Maximum permissible concentrations of carcinogenic substances in the air in Central Asian countries and their risk levels

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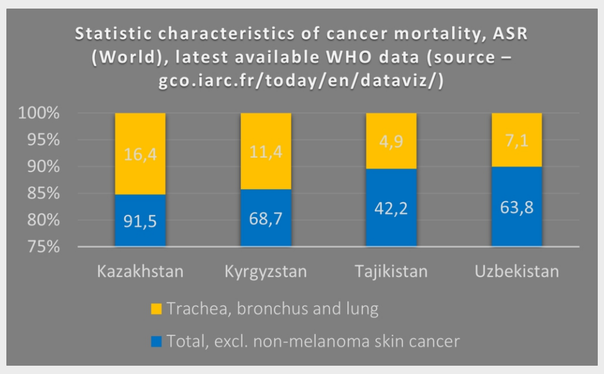
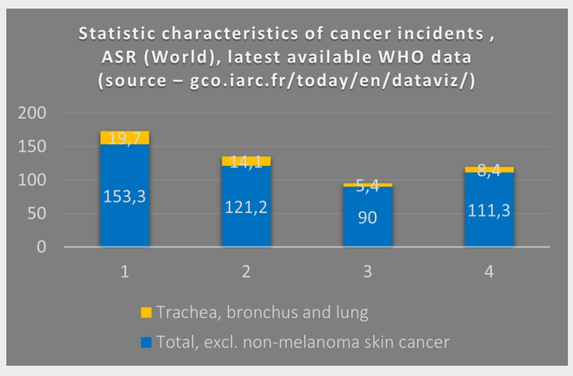
State standards of maximum permissible concentrations (MPC) of pollutants - carcinogenic substances in the atmospheric air of 4 countries of Central Asia (CA) were analyzed.

INTRODUCTION

In 2022, there were 20 million new cases of cancer and 9.7 million deaths from cancer worldwide. The most common cancer in the world is cancer of the respiratory system (bronchus, trachea and lungs), which accounts for more than 12% of the total number of new cancer cases. Lung cancer was the main cause of death from cancer in 2022 (1.8 million deaths from cancer), the mortality rate caused by it is 1.5 times higher than the mortality rate from cancer in general (IARC. Cancer today.... 2024).Residents of Central Asian countries are especially vulnerable. The incidence of cancer in these countries is lower than in developed countries, and the mortality rate from cancer is noticeably higher, with lung cancer occupying a special place. The risk of dying from cancer in Central Asian countries exceeds 12% (WHO)Data on standardized morbidity and mortality in the countries of Central Asia are shown below in graphs 1 and 2.





Graphs 1 and 2 show that for Central Asian countries the ratio of mortality to morbidity from tracheal, bronchial and lung cancer is significantly (1.4 - 1.9 times) higher than the ratio for morbidity in general.

Atmospheric air pollution in the CA countries.

It should be noted that part of the cancer incidence is caused by air pollution. The concentrations of many carcinogens in the air of these countries are not measured on a regular basis. Existing research shows widespread high levels of carcinogen pollution. Data on concentrations of fine particles in the air can be used as a generalized visual indicator of the level of pollution (which, for example, are regularly conducted within the framework of the non-governmental system IQAir). Air pollution and the fine particles it contains have been proven to be carcinogens (IARC) and cause lung cancer. As a generalizing visual indicator of the level of pollution, data on the concentrations of fine particles in the air can be used (which, for example, are regularly conducted within the framework of the non-governmental system IQAir). Air pollution and the fine particles it contains have been proven to be carcinogens (IARC) and to cause lung cancer.

5.1-10 Exceeds by 1 to 2 times	10.1-15 Exceeds by 2 to 3 times	5.1-25 Exceeds by 3 to 5 times	25.1-35 Exceeds by 5 to 7 times	35.1-50 Exceeds by 7 to 10 tim	>50.1 Exceeds by over 10 t		
Rank	Country/Regio	2023	2022	2021	2020	2019	2018
4	Tajikistan	49	46	59.4	30.9	--	--
18	Kyrgyzstan	33.1	31.1	50.8	43.5	33.2	--
23	Uzbekistan	28.6	33.5	42.8	29.9	41.2	34.3
40	Kazakhstan	22.2	23	31.1	21.9	23.6	29.8

table 1. World's most polluted countries & regions

MATERIALS & METHODOS

To determine acceptable levels of exposure to carcinogenic substances, the internationally accepted maximum risk limit was used. For air pollution with carcinogenic substances it is 10^{-4}

Risk – for carcinogenic substances, this is the likelihood of cancer occurring when exposed to the human body throughout life. When breathing throughout your life air in which the concentration of a carcinogenic substance is at the level of the maximum permissible concentration, the probability of developing the corresponding cancer should not be more than one in ten thousand. This level is accepted by WHO (XX), USA (EPA... n.d.), and other countries.Therefore, the main objective of this work was to assess the compliance of state standards for maximum permissible concentrations (MPC) of carcinogenic substances in the Central Asian countries with modern requirements- calculating risk, assessing the acceptability of maximum permissible concentrations and comparing the standards of different countries with each other. The final result should be recommendations on air quality standards and adjustments to standards.

