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Heavy metals as criteria of health and ecological well-being of the urban environment

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ABSTRACT

The study of the content of Pb, Cd, Ni, Zn, Mn, Cr, and Cu in biological media (the hair) of children living in the zones of the city of Kazan with different pollution levels was carried out. The identification of the zones in the city of Kazan was performed on the basis of the snow cover and soils pollution with heavy metals, which are natural accumulators of chemical substances and heavy metals (HM). Statistically significant differences ($p < 0.01$) in the content of certain metals in the hair, lead and cadmium in particular, were revealed in children living in the technologically polluted zone (Teplocontrol). Microelement composition of the hair in children with respiratory diseases (RD) varied widely in the content of lead ($p < 0.05$), and a statistically significantly lower level of zinc ($p < 0.01$) and copper ($p < 0.05$) compared with all the rest groups of children was determined in genitourinary diseases (GUD). However, relatively high values of toxic elements in the control zone show that the ecological status of the city and region is instable, and implies additional measures of the environmental monitoring and activities on chemical safety in certain city zones.

1. Introduction

Human biological monitoring (HBM) is an important tool to support environment and health policy [1]. Biomonitoring was regarded as "a Gold Standard" for the ecological effect assessment of chemicals [2–4], because it demonstrated and measured the markers for a biologically absorbed chemical in the human body. Appreciating the value of the biomonitoring data resulted in a widespread incorporation of biomonitoring in research development dedicated to the study of potential associations between the population health indicators and the exposure to chemicals in the environment [5,6].

However, the identification of regional (local) levels with the account of a complex of ecologo-hygienic factors in the territory under study, such as, morbidity of the population, the environmental status and assessment of the health risk on exposure to hazardous environmental factors, remains an important aspect [7,8]. For the biomonitoring purposes, possible biomarkers are determined in different biological media such as blood [7,9], urine [10], saliva [11], hair [12] and nails [13]. On the other hand, hair and nails are accumulating the contaminants long term, allowing for integral assessment of occupational and environmental exposure.

The aim of this study is to make sure that heavy metals can be certain criteria of health and reflect the ecological state and well-being of the urban environment.

Research in the territories (zones) in the city of Kazan with different levels of pollution with heavy metals included the analysis of Pb, Cd, Ni, Zn, Mn, Cr, Cu in the hair of children aged 8–12 years old. At the first stage of work, we identified the research zones in the territory of the city of Kazan. Identification of zones in the city of Kazan was carried out on the basis of the snow cover and soils pollution with heavy metal. Taking into consideration that snow and soils are natural accumulators of chemicals contained in the atmospheric air, then in a large industrial city, they can characterize a long-term pollution [14]. Atmospheric processes such as dry and wet deposition of trace elements play a crucial role in cleansing mechanism. Several studies have highlighted that atmospheric cycling of HMs (dispersion, transport, deposition) depends on a broad spectrum of environmental factors and local/regional anthropogenic sources [15].

According to research data, the major influence on the fine particle volume (mass) in the snow melt was concluded to be due to the elements from anthropogenic sources [16]. The advantage of the environment quality control as far as the extent of snow pollution lies in the fact that snow sampling is extremely simple, and it does not require complex equipment. The measurement of the pollutant parameters is carried out once a year during the period of maximal snow accumulation till the beginning of spring snowmelt. According to observation results, concentration of pollutants found in snow appears to be 2–3 orders of magnitude greater than in atmospheric air [17].

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