

Dynamics of Health Status of Residents in the Lugyny District after the Accident at the ChNPS

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Introduction

The Lugyny district lies in the northern part of the Zhytomyr region of Ukraine within 110-150 km from the Chernobyl nuclear power station (ChNPS). Its territory is crossed by the southern and south-western tracks that were formed by the Chernobyl accident in April 1986. The total territory of the district constitutes approximately 900 km², the territory of agricultural land — more than 300 km², and about 190 km² of them arable land. Practically all agricultural land in the district have the ¹³⁷Cs contamination density higher than 1 Ci/km² (Table 1).

Prior to the Chernobyl accident about 30 thousand residents were living in the Lugyny district. By the present moment the population of the district has dropped to approximately 22 thousand people due to resettlement from the most contaminated territories and the decrease in the birth-rate (Table 2).

1. Radiation situation within the Lugyny district

All settlements of the Lugyny district (50 in total) according to [1] are categorised as zones of radioactive contamination II, III and IV (see Table 3), and practically all population are qualified for different categories of the accident sufferers (Table 4).

Local authorities constantly have been taking measures to resettle the inhabitants in the zone of obligatory resettlement (zone II). However, many of these inhabitants refuse to leave, others return to their homes after resettlements. The number of resettled from the 1st of January 1996 to the 1st of July 1997, as well as the number of inhabitants of 4 settlements in the zone of obligatory resettlement on the 1st of July 1997, are given in Table 5.

In 48 settlements of the Lugyny district, i.e. in all except the completely resettled Granitny Karier, and Moschanitsa where only 5 inhabitants are remaining, a regular dosimetric monitoring of lands is performed.

Table 1. Territory of agricultural land of the Lugyny district with different ¹³⁷Cs contamination density levels, km²

Contamination density Ci/km ²	Agricultural land	
	Total agricultural land	Arable land
up to 1	5	2
from 1 to 5	283	162
from 5 to 15	42	25
higher than 15	02	1
Total	332	190

Table 2. Population of the Lugyny district in 1984-1996

Years	Total	Children total	Infants under 1 year
1984	30,049	6,536	445
1985	29,575	6,500	401
1986	29,276	6,500	456
1987	29,225	6,296	296
1988	28,467	5,809	359
1989	27,962	5,819	300
1990	27,420	5,595	200
1991	25,046	4,799	317
1992	24,803	4,643	335
1993	24,883	4,700	352
1994	23,903	4,525	304
1995	23,125	4,389	264
1996	22,552	4,327	269

Table 3. Number of settlements and population size in territories categorised as different zones of radioactive contamination

Zones	Number of settlements	Number of inhabitants
Zone of obligatory resettlement (zone II)	4	314
Zone of guaranteed voluntary resettlement (zone III)	35	18,815
Zone of intensified radio-ecological control (zone IV)	11	3,423
Total	50	22,552

Table 4. Number of inhabitants of the Lugny district qualifying for different categories of sufferers

Categories	Total number of inhabitants	Children
I	232	49
II	18,949	2,666
III	3,173	608
Total	22,354	4,323

Table 5. Number of inhabitants of settlements in zone II by 01.07.97

Settlement	Number of inhabitants resettled from 01.01.96 to 01.07.97	Number of inhabitants remaining on 01.07.97
village Malahovka	34	64
village Rudnya Povtchanskaya	22	194
village Rudnya Zherevtsy	13	51
village Moschanitsa	2	5
Total	71	314

According to its results, the registered annual dose rate (Fig. 1), in 7 settlements of the district does not exceed 0.5 mSv/year, i.e. the critical limit of qualifying as zone of intensified radiological control. None of the registered dose rate reach the value to be qualified for of obligatory resettlement (>5mSv/year). 22 and 19 settlements are qualified to be zones of guaranteed voluntary resettlement and intensified radiological control, respectively.

Regular examinations of inhabitants in settlements qualified for zones of radioactive contamination are performed with use of whole-body counters. Within the

8-year period (from 1989 to 1996) a total of 33,085 adults and 11,016 children has been examined. Radionuclide accumulation exceeding the control norm is found by 3,026 adults and 1,029 children (Table 6). The control norms of ¹³⁷Cs in the organism are 0.5 μCi for adults and 0.2 μCi for children.

