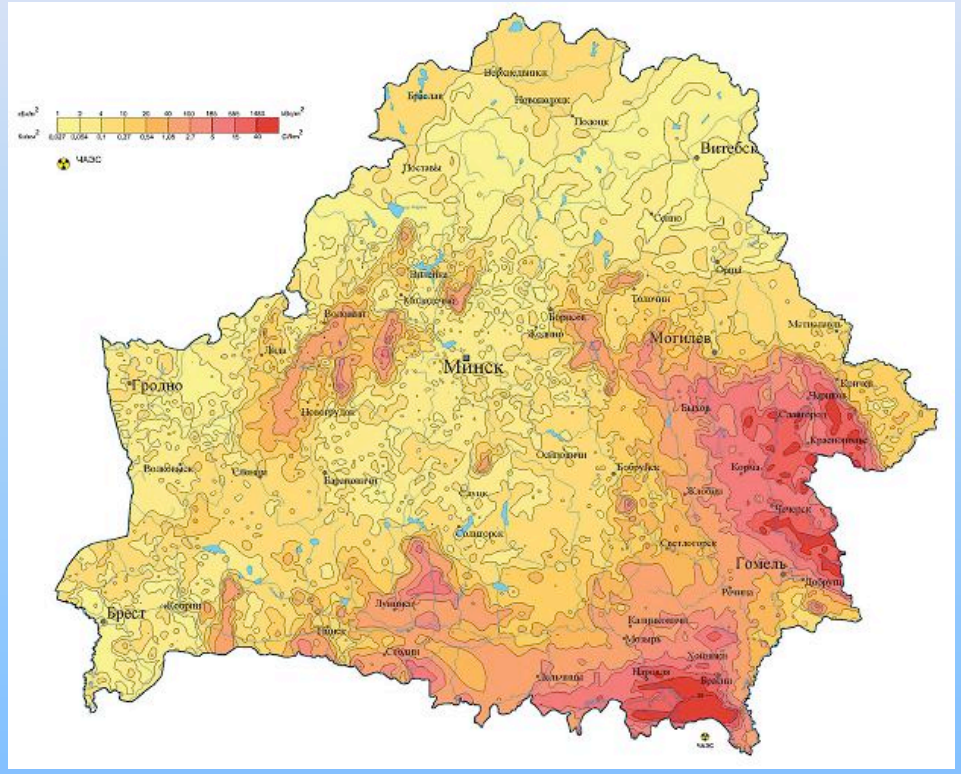
Non cancer illnesses and conditions in areas of Belarus contaminated by radioactivity from the Chernobyl Accident



Pollution territories of
Belarus Cs-137 on 1986 year

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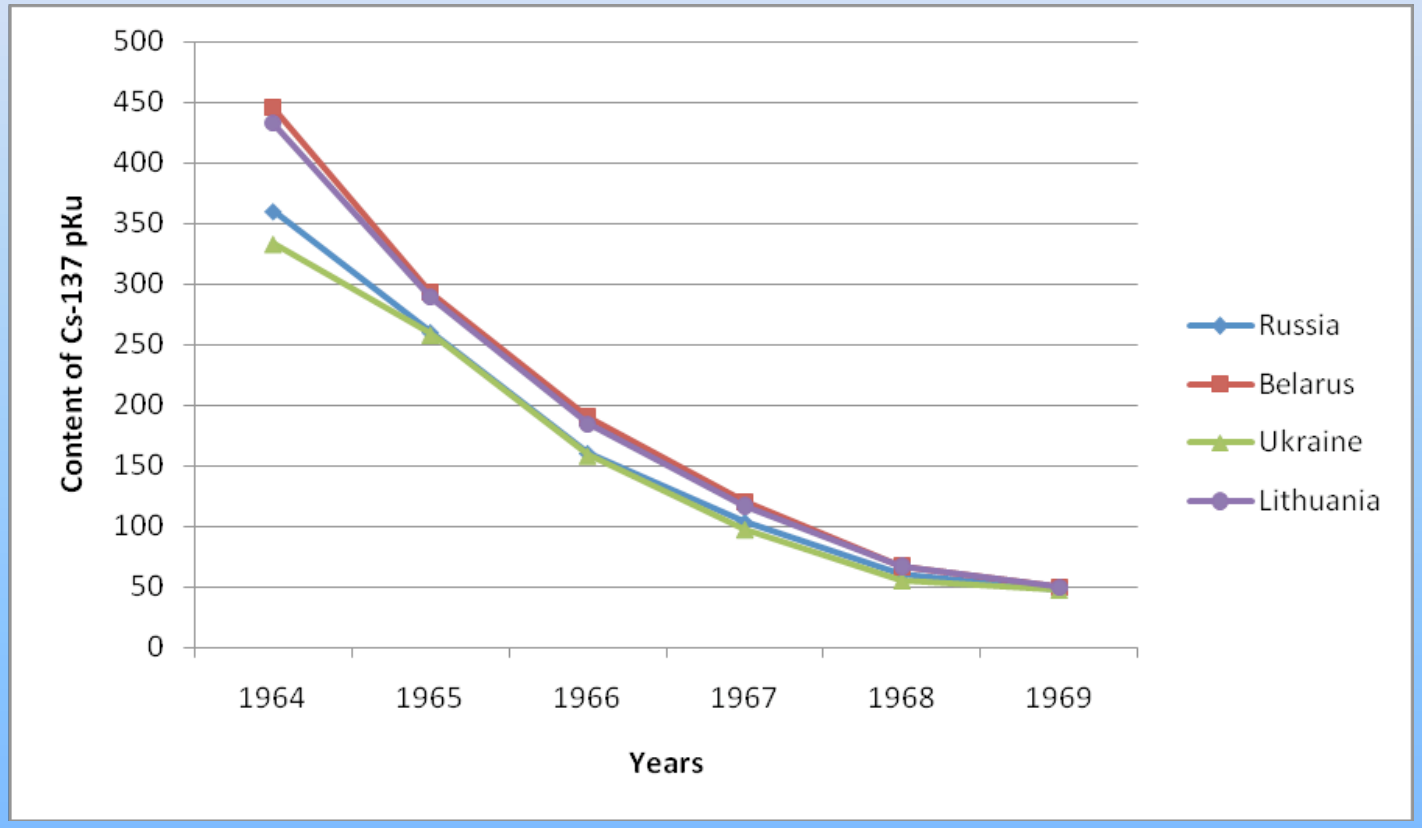
Radio-ecological problem

The ecological environment, influencing health of people, regulates developments of a human society. Not looking on considerable progress in business of protection of environment and therefore health of people, there are countries in which there are serious environmental problems. First of all, there are the countries of the former Soviet Union. The aspiration to catch up and overtake in the military and economic development of the country of the West forced a management of the former Soviet Union to introduce the industrial technologies, making fatal impact on environment and therefore on health of people. First of all it is necessary to consider the tests of the nuclear weapon spent by the USSR.

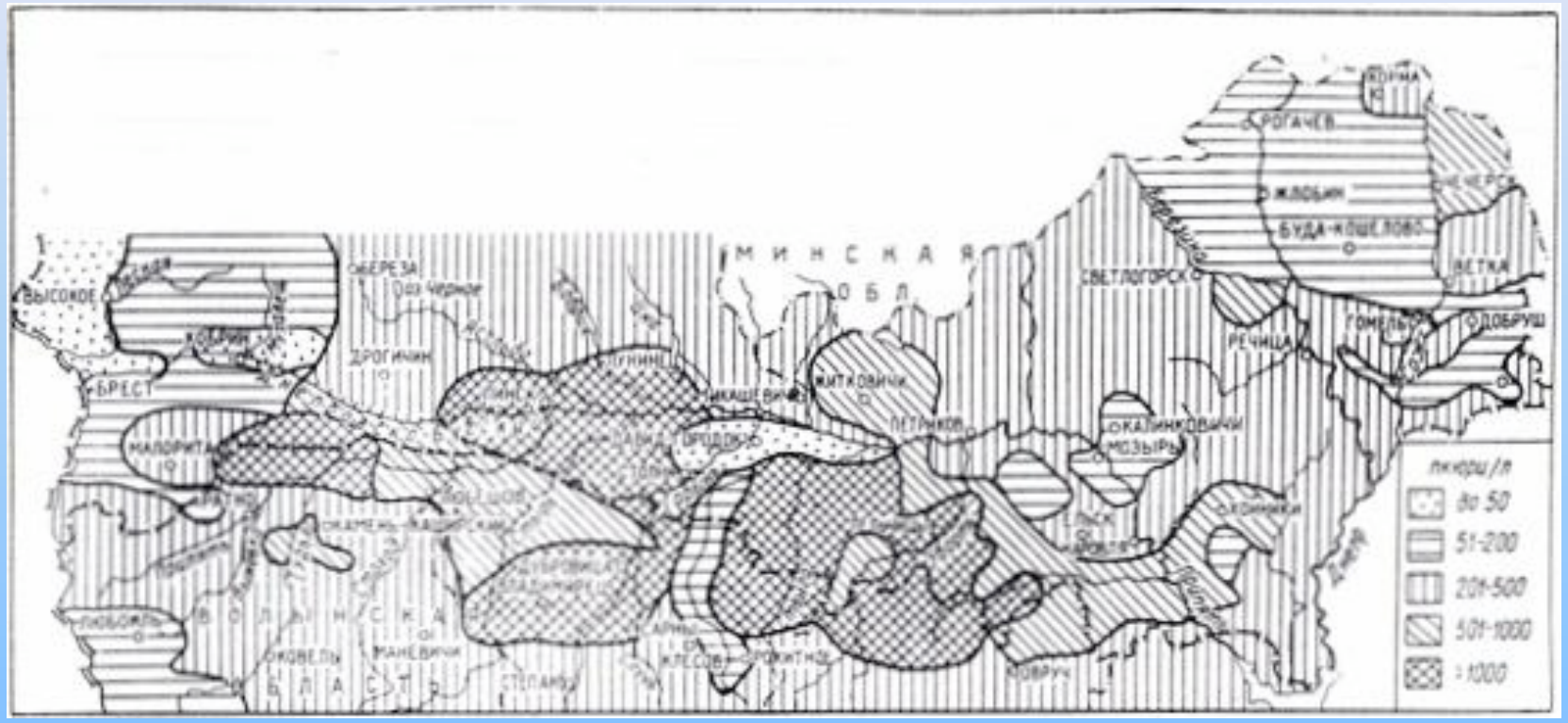
Pollution by radioactive elements of huge territories of Belarus, Lithuania, Latvia, Estonia, Ukraine, Russia, since 60th years of 20th century is a consequence of such activity. The population of these countries had no information on the existing radiating factor, and it could not is natural to protect itself from its influence in no way.

