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Principles of heavy metals on health

The article analyzes the literary publications devoted to the research in recent years. The nature and level of accumulation of metals in various biological fluids of man reflects the degree of pollution in the natural anomalous geochemical provinces, and allows us to study human impacts. The situation which has developed in Kazakhstan, complex multifactorial causes environmental effects on public health, which creates the need to carry out actions aimed at the adoption of specific solutions to control the state of heavy metals in the environment in the «habitat — a man.» According to the literature, there is a relationship between the accumulation of metals in the environment and their accumulation in the human biological fluids.

Key words: heavy metals, ecology, population health, industrial cities.

The primary and main sources of trace elements for living organisms are natural soil and water. At the time, Vernadsky pointed out that the composition of the soil is closely related to the composition of other parts of the biosphere. Circulation of the elements in the atmosphere – Natural water – soil – plant – animal organisms is the territorial law, which may violate the presence of foci with increased content of trace elements.

Environmental contamination with heavy metals — copper, zinc, chromium, lead, mercury, cadmium and others. Is formed by emissions into the atmosphere and further subsidence in the soil cover of ferrous and non-ferrous metallurgy, thermal power, etc. The processes of smelting and processing of steel accompanied by the release into the atmosphere of manganese, lead, mercury vapor, rare metals. The emissions and open-hearth steelworks convector present dust from the metal charge, and a pair of metal oxides, prevalent of which are iron and aluminum trioxide. Non-ferrous metals are the source of atmospheric air in aluminum, copper, lead, tin, zinc, nickel and others. Metal. Out of metals in the environment comes from the combustion of fuel and fuel at thermal power plants. The coal contains all the metals of the periodic table, and especially lead, mercury, arsenic, vanadium, nickel, chromium. It was found that most of the metal is deposited in the range of 1–2 km from the source of emissions, and 10–40 % — in the range of 8–10 km from the business [1–3].

The high level of metal contaminants observed in residential areas of industrialized regions [4, 5]. Precipitation adequately reflect the air pollution in populated areas. As part of the snow in accumulative indicators reflecting the specific anthropogenic load on individual sources or industrial areas. High concentrations of toxic and potentially toxic elements found in the snow cover settlements [5, 6].

Heavy metals can exchange or non-exchange captured the different components of the soil to fall in the form of insoluble salts. Possibilities of transfer of toxicants into the slow-moving state are not the same in different soils. Distribution of heavy metals on the surface of the soil is determined by many factors. It depends on the specific sources of pollution and meteorological characteristics of the region, geochemical factors of landscape environment in general and other factors [6, 7]. Elements — toxicants, soil contaminants are concentrated in the upper (0–10 cm) layer. It has been established that 57–74 % of the lead and in anthropogenic mercury contamination fixed in the 0–10 cm layer and only 3–8 % migrate to a depth of 30–40 cm [8–10]. An important role in the accumulation of heavy metals play a secondary mineral complexes with organic matter and hydroxides of iron and aluminum. Many organic compounds are soluble or insol-

uble complexes with copper, and therefore the capacity of the soil to bind or containing copper in solution is largely dependent on the nature and amount of organic substances. Organic components sorb and bind zinc in its stable shape, whereby the last accumulation is observed in the surface layers. An important role in enhancing the properties of migration of heavy metals water-soluble organic compounds play is associated with 60–90 % of migrating in the soil profile of metals [7, 11]. Understanding the processes of migration and transition elements from one medium to another is of great practical significance to study the mechanisms and pathways of human exposure, assess the toxicity of chemical elements [8, 12].

According to the observations, when the body of any one of trace elements in high concentrations change content and other trace elements. Redistribution, what is happening in the content of trace elements in the body tissues in the earliest period of receipt of any trace elements in high or low concentrations, is adaptive and protective in nature, aimed at ensuring the best performance of the tissues and organs under varying conditions. In the event that a trace element enters the body at concentrations that exceed the adaptive capacities necessary for normal functioning of the body, equilibrated relations between trace elements are broken and out of control of physiological regulation, and begins to show the action of pathogenic micro-nutrient. Recently established ecological conditionality of about 20 diseases occurring in the population [2, 9, 13–15].

Excessive concentrations of metals can cause serious changes in metabolism and disruption of metabolic processes, thereby reducing non-specific resistance of the organism, leads to disruption of allergic and physical status, and, consequently, to a violation of the functions of various organs and systems. Under the influence of metal damaged hematopoietic process, which in turn leads to an increase in the body immunodeficient state [10, 12, 13, 16, 17].

Under the action of toxic metals in varying degrees, suffer from circulatory, excretory, digestive, endocrine, immune, hematopoietic system. However, for all the polymorphism pattern of toxic effects for each metal is characterized by the greatest defeat of one of the above systems.

Lead in contact with the human body interacts with the sulfhydryl groups of proteins and blocking various enzyme systems. Lead is toxic to the central and peripheral nervous system, it is capable of accumulation in the body, especially in bone. Correlation method established the relationship between levels of lead and cadmium in the hair of students and their intellectual development. Lead exposure leads to the defeat of the renal tubules, accompanied by proteinuria and glucosuria. In the future, this leads to a deficiency of vitamin D and parathyroid hormone, to a violation of calcium metabolism in the body and causes the subsequent systemic bone loss — osteoporosis and osteomalacia. There is evidence that an imbalance in the body can lead to predict tumor cell growth. The excess copper leads to disruption of the blood, stimulates the development of anemia with degeneration of the liver and its complete atrophy. Since copper metabolism disorders in the body bind the early stages of malignant tumors. Zinc has no specific toxic properties, but when hit in significant quantities into the body causes dyspepsia. Inorganic cadmium compounds with prolonged inhalation and ingestion into the body, along with a general toxic causes gonadal — and embryotoxic effect [18–20].