Dynamics of the relative number of cases with ¹³⁷Cs accumulation in organism of adults and children in excess of the control norms is indicated in Fig.2. A significant increase is observed in 1994 in the background of a general trend towards a decrease. Such splash is explained in the first place by changes

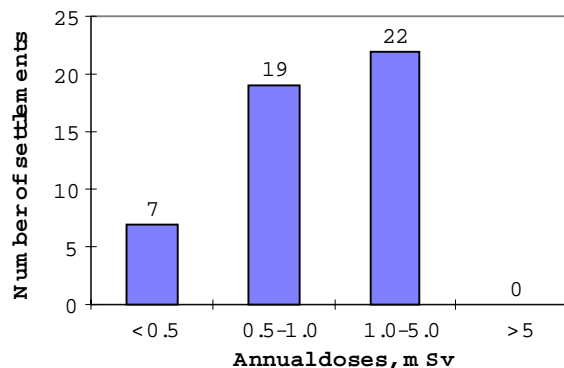


Fig. 1. Number of settlements of the Lugny district which fit the criteria to be qualified for different zones of radioactive contamination (according to [2])

Table 6. Results of dosimetric control of internal irradiation of the district population living in settlements with soil contamination from 5 to 15 Ci/km² and higher

Years	Number of examined persons		Found with dose exceeding norm, persons		Found with dose exceeding norm, %		
	Adults	Children	Adults	Children	Adults	Children	Total
1989	3,198	696	417	103	13	14.7	13.3
1990	8,432	2,296	809	280	9.5	12.1	10.2
1991	5,550	2,685	603	192	10.8	7.1	9.6
1992	3,892	1,636	432	186	11.1	11.3	9.3
1993	3,164	1,037	167	42	5.2	4	4.9
1994	2,156	534	372	164	17.2	30	19.9
1995	1,697	1,415	41	38	2.4	2.6	2.5
1996	4,996	717	185	24	3.7	3.3	3.6

Table 7. Results of dosimetric examination of the internal irradiation of the inhabitants of the district, living in settlements in zones II-IV

Year	Zone II		Zone III		Zone IV	
	Total	With excessive dose	Total	With excessive dose	Total	With excessive dose
1996	155	103 (66%)	4,755	104 (2%)	803	2 (0.2%)
1997	24	3 (13%)	1,749	21 (1%)	283	-

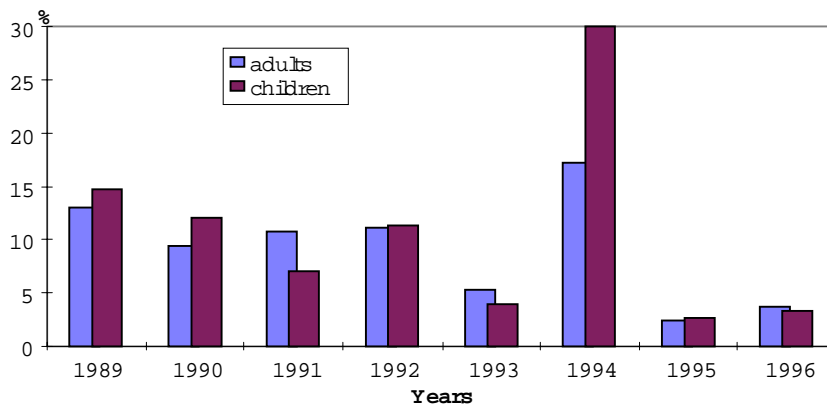


Fig. 2. Dynamics of changes in the relative number of cases with ¹³⁷Cs accumulation in organism of adults and children in excess of the set control values

in natural conditions, in particular in the rainfall amount and cropping capacity of wild mushrooms and berries. According to the data of radiometric control of foodstuffs in the district, radionuclide accumulation in human organisms is contributed by consumption of milk, mushrooms and berries by the population of the district. Excess of all-union Tentative Acceptable Levels (TAL-91) is 3-5% for milk, 1-5% for meat, 50% for mushrooms and berries for the period of 1993-1995.

