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Health status of the population living in the zone of influence of radioactive waste repositories

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ABSTRACT

Objective: To estimate the prevalence of diseases among the population depending on the length of residence in the zone of influence of technogenic factors of radioactive waste storage uranium-processing enterprise in Stepnogorsk.

Material and Methods: The article presents the results of an observational epidemiological study on the impact of harmful factors of uranium mining enterprises on the health of the population living near radioactive waste storage facilities. The study covers 1,877 adults of both sexes. Group I primary (N=908) were represented by the population living in the villages of the Factory, Quartzite and Aksu, which are located in the surrounding area of the radioactive waste storage uranium-processing enterprises Hydrometallurgical plant of Stepnogorsk city and 972 constituting the control group.

Results: The results revealed a high prevalence of chronic diseases in the population of the main group. Diseases of the circulatory system, respiratory diseases, diseases of the musculoskeletal system and connective tissue took the largest share in the structure of morbidity of the population of the main group. The pathology of the cardiovascular system, represented by essential arterial hypertension, as well as respiratory diseases, vertebrogenic lumbalgia and osteochondrosis, was the most characteristic for people living near radioactive waste storage facilities.

Conclusion: Living conditions in the zone of influence of radioactive waste repositories determine the wide prevalence among the population of the main group living in the settlements of Zavodskoye and Aksu. The results of the study indicate an almost complete absence of healthy individuals living in the area. Diseases of cardiovascular, respiratory and musculoskeletal systems occupy the first rank places in the structure of disease prevalence among the population of the main group. Length of living near radioactive waste storage affect the formation and character of general somatic morbidity: increase the duration of life in the areas adjacent to the tailings, leading to increased incidence of chronic diseases.

Keywords: prevalence of diseases, radioactive waste, population

INTRODUCTION

Currently, the study of the effects of low doses of ionizing radiation on biological objects continues to be a complex problem in the field of radiation biology. The urgency of this problem is due to the increase in the number of people exposed to man-made radiation in small doses, this category of the population includes people living near the storage of radioactive waste of uranium production (1,2). The risk of environmental problems and living conditions is high for public health. Radioactive contamination of the territories behind the sanitary protection zone, tailings of radioactive waste is one of the serious problems of the Republic of Kazakhstan.

As a result of earlier clinical and epidemiological studies found that the population living in a tense environmental situation, had a high medical and social risk of chronic somatic and cancer (3-5). However, the available literature data on the pathology of organs and systems after prolonged exposure of the population are contradictory. All of the above creates the need for scientific research, followed by systematic monitoring of the health of the population living in the area of radioactive waste storage.

Given the uncertainty in assessing health effects of people living in the zones of technogenic irradiation, we determined the following **research objective:** to estimate the prevalence of disease in the population, depending on length of stay in the zone of influence of technogenic factors of a radioactive waste storage uranium-processing enterprises of the city of Stepnogorsk.

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Table 1: *Characteristics of the population of the main and control groups*

Characteristics	Main group		Control group	
Number	908		972	
Middle age	50.0		47.2	
Gender	male	female	male	female
	442 (48.8%)	463 (51.2%)	545(56.1%)	457 (43.9%)
Employment	yes	no	yes	no
	510 (56.4%)	395 (43.6%)	447 (45.9%)	525 (54.1%)

MATERIALS AND METHODS

Depending on the place of residence, the study was conducted in two groups – the main and control, with a total of 1877 adults of both sexes. Group I primary (n=908) were represented by the population living in the villages of the Factory, Aksu and Quartzite, which are located in the surrounding area of the radioactive waste storage uranium-processing enterprises Hydrometallurgical plant of Stepnogorsk city. The II group «control» included people (n=972) who live for a long time in the village of Akkol, located more than 100 km from Stepnogorsk. The subjects of the study were adults of both sexes. The main criterion for selection in the study group was the period of residence in this area for more than 5 years. The criterion of exclusion was professional contact with sources of ionizing radiation – the fact of work at the Hydrometallurgical plant (HMP) of the Stepnogorsk mining and chemical plant (SGKH). A database on the health status of the population of these settlements was created for the purpose of the observational study. Characteristics of the study groups are presented in **Table 1**.

