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HYGIENIC ASSESSMENT OF HABITAT ADVERSE SOCIAL AND SANITARY FACTORS IN THE ALTAI KRA

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The materials on health status, socio-economic, sanitary living conditions of the population of the Altai Krai have been analyzed. The comparative analysis of the conditions of life and health outcomes in urban and rural settlements' population has been performed. The estimation of health indicators' correlation has been carried out in children of age group 0-1 years, children of age group 0-14 years, teens of age group 15-17 years and adults of age group over 18 years, depending on the type (urban or rural) of settlement with indicators of social and sanitary environmental factors. Regression equations for the health outcomes of different age groups on the level of hygiene and social environmental factors are set, regional critical (reference) values are justified. The hygienic assessment of unfavorable social, health and sanitation of the environment on the health of the population in the Altai Krai is provided.

Key words: *health status, socio-economic, sanitary living conditions, comparative analysis, evaluation of health indicators' correlation, urban and rural settlements, regression equation, regional critical (reference) values, hygienic assessment.*

Rationale. The concept of growth of the Russian Federation and its regions is based on dynamic and balanced development of the economy along with the natural factors and demographic situation. The effectiveness of programs in regions depends on the reference conditions of their socio-economic development [2, 6, 12]. Social and sanitary-epidemiological conditions are differentiated at the macro- and microlevels and can be broken down by individual settlements and local administrative and territorial systems [23]. Altai Krai is an agro-industrial RF region with a deformed economic structure [5, 11]. In view of the new economic conditions of market economy, the production priorities have shifted. Economic challenges have impacted all the public spheres including sanitary-epidemiological well-being and social security – unemployment, fall of living standards, natural population decline, poor food quality, etc. [13].

Hazardous living environment results in decreased non-specific resistance, development of diseases [7, 14] thus determining complex processes of long-term interaction of exogamic and endogenic factors [12, 16].

New research [1, 2] suggests that outdoor pollution increases allergy risks in children and causes respiratory, urinary, circulatory, skin and subcutaneous tissue diseases. The most common

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air pollutant – carbon monoxide – disrupts cell respiration and inhibits oxygen consumption in the tissues [22]. A human body is sensitive to sulfur dioxide in the outdoor air; in small concentrations, it causes irritation. Prolonged exposure to sulfur dioxide causes vegetovascular dysfunction, and neurocirculatory disorders in combination with a lesion of the gastro and liver. An increase in the daily average concentration of sulfur dioxide per each 10 µg/m3 is known to increase total morbidity by 0.6% including a 1.2% increase in morbidity from respiratory diseases, and a 0.6% increase in morbidity from cardiovascular diseases [9, 19, 26]. The contact of nitrogen dioxide with a wet surface of the mucous membrane of the eyes, nose, and the bronchi is followed by the production of nitric and nitrous acids which irritate the membrane and affect the alveolar lung tissue [27]. The WHO reports that an increase in the concentration of nitrogen dioxide in outdoor air by 30 µg/m3 results in a 20% increase in the incidence of respiratory diseases in children aged 5-12 [27].

One of the current environmental problems is air pollution with benz(a)pyren and other polynuclear aromatic hydrocarbons [18, 24]. Incomplete burning of mineral fuel produces soot-particles of solid carbon on the surface of which benz(a)pyrene, formaldehyde, and benzene are adsorbed. Having entered a human body, these substances can cause malignancies.

Contaminants in soil impact public health: higher levels of contamination causes higher morbidity, increased number of chronic conditions in children, disruptions in the functional state of the cardiovascular system [12, 16]. It was shown [21, 26] that soil contamination with heavy metals, benz(a)pyrene can increase general morbidity, complications of pregnancy and labor, and physical abnormalities in children [17, 20, 21].

The entry of lead into the human body brings about multiple pathological effects and causes disruptions in the functioning of the nervous, endocrine, and circulatory systems [1, 9, 21].

Recent Russian studies suggest that those people who consume drinking water with low levels of mineral substances are more prone to such diseases as hypertension, gastric ulcer and duodenal ulcer, chronic gastritis, goitre, complications in pregnant women, newborns and infants, such as jaundice, anemia, fractures and developmental problems [8, 10, 15].

