

CLINICAL AND EPIDEMIOLOGICAL ANALYSIS OF MORBIDITY AND MORTALITY FROM MALIGNANT NEOPLASMS AMONG EMPLOYEES OF RADIATION HAZARDOUS ENTERPRISES AND THE POPULATION LIVING NEAR NUCLEAR INDUSTRY AND NUCLEAR POWER FACILITIES

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Abstract. *The purpose of the study is to analyze the oncoepidemiological situation in the vicinity of nuclear industry and nuclear power plants.*

Materials and methods of the study. The main materials of the study were the data of official medical statistics for 2012-2018 on the incidence of malignant neoplasms and mortality from them: the contingent of medical treatment organizations of FMBA of Russia in 10 closed administrative-territorial formations of Rosatom State Corporation — a research sample; total contingent served by medical treatment organizations of FMBA of Russia — data of the Federal Center for Extreme Problems Information Technology of FMBA of Russia; population of Russian Federation as a whole.

An in-depth analysis of the morbidity and mortality from malignant neoplasms among employees of enterprises and the population served by medical treatment organizations of FMBA of Russia was performed using data from the Branch Cancer Registry of FMBA of Russia. *Results of the study and their analysis.* According to the results of the analysis an increase in the incidence of malignant neoplasms was observed in medical treatment organizations of the Federal Medical and Biological Agency of Russia in closed administrative territorial formations, in all medical treatment organizations of the Federal Medical and Biological Agency of Russia, and in the Russian Federation as a whole. In 2012-2018 the incidence of malignant neoplasms (per 100,000 population) was: in closed administrative territorial entities — 412.4 and 526.6 respectively; in all medical treatment institutions of FMBA of Russia — 328.4 and 390.1; in the Russian Federation as a whole — 367.3 and 425.5 respectively.

Analysis of mortality rates from malignant neoplasms showed that in all medical treatment institutions of the Federal Medical and Biomedical Agency of Russia the mortality rate from malignant neoplasms (per 100 thousand population) in this time interval was 149.1 and 167.9 persons respectively, which is significantly lower than the all-Russian rates of 201.0 and 200.0 persons respectively. Mortality from malignant neoplasms in closed administrative territorial units amounted to 220.1 and 257.3 persons respectively, which exceeds both all medical treatment institutions of the Federal Medical and Biological Agency and the Russian Federation as a whole.

Key words: *closed administrative-territorial formations, employees of radiation hazardous enterprises, malignant neoplasms, medical treatment organizations, morbidity, mortality rate, population, nuclear industry facilities, nuclear power, nuclear power facilities*

Conflict of interest. The authors declare no conflict of interest

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КЛИНИКО-ЭПИДЕМИОЛОГИЧЕСКИЙ АНАЛИЗ ЗАБОЛЕВАЕМОСТИ ЗЛОКАЧЕСТВЕННЫМИ НОВООБРАЗОВАНИЯМИ И СМЕРТНОСТИ ОТ НИХ СРЕДИ РАБОТНИКОВ РАДИАЦИОННО ОПАСНЫХ ПРЕДПРИЯТИЙ И НАСЕЛЕНИЯ, ПРОЖИВАЮЩЕГО ВБЛИЗИ ОБЪЕКТОВ АТОМНОЙ ПРОМЫШЛЕННОСТИ И ЯДЕРНОЙ ЭНЕРГЕТИКИ

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Резюме. *Цель исследования – анализ онкоэпидемиологической ситуации вблизи предприятий атомной промышленности и ядерной энергетики.*

Материалы и методы исследования. Основными материалами исследования являлись данные официальной медицинской статистики за 2012–2018 гг. о заболеваемости злокачественными новообразованиями (ЗНО) и смертности от них: контингента лечебных медицинских организаций (ЛМО) ФМБА России в 10 закрытых административно-территориальных образованиях (ЗАО) Госкорпорации «Росатом» – исследовательская выборка; всего контингента, обслуживаемого ЛМО ФМБА России – данные Федерального центра информационных технологий экстремальных проблем (ФЦИТЭП) ФМБА России; населения Российской Федерации в целом – данные Московского научного исследовательского онкологического института (МНИОИ) им. П.А.Герцена – филиала НМИЦ радиологии Минздрава России.

Углубленный анализ заболеваемости ЗНО и смертности от них среди работников предприятий и населения, обслуживаемых ЛМО ФМБА России, осуществлялся с использованием данных Отраслевого онкологического регистра ФМБА России.