Starting with the sixties there has been a great number of Cs-137 radionuclides contents in foodstuffs consumed by the inhabitants of mentioned states within many years. (Marey A.N. and co-authors, 1974. Rusyayev A.P. and co-authors, 1974. Ternov V.I., Gurskaya N.V., 1974).



Cs-137 contents in villagers' daily food allowance in **pCi** (Marey A.N. and co-authors, 1974).

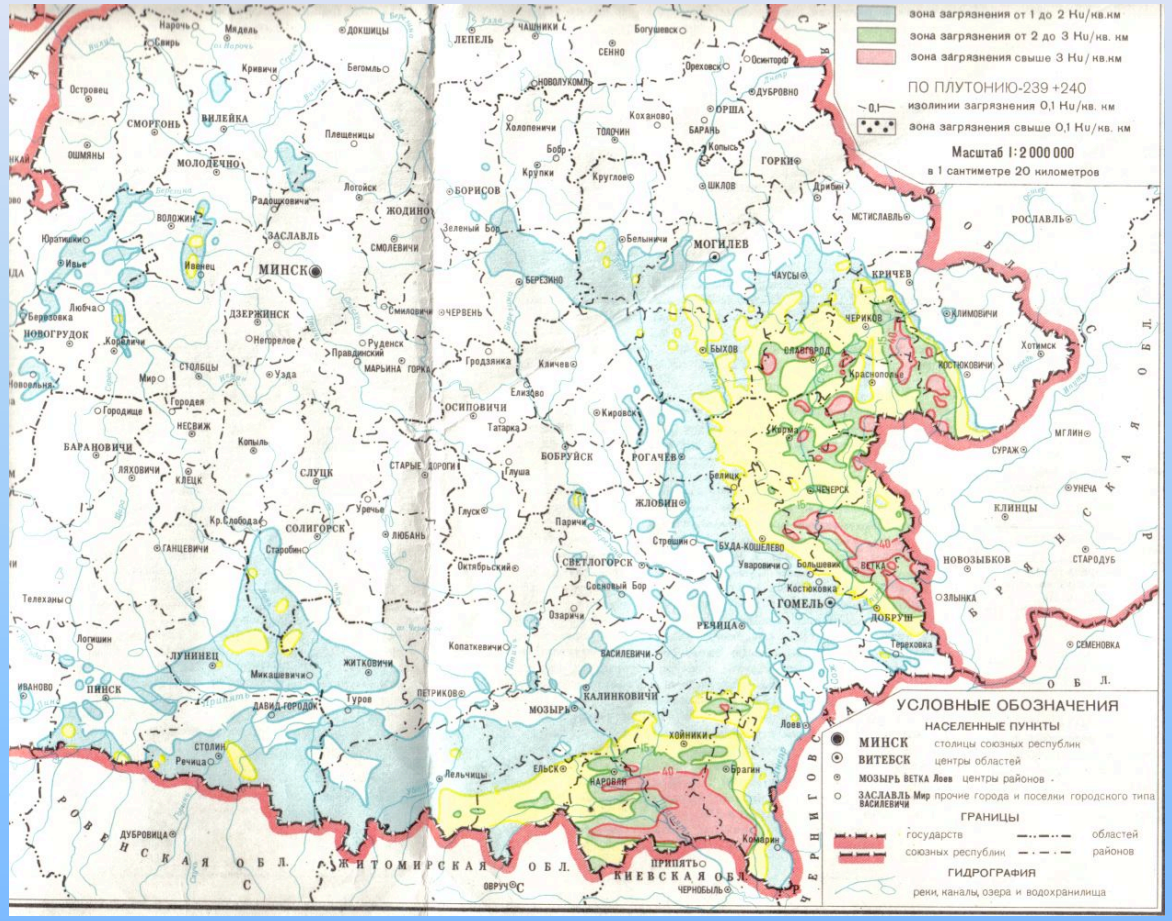
Cow's milk is one of the basic products forming rather high levels of Cs-137 radionuclides contents in inhabitants of Belarus and Baltic lands. “Milk-Caesium Map” was created – the largest Cs-137 radionuclides contents were observed from 1967 to 1970 in Gomel region of the Republic of Belarus.



Cs-137 contents in cow's milk from different districts of Belarus in the sixties of the 20th century.

The Chernobyl accident of 1986 intensified a lot the already existing radiation effects on the population of some European countries and the Republic of Belarus, first of all.

The map of Cs-137 radionuclides deposition in the territory of Belarus after the Chernobyl accident in 1992 almost corresponds to the map of such radionuclides deposition in the territory of Belarus in the sixties published in 1974 (Marey A.N. and co-authors, 1974.).

