type of school, stress, educational process, nutrition, morbidity in schoolchildren.

## PECULIARITIES OF THE CELLULAR IMMUNE PROFILE OF THE CHILDREN POPULATION OF THE POLAR REGIONS OF EASTERN SIBERIA

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The study includes the analysis of the features of the cellular immune profile of the children population in the polar areas of Eastern Siberia exposed to unfavorable climatic and geographical factors of this territory. The immune status of the examined children is characterized by a deficiency of CD3<sup>+</sup>- and CD3<sup>+</sup>CD25<sup>+</sup>-lymphocytes, a decrease in the calculated immunoregulatory index CD4<sup>+</sup>/CD8<sup>+</sup> against the background of an excess of CD3<sup>+</sup>CD8<sup>+</sup>, CD3<sup>+</sup>CD95<sup>+</sup>- and CD127-lymphocytes as compared to the control group ( $p < 0.05$ ). The established signs of inhibition of cellular immunity (CD3<sup>+</sup>- and CD3<sup>+</sup>CD25<sup>+</sup>-lymphocyte deficiency), decrease in the immunoregulatory index (CD4<sup>+</sup>/CD8<sup>+</sup>), as well as disorders of apoptosis (CD3<sup>+</sup>CD95<sup>+</sup>) and activation of immunoregulatory processes (CD127) reflect the peculiarities of adaptation of children to the climatic and geographical conditions of this region. Consequently, under the harsh climatic and geographical conditions, children develop the immune profile of an adult, which causes acceleration of biological events in the individual development of the organism and, consequently, its earlier aging. Thus, the revealed changes in the cellular immune profile (CD3<sup>+</sup>- and CD3<sup>+</sup>CD25<sup>+</sup>-deficiency and CD3<sup>+</sup>CD8<sup>+</sup>-, CD3<sup>+</sup>CD95<sup>+</sup>-, and CD127-excess) form a set of marker immunological indicators of exposure to climatic and geographic factors of the polar regions of Eastern Siberia, characterizing early desadaptive changes in the health of the examined population, which can be used for the prevention and early diagnosis of environmentally dependent pathologies of the child population in this territory.

**Keywords:** immune profile, polar areas, children, climatic and geographic factors.

# METHODOLOGICAL SUPPORT FOR THE DETERMINATION OF POTENTIALLY HAZARDOUS HIGHLY TOXIC COMPOUNDS IN HUMAN BIOLOGICAL MEDIA FOR RISK ASSESSMENT AND BIOMEDICAL RESEARCH

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The article represents the results of experimental studies on the development of a complex of gas chromatographic methods for the determination of N-nitrosoamines and organochlorine compounds in biological media (blood, urine), acrylonitrile in exhaled air.

The development of gas chromatographic highly sensitive and selective methods for the determination of N-nitrosoamines in biological media included the development of special techniques to increase sensitivity and obtain effective extraction of detectable compounds from a biological matrix of complex composition. The complex use of distillation in combination with the optimal elution scheme of solid-phase extraction and concentration of distillate on a Coconut 6 ml carbon cartridge made it possible to achieve a high completeness of extraction, which was 98.5 % for N-nitrosodimethylamine, 100 % for N-nitrosodiethylamine. The developed gas chromatographic techniques allow the determination of N-nitrosoamines in blood and urine in the presence of other organic compounds of this class in the concentration range of 0.002–0.1 micrograms/cm<sup>3</sup> for blood and 0.0095–0.6 micrograms/cm<sup>3</sup> for urine with a determination error of 23 %.

The technique for determining acrylonitrile in exhaled air is based on the sorption of the studied compound on Tenax TA sorbent in combination with optimal conditions of sample preparation, thermal desorption and capillary gas chromatography application and allows us to determine the toxic compound at the level of 0.0003 µg in the analyzed sample volume, with an extraction degree of 96.7 % selectively, reliably, with high sensitivity according to the tasks of social and hygienic monitoring.

Gas chromatographic techniques for the determination of aliphatic chlorinated hydrocarbons modified for blood and urine (chloroform, tetrachloromethane, 1,2-dichloroethane, dibromochloromethane, dichlorobromomethane) in biological material (urine, blood) allow to perform determination with the detection limit (µg/cm<sup>3</sup>) for blood and urine respectively: chloroform – 0.005 and 0.0015, tetrachloromethane – 0.0006 and 0.0004, 1,2-dichloroethane – 0.05 and 0.0125. The determination error is 9.1–28.9 %.