RESULTS

The number of substances included in the state standards of maximum permissible concentrations of pollutants in the atmospheric air of 4 CA countries was compared with the number of carcinogenic substances included in IARC groups 1 and 2. It was found out that in CA countries the MPC system regulates pollution by only a small part of known carcinogenic substances (49)- less than 20% of internationally accepted ones.Only those substances were selected from the obtained list, for which the U.S. Environmental Protection Agency quantified the carcinogenic risk for inhalation exposure, and the IRIS database (EPA) shows the numerical value of the risk for the inhalation unit. For these substances, the risk was calculated and compared to the generally accepted maximum acceptable risk level for inhalation exposure of one ten-thousandth (10-4). There were 22 such substances in the regulations establishing

SUBTANCES	Kyrgyzstar	Kazakhstar	Uzbekistar	Tadjikistar
Dioxins/in terms of 2,3,7,8-tetrachlorodibenzo-1,4-dioxin/	0,19	0,19	0,19	0,19
Acetaldehyde (Ethanal, Acetaldehyde)	0,22	0,22	0,11	0,22
Benzene	2,2	2,2	0,11	2,2
Benz/a/pyrene(3,4-Benzopyrene)	0,006	0,006	0,006	0,000006
(Chloromethyl)oxirane (Epichlorohydrin, 1-Chloro-2,3-epoxypropane)	0,0048	2,4	0,012	0,0048
Oxirane (Ethylene oxide, Epoxyethylene)	900	900	30	900
Formaldehyde (Methanal)	0,39	1,3	0,39	0,39
N-Nitrosodimethyl Amine (Dimethylnitrosamine	7	7	7	7
Trichlorethylene	41	41	2,05	41
Chlorethylene (Vinyl chloride, Ethylene chlorid	0,88	0,88	0,88	0,88
Nitrobenzene	3,2	3,2	3,2	3,2
1,3-Butadiene	300	300	0,9	300
Acrylonitrile	20,4	20,4	0,68	20,4
Beryllium	2,4	2,4	9,6	2,4
Bromoform	0,55	0,55	0,55	0,55
Dichloroethane	260	260	104	260
Cadmium	5,4	5,4	5,4	5,4
Arsenic	12,9	12,9	0,645	12,9
Nickel	2,4	2,4	0,12	2,4
Carbon tetrachloride	42	42	1,02	42
Chloroform	6,9	6,9	0,92	6,9
Chromium	180	180	0,96	180

Table 2. Multiplicity of excess of permissible risk levels for maximum permissible concentrations of carcinogenic substances in the air of Central Asian countries

The risk estimates at the MPC level for the 22 substances show that the countries differ significantly in their compliance with current requirements. For Kyrgyzstan, Kazakhstan and Tajikistan, 70-80% of the carcinogenic substances considered do not provide an acceptable risk, in Uzbekistan only 40% of such substances. This is probably due to the availability of annual average MPCs in Uzbekistan, while in other countries the standards only set maximum single and average daily MPCs

	Kyrgyzstan	Kazakhstan	Uzbekistan	Tadjikistan
Total regulated substances in the air	650	678	710	632
Total regulated cancerogenic substances in the air	49	49	49	49
Total substances with risk level defined in EPA IRIS database	22	22	22	22
Total number of exceeding 10-4 risk	15	17	8	15
Total number exceeding more than 10 times	8	8	2	8
Total number exceeding more than 100 times	4	4	2	4

Table 3. Quantitative assessments of carcinogenic substances, the maximum permissible concentrations of which do not provide an acceptable level of risk.

Of the 22 examined, the maximum permissible concentrations for 8 substances do not provide an acceptable risk in all countries. Of these substances, 5 are quite common- trichlorethylene, nitrobenzene, dichloroethane (the permissible risk is 100 times higher), cadmium, carbon chloride tetracarbon.

CONCLUSION

Based on the assessments made, it can be concluded that the best compliance with permissible risks is demonstrated by the standards of Uzbekistan. Thus, out of 8 non-compliant substances in Uzbekistan, only two substances have a risk at the level of MAC above the permissible by more than 100 times.In the remaining 3 countries- with less synchronized regulation- increased risk corresponds to 15 substances (17- for Kazakhstan), and for 4 it exceeds the permissible level more than 100 times.For substances common in CA, in all countries the risk of concentration at MAC level for dichloroethane is more than 100 times higher than the permissible level. The MACs for cadmium, benzene, trichloroethylene, and nitrobenzene also do not provide acceptable risk.Translated with DeepL.com (free version)

RECOMMENDATIONS

Bring the maximum permissible concentrations of carcinogenic substances into line with the acceptable level of risk, primarily for dichloroethane, cadmium, benzene, trichlorethylene, and nitrobenzene.It is advisable for Kyrgyzstan, Kazakhstan and Tajikistan to introduce average annual maximum permissible concentrations and establish them for carcinogenic substances, taking into account modern knowledge about inhalation risks.It

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