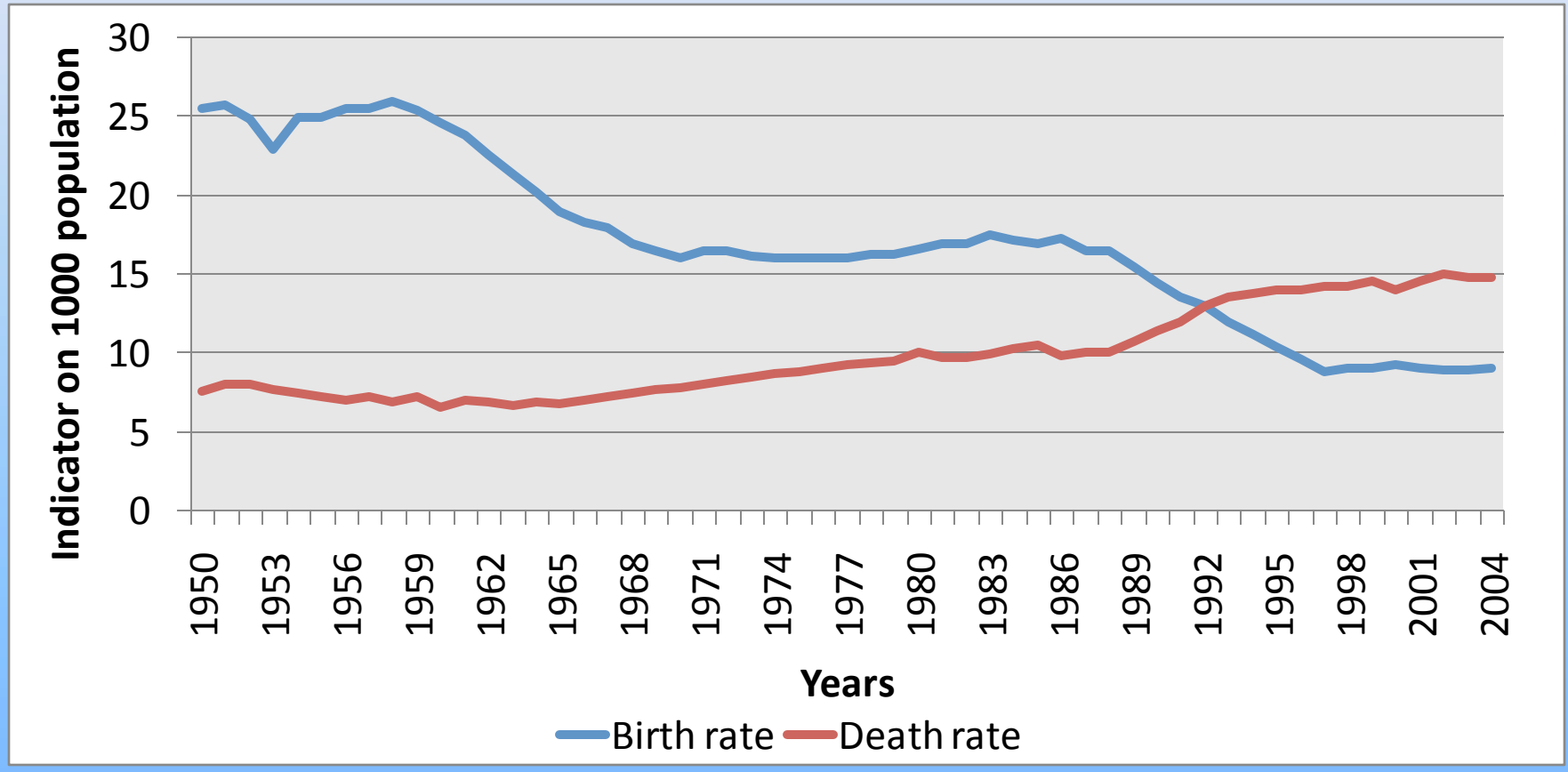


Map of Cs-137 deposition in the territory of Belarus in 1992.

Just after the Chernobyl accident of 1986 due to the actions performed by the western public organizations it became to be possible to speak about the influence of radiation agents on the health of people in Belarus and another countries.

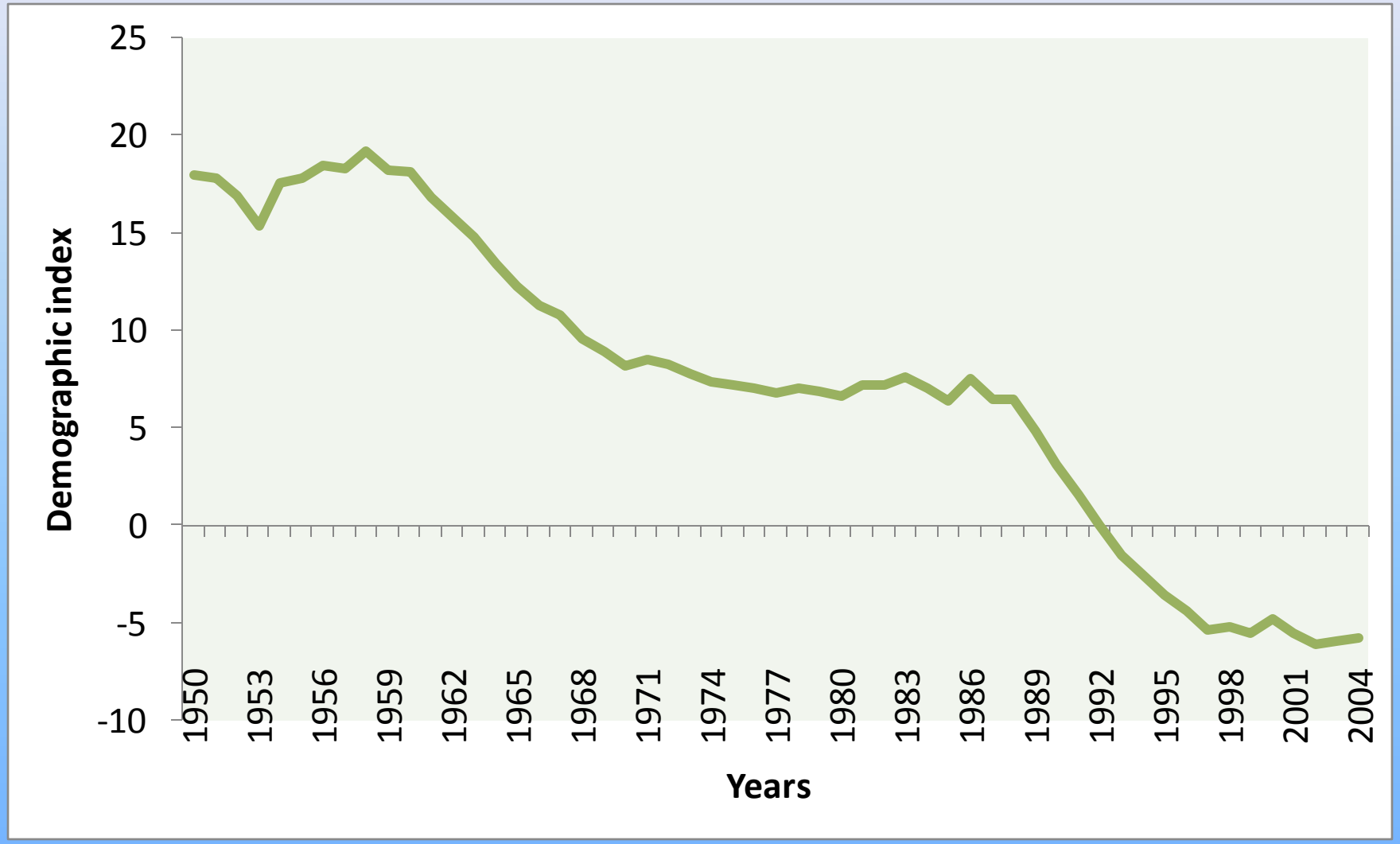
According to the scale and consequences the Chernobyl accident dated to April 26, 1986 is considered to be the largest man-caused catastrophe in the human history. Its social, medical and ecological consequences require the detailed study. From all the European countries Belarus was affected to a greater extent. About 70% of radioactive substances released to the atmosphere as a result of the accident at the 4th block of the Chernobyl NPP contaminated 23% of the territory of the republic. At present in the zone there live about 1.4 million inhabitants including 260 thousand children. The radiation situation in several affected regions is still difficult. The main danger for health comes from Cs-137 et Sr-90 radionuclides getting into inhabitants' organisms with food. The contribution of the mentioned radionuclides to the internal dose reaches to 70 to 80% (National report. 20 years after the Chernobyl accident). The contact with radiation agents led for the death-rate of the population in the Republic of Belarus to be increased in 2 times within the last 20 years. Only during 1990-1999 the death of population has grown on 32,7% (from 10,7 to 14,2 on 1000 people), including men - on 40,2 %, women - 24,3 %.The process of the death of people in the district with a high level of contamination of the territory by Cs-137 and Sr-90 radionuclides is especially expressed.

The increase of death and reduction of birth in Belarus have led that since 1993 an indicator of a natural increase of the population (the demography index) has got negative values: 2002-5,9‰, 2003-5,5‰, 2005 – 5,2‰. And we can say that it is not a natural increase indicator, but it is an indicator of natural decline in population.