**Keywords:** biological media (blood, urine, exhaled air) acrylonitrile, N-nitrosoamines, gas chromatographic analysis, completeness of extraction, equilibrium vapor phase analysis, solid-phase extraction.

## PECULIARITIES OF HEALTH IMPAIRMENT INDICATORS IN THE ADULT POPULATION OF THE ARSENIC HYDROGEOCHEMICAL PROVINCE

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The conducted study aimed to identify indicators of adverse effects on the adult population living in conditions of arsenic-associated geochemical province, excessive contamination of the biological environment with arsenic. This study revealed an imbalance of metabolic indicators and immune regulation: markers of urinary system such as creatinine, uric acid, urea, as well as over-expression of proteins reflecting specific sensitivity to arsenic, according to the criterion of specific IgG levels to arsenic.

**Keywords:** water supply systems, skin pathology, arsenic, arsenic anomaly, hydrogeochemical province, biochemical and enzyme immunoassay.

## PECULIARITIES OF IMMUNE STATUS OF CHILDREN WITH AUTONOMIC NERVOUS SYSTEM DISORDERS UNDER AEROGENIC EXPOSURE TO ALUMINUM

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The study presents the findings on the immune status of preschool children with autonomic nervous system disorders living in the zone of influence of the industrial facility manufacturing aluminum. The study revealed elevated aluminum levels in the biological media (urine) of the children in the observation group. The study identified a 1.4-fold increase in the expression of the inhibitory synaptic mediator  $\gamma$ -aminobutyric acid compared to the control group. The children in the observation group, demonstrated significant violations of the cellular link of immunity, which were



manifested in the overexpression of the indicators of cell death Annexin V-FITC<sup>+</sup>7AAD<sup>-</sup>, Annexin V-FITC<sup>+</sup>7AAD<sup>+</sup>, anti-apoptotic protein Bcl-2, increased oncosuppression factors Bax, p53 and the TNFR membrane factor level, with simultaneous inhibition of the pro-apoptotic receptor of cellular death CD95<sup>+</sup>. The study revealed a significantly increased level of specific IgG to aluminum by 1.5 times in comparison with the norm, as well as by 4 times relative to this indicator in the control group ( $p < 0.05$ ). The study established a reliable correlation between changes in the content of immunological markers and the aluminum content in urine.

**Keywords:** immune status, nervous system disorders, aluminum, neurotransmitter, apoptosis.

## STRUCTURE AND DYNAMICS OF MORBIDITY OF CADET SCHOOL STUDENTS IN THE COURSE OF THE EDUCATIONAL PROCESS

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The educational process has an ambiguous impact on the health of students and leads to a threefold decrease in the number of healthy graduates by the end of the period of education. The risk factors affecting education cause the so-called school-induced diseases – diseases of the musculoskeletal system, organs of vision, and the nervous system. The peculiarity of cadet training is a combination of intensive curriculum with military training classes and regular physical activity. Objective: to study the features of the structure of morbidity of cadet school students in the course of the educational process. The authors conducted a comprehensive clinical-laboratory and instrumental examination of 89 boys attending a cadet school, of which Study Group 1 consisted of 50 first-grade students and Study Group 2 consisted of 39 10th- and 11th-grade students. Diseases of the musculoskeletal system ranked first among students in grades 10–11, with scoliosis registered 3 times and flat feet 1.5 times more frequently. Diseases of the ENT organs were 1.6 times less common among students in grades 10–11, hypertrophy of the palatine tonsils was 5.5 times less common, and adenoid vegetation was 10 times less common. About half of the students of both groups suffered from digestive diseases, while by the end of training there was a threefold decrease in the proportion of functional disorders and the appearance of chronic gastritis, not present in the first-graders. During the training, there was a significant increase in vegetative-vascular dystonia: from 1.5 to 23.5 %. A significant increase in the prevalence of hypothyroidism was established: from 6.2 % at the beginning of training to 25.5 % by grades 10–11. The study revealed a significant increase in the number of children suffering from alimentary-dependent pathology (excess body weight) in the group of upper-grade students. Eye diseases were diagnosed three times more frequently in Study Group 2 than in Study Group 1, and myopia was registered only in the group of upper-graders (15.7 %) compared to its absence among first-graders.

