AJPMHS GLOBAL RESEARCH NETWORK

AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 01, Issue 08, 2023 ISSN (E): 2993-2149

Hygienic Assessment of Radioactive Deposition in the Territory of Tashkent

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Abstract: The article provides a hygienic assessment of radioactive fallout on the territory of Tashkent. Weight volume of atmospheric fallout in the city of Tashkent, no significant differences in the average volume of fallout on the territory of various elements of the city's infrastructure were identified (16.3 ± 0.8 g per 1 m2 per day), but in the local area of the residential area and in the park area at some points they were noted significantly higher rates of atmospheric fallout (up to 21.3 g/ m2 per day); the average level of atmospheric radioactive fallout in Tashkent is 8.11±0.010 Bq/ m2 per day.

Keywords: atmospheric fallout, park area, local area, atmospheric air, gamma background value, residential area.

Relevance. One of the central places in ensuring sustainable development of human society is the problem of environmental protection. Currently, environmental monitoring has become a key system for ensuring the quality of the natural environment, and its most important part is radiation monitoring as the basis for ensuring radiation safety of the living environment. Today, significant radioactive contamination of the territories of the globe, caused by both military-industrial and civilian use of nuclear technologies, makes it very important to improve the system for organizing and conducting radiation monitoring of the natural environment [3, 4].

Researchers in this direction have studied in order to characterize by natural radioactivity not all of the above-mentioned rocks and ores, but mainly only those of them that are the basis for the production of various building materials, the extraction of chemical and other useful ore and non-metallic components [5]. Radioecological assessment of territories is most often carried out based on gamma radiation dose rate. However, it must be borne in mind that at any point on the Earth's surface there is a constant deposition of radionuclides from the atmosphere, so monitoring the level of radioactive fallout from the atmospheric air deserves special attention, since it is the most important link in the processes of translocation of radionuclides in the environment.

The radiation situation on the territory of the Republic of Uzbekistan is generally within normal limits, however, it is impossible to completely exclude man-made radiation contamination on the territory of the republic, since there are a number of objects that pose a potential danger for radioactive contamination of the territory [1, 2]. These are dumps of off-balance uranium ores from ore objects, including those that have ceased their operations, as well as emissions from the reactors of some enterprises. The possibility of transboundary transfer of radionuclides from the territory of other states cannot be excluded.

To assess the degree of radiation hazard, it is necessary to know the background radiation indicators in the controlled area, including the level of radioactive fallout. When analyzing the

scientific literature, we did not identify a single publication devoted to assessing the level of radioactive fallout on the territory of Uzbekistan. Until now, no one has attempted to search for data, analyze and summarize them, or conduct independent research on the characteristics of radioactive fallout on the territory of the republic.

Purpose of the study: assessment of the level of radioactive fallout in the territory of Tashkent.

Materials and methods of research. The research material was atmospheric fallout and background radiation in the city of Tashkent. The Mirzo-Ulugbek and Yashnabad districts of the city of Tashkent were taken as the study area, where residential areas, green areas, developed local areas, and mid-level industrial facilities (tram depot) are represented. Measurement points were determined in different zones, where atmospheric fallout was collected.

When conducting research, the following instrumental methods were used: sedimentation method of sampling, measurement of radiation dose rate, radiometric and spectrometric analysis, calculation methods, analytical method.

To solve these problems, an analysis of archival materials of the Committee for Sanitary and Epidemiological Stability and Public Health of the city of Tashkent was carried out, 24 samples of atmospheric fallout in the central part of the city were collected, and the weight volume of fallout per unit surface was measured. We collected atmospheric fallout for 30 days in the autumn, since according to other studies, it is in the summer-autumn period that the most intense radioactive fallout is observed. The total beta activity of the samples was determined, the average statistical indicators of the level of fallout and their radionuclide composition were calculated; the gamma background value at the sampling sites and its dependence on the level of radioactive fallout was measured; A correlation analysis of the relationship between indicators was carried out, and the recommended control level of radioactive fallout in the territory of Tashkent was calculated.

The results of the research made it possible to establish that previously the Committee of Sanitary-Epidemiological Stability and Public Health had not carried out a systematic analysis of radioactive fallout, therefore for the city of Tashkent there is no data on the level of radioactive atmospheric fallout in previous years.

The average statistical weight volume of atmospheric fallout in Tashkent is currently 16.3 ± 0.8 g per 1 m^2 per day. No significant differences in the average statistical volumes of fallout in the territory of various elements of the city infrastructure (industrial zone, residential area, adjacent areas, park area) were revealed, but in the adjacent territory of the residential area and in the park area, at certain points significantly higher rates of atmospheric fallout were noted - up to 21 .3 g/ m^2 per day (Table 1)