Clinical studies have found the signs of pathological processes in children caused by a higher level of manganese and chloroform in blood is connected with autonomic dysfunctions (parasympathetic type), reactive changes in the liver tissues, biliary dysfunction of the hypokinetic type, impairment of the motor function of the gastro and duodenum of the hyperkinetic type. Exposure to chloroform and manganese in drinking water pre-determine pathomorphosis of the pathological process with the development of atrophic / subatrophic changes in the mucosa of the upper gastrointestinal tract [13, 14, 25].

The health risk assessment methods used to evaluate the risks associated with the environmental pollution of the air, soil, water, and food, - can help identify the object – source of risk, validate the critical population groups, and develop an effective mitigation strategy [12, 18].

Goal-directed, well-coordinated, and consistent measures based on objective findings about the current social phenomena are needed to overcome negative social and sanitary-epidemiological effects [5, 6[.

The purpose of this study is to perform a hygienic analysis of the social and sanitary-hygienic environmental factors and validate the biggest risk factors.

The objectives of the study are to characterize the health state indicators; to compare the living standards (and state of health); to compare the living standards and health indicators of the urban and rural population; to evaluate the correlations of health indicators of the infants aged 0-1, children 0-14 yo, teenagers 15-17 yo, and adults 18+ depending on the size of the town they live in (urban population vs rural population) with the indicators of the social and sanitary-hygienic environmental factors; to determine regression for the health indicators in various age groups depending on the level of hygienic and social factors; to perform a hygienic assessment of the social and sanitary-epidemiological factors in the Krai.

The test objects of the research included 60 rural and 10 urban municipal entities of Altai Krai characterized by the socio-economic indicators, level of public health, level of healthcare, social living conditions, hygienic state of the living environment (outdoor air, drinking water, food products), natural and climatic conditions for the period 2011–2013.

Materials and methods. For the purposes of the research, we used the results of the federal and regional socio-hygienic monitoring conducted by the Altai Branch of Rospotrebnadzor in 2011-2013: outdoor air – in 24 settlements, 45 monitoring stations, 26 pollutants; drinking water – 361 monitoring points, 31 169 studies; food products – 11385 studies; - information from the socio-economic profiles of the towns and districts, and the data on the natural and climatic conditions [15] for 2011-2013.

In the assessment of public health, we used the number of births and deaths, including deaths from new growths, initial referrals to healthcare facilities of infants under 1, children aged 0-14, teenagers aged 15-17, and adults 18+. The data was analyzed with the help of the methods of hygienic and statistical analysis [4].

In the assessment of health risks, we referred to the Guidance… [18].

To evaluate different objects of the research, we compared the average values, and calculated the correlation coefficient and linear regression coefficient. The statistical processing of data was performed by using Statistica 6.0 software and Excel spreadsheets.

Results of the research. Differences in the social setting of the urban and rural population of the Krai are reflected in the different age and social structure of the residents (Table 1).

The share of infants >1 in the urban settlements is 15% of the total population, in the rural settlements – 18%. In bigger towns, the share of employed people aged 16 and up is 1.5 times higher than in the rural settlements (40% and 27% respectively).

Table 1

Age and social population structure of Altai Krai (average for 2011-2013)

Population Group	Indicator	Town	Settlement	Krai
Population at large	Population at large, people	1 376 317	992 821,00	2 369 139,00
Children 0-1 y.o.	Population at large, people	17 796	14 445,00	32 241,00
	Population share, %	1,3	1,5	1,4
Children 0-14 y.o.	people	212 314	179 711,00	392 025,00
	Population share, %	15,4	18,1	16,5
Teenagers 15-17 y.o.	people	33 794	30 251,0	61 045,0
	Population share, %	2,5	3,0	2,6
Adults >18	people	1 130 210	782 759	1 913 069,0
	Population share, %	82,1	78,8	80,7
Employed	people	456 858	207 693	664 551,00
	Population share, %	33,2	20,9	28,1

The number of births in the rural and urban settlements of Altai Krai (see Table 2) does not differ (13.5 per 1000 inhabitants in urban areas, and 13.9 in the rural areas, $p=0,402$). It is obvious that a larger share of child population in the rural areas is caused not by a higher number of births, but a higher population loss (total number of deaths per 1000 inhabitants in the rural and urban areas – 16.24 and 14.19 cases respectively, $p=0,002$).