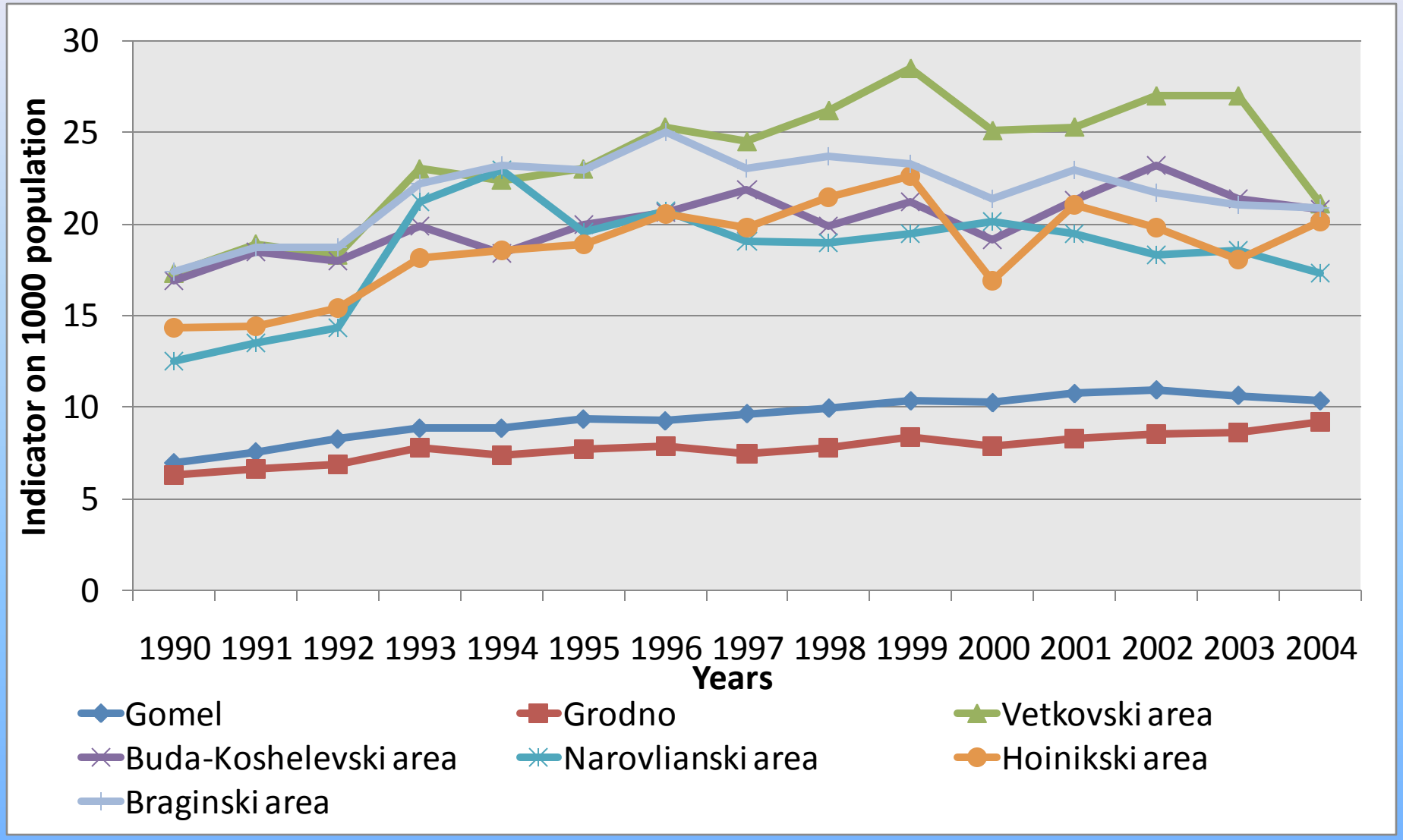


Indices of the death-rate and the birth-rate (per 1000 inhabitants) in the Republic of Belarus.

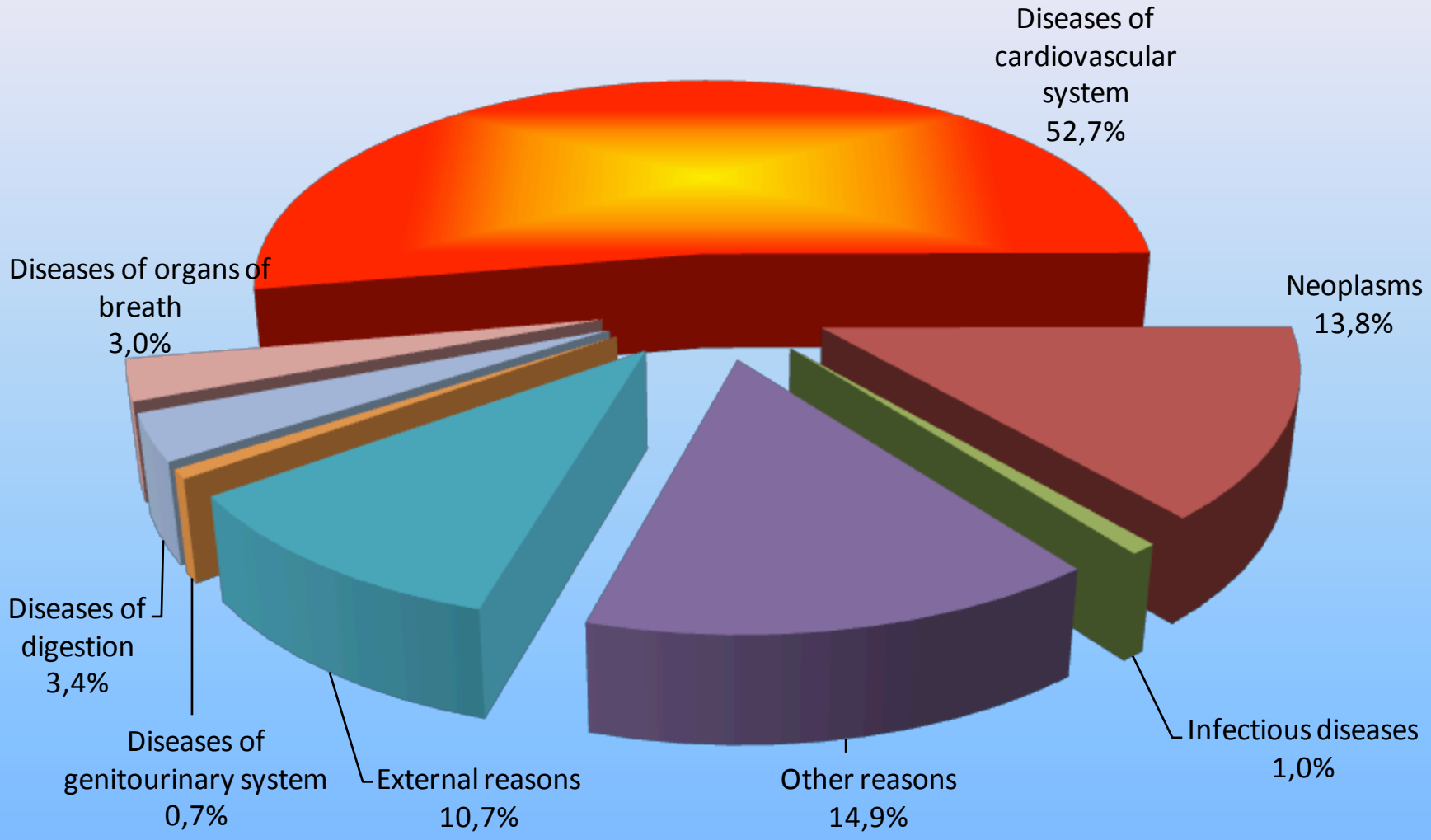
Demographic index in the Republic of Belarus



The dynamics of the death-rate of the population in different districts of Belarus

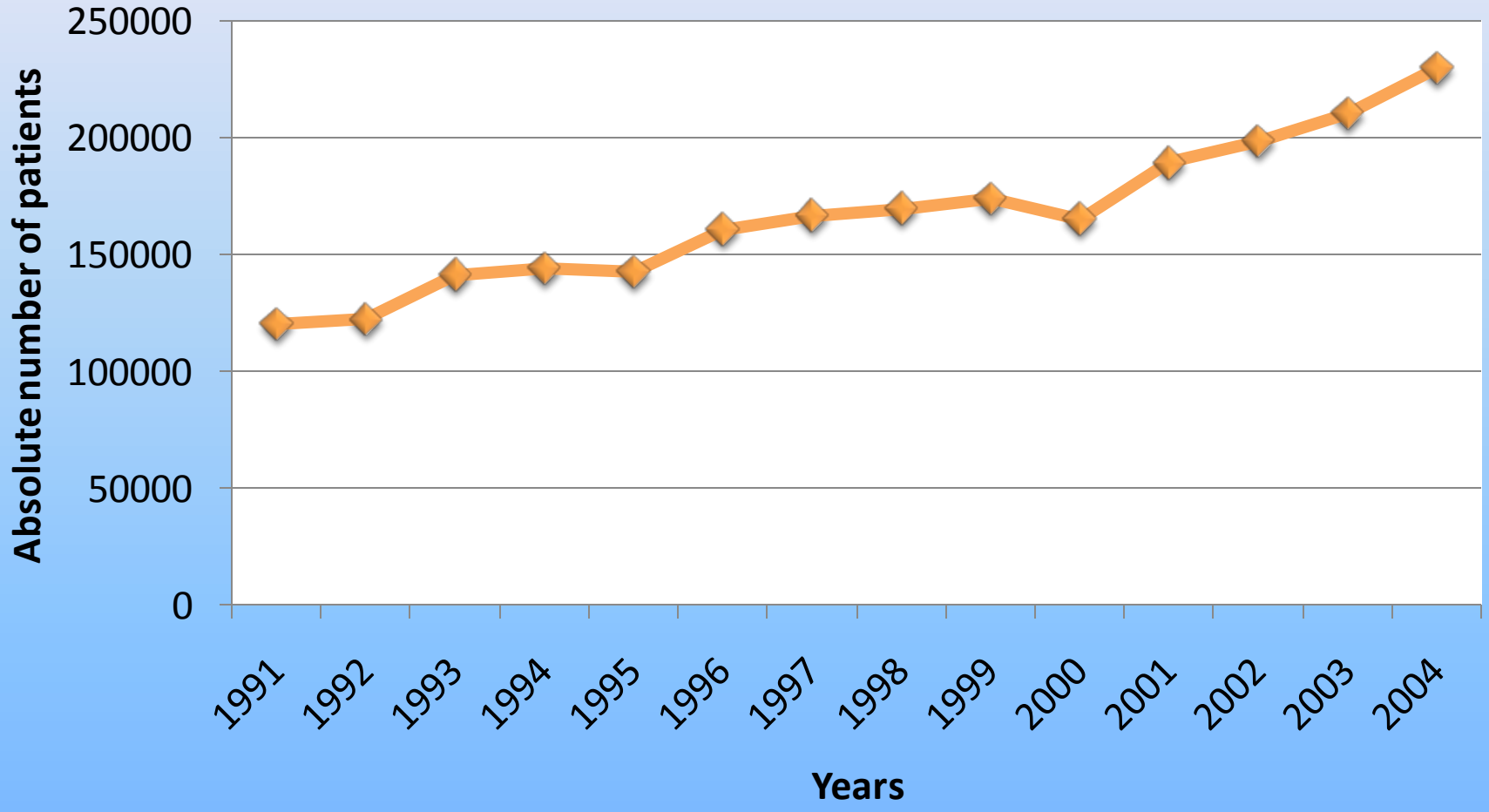


Among the causes of death of the inhabitants of Belarus cardiovascular and oncologic diseases take dominant place.