Table 1. Volume of atmospheric fallout in Tashkent (2014), g

Sampling area	Zone No.	Number selected samples	Fallout mass, g, M±m		
			by 50cm^2 in 30 days	by 50cm^2 in day per	1 m^2 per day
Production facility location area (trauma depo)	1	6	2,6± 0,9	0,09± 0,04	17,3± 1,9
Mirzo-Ulugbek district, residential buildings, 2nd floor	2	6	2,1± 0,2	0,07±0,02	14,2±1,1
Adjacent territory of residential buildings (Yashnabad district)	3	6	2,4±0,2	0,08±0,03	16,1±1,2
Green area (Gulshan Park)	4	6	2,7±0,8	0,09±0,04	18,0±2,4
Average		24	2,5±0,06	0,08±0,02	16,3±0,8

The total beta activity of atmospheric fallout in Tashkent currently ranges from 5.5 to 11.1 Bq/ m^2 per day, with fluctuations from 5.50±0.43 to 11.09±1.02 Bq/m^2 for various parts of the city; the average level of atmospheric radioactive fallout in Tashkent is 8.11±0.010 Bq/m^2 per day (Table 2).

Level of β-active deposition in Tashkent (2015)

Zone No.	Place of selected samples	Average mass collected loss, g, M±m	Activity samples, Bq	Activity samples, Bq	Fallout level Bq/m2 per day
1	Territory of the production facility	2,6± 0,9	0,055±0,010	0,825±0,010	5,50±0,43
2	Residential buildings of M.-Ulugbek district	2,1± 0,2	0,080±0,015	0,832±0,014	5,55±0,51
3	Green zone of the local area	2,4±0,2	0,137±0,007	1,664±0,080	11,09±1,02
4	Park area	2,7±0,8	0,115±0,017	1,535±0,019	10,28±0,98
	Average	2,5±0,06	0,010±0,004	1,21±0,04	8,11±0,010

In comparison with other studies, it can be noted that the indicators we identified can be characterized as average. Thus, in the city of Obninsk (Russia), the level of radioactive fallout registered in 2012 was 8.1-12.2 Bq/m2 per day. After testing nuclear weapons in China (1980), the level of atmospheric fallout in Khabarovsk reached 19 Bq/m2 per day, and in the Tomsk region of the Russian Federation in the area of the nuclear industrial facility, the level of atmospheric fallout in 1994 due to Cs-137 alone reached 250-300 Bq /m2.

Based on a spectrometric study, it was revealed that the radioactivity of atmospheric fallout in Tashkent is currently determined by natural radionuclides 238U, 226Ra, 232Th, 40K, with more than 80% of the activity due to 40K.

As a result of a radiometric study of identical weighed deposits (200 mg), it turned out that in the local area and in the green areas the activity of atmospheric fallout was significantly higher than in other zones and on average for the entire studied territory. We have no explanation for this, but there is an assumption that in the local area and in the area of green spaces, air aerosols are represented mainly by loess dust, in which the content of natural radionuclides is possibly higher than in dust hovering at an altitude of more than 2- x meters (roof of the tram depot and level of the 2nd floor balconies).

Indeed, a correlation analysis of the dependence of the activity of samples on the place of their collection showed that there is a direct average correlation between the activity of dust and its nature: loess dust from local areas has a higher activity (Table 3).

Dependence of fallout activity on sampling location

Zone No.	Average weight samples taken, mg, “X”	Average activity weight, Bq, "U"	d_x	d_y	d_x^2	d_y^2	d_x x d_y
1	200,5	0,055	-0,12	-0,042	0,014	0,0017	0,0050
2	200,7	0,080	0,08	-0,020	0,0064	0,0004	-0,0016
3	200,7	0,187	0,08	0,037	0,0064	0,0014	0,008
4	200,6	0,115	-0,02	0,015	0,0002	0,0002	0,0003
M	200,62	0,10			Σ0,027	Σ0,0037	Σ0,0061

$r = 0,0061/ \sqrt{0,027 \times 0,0037} = 0,6$

This suggests that the specific level of radioactive fallout is largely determined by the composition of the dust and the degree of dispersion of dust particles. Scientific literature data indicate that in various dust fractions there is a 2-4 fold increase in the concentration of radionuclides with a decrease in the size of dust particles (Stasov V.V. et al., 2007), and loess dust, as a rule, is fine dust.

The calculated value of 8.08±0.59 Bq/m^2 per day is recommended by us as a control level of radioactive fallout in the territory of Tashkent.

A comparison of the gamma background value in the places where atmospheric fallout samples were taken with the total level of their activity showed that there is no connection between the compared indicators (r = 0.12), i.e. The measured gamma radiation dose rate does not depend on the level of atmospheric radioactive fallout currently detected.

Conclusion. Thus, the conducted research allows us to draw the following conclusions:

- taking into account the current situation associated with the expansion of the use of radioactive substances in various fields of human activity, the increased danger of radiation accidents and incidents, as well as the specifics of the international situation, it should be considered necessary to carry out systematic monitoring of radioactive atmospheric fallout not only in the territory of Tashkent, but also in general – for the republic due to the lack of data on the level of radioactive fallout in Tashkent in previous years, to assess the level of radioactive fallout it is necessary to rely on our calculated value -8.08±0.59 Bq/m^2 per day, which is recommended as a reference level of radioactive fallout on the territory of Tashkent.

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