Comparison of the internal irradiation dose year by year shows the following: until 1990 maximal registered values of ¹³⁷Cs in adults exceeded 10 µCi, and beginning from 1991 the maximal values in general constituted 2 µCi in adults and 0.6 µCi in children.

According to the data of the UKP "Truskavets"¹ 2,020 children and parents living in the radiation contaminated territory of the district have been examined. In 80% of children the radio-caesium activity was found to be higher than 1,000 Bq, in 15% — higher than 5,000 Bq.

The relative number of inhabitants with excessive ¹³⁷Cs accumulation is significantly higher in zones with higher levels of radioactive contamination (Table 7).

According to the data of the thyroid dosimetric conditioning of settlements in the Zhitomir region performed by the UNCRM in 1994 by the request of the Ministry of Chernobyl of the Ukraine, inhabitants of the Lugny district had received high thyroid

¹ "Truskavets" is a resort in the Carpathians which receives children from zones of radioactive contamination for recreation in summertime.

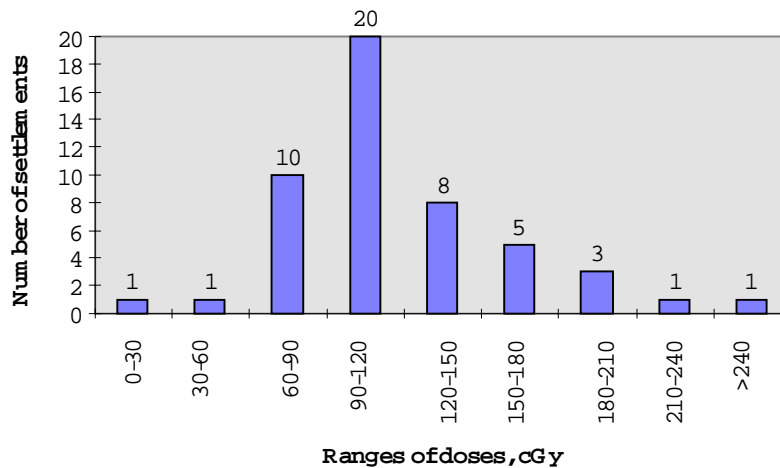


Fig. 3. Distribution of the number of settlements in the Lugyny district according to thyroid irradiation doses for children born in 1986 (according to [3])

irradiation doses during the first stage after the accident, especially children (Fig. 3). In 38 of 50 settlements in the Lugyny district thyroid irradiation doses by children born in 1986 exceed 90 cGy.

The population is divided into seven age-groups in the thyroid dosimetric registration and the relative distribution of thyroid irradiation doses for different age-groups of the population residing in the same settlement is given in Fig. 4.

2. Health status indices of the Lugyny district

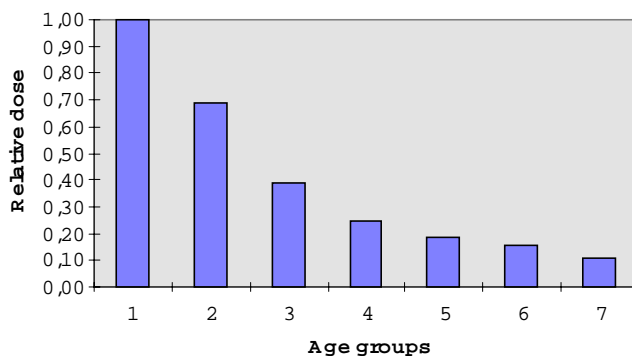
The medical system of the former Soviet Union was succeeded by the Ukraine, as well as its merits and demerits. It constitutes one kind of hierarchy structure of medical institutions, ranking from national medical centres down to hospitals in regions, districts, and towns (villages). Within the structure of this system, one central hospital is distributed in each district. In the Lugyny district we can, therefore, collect all medical information of the population at the Hospital of the

Lugyny Territorial Medical Association (which is the central district hospital) district where one of the present authors is working.