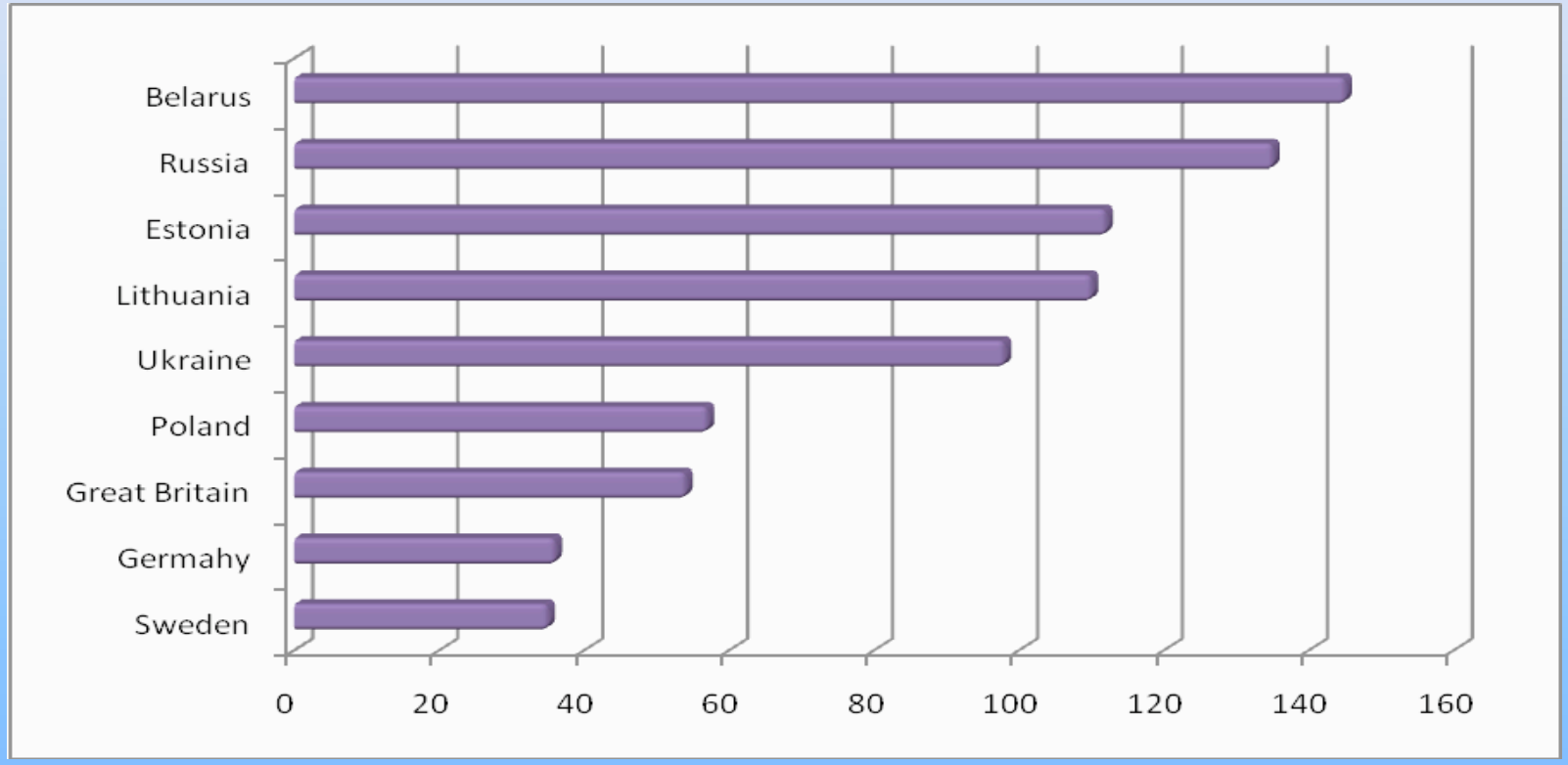
Structure of the causes of death in 2008

There causes anxiety the scientifically significant increase of the primary incidence with the diseases of blood circulation system especially among the participants of the liquidation of consequences of the accident at the Chernobyl nuclear power plant.



The dynamics of cardiovascular diseases in the Republic of Belarus.

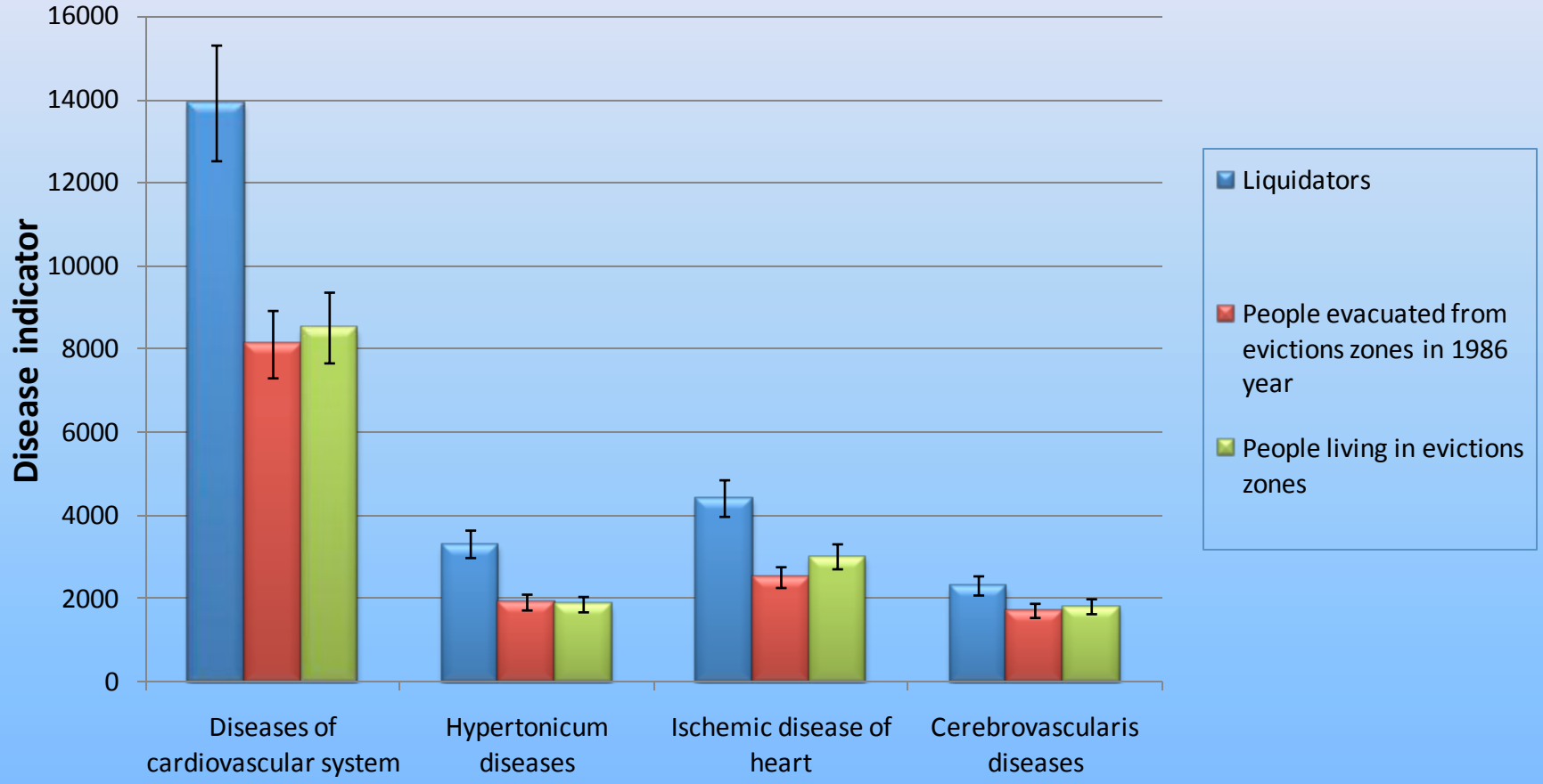
The indices of morbidity in the countries of the former USSR differ sharply for the worse from same in the western countries.