Socio-economic indicators of the rural and urban areas differ by the amount of fixed capital expenditures per capita (in urban areas – 30.9 thousand rubles, in the rural areas – 17.3 thousand rubles), the level of per capita income (in urban areas - 18.4 thousand rubles, rural areas - 13.9 thousand rubles), the number of doctors (in urban areas - 709.3, and 38.6 - in the rural areas) and nurses (in the urban areas - 1 543.1, and 144.3 - in the rural areas). Expenditures on education per student in the rural areas exceed those in the urban areas (12 631.2 rubles and 10 457.2 rubles respectively) (Table. 3).

In urban areas, there is 10% less living space per person than in the rural areas (22,4±0,72 sq.m., and 24,59±0,35 sq.m. respectively, $p<0,05$), 2 times less apartments with no running water (18,2±3,9 percent and 36,86±2,76 percent respectively, $p<0,05$), and 42% less apartments with no waste-water disposal (31,1±5,01 percent and 54,31±2,51 percent respectively, $p<0,05$); the relative share of residential space equipped with central heating is more than 3 times higher than in the rural areas (53±7,1 percent and 16±2,6 percent respectively $p<0,05$); the monthly average salary is 30% higher in the urban areas (18 456±753 rubles in the urban areas, and 13 848±189 rubles in the rural areas, $p<0,05$).

Table 2

Birth and death rates in the urban and rural areas of Altai Krai (average for 2011-2013)

Indicators	Town, N=10	Settlement, N=60	Student's, t	Significance, p
Births (per 1000 inhabitants)	13,52±0,3	13,91±0,2	–0,84	0,403
Total deaths (per 1000 inhabitants)	14,19±0,6	16,24±0,3	–3,19	0,002
Infant deaths (per 1000 born alive)	9,23 ±1,1	9,61±0,9	–0,18	0,852

Table 3

Socio-economic development and climate in the urban and rural areas of Altai Krai

Indicators	Urban	Rural	Significance of average differences, p
	Average	Average	
Fixed asset expenditures per capita, thousand rubles	30 919±9882	1 713±1498	0,18
Doctors of all specialties, (per 10 thousand inhabitants)	70,92±53,42	37,8±2,6	0,22
Polyclinic doctors, (per 10 thousand inhabitants)	46,78±302,0	32,1±1,9	0,16
Living space per 1 person, m^2	22,4±0,7	24,5±0,35	0,01
Nursing staff (per 10 thousand inhabitants)	154,30±89,8	141,8±8,9	0,13
Apartment with no running water	18,2±3,9	36,8±2,7	<0,05
Apartments with no waste-water disposal	31,1±5,0	54,3±2,5	<0,05
Expenditures on education,	10 457±551	12 697±190	0,00
Average monthly salary, rubles	18 456±753	13 848±189	<0,05
relative share of residential space equipped with central heating, %	53±7,1	16±2,6	<0,05
Total population, people	120375±63047	17 894±1272	0,12
Temperature in January, C	–17,3±0,4	–17,7±0,4	0,49
Temperature in July, C	19,7±0,16	19,6±0,16	0,64
Distance to Barnaul, km	195,2±32,6	230,1±14,2	0,44
Temperature range, C	37,1±0,38	37,4±0,42	0,64
Average temperature in January and July, C	2,3±0,51	1,8±0,42	0,43

The state statistics reports that the incidence rate in the urban areas is higher than in the rural areas – total incidence rate in infants aged 0-1 (227 059 per 100 000 urban residents and 173 996,7 per 100 000 rural residents, $p<0{,}05$); respiratory diseases (per 100 000 inhabitants in urban areas - 101 725,7 and 71 247,7 per 100 000 rural residents, $p<0{,}05$) (Table 4).

The number of babies born with the body mass 1000-2500 g in the urban areas is 6 times higher than in the rural areas (6.6 per 1000 newborns in the city and 1 per 1000 newborns in the rural areas). At the same time, the incidence of circulatory and blood-forming organs diseases as well as individual immune disorders in infants aged 0-1 is more than 2 times higher in the rural areas. (17 071,0 per 100 000 infants aged 0-1 in the rural areas, and 7 655,5 per 100 000 infants aged 0–1 in the urban areas), the incidence of anemia is 16 928,6 per 100 000 infants aged 0–1 in the rural areas, and 7 605,6 per 100 000 in the urban areas).