As indices of the health status, we shall analyse state of the immune system, spread of endocrine pathologies, morbidity by newly-born, psycho-neurological status of the population, premature ageing, and structure of mortality.

The immune system

The state of the immune system is one of the most important indices of the health status. According to the data of the Central District Hospital of the Lugyny district, depression of reactivity of the immune system is found practically by all patients. This depression is clinically manifested through the increase in the number and duration of infectious diseases, growth of destructive forms of tuberculosis, relapse of diseases, increase in the number of frequently ill people, reduction of remaining life of oncology patients after



Group	Year of birth
1	1986
2	1983-1985
3	1979-1982
4	1975-1978
5	1971-1974
6	1968-1970
7	before 1968

Fig. 4. Relative thyroid gland irradiation doses for different age-groups of inhabitants residing in the same settlement

Table 8. Remaining life of patients in the Lugyny district with grade III-IV malignant tumours of the stomach and lungs after the moment of diagnosis before and after the Chernobyl accident, (in months)

Years	Remaining life by cancer	
	stomach	lungs
1984	62	38
1985	57	42
-	-	-
1992	15.5	8.0
1993	11.0	5.6
1994	7.5	7.6
1995	7.2	5.2
1996	2.3	2.0

Table 9. Dynamics of the number of the first detected tuberculosis cases in the Lugyny district, per 100 thousand inhabitants

Years	All forms, per 100 thousand inhabitants	Destructive forms among first detected cases, %
1985	75.8	17.2
1986	84.5	28.7
1987	64.0	17.7
1988	54.7	14.5
1989	91.2	37.5
1990	12.2	66.6
1991	28.4	42.3
1992	49.8	33.3
1993	53.9	54.5
1994	59.8	50.0
1995	73.3	50.0
1996	84.0	41.7

their diagnosis, a more severe course of diseases, increase in virulence of infecting agents, as well as growth of the number of allergic diseases.

Investigation of medical records of the patients suffering from malignant tumours has disclosed the following regularity: after the accident at the Chernobyl NPS the remaining life of such patients after the moment of their diagnosis decreases with every year. Before the accident, in 1984-1985 the remaining life of patients with grade III-IV cancer of stomach was about 60 months after the moment of diagnosis, with grade III-IV pulmonary tumours — about 40 months. In 1992 the remaining life made up 15.5 months in the case of grade III-IV cancer of stomach and 8 months in the case of grade III-IV lung cancer, and in 1996 — 2.3 and 2 months (!!!) respectively (Table 8). At the same time the detection techniques, diagnostics and treatment remain at the level of the pre-accident years.

Where does the reason of such difference in the remaining life lie? The importance of the immune system for viability of organism has become especially evident after the accident at ChNPS. The immune system plays an important role in maintenance of stable internal environment of the organism and is involved in anti-tumour protection. Effects of radiation expose the immune system to extreme stress with subsequent development of immune deficiency, which in turn results in progressing of malignant diseases, as well as

in contraction of incurable infection and associated diseases, that are generally the cause of death of such patients

Special concern of physicians is also caused by the growth of the number of destructive forms of tuberculosis among the first detected tuberculosis cases (Table 9), which is also an evidence of the depression of the immune system.

By an order of the administration of Health Care authorities, the number of roentgeno-photography examinations in the framework of sanitary observation programmes was sharply decreased in 1990 in order to prevent unjustified additional irradiation of the population. Namely this fact explains the drop in the number of the first detected tuberculosis cases in 1990 as compared to the previous year (Table 9). The drop in 1990 was not the actual decrease in the number of tuberculosis patients. Subsequently, after renovation of the roentgeno-photography rooms and installation of more up-to-date equipment, the roentgenography examinations have been resumed to the initial extent.