**Keywords:** cadets, morbidity, school-induced diseases.

## THE IMPACT OF ATMOSPHERIC AIR TEMPERATURE ON ARTERIAL BLOOD PRESSURE IN THE ADULT POPULATION IN CONDITIONS SIMILAR TO THOSE OF THE FAR NORTH

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The study assessed the influence of atmospheric air temperature on arterial blood pressure in the adult population in the area with conditions similar to those of the Far North. The authors used the blood pressure measurements of participants in the "Know Your Heart" study of people aged 35–69, conducted in 2015–2017 in the city of Arkhangelsk. During the warm season, high temperatures of atmospheric air relative to average values cause a decrease in systolic and diastolic blood pressure in the group of participants without arterial hypertension and in those with treated arterial hypertension. However, in individuals reporting previously diagnosed arterial hypertension and not taking hypotensive medications, changes in atmospheric temperature above and below average for this period cause an increase in both systolic and diastolic blood pressure, and high atmospheric air temperatures have no effect on blood pressure. During the cold season, when the atmospheric air temperature rises relative to the average values, there is a decrease in diastolic blood pressure in the group of participants with untreated arterial hypertension, as well as a decrease in both systolic and diastolic blood pressure in the group of persons taking hypotensive medication.

**Keywords:** arterial blood pressure, arterial hypertension, ambient temperature, meteorological factors, weather conditions.

## STUDY OF ALCOHOL AND TOBACCO CONSUMPTION PATTERNS IN THE ADULT POPULATION OF NIZHNY NOVGOROD REGION ACCORDING TO EPIDEMIOLOGICAL MONITORING DATA IN 2021

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In 2021, the employees of the Nizhny Novgorod Research Institute of Hygiene and Occupational Pathology of the Russian Federal Agency for Health and Consumer Rights together with the

Nizhny Novgorod Regional Center for Public Health and Disease Prevention conducted an epidemiological monitoring of the prevalence of risk factors for chronic non-infectious diseases among the adult population on the territory of Nizhny Novgorod region.

One of the parts of the study was the research of alcohol and tobacco consumption patterns. The study found out that half of those surveyed consumed alcohol, with a significantly higher rate for men than for women. The surveyed residents of the region preferred strong alcoholic beverages, followed by beer and dry wine.

One fifth of the surveyed population (18.0 %) consumed tobacco products, while men did it significantly more often than women; one third of the smokers had low motivation towards a healthy lifestyle.

**Keywords:** epidemiological monitoring, chronic non-contagious diseases, alcohol, smoking, risk factors.

## **MMP9 836A>G POLYMORPHISM AND MARKERS OF OSTEOMETABOLISM IN CHILDREN UNDER STRONTIUM EXPOSURE**

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The specifics of the micronutrient environment in the population of individual geochemical provinces determines the peculiarities of homeostasis regulation processes. In conditions of excessive intake of strontium with drinking water, it is possible to form pathological changes in bone metabolism with the involvement of cytokine regulation mechanisms.

The authors examined preschool-age children permanently residing in the territory of the strontium geochemical province and consuming drinking water with an excessive content of strontium. The control group consisted of children who consumed drinking water with an acceptable content of strontium. The strontium content in the blood was studied by inductively coupled plasma mass spectrometry. Markers of osteometabolism were determined by enzyme immunoassay. Genotyping was conducted by the method of polymerase chain reaction in real time.

The results revealed excessive levels of strontium in the blood of children of the study group, simultaneously associated with an increased content of ionized Ca<sup>2+</sup>. The study also demonstrated changes in the system of cytokine markers of osteometabolism with a decrease in OPG by 1.51 times and an imbalance in the RANKL/OPG system ( $p < 0.05$ ). Genetic analysis allowed to establish an increased (by 2.55 times) frequency of the variant allele of the G

gene *MMP9* 836A>G matrix metalloproteinase-9 in children of the main group relative to the control group (OR = 3.48; 95 % CI = 1.44–8.43), regulating the binding of calcium and hydroxyapatites of the extracellular matrix and the expression of proinflammatory mediators. The study revealed a significant increase in RANKL by 1.83 times in carriers of the *G* allele *MMP9* 836A > *G*, which indicated the participation of MMP9 in the development of pathological changes in the conditions of an imbalance of strontium-calcium interaction, activation of bone resorption processes mediated by increased expression of proinflammatory cytokine mediators, and the formation of specific strontium ossification in the children of the strontium geochemical province consuming drinking water with excessive strontium content.