The cohort of the population studied by age and sex is almost indistinguishable from the control group. In addition, climatic, social and other conditions of the population of the main and control groups were approximately the same because of living in Akmola region.

Assessment of the health status of the population living in the zone of influence of radioactive waste repositories was carried out on the basis of outpatient circulation (outpatient cards (form-025-u)). To compare the frequency and expected probability of developing the prevalence of somatic diseases, groups were created according to the main nosologies available in the main and control groups of the population. The obtained results were processed using standard statistical methods. A 95% confidence interval (CI) was used to assess the reliability of the data. Differences in the results were considered statistically significant at $p<0.05$.

RESULTS AND DISCUSSION

The available data on the state of health of the population of the village of Zavodskaya and Aksu showed that only 0.3% of people of group I were practically healthy and each person had 1,1 diagnoses of acute and chronic diseases.

The calculation of extensive indicators in the study groups showed that in the structure of morbidity of the population of the main group, the largest proportion was occupied by diseases of the circulatory system (19.9%), respiratory diseases (16.3%), diseases of the musculoskeletal system and connective tissue (15.3%) in the comparison group, respiratory diseases (19.5%) are in the first place, followed by diseases of the circulatory system (18.5%) and digestive diseases (11.5%).

The greatest contribution to the prevalence of diseases in the population of the main group was made by hypertension (58%). The wide prevalence of hypertension is consistent with the literature data, as the last decades of BSC occupy a leading position in the structure of primary morbidity, mortality and disability (6,7). Also, a number of authors note the possible direct and indirect effects of radiation on the cardiovascular system, however, studies have not yet allowed to clearly establish the dose limits of radiation exposure to the development of pathological processes or diseases of the circulatory system (8).

Respiratory diseases are on the second place in the structure of morbidity of the population of the main group. The level of general morbidity in the class of «respiratory diseases» was 18.1 per 100 people. Acute respiratory diseases accounted for the largest share (22%). Diseases of the musculoskeletal system and connective tissue occupy the third place in the structure of morbidity of the study group. The prevalence rate is 15.3 per 100 people. The largest share in the incidence of vertebrogenic lumbalgia – 33%, osteochondrosis – 25%. The wide prevalence of lumbalgia is consistent with the literature data, since lower back pain is the second most common cause of patients treatment to a doctor after acute respiratory diseases. Vertebrogenic lumbalgia is a frequent neurological manifestation of spinal osteochondrosis, so their high combined prevalence is natural (9,10).

Table 2: *Comparative characteristics of the prevalence of diseases of the population of the study groups (per 100 employees)*

Class of the disease according to ICD-10	Disease prevalence per 100 people	
	Main group (n=905)	Control group (n=972)
Infectious and parasitic diseases	4.0	3.3
Neoplasms	1.9	2.0
Blood disorders	3.1	4.3
Disorders of the endocrine system	7.4	5.3
Nervous system diseases	5.1	3.1
Mental disorders	1.5	1.0
Eye disorders	4.4	5.7
Ear disorders	1.4	1.6
Circulatory system diseases	22.2	21.3
Respiratory system diseases	18.1	22.4
Digestive system diseases	10.9	13.3
Skin disorders	2.2	3.2
Diseases of the musculoskeletal system and connective tissue	17.0	10.6
Diseases of the genitourinary system	7.6	10.0

