

Cohort Formation for Epidemiological Study of Medical Consequences of the Chernobyl Accident

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Abstract. Belarus State Registry of the Chernobyl-affected population contains information about 276 000 residents of the Republic of Belarus exposed due to the Chernobyl NPP accident. Evidently, the population who lived in the evacuation zone was exposed mostly to radiation and also people participating in the liquidation of the Chernobyl accident consequences (emergency workers) within this zone in early post accident period of the catastrophe. Taking into account this criterion, we singled out the group out of all data files including all people who stayed in the evacuation zone not later than on May 31, 1986. The total number of the group made up 39 548 people including 4 251 people who were under 18 at the moment of the accident. By preliminary estimation the number of person-years taking into account the deceased and left out of observation made up at the beginning of 2007- 735 600. During the period since 1986 there was detected 2 671 cases of malignant tumors in the cohort and among people who were children and adolescents in 1986 there was registered 106 cases of malignant tumors (82% -thyroid cancer). Among 7 483 of the deceased, malignant tumors is the cause of death at 1 260 people. At present the real number of alive and remained subjects under observation makes up 25 359 people including 2 321 people who were under 18 at the moment of the accident. This group will form the base for further prospective research aiming at assessment of medical consequences of the Chernobyl NPP accident.

KEY WORDS: *Belarusian State Registry, evacuation zone, malignant tumors, thyroid cancer.*

1. Introduction

In the Republic of Belarus specialized medical follow up over all groups of the affected population is conducted through regular mass medical examinations. Annual individual medical data for over 1.5 millions individuals are collected by 201 regional departments and accumulated in the database of the Belarus State Registry of Population Exposed to Radiation as a Result of the Chernobyl Accident (Chernobyl Registry).

Data of the Chernobyl Registry are required for making decisions. They are used for scheduling of treatment and rehabilitation measures, development of long-term programs of medical rehabilitation, and regulatory documents for social protection of population exposed to radiation due to the Chernobyl accident.

On the other hand these data serve as a ground for studying medical-biological effects of the accident. By now, as a result of twenty years follow up over the cohort of the affected population one could state the following:

- There was proved radiation-induced nature of excess thyroid cancer incidence in individuals exposed to iodine radionuclides in childhood and adolescence. Thyroid cancer incidence continues growing steadily among adult population of Belarus. Due to early diagnostics and timely medical intervention possible lethal outcomes caused by thyroid cancer have been brought to minimum.
- Recently conducted studies still have not demonstrated direct relationship of the effect of accidental radiation and increased rate of other diseases except thyroid cancer. At that we should consider short period of time passed since the end of theoretically minimal latent period.
- Among the most exposed cohort of liquidators excess growth of such malignant tumors as of lung, bladder, skin, and stomach has been recorded vs. control group. The risk to have malignant tumors of all sites in liquidators is 23% higher than in non-exposed population: stomach cancer – 15%, colon – 33%, lung cancer – 26%, urinary bladder – 65%, kidney – 24%, thyroid – 2,6 times.

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- In children resided in radionuclides contaminated areas of Gomel and Mogilev regions in 1993-2003 vs. pre-accidental period growth of leukemia including Hodgkin disease and non Hodgkin lymphoma was not recorded. However these regions showed incidence growth of all forms of chronic leukemia for population in general and significant growth of non- Hodgkin lymphoma incidence.

- Special attention should be paid to recorded mostly among cleanup workers growth of cataract incidence.

- Serious concern is caused by the significant growth of diseases specified by hypertension, cerebrovascular disorders, myocardial infarction, thyroid pathologies among able-bodied liquidators and population resided in radionuclides contaminated territories [1].

2. Materials and Methods

Belarus State Registry is the instrument for conducting radiation-epidemiology study [2].

Belarus State Registry of the Chernobyl-affected population contains information about 276 000 residents of the Republic of Belarus exposed due to the Chernobyl NPP accident.

Evidently, the population who lived in the evacuation zone was exposed mostly to radiation and also people participating in the liquidation of the Chernobyl accident consequences (emergency workers) within this zone in early post accident period of the catastrophe. Besides this group of population the most affected stress: evacuation, closeness to the Chernobyl NPP, duty to take part in the emergency actions.

A stay in the zone of evacuation in the first after-accidental months had been accepted as a main criteria for formation of cohort for epidemiological study of medical consequences of the Chernobyl accident.