Endocrine pathology

Endocrine pathology includes diffuse goitre, nodular goitre, diabetes mellitus, liposis and others. Special concern is the growth of endocrine pathology in children. Beginning from 1990-1991 a stable increase in the number of endocrine system diseases in

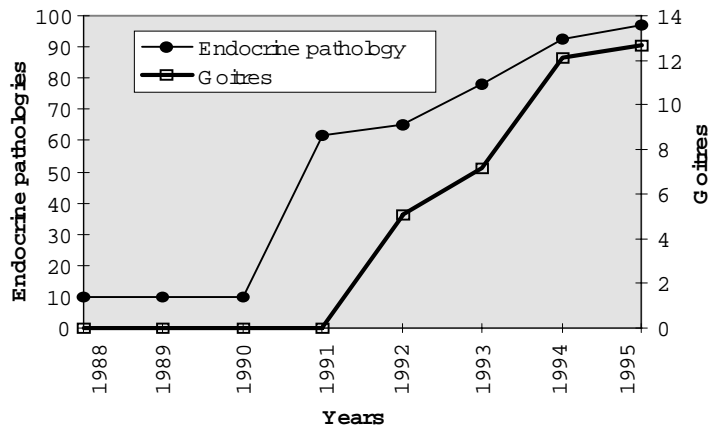


Fig. 5. Dynamics of the growth of endocrine pathology and goitres in children after the Chernobyl accident (per 1,000 children)

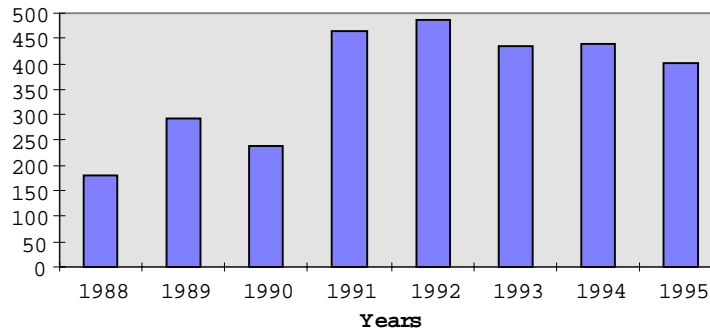


Fig. 6. Dynamics of the number of thyroid gland hyperplasia in children (per 1,000 children)

children is observed (Fig. 5). Prior to 1986 morbidity of endocrine pathology did not exceed 10/1000. Nodular and diffuse goitres had not been registered in the district at all. By analysis of thyroid morbidity, it is noted that the sufferers are mainly children who were subject to the iodine strike in 1986, when no prophylactics was performed. Iodine potassium prophylactics was started 3 weeks after the accident. Thyroid gland pathology is also observed in adults. Unfortunately, there are practically no medical facilities and financial means to conduct specialised examinations of the population aimed at detection of nodular goitre. Tumours of thyroid gland have not been registered within the period since the accident. However, a significant increase in the number of thyroid gland hyperplasia is established (Fig. 6). Hyperplasia (enlargement) of thyroid gland is not an illness proper, but indicates the reaction of the organism to external injurious effects. Before 1988 hyperplasia of thyroid gland was not registered in the district; at present it is typical of almost half of the children in the district.

Morbidity in newly-born

A growth of the morbidity in newly-born (age of up to 7 days) is marked after the Chernobyl accident, as well as the number of their anomalies (Fig. 7). Dynamics of newly-born anomalies (they are cleft lip, atresia of internal organs), shows a more complex

tendency in the post-accident period. However, as Fig. 8 shows, their average level in the period after 1988 is several times as large as the pre-accident level.

Psycho-neurological disorders

Of the most important problems which physicians had to face suddenly and which have been continuously aggravated — is psychological pathology. More and more patients go to physicians with anxiety-depression syndromes and different phobias. Predominant symptoms are neurosis-like conditions, and asthenic and psycho-chondric symptoms that are manifested by way of anxiety, fear and emotional imbalance.

Apparently, as a result of the combined effect of ionising radiation and psycho-emotional stress on the organism, its homeostasis is impaired and an endogenic intoxication emerges, which are leading to psycho-neurological disorders. It is possible as well that low radiation doses determine dysfunction of brain structures, which are being manifested through significant increase of vegeto-vascular dystonia with diencephalic syndromes. Before the accident, practically no cases of vegeto-vascular pathology were registered. At present, this pathology is one of the most widespread causes for people to see physicians.