When analyzing the hazardous environmental factors, we determined that the total individual carcinogenic risk from food products exceeds the allowable level (10^{-4}) (Table 5) - by 1,7 and 5,6 times in the urban and rural areas respectively. In the urban areas, higher carcinogenic risk is determined by the high level of arsenic in food products ($1{,}2*10^{-4}$), in the rural areas – by lead ($3{,}7*10^{-4}$) and arsenic ($2{,}5*10^{-4}$).

The level of individual carcinogenic risk associated with arsenic in food products exceed the allowable values in the following towns: Barnaul ($1{,}9*10^{-4}$), Belokurikha ($3{,}1*10^{-4}$), Novoaltaisk ($1{,}5*10^{-4}$). The level of individual carcinogenic risk from lead in food products exceeds the allowable values in the following rural areas: Kluchevskoy ($1{,}5*10^{-2}$), Loktevskiy ($1{,}3*10^{-4}$), Nemetskiy Natsionalniy ($1{,}8*10^{-4}$), Petropavlovksiy ($1{,}1*10^{-4}$), Tretiyakovskiy ($1{,}1*10^{-4}$), and Khabarskiy ($2{,}4*10\text{-}^{4}$) administrative districts.

Table 4

The rate of incidence in children aged 0-1 (per 100 000 inhabitants) in Altai Krai in 2011–2013

Indicators, ICD-10 codes	Mean Urban, N=10	Mean Rural, N=60	*t*-value	p
Total diseases A00-T98 including:	227 059,0±18151,1	173 996,7±5584,4	3,49	0,00
certain infectious and parasitic diseases, A00-B99	4 985,0±869,2	3 574,0±359,2	1,42	0,16
diseases of the blood forming organs and certain disorders involving the immune mechanisms D50-89	7 655,5±1410,0	17 071,0±1392,0	–3,00	0,001
anemia, D50-64	7 605,6±1396,0	16 928,61366,8	–2,91	0,01
Endocrine diseases, eating disorder, metabolism disorder E00-90	3 337,7±827,8	3 907,2±533,5	–0,43	0,67
Respiratory diseases J00-99	101 725,7±10465	71 247,7±3225	3,44	0,00
Digestion-related diseases K00-93	11 998,0±3638	7 784,7±845	1,92	0,06
congenital anomalies (birth defects), deformations and chromosomal abnormalities Q00-99	6 306,7±1887,5	4 049,1±3556,8	1,87	0,07
Number of children born weighing 1000 to 2500 g (total number of babies born alive and dead) P05.1.	6,6±1,3	1,0±0,2	6,94	0,00
Certain conditions originating in the perinatal period P00-96	44 945,5±7776,2	38 042,7±2389,5	0,96	0,347

Table 5

Carcinogenic risks from cancer-bearing food products in the urban and rural areas of Altai Krai in 2011–2013

Carcinogen	Urban, n=10		Rural, n=60		Significance of differences, p
	Mean	Standard error	Mean	Standard error	
Cadmium	2,6E-05	4,1E-06	4,5E-05	7,6E-06	7,7E-02
Lead	5,3E-05	2,1E-05	3,7E-04	2,9E-04	3,2E-01
Arsenic	1,2E-04	3,6E-05	2,5E-04	4,3E-05	6,3E-02
Benz(a)pyrene	1,0E-07	–	–	–	–
hexachlorobenzene	9,8E-07	7,1E-09	3,7E-05	2,5E-06	5,7E-03
DDT	3,8E-06	1,2E-06	2,6E-05	3,3E-06	3,3E-02
Total NDMA and NDEA	1,1E-05	4,1E-06	2,8E-05	4,7E-07	3,0E-01
2,4-D	3,5E-08	4,7E-10	1,1E-06	1,5E-08	2,9E-05
treflan	–	–	4,2E-07	–	–
Total carcinogenic risk	1,7E-04	4,3E-05	5,6E-04	2,8E-04	2,0E-01

Note: NDMA and NDEA - NDMA and nitrosodiethylamine 2,4-D-2, 4-dichlorophenoxyacetic acid

Analysis of the total indices of chemical risks associated with food showed that the excess of the permissible level (1.0) is observed for arsenic (1.7), lead (3.2), nitrate (1.3), oksimetifurfurolu (9.8) and histamine (600.7 4) (Table 6).