Результаты исследования и их анализ. По результатам проведенного анализа отмечен рост заболеваемости ЗНО как по ЛМО ФМБА России в ЗАО, во всех ЛМО ФМБА России, так и по Российской Федерации в целом. В 2012–2018 гг. заболеваемость ЗНО (на 100 тыс. населения) составила: в ЗАО – 412,4 и 526,6 чел. соответственно; во всех ЛМО ФМБА России – 328,4 и 390,1; в Российской Федерации в целом – 367,3 и 425,5 чел. соответственно.

Анализ показателей смертности от ЗНО показал, что во всех ЛМО ФМБА России смертность от ЗНО (на 100 тыс. населения) в данном интервале времени составляла: 149,1 и 167,9 чел. соответственно, что значительно меньше общероссийских

показателей – 201,0 и 200,0 чел. соответственно. Смертность от ЗНО в ЗАТО составила 220,1 и 257,3 чел. соответственно, что превышает показатели как по всем ЛМО ФМБА России, так и по Российской Федерации в целом.

Ключевые слова: заболеваемость, закрытые административно-территориальные образования, злокачественные новообразования, лечебные медицинские организации, население, объекты атомной промышленности, объекты ядерной энергетики, работники радиационно опасных предприятий, смертность, ядерная энергетика

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Introduction

The Federal Medical and Biological Agency (FMBA of Russia) is a unique complex of specialized medical and scientific centers. It allows preserving health and ability to work of people whose professions bear extreme strains or health risks. One of the most important tasks of FMBA of Russia is the fight against oncological diseases and the reduction of overall mortality from malignant neoplasms. A particularly important component of this task is the reduction of premature mortality in working age.

According to the International Agency for Research on Cancer (IARC), the number of cancers is increasing worldwide. This is mainly due to an increase in life expectancy. By 2040, annual number of newly diagnosed cancers is projected to increase from 17.0 million to 27.5 million, an increase of 61.4%. About 40% of cancers can be prevented with structured primary prevention.

On the basis of numerous experimental and epidemiological studies, conclusions were made about the risk factors or etiological factors of tumor appearance. The main cause (90-95%) is lifestyle and environmental factors [1, 2]. These include: smoking and other forms of tobacco consumption; excessive body weight; low physical activity; diet rich in processed meats and meat and poor in fruits and vegetables; alcohol consumption; certain types of viral and bacterial infections; excessive exposure to sunlight; carcinogens in the workplace and in the air [3-5].

Occupational cancers account for 3-5% of the total number. And they can be prevented by taking measures of primary and secondary prevention, as well as by observing occupational hygiene [1, 6].

Monitoring level and dynamics of cancer incidence is necessary to assess the impact of ionizing radiation on the human body. This is the most important for medical professionals, workers at radiation hazardous enterprises, and the population living near nuclear industry and nuclear power facilities.

The carcinogenic effect of ionizing radiation has been proven by a number of epidemiological studies. They have been conducted among those who were exposed medically, in the workplace, during atomic weapons tests, accidents at nuclear power plants and other nuclear facilities, and, of course, during the atomic bombing of Hiroshima and Nagasaki [5-7]. But uncertainty remains in estimates of cancer risk in those who are exposed to long-term occupational sources of ionizing radiation. This points to the need for radiation and epidemiological studies among workers at radiation-hazardous enterprises and

population living near nuclear industry and nuclear power facilities [8-11].

The purpose of the study is to analyze the oncoepidemiological situation in the vicinity of nuclear industry and nuclear power plants.

Research Objectives:

1. Comparative analysis of the dynamics of cancer morbidity and mortality among patients of all medical treatment organizations of FMBA of Russia, among patients of medical organizations of FMBA of Russia in closed administrative-territorial formations of ROSATOM (research sample) and among the population of the Russian Federation as a whole in 2012-2018.

Analysis of the dynamics of morbidity and mortality from cancer by the following age groups: 0-19 years; 20-39 years; 40-59 years; 60-85 years and by nosological forms of the International Classification of Diseases, 10th edition (ICD-10).

Materials and methods of the study. The main materials of the study were the data of official medical statistics for 2012 – 2018 on the incidence of malignant neoplasms and mortality from them: contingent of medical organizations of FMBA of Russia from 10 closed administrative-territorial formations – research sample; total contingent served by medical organizations of FMBA of Russia – according to the Federal Center for Information Technologies of Extreme Problems of FMBA of Russia – form № 7 – Information on diseases with malignant neoplasms

An in-depth analysis of the morbidity and mortality from malignant neoplasms among employees of enterprises and population served by medical organizations of FMBA of Russia was performed using data from the Cancer Registry of FMBA of Russia.