Ischemic heart disease rate in Europa for 100 thousand inhabitants in 1993-1994.

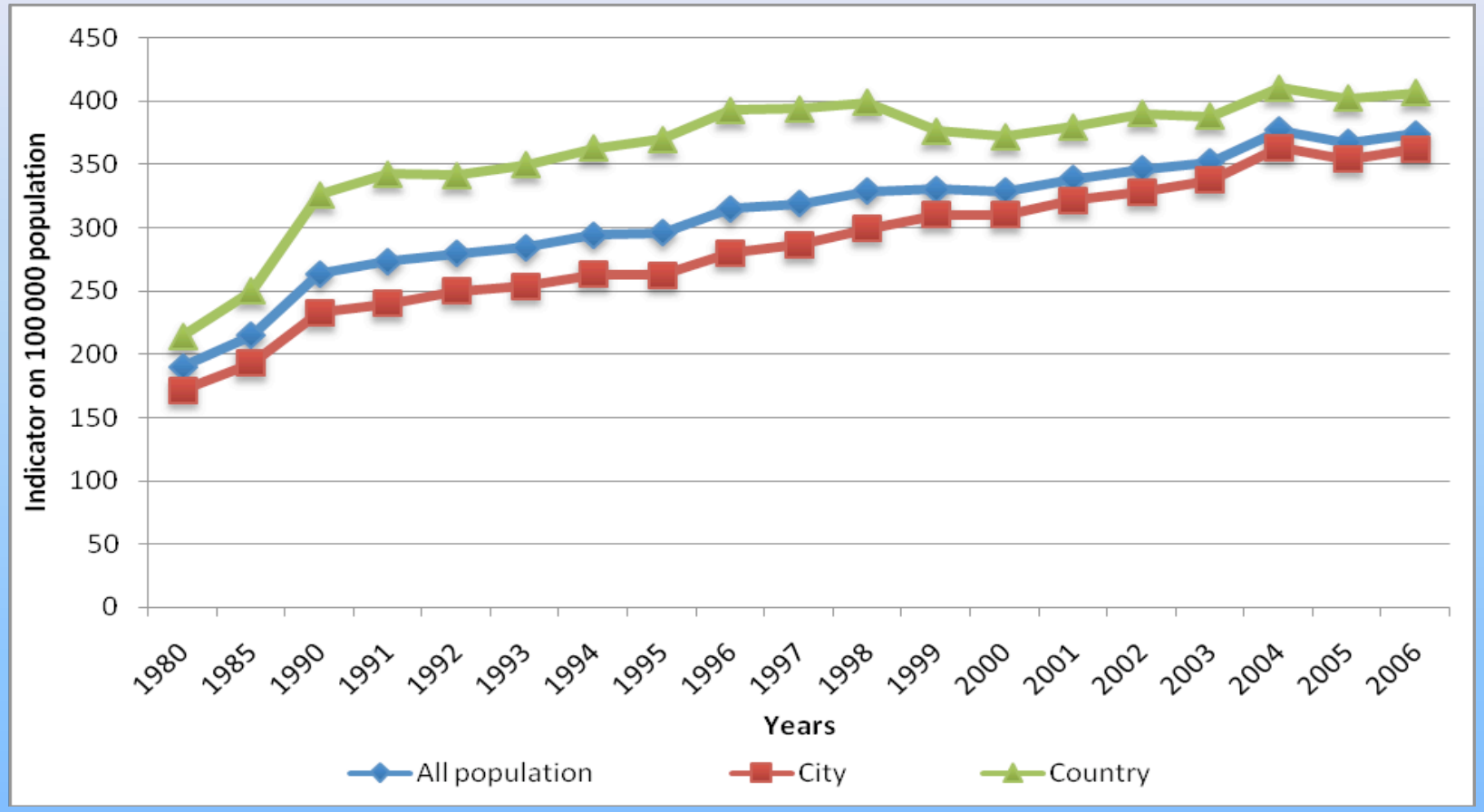
«The population health in Europe. Report on monitoring measures to obtain health for everyone in 1993-1994. Regional WHO publications, European edition, № 56, Copenhagen, 1995».

There should be emphasized the scientifically significant increase of the incidence level with the diseases defined by increased blood pressure, myocardial ischemia, including acute myocardial infarction, and by cerebrovascular diseases among the male liquidators in comparison with the same figures among the man of another categories of the affected population.

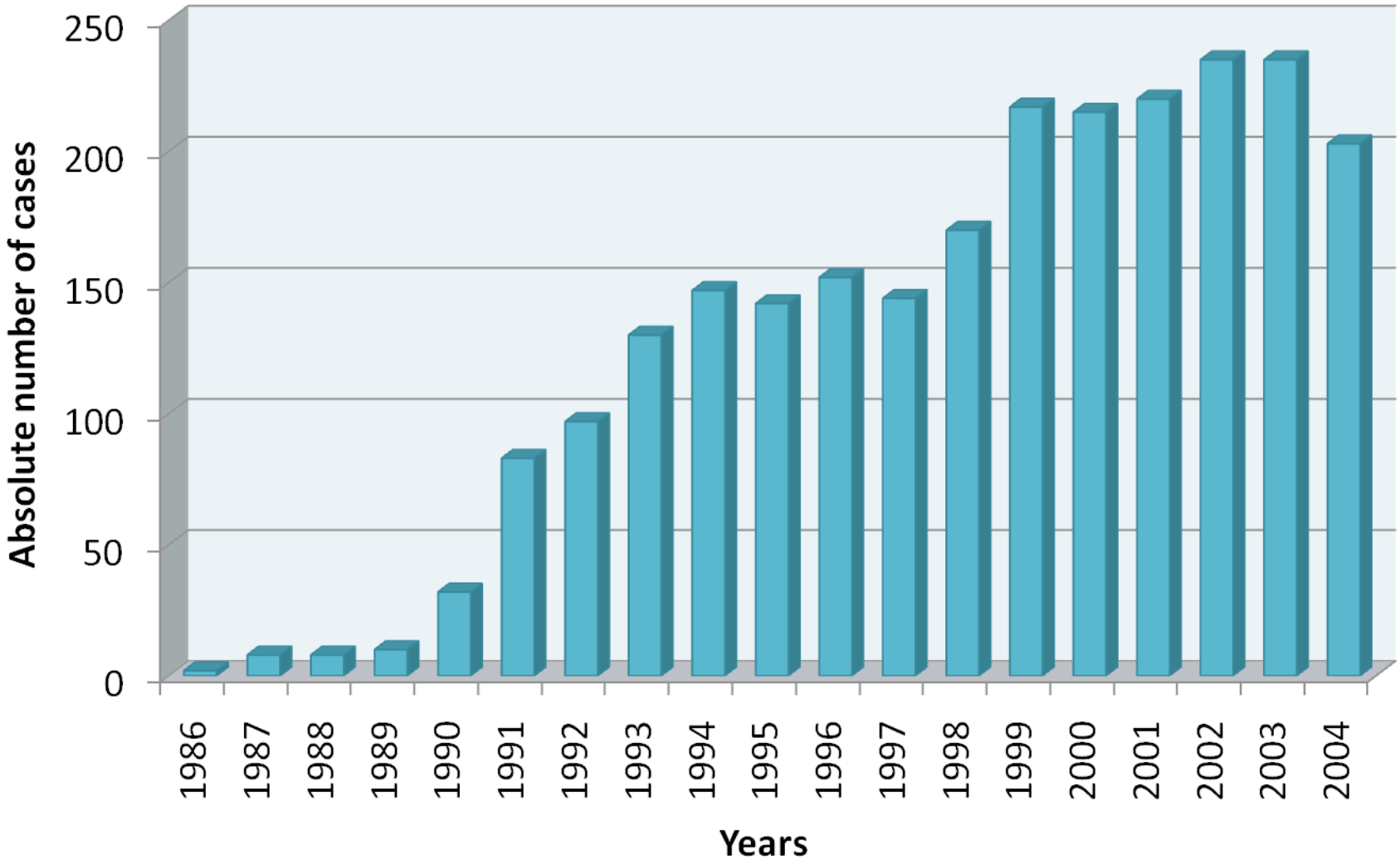


Standardized figures of the incidence of the men of the Republic of Belarus affected by the accident at the Chernobyl NPP with the diseases of blood circulation system.