The input of food products into the elevated hazard index of arsenic is as follows: dairy products (23%), bakery products (22%), and canned fish and food products (17%). The input of lead into the total hazard index of food is mainly (82%) due to its content in vegetable oil. A large input into the hazard index of nitrates is made by vegetables (63%) and potatoes (32%).

Out of 14 critical organs and systems, for which the presence of toxic substances in the food products is hazardous, the central nervous system in the urban residents is at risk the most. In the rural residents, the following 3 critical systems are at risk the most: hormonal, central nervous system, and the hemic system.

The conditional risk of health impact in the form of the total hazard indices of individual critical organs and systems for the urban residents stood at 7.9, and for the rural residents – at 9.5. Consequently, the rural areas are facing a higher carcinogenic risk (by 20%) caused by toxic chemicals in food products.

Calculation of the chronic hazard indices for the toxic chemicals in outdoor air showed that none of the controlled chemicals had a chronic hazard index higher than 1 (average value at several observation stations) (Table 7).

Table 6

The hazard coefficients of the food chemicals in the urban and rural areas in Altai in 2011-2013

Chemical	Urban areas			Rural areas		
	Mean	min	max	Mean	min	max
Cadmium	0,13	0,03	0,19	0,21	0,0007	1,1
Lead	0,34	0,0004	1,2	2,1	0,002	92
Arsenic	0,24	0,003	0,7	0,6	0,0008	2,5
Mercury	0,04	0,01	0,07	0,15	0,004	0,32
Zinc	0,68	0,68	0,68	N/D	N/D	N/D
Benzo (a) pyrene	0,000027	0,000027	0,000027	N/D	N/D	N/D
Tin	N/D	N/D	N/D	N/D	N/D	N/D
Copper	0,0018	0,0012	0,0023	0,0012	0,00021	0,0023
aflatoxin M1	0,001	0,0007	0,0013	0,01	0,008	0,013
aflatoxin B1	0,12	0,001	0,33	0,29	0,004	0,52
HCH	0,027	0,007	0,04	0,17	0,006	1,1
Gamma-HCH	N/D	N/D	N/D	N/D	N/D	N/D
(Lindane)	0,022	0,006	0,046	0,145	0,011	0,5
DDT	1,05	0,2	1,5	1,2	0,12	8,6
Nitrates	0,00017	0,00006	0,00036	8,2E-05	0,00007	0,00008
hexachlorobenzene	0,0025	0,0025	0,0025	0,12	0,06	0,27
Total NDMA and NDEA	0,008	0,006	0,009	0,072	0,072	0,072
hydroxymethyl furfural	35	35	35	0,018	0,018	0,018
T-2 toxin	0,000087	0,000087	0,000087	0,0058	0,0058	0,0058
zearalenone	0,00083	0,00083	0,00083	0,061	0,061	0,061
Preparations of 2,4-D	0,033	0,033	0,033	0,0058	0,0058	0,0058
Mercury-containing pesticides	0,0058	0,0058	0,0058	0,061	0,061	0,061
2,4-D amine salt	0,061	0,061	0,061	0,013	0,013	0,013
decis	N/D	N/D	N/D	N/D	N/D	N/D
Tsimbush	0,0016	0,0016	0,0016	N/D	N/D	N/D
Sherpa	N/D	N/D	N/D	N/D	N/D	N/D
Karate	N/D	N/D	N/D	0,0072	0,0072	0,0072
treflan	0,000027	0,000027	0,000027	N/D	N/D	N/D
Polychlorinated	0,033	0,033	0,033	N/D	N/D	N/D

Note: N/D – not detected.

Analysis of the average annual levels of carcinogenic risk associated with air pollution in the urban and rural settlements showed a higher risk level overall (> 10^{-4}) that exceed the maximum permissible concentration by 3.3 times in the urban areas and by 2.2 times in the rural areas. As a result, the total chronic inhalation carcinogenic risk constitutes $2.9*10^{-4}$ (Table 8).