To analyze the incidence of malignant neoplasms and mortality from them among workers of radiation hazardous enterprises and population living near nuclear industry and nuclear power facilities, we calculated and analyzed crude intensive (CR) rates of malignant neoplasms morbidity and mortality from them per 100 thousand population.

Results of the study and their analysis. According to the results of the statistical analysis, the growth of cancer morbidity in 2012-2018 was observed both for closed administrative-territorial formations (research sample), and for all medical organizations of FMBA of Russia and for the Russian Federation as a whole (Table 1, Fig. 1).

The dynamics of the incidence of malignant neoplasms (per 100 thousand people) among employees and the population of closed administrative-territorial entities (research

sample) serviced by medical institutions of FMBA of Russia in 2012-2018 was 412.4-526.5 people. It was 412.4-526.5 people and was higher than the dynamics of indicators for the Russian Federation as a whole (367.3-425.5 people), as well as of indicators for all medical institutions of the Federal Medical and Biological Agency of Russia (328.4-390.1 people).

A higher (4.2%) average annual growth rate of the incidence of cancer of all localizations was registered among the population of 10 closed administrative-territorial entities of FMBA of Russia as compared to that in all medical institutions of FMBA of Russia (2.9%) and in the Russian Federation as a whole (2.7%).

As for age-specific indicators of malignant neoplasms morbidity, as it has been previously noted in our investigations and in the works of other authors, the greatest number of cancer cases was observed in the senior age groups: 40-59 years — 23.3-26.6%; 60-85 years — 72.2-68.3% (Table 2, Fig. 2) [4, 6, 7, 9].

In our studies we also performed a comparative analysis of the dynamics of malignant tumor mortality rates among residents of closed administrative-territorial formations served by the healthcare institutions of the Federal Medical and

Biological Agency of Russia, among patients of all healthcare institutions of FMBA of Russia, and cancer mortality rates of the Russian Federation as a whole. The results are presented in Table 3 and Fig. 3.

As can be seen from the data presented in Table 3 and Fig. 3, the dynamics of cancer mortality (per 100,000 population) among patients of all medical institutions of the Federal Medical and Biological Agency of Russia in 2012-2018 was 149.1-167.9, which is significantly lower than the all-Russian rates: 201.0-200.0. This can be explained by earlier detection of diseases and the quality of medical care in the medical institutions of the Federal Medical and Biological Agency of Russia. The mortality rate from cancer (per 100 000 of population) among the residents of closed administrative-territorial formations over the period of time amounted to 220,1-257,3 persons. This exceeds the mortality rates both among patients of all medical institutions of FMBA of Russia and in the Russian Federation as a whole.

It should be emphasized that malignant neoplasms are heterogeneous diseases and both environmental and hereditary factors are involved in their development [3-5].

Our previous works have described the influence of lifestyle factors (smoking, alcohol), socioeconomic factors

Таблица 1/ Table No. 1

Динамика заболеваемости ЗНО (на 100 тыс. населения) пациентов ЛМО ФМБА России в ЗАТО; пациентов всех ЛМО ФМБА России и населения Российской Федерации в целом в 2012-2018 гг., чел.

The dynamics of cancer incidence (per 100,000 people) among patients of closed administrative territorial entities' medical facilities of FMBA of Russia; patients of all medical facilities of FMBA of Russia and population of the Russian Federation as a whole for 2012-2018, people

Контингент Contingent	2012	2013	2014	2015	2016	2017	2018	Среднегодовой темп прироста, % Compound annual growth rate, %
Пациенты ЛМО ФМБА России в ЗАТО Patients of closed administrative territorial entities' medical facilities of FMBA of Russia	412,4	436,3	486,4	458,1	450,2	496,8	526,5	4,15
Пациенты всех ЛМО ФМБА России Patients of all medical facilities of FMBA of Russia	328,4	325,0	355,5	345,8	359,6	375,1	390,1	2,91
Население Российской Федерации в целом Population of the Russian Federation as a whole	367,3	373,4	388	402,6	408,6	420,3	425,5	2,7

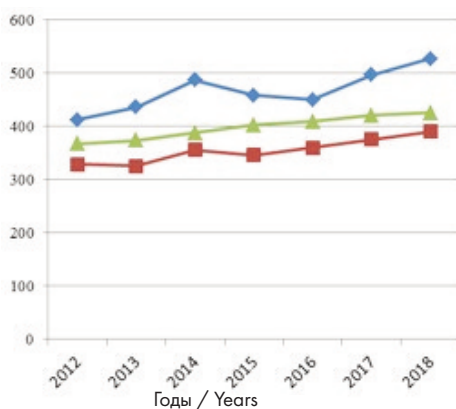


Рис. 1. Динамика заболеваемости ЗНО (на 100 тыс. населения) пациентов ЛМО ФМБА России в ЗАТО; пациентов всех ЛМО ФМБА России и населения Российской Федерации в целом в 2012-2018 гг., чел.

