

Systemic biomonitoring needed to mitigate Arctic health risks

This Policy Brief highlights the need for biomonitoring to assess the risks of public health disorders and negative demographic implications caused by the ingestion of hazardous pollutants into the human body. These pollutants can accumulate in food chains and spread with migratory species of commercial fish, birds and wild animals. Consequences of climate change increase the ingestion risks, and the dependence of indigenous peoples on the resources in their environment makes them particularly vulnerable. Hence, relevance of this issue for Russia and the Arctic countries is obvious and requires attention.

The mitigation of negative effects of climate change on the health of indigenous people in the Arctic requires the establishment of systemic biomonitoring at the legislative level.

The monitoring must

- be implemented on a regular basis
- take into account not only the effect of pollutants to the body, but also the deficiency of vital trace elements, such as iodine, iron, magnesium, etc., which are essential for the proper functioning of the body.
- include chemical analysis of environmental samples, animals and birds, which indigenous peoples consume, as well as human biological samples (urine, blood, breast milk, hair, teeth).

Effect of climate change on indigenous people

Indigenous peoples are among the first to experience the effects of climate change, because their culture and lifestyle are closely linked to their environment and natural resources. The negative effects of climate change are felt quite abruptly by indigenous communities, whose entire way of life is based on the following of natural fluctuations and predicting weather events that e.g. influence the behavior of animals with which their livelihoods are associated. For example, due to global warming, the regime of snow cover and the regime of ice freezing are changing, the species and quantity of commercial fish and other animals as well as their migration paths are changing, and the risks of contaminants entering traditional food are increasing.

The traditional diet of indigenous peoples of the North depends on many factors. For people living a traditional lifestyle, the diet consists mainly of natural resources found in their places of residence. Such resources include meat of marine and freshwater fish, meat and offal of deer, as well as marine mammals, meat and eggs of migratory birds.



Picture 1: Indigenous people of Nenets Autonomous Area

There are three kinds of risks associated with the consumption of traditional foods:

- 1) Deficiency of many essential elements (calcium, magnesium, selenium, zinc, iodine, etc.). The Northern diet is characterized by a paucity of choice and diversity. There is a lack of fruits, vegetables and cereals, which may lead to insufficient intake of many essential elements.
- 2) The presence of inorganic (cadmium, lead, arsenic, etc.) and organic (PCB, DDT, etc.) toxic compounds in food. Food products that are consumed by indigenous peoples may be contaminated with various pollutants. The main pollutants that

are hazardous to human health and may be found in food are persistent organic pollutants (POPs) and so called “heavy metals”, in particular mercury;

- 3) Bioaccumulation of toxic compounds. The human body accumulates chemicals from the environment at a concentration greater than that found in the environment. Despite the fact that the food may contain minor concentrations of toxic substances, it is consumed constantly. At the same time, the period of excretion of some harmful substances from the body can be decades. Bioaccumulation of toxic compounds in the body depends on both their total amount entering the environment and their bioavailability, as well as the route of entry into the body, distribution, and metabolism.

The levels of accumulation of pollutants in biological objects (birds, fish, animals) vary due to the specifics of the nutrition of these organisms and their habitats and migration routes. For example, migrating herbivorous birds from the Anatidae family, such as the goosebird goose (*Anser fabalis*), the large white-fronted goose (*Anser albifrons*), and the white-chested goose (*Branta leucopsis*) winter in Western Europe (Germany, the Netherlands) and Asia (Uzbekistan), where they feed on agricultural land. In the same territories, there is a wintering season for the small tundra swan (*Cygnus columbianus*) and the sea eater (*Clangula hyemalis*), eating bottom mollusks and fish. Wintering in Europe and Asia is potentially associated with the receipt of doses of organic pollutants by birds, since it is known that pesticides containing organochlorine compounds were previously actively used in these territories. These species hatch in the Russian Arctic and form the diet of the local population in spring and autumn.

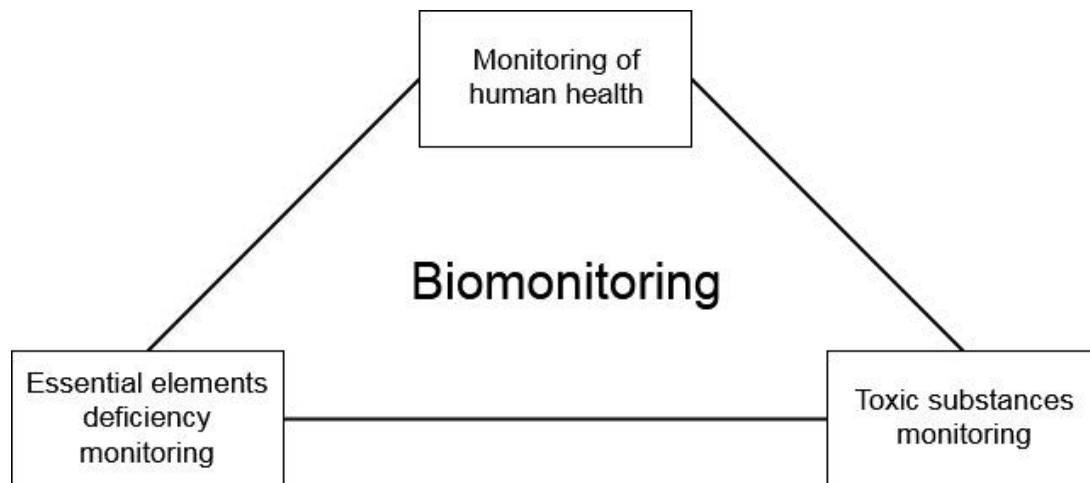
Most toxic substances (especially heavy metals, polychlorinated biphenyls and other organochlorine compounds) have a negative effect on human health:

- endocrine system (since they have hormone-like properties and, being introduced into the endocrine system, disrupt its normal functioning);
- reproductive system (e.g., pathologies of pregnancy, tumors, infertility, etc.);
- immune system (allergies, susceptibility to viruses);
- and cardiovascular system (heart attacks, strokes, heart failure).



Biomonitoring as an evidence-based tool for assessing health risks

Biomonitoring both at the international, national and regional levels is a unique tool for assessing the current state of environmental pollution and public health. The main objective of biological monitoring is to obtain data that allows an evidence-based risk assessment of health effects caused by harmful chemical factors. In addition, biomonitoring plays an important role in the development, application and evaluation of the effectiveness of protective measures for the most vulnerable elements of the ecosystem and population groups, such as indigenous peoples.



Picture 1: The content of biomonitoring

Despite the fact that there are today many programs to study the effects of various contaminants on the health of the indigenous population, these programs are mostly irregular and selective. In addition to the effect of pollutants on the body, it is necessary to take into account the deficiency of vital trace elements, such as iodine, iron, magnesium, etc., which are essential for the proper functioning of the body. Therefore, it is necessary to develop and introduce at the legislative level a system of annual biomonitoring. These activities should include chemical analysis of environmental samples, animals and birds, which indigenous peoples consume, as well as human biological samples (urine, blood, breast milk, hair, teeth). This will allow assess the risks associated with negative health effects for indigenous peoples of the Arctic, arising from the consumption of persistent toxic substances and from the deficiency of essential elements in the diet.

Sources

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