The highest level of chronic inhalation carcinogenic risk was registered in Kamen-on-Ob ($1,5*10^{-3}$) and Talmenka administrative district ($4,8*10^{-4}$). The list of carcinogenic substances in the outdoor air by the level of total chronic inhalation carcinogenic health risk included:

- In urban areas - carbon black (Aleisk, Slavgorod - 100%, Biysk - 78.1%, Rubtsovsk - 62.4%), formaldehyde (Zarinsk - 100%, Barnaul - 55, 6%), benzene (Kamen-on-Ob - 66.6%), toluene (Novoaltaysk - 68.7%), cadmium oxide (Zmeinogorsk - 62%);

- In rural areas - carbon black (Krutikha, Pawlowsk - 100% of the administrative areas), formaldehyde (Talmenka - 64.6%, Rubtsovsk - 54.2% of the administrative areas), cadmium oxide (Loktevsky - 94.8%, Zmeinogorsk - 63.3%, Tretyakov - 62.3% administrative regions).

The calculated hazard indices of the chemicals in drinking water in the urban and rural areas suggest that the drinking water be clean in most of the Krai. The mean and the maximum hazard index of the chemicals in drinking water in the urban areas do not exceed the permissible level 1.0. The hazard index of chemicals in drinking water (the maximum level) in the rural areas exceeds the permissible level of 1.0 in terms of nitrates (up to 1,58). The elevated level of non-cancer health risk from the nitrates in drinking water results in hematic system and cardiovascular system disorders and affects 24 000 residents (Table 9).

Table 7

Hazard index for the chemical pollutants in outdoor air in Altai Krai in 2011-2013

Chemical	Urban			Rural		
	Mean	min	max	Mean	min	max
diVanady pentoxide	0,727	0,727	0,727	–	–	–
suspended solids	0,072	0,036	0,146	0,088	0,002	0,128
hydrochloride	0,050	0,042	0,060	–	–	–
Ammonia	0,035	0,027	0,047	0,028	0,021	0,037
Lead	0,001	0,001	0,001	0,001	0,001	0,001
Sulfur dioxide	0,027	0,003	0,074	0,013	0,001	0,063
Benz(a)pyrene	0,111	0,051	0,174	–	–	–
Carbon monoxide	0,034	0,015	0,056	0,045	0,029	0,065
Carbon black	0,021	0,002	0,059	0,020	0,004	0,048
Nitrogen (IV) oxide	0,036	0,001	0,108	0,057	0,012	0,111
Phenol	0,009	0,001	0,018			
Formaldehyde	0,094	0,026	0,163	0,105	0,009	0,258
Benzene	0,046	0,006	0,124	0,005	0,005	0,005
Toluene	0,002	0,001	0,002	–	–	–
Copper (II) oxide	0,998	0,998	0,998	0,998	0,998	0,998
Cadmium oxide	0,791	0,791	0,791	0,800	0,791	0,820
fluoride gases	0,002	0,001	0,002	–	–	–

Table 8

Chronic carcinogenic risk associated with outdoor air carcinogens in the urban and rural settlements of Altai Krai

Substances	Urban	Rural	Total
Benzo (a) pyrene	0,000003	–	0,000003
Lead	5E-07	1,3E-06	0,000001
Carbon black	0,00014	0,00014	0,00014
Formaldehyde	0,00016	0,00012	0,00016
Benzene	0,00019	0,000074	0,00018
Toluene	0,0002	0,000051	0,00019
Cadmium oxide	0,00028	0,00028	0,00028
Total	0,00033	0,00022	0,00029

Table 9

Hazard indices of chemicals in drinking water in the urban and rural areas of Altai Krai in 2011-2013

Chemicals	Urban		Rural	
	Mean	max	Mean	max
Mercury	0,0014	0,0139	0,0	0,0
Lead	0,0008	0,0073	0,0001	0,0058
Selenium	0,0024	0,0244	0,0015	0,0582
Ammonia	0,0145	0,0596	0,0114	0,0676
Strontium	0,0577	0,5589	0,0187	0,463
Antimony	0,0158	0,1578	0,0	0,0
Carbon tetrachloride	0,0001	0,0007	0,0	0,0
Chloroform	0,0064	0,0638	0,0	0,0
Fluoride areas I-II	0,2656	0,5901	0,1398	0,7645
Zinc	0,0004	0,0029	0,0002	0,0031
boron	0,0184	0,0935	0,0127	0,217
Aluminum	0,0001	0,0004	0,00001	0,0003
Iron	0,0374	0,0875	0,0398	0,235
Cadmium	0,0001	0,0011	0,0	0,0
Magnesium	0,0416	0,1115	0,0536	0,5329
Manganese	0,0139	0,0504	0,0131	0,1133