During 20 years after Chernobyl the incidence with malignant neoplasms increased in several times in the Republic of Belarus.

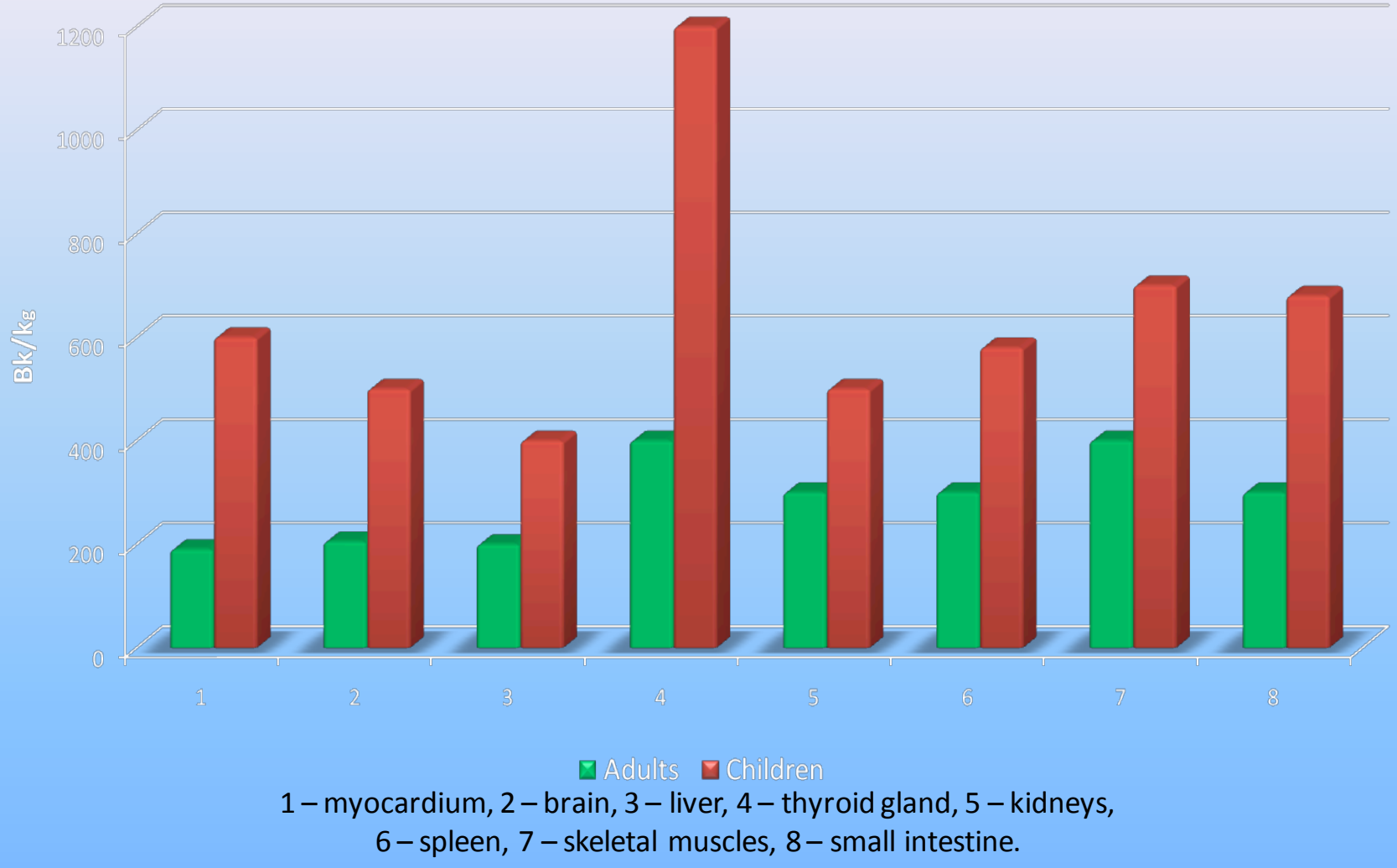


Incidence of the population of the Republic of Belarus with malignant neoplasms (per 100 000 inhabitants).



The dynamics of the absolute number of the cases of thyroid cancer detected for the first time.

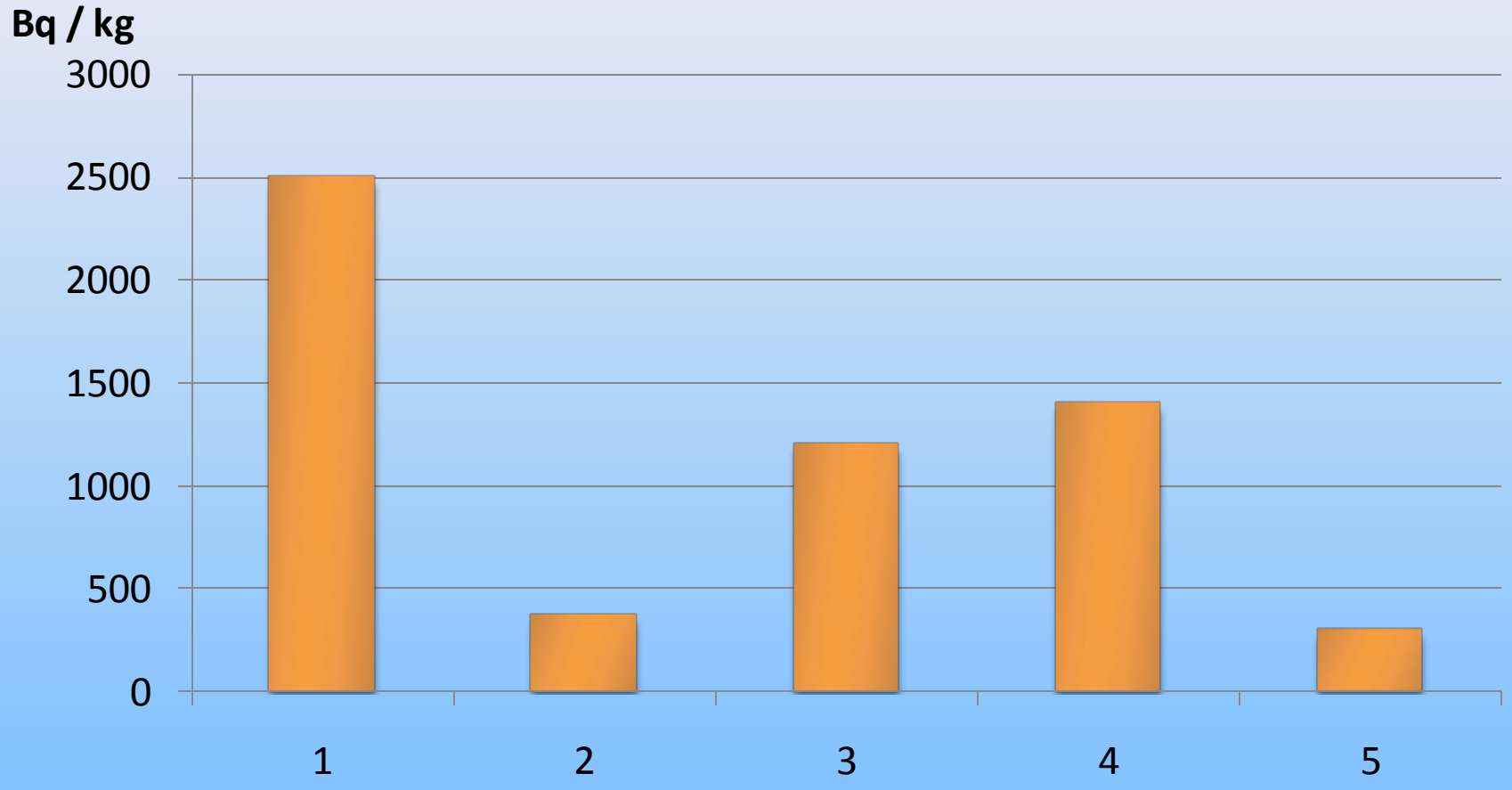
Cs-137 radionuclides under conditions of permanent chronic intake by people with food are accumulated in vitally important organs: thyroid gland, heart, kidneys, spleen, brain, spleen ; degree of expressiveness of incorporation is various.



1 – myocardium, 2 – brain, 3 – liver, 4 – thyroid gland, 5 – kidneys, 6 – spleen, 7 – skeletal muscles, 8 – small intestine.