**Keywords:** genetic polymorphism, *MMP 9 gene*, RANKL, OPG, strontium.

## EXPERIMENTAL STUDIES ON THE CHOICE OF SAMPLE PREPARATION METHOD FOR CHEMICAL ANALYSIS OF FURAN AND METHYL FURAN IN FOOD PRODUCTS ON THE EXAMPLE OF INFANT CEREALS BY CHROMATOGRAPHY-MASS SPECTROMETRY

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In the research process of working out the method of food sample preparation for chemical analysis of furan and methyl furan, the authors used the traditional method of extraction and the automatic method of solid-phase extraction (SPE).

The study used liquid extraction schemes taking into account the influence of temperature, the nature of the solvent, the pH of the medium, and the presence of salting-out reagents. The authors took into account the effect of the type of the solvent, the pH of the medium, and the presence of desalting reagents to develop the optimal scheme of solid-phase extraction. The results indicated that the traditional extraction method of furan and methyl furan was ineffective, with less than 1% extraction completeness. The authors applied a solid-phase extraction method to increase the efficiency of extraction of furan and methyl furan from infant cereal. The researchers developed an optimal elution scheme based on selecting the elution cartridge, the elution solvent, and the distillation method using standard food product solutions. The study achieved the extraction rate of furan and methyl furan through solid-phase extraction. The extraction completeness for furan and methyl furan was 100 %.

**Keywords:** chromatography-mass spectrometry (GC/MS), infant cereal, furan (methylfuran), solid-phase extraction, liquid extraction.

## FIVE-YEAR ANALYSIS OF MUSCULOSKELETAL MORBIDITY IN CHILDREN (0–14 YEARS OLD) AND SCHOOL FURNITURE PURCHASES IN THE REGIONS OF THE RUSSIAN FEDERATION

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Disorders and pathologies of the musculoskeletal system in children and adolescents occupy one of the leading places in the structure of childhood pathology escalating from the age of 3 to the age of 18. The pathology structure mainly includes flat feet, impaired posture and scoliosis. The purchase of school furniture, its fitting taking into account the age and height characteristics of students and further proper use has an impact on reducing the overall incidence of diseases of the musculoskeletal system in students. The study examined the differences in the purchases of student furniture by the regions of the Russian Federation (in 2014–2018) and the incidence of musculoskeletal morbidity in children aged 0–14 years (in 2009–2019).

**Keywords:** school furniture, morbidity in children, musculoskeletal system, hygienic regulation.

## PECULIARITIES OF HEPATOBILIARY PATHOLOGY IN CHILDREN WITH HERPETIC INFECTION LIVING UNDER CONDITIONS OF EXPOSURE TO ANTHROPOGENIC CHEMICALS

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Herpes viral infection is widespread among children and adults. The purpose of this work was to study the features of hepatobiliary pathology in children with herpes infection living under the influence of chemicals of anthropogenic origin. The authors examined 354 children aged from 5 to 17 years. The study group included 206 children living under chronic low-level atmospheric air pollution caused by anthropogenic chemical compounds. The results of the chemical and analytical study revealed that in children of the study group, the level of formaldehyde,

toluene and manganese in the biological media (blood) was 1.2–3.6 times higher than the reference values. Markers of herpes virus infection were detected in three-quarters of all the examined children.

The study revealed that in chronic low-level atmospheric air pollution with chemical compounds of anthropogenic origin, herpes viruses contributed to the formation of oxidative stress (increased MDA), disruption of cytokine regulation (increase of IL-10 synthesis) and activation of cytotoxic processes in the liver (increase of total and direct bilirubin), development of morpho-functional disorders of hepatobiliary system (increased liver size, reactive changes of liver parenchyma, signs of dyscholia) against the background of gall bladder anomaly.