Copper	0,0017	0,0059	0,0001	0,0035
Arsenic	0,0284	0,2841	0,0	0,0
Oil mnogosernistaya	0,00005	0,0005	0,0	0,0
Nickel	0,0019	0,0137	0,0	0,0018
Nitrates (as NO3)	0,0722	0,3233	0,186	1,58
Nitrite (as NO2)	0,0265	0,1747	0,0171	0,2384
Chlorine free	0,0173	0,1727	0,0	0,0
Chlorine combined	0,0129	0,1289	0,0	0,0

The results of health risk assessment were compared against the results of a study of correlation between the hygienic parameters of the environment (outdoor air, drinking water, and climate) and the health indicators of urban and rural residents. It was determined that infant mortality is significantly correlated with the total air pollution index (r=+0.83) while the total hazard index associated with outdoor air pollution in the urban areas is 2 times higher than the standard level. A close significant correlation is observed between the value of the total inhalation carcinogenic risk and infant mortality in the urban settlements (soot – r=+0.78; combined carcinogens r=+0.77). At the same time, the level of risk associated with these chemicals, exceeds the permissible level and totals $6*10^{-4}$ и $16*10^{-4}$.

We revealed a direct correlation between the total air pollution (the pollutants which affect the respiratory system), and the incidence rate of bronchial asthma in teenagers aged 15-17 (r=+0,77; HI=2). The prevalence of postural disorder in teenagers is significantly associated with the level lead consumed with food products (r=+0,73: HI=1,2), and metabolism disorders and obesity – with consumption of arsenic with food products (r=+0,75; HI=0,69).

Also, we found a direct correlation between the level of lead in the food products and metabolism disorders and obesity (r=+0,66; HI=1,2).

Central heating decreases the incidence rate of congenital abnormalities in infants aged 0-1 (r= –0,33), total morbidity in children aged 0-1 (r= –0,36), and general morbidity (r= –0,34).

In rural areas, consumption of hexachlorocyclobenzene with food products increases the general morbidity in children aged 0-14 (r=+0,66, HI=1,1).

There is a direct correlation between colder climate and morbidity of adult population in the rural areas: lower average January temperature causes a higher rate of bronchial asthma (r=+0,27).

Uncertainties in risk assessment. Uncertainty is a situation of imperfect knowledge about the parameters and processes used in risk assessment [4]. In this study, at the stage of hazard identification, uncertainty is related to the possible inadequacy of information about the average annual concentrations of pollutants in the outdoor air, drinking water, foods, and concentration of impurities in food products.

At the stage of analyzing the “dose-response” relationship, uncertainty concerns determination of the reference level of impact, and transferring of the results of epidemiological studies to the population of Altai Krai under study, the degree of evidence of a carcinogenic effect in critical organs / systems and harmful effects as well as features of the toxicity of substances at different ways of entry. The uncertainty when determining total risk and total hazard indices is associated with the possible synergy and antagonism of the chemicals, the use of the standard exposure and target values for all variables expressed in one figure rather than a range.

Conclusion. To conclude, the performed analysis of the social and sanitary-epidemiological conditions faced by the Altai residents revealed: 1) demographic effectiveness of the implemented measures of socio-economic development of the region; 2) outdoor air pollution in the urban and rural areas is characterized by an elevated level of noncancer risk caused by a range - pentoxide, arsenic, formaldehyde – combustion products of fossil fuel, as well as copper and cadmium oxides - contained in the emissions of mining companies, which testifies to the relevance of sanitary measures not only at the air pollution sources, but also regional planning of the populated areas, protection of residential areas from industrial emissions; 3) the leading place in the structure of carcinogenic risk caused by food products is taken by arsenic for the urban residents (vegetables, bakery products) and lead, arsenic – for the rural residents (potatoes, milk, meat, and baked goods) which demonstrates the need for systematic safety regulation of the crop production, safety assessment of the agricultural land, and control over the use of chemical fertilizers; 4) critical organs and systems impacted by the toxic chemicals in the food substances include the central nervous system, endocrine system, and the blood system, which requires the organization of targeted prophylactic medical examinations of the child population and clinical examination of adults to identify individuals from high-risk groups of environmentally-induced disease.

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