Physicians faced the problem of psycho-neurological disorders only in the last 4 years.

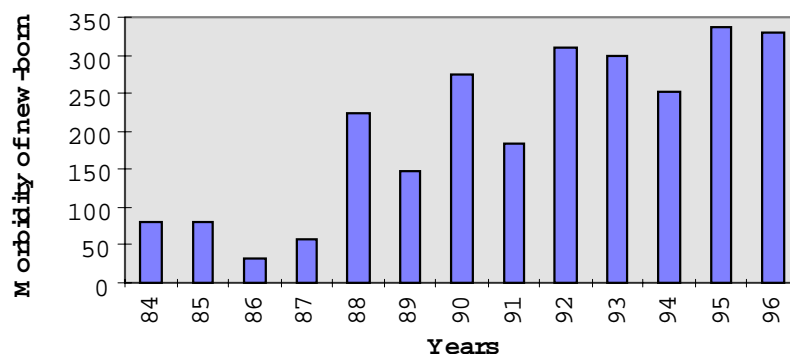


Fig. 7. Morbidity in newly-born (age of up to 7 days), including inherent development anomalies in children (per 1,000 newly-born)

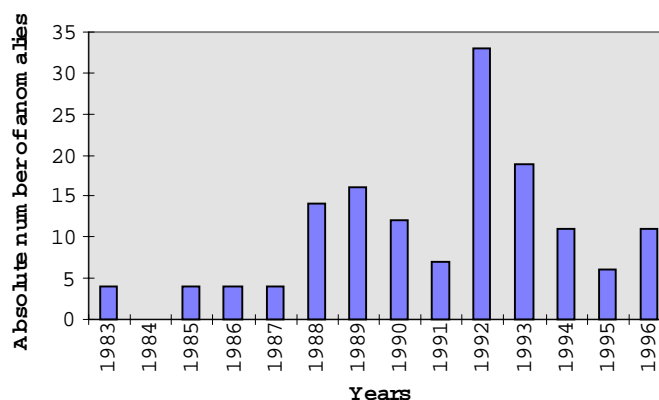


Fig. 8. Dynamics of inherent development anomalies in newly-born (absolute number)

Today, one needs to realise the responsibility to cope with these psychosomatic disorders and diseases because an increase in the number of suicides and severe psychic diseases is to be expected in the future.

Premature ageing

In the course of life process, more and more cells are decaying due to effects of internal and external irradiation factors. This leads to premature ageing and shortening of life span. The fact of early ageing is confirmed by markers of ageing in younger ages. These markers include different tests that determine capabilities of all systems of the organism, e.g. for the cardiovascular system — blood pressure, rapid pulse in young ages, statistically reliable increase in the number of hypertension and ischemic cases in young ages; for nervous system — increase in the number of anxiety-depression syndromes, phobic neurosis-like conditions arising on somatic grounds and others. All of these phenomena can be easily checked in clinical observation.

What has been influencing on the increase of ageing pathologies and associating premature deaths? The major factors are — the increased level of radiation and presence of permanent stress situations. Mechanisms of the effects of these factors are practically the same: their direct or indirect impact on the systems and organs impairs metabolism and circulation of blood, which results in dystrophic

processes in organs and systems of the organism determining premature ageing and death. Average life-expectancy of the Lugyny district population before the accident at the Chernobyl NPS (1984, 1985) has been 75 years, after the accident (1990-1996) — 65 years.

Mortality structure

According to the mortality data, after the accident death has become 10 years "younger" than before the accident and the mortality peak falls on the age of 65-69 years (Fig. 9). Women live approximately 8 years longer than men. The total mortality of the population in 1985 in the district was 10.9 per 1,000 inhabitants with maximum mortality in the age of more than 80 years. Oncologic diseases occupied the third place in the mortality structure with an index of 0.7. The first and second places were occupied by cardiovascular diseases (6.5) and diseases of the respiratory organs (1.7), respectively. In the age structure of mortality a smooth rise of the curve was found to the 80-years age in both men and women, with a 10 year longer life expectancy for women.