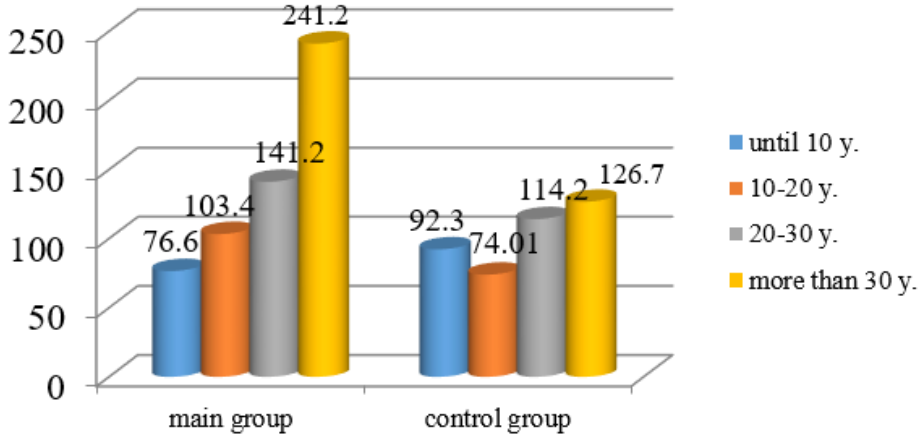

Figure 1: *Prevalence of diseases of the main population group depending on the duration of residence in the zone of influence of radioactive waste storage*

In addition, diseases of the digestive system are prevalent in the structure of the general morbidity of the main group. The high prevalence of diseases of the gastrointestinal tract (GI) was revealed mainly due to cholecystitis and pancreatitis (52.77%), chronic gastritis (13.89%). In the structure of general morbidity of other organs and systems of the population living in the zone of influence of radioactive waste storage the following diseases prevailed: endocrine system – diabetes mellitus (49%), nervous system – dyscirculatory encephalopathy (34%), urogenital system – chronic pyelonephritis (21%).

In addition to the structure of the morbidity of the population, intensive indicators demonstrating the frequency of the phenomenon in the environment were calculated. The total morbidity of the population was calculated per 100 people for the main classes of diseases ICD-10. The assessment of the frequency of diseases in the population living near the storage of radioactive waste of uranium production showed that the level of their prevalence did not differ significantly from the indicators in the control group: 111.4 against 115.2 per 100 people.

The significant significance of differences in the prevalence of diseases of the nervous system (χ^2= 4.94, $p<0.05$), and the musculoskeletal system (χ^2= 5.29, $p<0.05$), which exceeded similar indicators in the comparison group, was revealed.

The study population was divided into subgroups depending on the length of residence in the territory adjacent to the radioactive waste storage: 1) 5-10 years (26.9%), 2)10-20 years (52.5%), 3) 20-30 years (13.1%) and 4) more than 30 years (7.5%).

Analyzing the research results, we note a clear pattern of the distribution of the incidence of the pathology among the population, depending on the length of stay in the territory longer duration of residence in the territory of the tailings, the greater the prevalence of diseases observed in the population.

In the population of the control group, the prevalence of diseases, depending on the period of residence in the Akkol settlement of Akmola region, tended to increase, but did not change significantly. This may indicate that the influence of technogenic factors of radiation nature on the overall morbidity of the population living near the tailings dump for a long time is not excluded. A significant increase in the prevalence of diseases, depending on the length of residence in

ecologically unfavorable areas, was detected for diseases of the eye, cardiovascular system, digestive and genitourinary systems.

SUMMARY

Thus, living conditions in the zone of influence of radioactive waste repositories determine the wide prevalence among the population of the main group living in the settlements of Zavodskaya and Aksu. The results of the study indicate an almost complete absence of healthy individuals living in the area. The study of outpatient visits, morbidity with temporary disability and hospitalization showed that in the structure of the first rank places among the population of the main group are diseases of the cardiovascular, respiratory and musculoskeletal systems. The most common diseases in these categories were hypertension, respiratory diseases, vertebrogenic lumbalgia and osteochondrosis. However, only the prevalence of diseases of the nervous and musculoskeletal systems in the study group significantly exceed those in the control group. Length of living near radioactive waste storage affect the formation and character of General somatic morbidity: increase the duration of life in the areas adjacent to the tailings, leading to increased incidence of chronic diseases.

It should be noted that in order to fully assess the health of the population of the settlements of Zavodskaya and Aksu under prolonged exposure to radioactive waste storage factors, data are required, which will be obtained in the course of further research. This will make it possible to develop additional and more effective preventive and rehabilitation measures to improve the health of persons living in the area of radioactive waste storage.

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