**Keywords:** children, herpes infection, substances of chemical origin, hepatobiliary disorders.

## OXIDIZED LOW-DENSITY LIPOPROTEINS AS A RISK FACTOR FOR THE DEVELOPMENT OF EARLY ATHEROSCLEROTIC CHANGES IN YOUNG AND MIDDLE-AGED PEOPLE WORKING IN METALLURGICAL INDUSTRY

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The authors examined 174 employees of a metallurgical enterprise in the Nizhny Novgorod region (men aged 25 to 51 years). All employees came into contact with hazardous factors of the working environment (production noise, industrial aerosols). The study evaluated the levels of circulating oxidized low-density lipoproteins (oxLDL) in young and middle-aged people, and determined their correlation with risk factors for the development of early atherosclerotic changes. The amount of oxLDL in the blood serum was determined by solid-phase enzyme immunoassay. oxLDL was detected in 90.9 % of the examined employees. The concentration of oxLDL in the blood serum of workers exposed to harmful factors was significantly higher than this value in the group of workers who were not exposed to occupational hazards. The study determined correlation of oxLDL content with the concentration of triglycerido, cholesterol, atherogenicity index levels, body mass index, arterial pressure and glucose. Elevated oxLDL in employees under occupational hazards may be an additional risk marker for metabolic syndrome, subclinical atherosclerosis, and cardiovascular pathology.

**Keywords:** oxidized low-density lipoproteins, atherosclerosis, occupational hazards, working population.

## ASSESSMENT OF THE INFLUENCE OF NUTRITION ON THE DEVELOPMENT OF DISEASES CHARACTERIZED BY HIGH BLOOD PRESSURE USING THE METHOD OF CLASSIFICATION TREES

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The most common alimentary-dependent diseases are the diseases characterized by high blood pressure (hypertension). Lack of hypertension prevention can lead to the development of circulatory diseases, including coronary heart disease, the leading cause of death and disability in Russia and the rest of the world. Adjustment of the daily diet is an effective prevention of the development of alimentary-dependent diseases. Mathematical modeling using the method of classification trees was used to determine the optimal diet. The decision tree model is based on the results of a survey of 808 adults aged 18–65 years in various regions of the Russian Federation. A diet based on the results of mathematical modeling can reduce the likelihood of developing diseases characterized by high blood pressure by 2.8 times. In turn, a low proportion of vegetable fats and an excessive proportion of salt in the diet can increase the likelihood of nosologies by 3 times.

**Keywords:** questionnaire, modeling, nutrition, high blood pressure, decision trees.

## PERIODIC MEDICAL CHECK-UPS AS A MECHANISM FOR IMPLEMENTING OCCUPATIONAL PATHOLOGY CARE FOR THE WORKING POPULATION DURING THE COVID-19 PANDEMIC

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During the COVID-19 pandemic, the organization and conduct of periodic medical check-ups proved to be extremely challenging, causing a continued deterioration in their overall effectiveness. In order to assess the effectiveness of periodic medical check-ups for workers in adverse

and hazardous working conditions, we studied data from the closing statements and annual reports for 2019 and 2020 submitted by medical organizations to the regional Centre for Occupational Pathology. In 2020, the number of employees covered by periodic medical check-ups in the Republic of Bashkortostan decreased sharply compared to 2019 and amounted in different regions to 70.0 % to 95.6 %; the detection of persons with signs of occupational disease also decreased by 20 %, which led to a sharp decrease in the occupational morbidity. Despite the grave epidemiological situation, medical check-ups should continue to be the most essential task of general practitioners and occupational pathologists. Decreased quality of check-ups has a direct detrimental effect on the health of workers and causes significant economic damage.

**Keywords:** periodic medical check-ups, employees, quality, COVID-19 pandemic, occupational morbidity.

## OBESITY AND INSULIN RESISTANCE IN ADOLESCENCE AS A PREDICTOR OF THE FORMATION OF COMORBID PATHOLOGY

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Obesity among young people can be attributed to the number of problems that have obvious medical and social significance and require active correction in order to prevent the manifestation of comorbid diseases in the future. The disease increases the risk of developing metabolic syndrome and diabetes mellitus, cardiovascular pathology, arthritis at a young age, hypogonadism, erectile dysfunction.

The aim of the study was to identify insulin resistance in overweight and obese young men and its association with somatoscopic, somatometric and metabolic indicators characterizing cardiovascular risk.

**Materials and methods.** The authors examined 195 young male students of the vocational school, aged 16–19 years, including those with excessive body weight and obesity. The study assessed the association of insulin resistance in overweight and obese young men with somatoscopic, somatometric, and metabolic indices characterizing cardiovascular risk. The degree of obesity was determined according to the body mass index (BMI); the type of obesity was assessed according to the waist-hip circumference ratio. As predictors of cardiovascular risk, we considered the resistance index RI estimated indirectly by *HOMA* index and blood lipid spectrum. The study examined the association of lipid metabolism disorders with the functional status of the thyroid gland by correlating the thyrotrophic hormone (TSH) level with lipidogram indices.