Fig. 1. Dynamics of the incidence of cancer (per 100 thousand population) of patients of the LMO of the FMBA of Russia in the closed city; patients of all LMO FMBA of Russia and the population of the Russian Federation as a whole in 2012-2018, people

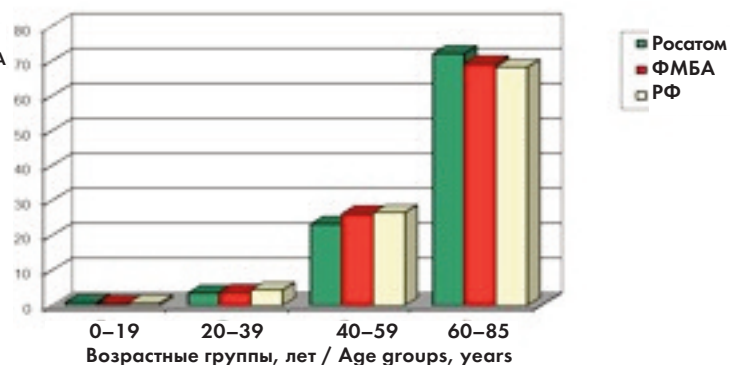


Рис. 2. Распределение по возрастным группам заболевших ЗНО среди пациентов ЛМО ФМБА России в ЗАТО; пациентов всех ЛМО ФМБА России и населения Российской Федерации в целом в 2018 г., %

Fig. 2. Distribution by age groups of cancer patients among patients of the LMO FMBA of Russia in the closed city; patients of all LMO FMBA of Russia and the population of the Russian Federation as a whole in 2018, %

Распределение по возрастным группам заболевших ЗНО среди пациентов ЛМО ФМБА России в ЗАТО; пациентов всех ЛМО ФМБА России и населения Российской Федерации в целом в 2018 г.

Incidence of cancers by age group among patients of closed territorial entities' medical facilities of FMBA of Russia, patients of all medical facilities of FMBA of Russia and population of the Russian Federation as a whole in 2018

Контингент Contingent	Число заболевших ЗНО, чел., всего Number of cancer patients, people, total	Заболеваемость ЗНО по возрастным группам, чел./% Incidence of cancers by age group, persons/%			
		0–19 лет 0-19 y.o.	20–39 лет 20-39 y.o.	40–59 лет 40-59 y.o.	60–85 лет 60-85 y.o.
Пациенты ЛМО ФМБА России в ЗАТО Patients of closed territorial entities' medical facilities of FMBA of Russia	3777	33/0,9	135/3,6	881/23,3	2728/72,2
Пациенты всех ЛМО ФМБА России Patients of all medical facilities of FMBA of Russia	10243	50/0,5	394/3,8	2699/26,3	7100/69,3
Население Российской Федерации в целом Population of the Russian Federation as a whole	624709	4389/0,7	27331/4,4	166229/26,6	426760/68,3

Таблица 3 / Table No. 3

Динамика смертности от ЗНО (на 100 тыс. населения) среди пациентов ЛМО ФМБА России в ЗАТО; пациентов всех ЛМО ФМБА России и среди населения Российской Федерации в целом в 2012–2018 гг., чел.

The dynamics of mortality from cancer (per 100,000 people) among patients of closed administrative territorial entities' medical facilities of FMBA of Russia; patients of all medical facilities of FMBA of Russia and population of the Russian Federation as a whole for 2012-2018, people

Контингент Contingent	2012	2013	2014	2015	2016	2017	2018	Среднегодовой темп прироста,% Compound annual growth rate, %
Пациенты ЛМО ФМБА России в ЗАТО Patients of closed territorial entities' medical facilities of FMBA of Russia	220,1	219,1	232,8	226,1	245,6	241,9	257,3	2,6
Пациенты всех ЛМО ФМБА России Patients of all medical facilities of FMBA of Russia	149,1	143,0	154,5	154,0	168,3	172,6	167,9	2,0
Население Российской Федерации в целом Population of the Russian Federation as a whole	201,0	201,1	199,5	202,5	201,6	197,9	200,0	0,1

and environmental factors, including occupational exposures on the occurrence of malignant diseases and mortality from them — both on patients of medical institutions of FMBA of Russia and on the population of the Russian Federation as a whole [12].