In 1990 the total mortality was 12.9 per 1,000 inhabitants. As seen in Fig.9, a mortality increase of step character can be noted in the 50-54 years interval (0.8 per 1,000), and a second peak in the 65-69 years interval (1.9). As compared to 1985, the life-expectancy for men in 1990 has dropped by 10

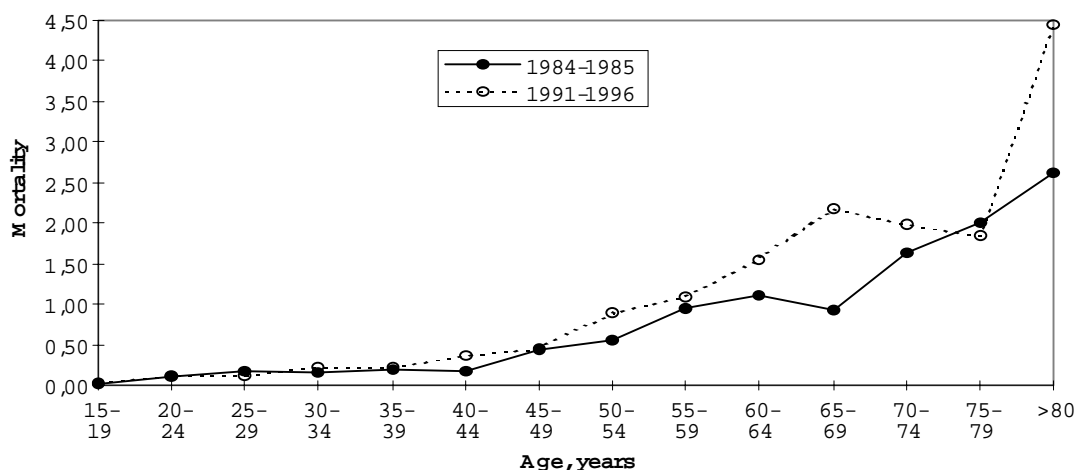


Fig. 9. Age structure of mortality in the Lugny district in the pre- and post-accident periods

years. In the case of women, the mortality curve is still smoothly rising with a peak on the 65-69 years interval. The life-expectancy for women was 10-15 years longer than for men. Mortality from oncologic diseases was 1.9 per 1,000 inhabitants and moves to the second place after cardiovascular diseases (5.7).

The total mortality in 1991 has increased and was 15.5 per 1,000 inhabitants. The mortality curve of men sharply stepped up with a peak in the 50-54 years interval (0.8) and kept the increased level till 65-69 years. In women the mortality curve is still smoothly rising with a peak on the 60-64 years. On the average, the life expectancy for men was 15 years shorter than for women. Mortality from oncologic diseases occupied the second place (1.6) after cardiovascular diseases (7.3).

The age-profile of mortality of men in 1990-1992 as compared to 1985 clearly indicated that death came 15 years earlier in men than in 1985. Peak of the mortality curve of men has moved to younger ages, indicating that more younger men will die in the future. As far as mortality of women is concerned, the mortality curve has been moving slower and in comparison with 1985 the life expectancy was 5-8 years shorter.

Conclusion

At first it should be noted that the *immune system* of inhabitants in the Lugny district is depressed. This fact is indicated by the followings: drop in remaining life of oncologic patients, reduction of the periods between stages of oncologic diseases, a more severe course of diseases, increase in the destruction of lungs on the background of growth of tuberculosis of lungs, increased morbidity of children, and increase in the number of infectious diseases.

The *increase in the number of nodular goitres in the background of a significant growth of thyroid gland hyperplasia in children* occupies the second place.

In the third place is a yet incomprehensible for us physicians *psycho-neurological aspect with its anxiety-phobic depression syndromes*, which will lead to unpredictable consequences in future.

A *growth of the morbidity in newly-born* is established, to be more exact — the prenatal morbidity of the foetus (e.g., inherent pneumonia, etc.).

More and more cases of vegeto-vascular dystonia with diencephalic syndromes are registered.

Premature ageing and a significant reduction of life expectancy is found in inhabitants of the district.

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