Manganese is a neurotropic metals causes hyperplasia of the thyroid gland. There is information on the mutagenic effects of manganese and Gonadotoxic action. Pathological processes in the body due to the intake of manganese, associated with the metabolism of the latter. Manganese enters the plasma and associated with B-globulin and then distributed throughout the body. Manganese is concentrated in tissues that are rich in mitochondria, with the highest concentrations found in the liver, pancreas, kidneys and intestines. He is able to penetrate the blood-brain and placental barriers (WHO data). When studying the manganese uptake from the gastrointestinal tract it has been found that the presence of iron deficiency anemia increases the rate of absorption of manganese (Meno et al. 1969). At high levels of manganese in the body increases the rate of excretion of manganese which is accompanied by increased excretion of iron. This exacerbates the already existing interconnection anemia, thus increasing the rate of absorption of manganese (WHO data). By the end of the 80s in animal experiments shown transplacental carcinogenic substances are more than 60, and combinations thereof, belonging to different classes, including compounds of metals such as cobalt, zinc, magnesium, lead. The metal ions are capable of binding oxygen, sulfur, nitrogen, forming part of proteins and nucleic acids, and can affect the activity and correct operation of the DNA and RNA polymerases. The ability of metals to the carcinogenic effect is characterized as follows: As > Cr > Ni > Be > Pb > Cd > Hg [11, 21].

Iron deficiency anemia (IDA) — an extremely common form of clinical manifestations of iron deficiency states — to reach groups of the population is one of the first places, presenting a major challenge as the global and the national health care. According to the World Health Organization (WHO), about 2.5 bil-

lion earthlings have problems with the status of iron in the body, and the prevalence of anemia among the most vulnerable people on the planet is about 50 — 60 % of pregnant women and children in developing and 10–20 % — developed countries [22, 23]. IDA problems caused not only widespread, but also with serious consequences for health of vulnerable populations like young children, teenagers, pregnant women, women of childbearing age, the elderly [24]. With the presence of iron deficiency in the body are associated deterioration of mental and physical activity, reduced efficiency and productivity, increased risk of infectious diseases, impaired function of many organs and body systems. Iron deficiency in women adversely affects the course of pregnancy and labor, increases maternal and perinatal mortality, the birth of children with low birth weight. The infant is the child's psychomotor retardation, cognitive impairment and behavioral reactions irreversible backlog of mental and physical development [25].

The high prevalence of anemia in children and women of reproductive age has a negative impact on the intellectual, social and economic potential of communities and states. There is no doubt that its decision is an important condition for social and economic progress of many countries, including Kazakhstan and Central Asia. The exceptional importance of the prevention and treatment of IDA for our republic is reflected in documents such as the Declaration and Plan of Action on Nutrition in Kazakhstan and the Central Asian Republics, adopted at the International Conference of 1996, documents on national policy power in Kazakhstan [22–25].

Mutagenic effects of some metals is manifested in the prevailing impact on the genetic structures, and others — to disrupt the metabolic situation in the cells. Most obviously reproductive disorders develop in cities with developed metallurgical industry. So, the residents of the industrial center more frequently observed spontaneous abortions, stillbirths and higher [1, 11, 25]. When transplacental chemical action, in particular blastomogenic agents, the embryo may occur disorders that depend on the nature of the compound, dose, timing and exposure period. Thus, under the influence of the agent on blastomogenic 1–6 weeks after fertilization (the period of division of the zygote, implantation, organogenesis, placentation) is implemented embryotoxic effect leading to the death of the fetus and spontaneous abortion, from 2nd to 8th week (organogenesis) — teratogeny effect as malformations of the embryo (placentation periods, histogenesis, organogenesis and fetal growth) — carcinogenic effects — there are malignant tumors [22].

Thus, numerous publications and conducting independent research, found a direct linear relationship between the content of chemical elements in the environment (soil, water, air), and the incidence among the population.

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Тұрғындардың денсаулық жағдайына ауыр металдардың әсер ету қағидалары

Мақалада соңғы жылдары зерттеуге арналған әдеби басылымдардың талдауы ұсынылған. Металдардың сипаты мен жинақтау деңгейі адамның түрлі қоршаған ортасында табиғи-қалыпсыз геохимиялық провинциялар ластау дәрежесін көрсетеді және техногендік жүкті оқуға мүмкіндік береді. Қазақстанда әзірленген жағдайында күрделі көп факторлы денсаулық сақтау экологиялық әсерін тугызды, қоршаған ортаға ауыр металдар мемлекеттік бақылауға нақты шешімдер қабылдауға бағытталған іс-шараларды жүзеге асыру қажеттігін тудыратын «тіршілік ортасы — адам». Ғылыми әдебиет негізінде қоршаған орта мен адам биологиялық қоршаған орта арасында металдардың жинақталуы бойынша қарым-қатынас бар екендігі туралы қорытынды жасалған.

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Принципы воздействия тяжелых металлов на состояние здоровья населения

В статье дан анализ литературных публикаций, посвященных проведенным исследованиям последних лет. Отмечено, что характер и уровень накопления металлов в различных биологических средах человека отражают степень загрязнения окружающей среды в естественно-аномальных геохимических провинциях и позволяют изучить техногенную нагрузку. Положение, которое сложилось в Казахстане, подчеркивают авторы, обуславливает комплексное многофакторное воздействие окружающей среды на здоровье населения, что создает необходимость осуществлять действия, которые направлены на принятие конкретных решений по контролю за состоянием тяжелых металлов в объектах окружающей среды в системе «среда обитания — человек». На основе данных научной литературы сделан вывод, что существует связь между накоплением металлов в объектах окружающей среды и в биологических средах человека.

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