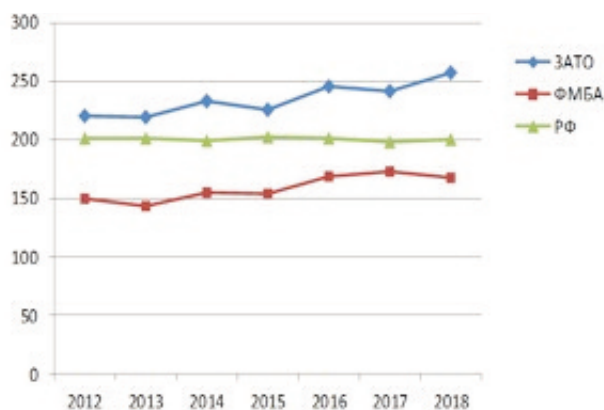


Рис. 3. Динамика смертности от ЗНО (на 100 тыс. населения) пациентов ЛМО ФМБА России в ЗАТО; пациентов всех ЛМО ФМБА России и населения Российской Федерации в целом в 2012–2018 гг., чел.

Fig. 3. Dynamics of mortality from malignant neoplasms in patients at medical facilities of the ZATO, FMBA and the RF for 2012-2018

In 2018, in the structure of mortality from malignant neoplasms (ICD-10) in medical institutions of FMBA of Russia, the largest share of tumors were of trachea, bronchi, lung (13.7%), stomach (10.3%), colon (9.1%), breast (8.7%), rectum, rectosigmoid junction, anus (6.3%), prostate (5.4%), lymphoid and hematopoietic tissue (5.3%). In the Russian Federation as a whole in 2018 the structure of population mortality from cancer was similar [13].

Conclusion

A study of the morbidity rates for malignant neoplasms of the employees of enterprises, organizations and attached population served by medical institutions of FMBA of Russia showed that they slightly differ from the all-Russian rates: the morbidity rate of this population is lower than in Russia as a whole. The ratio of morbidity in closed administrative-territorial entities/institutions of the Federal Medical and Biological Agency of Russia as a whole is 1.3; FMBA of Russia/Russian Federation as a whole is 0.9.

The dynamics of cancer mortality in the FMBA health care institutions in the studied time interval was 149.1-167.9, which is significantly less than the all-Russian figures of 201.0-200.0.

An analysis of the cancer mortality rates of employees of enterprises, organizations and attached population served by medical institutions of FMBA of Russia also revealed positive trends: the level of overall mortality (the number of deaths per 100 thousand people) among the contingent served by institutions of FMBA of Russia was significantly lower than in Russia as a whole — the ratio for mortality of FMBA of Russia / Russian Federation as a whole — 0.47.

As for age-specific indicators of cancer morbidity in the contingents under study, we can note that, as in the Russian Federation as a whole, the greatest number of malignant neoplasms was observed in the older age groups: 40-59 years: 23.3-26.6%; 60-85 years: 72.2-68.3%.

Thus, the incidence of malignant neoplasms grew in all study groups at approximately the same rate — the growth rate was statistically significantly different from 0 and was about 3% per year.

Mortality rates from malignant neoplasms were also within the described trends.

The greatest attention is attracted by the "leadership" of the population of closed administrative-territorial formations in terms of morbidity and mortality in comparison with all medical institutions of FMBA of Russia and the population of the Russian Federation as a whole. We would like to warn our

readers against making radiophobic conclusions: there are no radiation risks there! We mentioned this when describing the contribution of the radiation factor to the carcinogenic situation [12]. It is the population of closed administrative-territorial formations, as a community unique in its mental, national, professional and qualification characteristics, that is the main point of application of FMBA's efforts to improve health, to prevent and to rehabilitate diseases. It is by improving the quality of life and saving active professional longevity that the average age of the population there is higher than the average age of Russia as a whole, and 72.2% of malignant neoplasms occur in the age group of 60-85 years.

The conducted studies testify to the fact that further cancer control as an important strategic direction in the activity of the Federal Medical and Biological Agency should be based on the understanding of the complex carcinogenic environment of the industrial and domestic sphere as an integral danger of damage to human health. This dictates the need to improve the practice of hygienic regulation in the conditions of normal operation of radiation hazardous facilities, taking into account domestic experience and international norms and rules. It also requires introduction of new effective forms of organization and management of sanitary and epidemiological well-being.

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