Taking into account this criterion, we singled out the group out of all data files including all people who stayed in the evacuation zone not later than on May 31, 1986. The total number of the group made up 39 548 people including 4 251 people who were under 18 at the moment of the accident.

3. Results and discussion

By preliminary estimation the number of person-years taking into account the deceased and left out of observation made up at the beginning of 2007- 735 600 .

As of 01.01. 1996 in Belarus the status of liquidators (emergency workers) had 113000 persons, from them 91000 person have been included in the Chernobyl registry. The analysis of the data of the registry has shown that about 9% of liquidators have official records about doses of an exposure that change in a wide range. The maximal doses of an external exposure were received by liquidators of 1986 – the average dose was 60 mGy, at 95th percentile was equal 138 mGy (Table 1) [2].

Table 1. Distribution of Doses Received by Belorussian liquidators (emergency workers)

Period of work	Number of liquidators	Share of persons with known dose, %	External dose ^a , mGy			
			Average	Median	75% percentile	95% percentile
1986	68 000	8	60	53	93	138
1987	17 000	12	28	19	29	54
1988	4 000	20	20	11	31	93
1989	2 000	16	20	15	30	42
1986-1989	91 000	9	46	25	70	125

^a for convenience external dose is expressed in mGy.

The majority of liquidators in 1986-1987 received doses not exceeded 100 mGy (80% in 1986 and 96 % – in 1987). It is shown in Table 2.

Table 2. Distribution Liquidators (emergency workers) by the Dose Intervals

Dose Interval, mGy	Number of liquidators by years			
	1986	1987	1988	1989
0-50	2539	1943	865	387
50-100	1656	183	37	8
100-250	1027	78	10	7
250-500	47	4	1	1
Total	5269	2208	913	403

108 Belarus settlements with 24600 inhabitants had been evacuated in the first half of 1986. Distribution of individual external dose, received by evacuated Belarus inhabitants for the first year after the accident, shows that the doses for the majority of individuals not exceed 50 mSv (Table 3).

Table 3. Distribution of Belarus evacuated inhabitants by individual external dose intervals

Dose, mSv	0-50	50-100	100-200	200-400	>400
Number of inhabitants	21347	2286	800	244	28

In general, exposure dose received by evacuees depended on the date of evacuation. (Table. 4) [3].

Table 4. Average doses of evacuated population in dependence of the date of evacuation in 1986

Stage of evacuation	Absorbed thyroid dose from iodine-131, Gy	Effective dose	
		Internal exposure from cesium-137, mSv	External exposure, mSv
2-7 May	1,33	2,1	31,2
3-10 June	1,04	1,6	15,9
August-September	0,66	0,9	20,3

The results of dose assessment shows that the most exposed contingent of affected inhabitants was evacuated in the first (initial) period.

Thus, distributions of dose in evacuees and liquidators (emergency workers) in the forming cohort are similar. 2358 persons from evacuated inhabitants and 2730 liquidators-1986 had doses more then 50 mGy. If we suppose that a kind of dose distribution both in liquidators with known dose be the same both in liquidators without any official records on dose, then practically all subjects from already had been formed cohort would be given a dose characteristic. Such, the cohort become suitable for conducting long-term radiation epidemiological study.

In whole group consist of 29152 residents. Age distribution in cohort is shown on the figure 1. It corresponds age distribution in Belarus population in 1986. The last allow to conduct a correct study of oncology and non-oncology morbidity in the cohort in comparison with the whole population, not been involved in the accident.



Fig. 1. Distribution of cohort subjects by age

Oncology and non-oncology morbidity in the cohort had been followed (studied) (Table 5).

Table 5. Number of malignant tumors and structure of oncology morbidity in the cohort

Показатель	Female		Male	
	N	%	N	%
Number of Group	11752	-	17400	-
Number of cases of cancer morbidity:	671	100	1266	
Thyroid cancer, C73	83	12,4	69	5,4
Stomach cancer, C16	65	9,7	170	13,4
Bowels cancer, C18	17	2,5	36	2,8
Lung cancer, C34	13	1,9	211	16,7
Skin cancer, C44	78	11,6	116	9,2
Breast cancer, C50	99	14,7	4	0,3

4. Conclusion

Presented materials shows, that preliminary results of analyses of cancer morbidity, taking in account a duration of control (observation) and information about individual doses, allowed to conduct analyses of radiation risk of stochastic effects in cohort persons.

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