**Results and discussion.** The average *HOMA* index depending on the obesity class was  $2.48 \pm 0.36$  in the case of increased nutrition,  $2.99 \pm 0.31$  in the case of class I obesity, and



$2.99 \pm 0.31$  for class II obesity and  $3.86 \pm 0.33$ , for class III obesity. The TSH levels demonstrated a negative association with RI, basal insulinemia, and  $\alpha$ -cholesterol. The correlation of TSH with total cholesterol, triglycerides, and  $\beta$ -lipoproteins was positive.

**Conclusion.** Insulin resistance in obesity occurs in 45 % of young men and increases with the development of obesity. The cardiovascular risk in insulin resistance is realized mainly due to the effect on the antiatherogenic potential of lipidogram, concomitant hormonal disorders can potentiate the atherogenic effect.

**Keywords:** insulin resistance, metabolic disorders, adolescents, obesity, dyslipidemia.

## CONDITION OF THE BONE SYSTEM IN CHILDREN AND ADOLESCENTS CONSUMING DRINKING WATER WITH INCREASED STRONTIUM CONTENT DUE TO GEOCHEMICAL CHARACTERISTICS OF THE TERRITORY

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Excessive intake of heavy metals of natural origin with drinking water increases the risk of the formation of non-communicable diseases of systems and organs, depending on the tropicity of the chemical compound. Objective: to study the condition of the bone system in children and adolescents consuming drinking water with an increased content of strontium due to the geochemical characteristics of the territory. A total number of 241 people were examined. The study group consisted of 93 children living in a geochemical province with a stable strontium content exceeding 2 MPC in the water of the centralized drinking water supply system, the control group consisted of 148 children living in an area where the concentration of strontium in drinking water did not exceed 1 MPC. The authors of the study conducted an analysis of the prevalence of osteopathies and the results of ultrasound densitometry. The osteopathy incidence rate for the period of 2010–2019 in children and adolescents on the territory of the study was 1.8 and 2.0 times higher than in the control area. The concentration of strontium in the blood of children and adolescents living in the territory of the geochemical province exceeded the permissible reference by 2.1 times and the indicator of the control group by 2.9 times. A decrease in the Z-index in the study group was recorded 2.3 times more often. The study established significant inverse correlations between the Z-index value and strontium content in blood. Children living in geochemical provinces with high strontium content have a higher prevalence of osteopathies.

**Keywords:** strontium, drinking water, children, osteopathies, geochemical province.

## QUANTITATIVE ASSESSMENT OF THE IMPACT OF EDUCATIONAL PROCESS ON THE RESULTS OF PSYCHOLOGICAL TESTING OF STUDENTS AT DIFFERENT LEVELS OF EDUCATION IN INSTITUTIONS OF GENERAL EDUCATION

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The paper examines the influence of the intensity and potential stress of the educational process at different educational institutions on the results of psychological testing of students.

The urgency of the problem is caused by a significant increase in the academic workload and, as a consequence, a deterioration of the psychological well-being of students.

The study of the basic indicators of the educational process has allowed to establish a correlation between these indicators and the psychological reactions in children.

The conducted study gives reason to believe that with the existing approaches to the organization of the educational process, the students of educational organizations may experience negative changes in their psychological well-being.

**Keywords:** children, educational process indicators, educational institutions, psychological testing, cognitive functions, operative memory.

## PECULIARITIES OF IMMUNE STATUS AND CORTICOID-CATECHOLAMINE REGULATION IN ADOLESCENT GIRLS WITH ALDEHYDE-CONTAMINATED NERVOUS SYSTEM PATHOLOGY

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The article is devoted to the study of the effect of contamination with aldehydes (formaldehyde, acetaldehyde, propionic aldehyde, oil aldehyde) in the blood on the immuno-endocrine regu-

lation of adolescent girls with pathology of the nervous system. The study revealed specific features of the state of markers of phagocytic activity (activation of the percentage of phagocytosis and phagocytic number), cytokine activity (activation of anti-inflammatory cytokine IL4, and inhibition of gamma-interferon), as well as increased expression levels of adaptogenic markers cortisol and dopamine. Spearman's correlation analysis revealed a reliable direct dependence of cortisol levels on the level of aldehyde contamination.

**Keywords:** pathology of the nervous system, aldehyde contamination, adolescent girls, cortisol, phagocytosis.

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