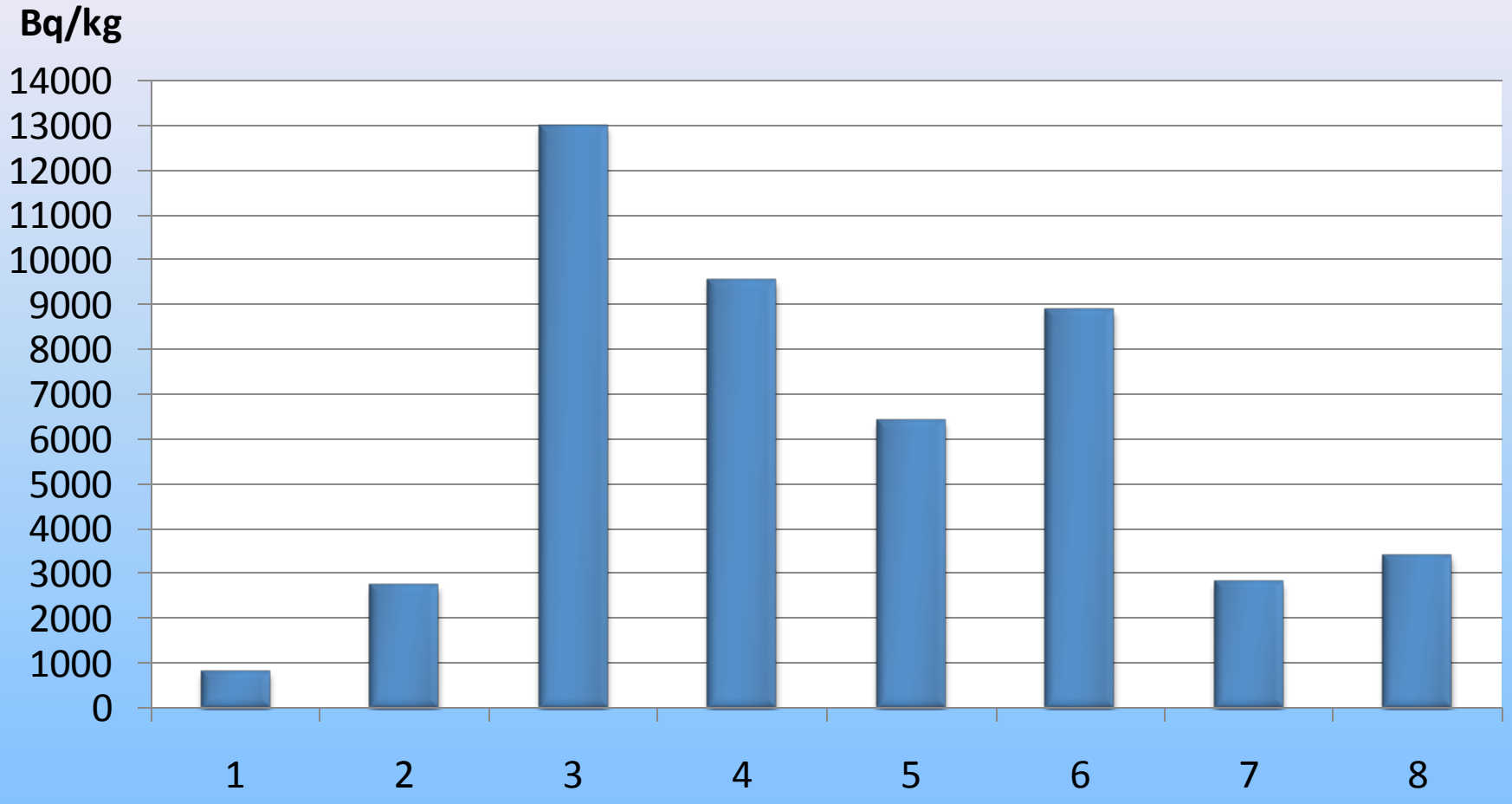
Cs-137 contents in adults' and children's viscera according to the data of radiometric measurements of the autopsies of inhabitants of Gomel region in 1997 and 1998 (Yu. I. Bandazhevsky, 1999, 2003).

This dependence is traced at experimental animals with relatively small level of radionuclide in their organism.



Cs-137 accumulation by organs and bodies of experimental animals: **1** – heart; **2** – liver; **3** – spleen; **4** – kidneys; **5** – body.

The increase of coming Cs-137 in organism through gastrointestinal tract causes its accumulation in other organs, in particular skeletal muscles.



Cs-137 accumulation by internal organs of albino rats with daily introduction of 180 Bq: **1** - living organism; **2** – liver; **3** – kidneys; **4** – myocardium; **5** – spleen; **6** – skeletal muscles; **7** – testicle; **8** – lungs.

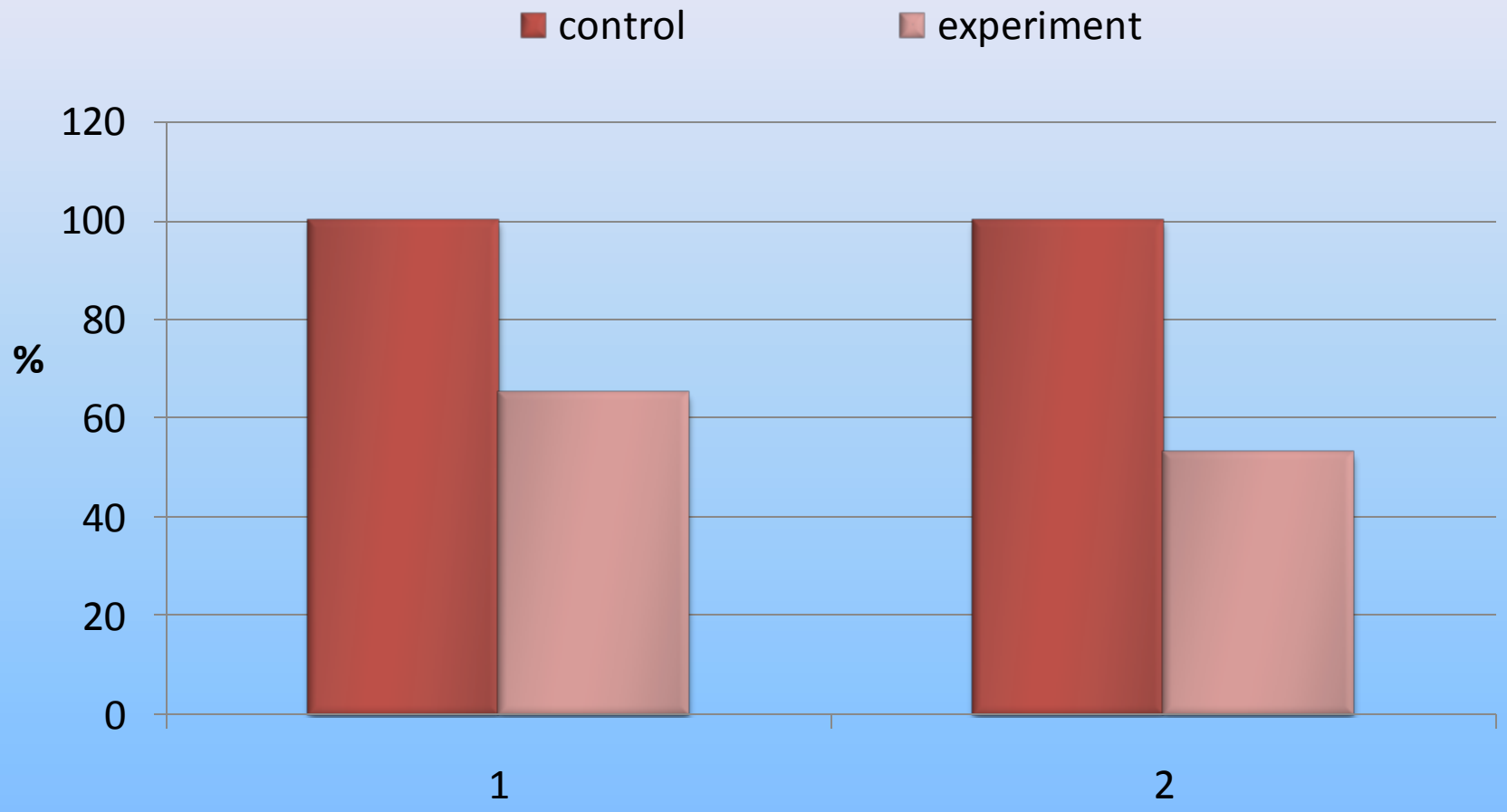
Cs-137 incorporation leads to the energy and plastic metabolism disorders in highly differentiated cells and dystrophic and necrobiotic processes development. The degree of disorder is the function of the Cs-137 concentration in the organism and the organs mentioned above. The more intense is the process, the higher is the degree of disorder.

As a rule, several organs are subjected to the radiotoxic effects simultaneously, provoking the effect of metabolic dysfunction. It should be noted, the organs and tissues with the negligible or absent cells proliferation (myocardium) under physiological condition suffer to the greatest extent. Cs-137, accumulated in the organism, intrudes the metabolic processes and affects membrane cell structures.

The process provokes structure and function disorder in many vital systems, primarily the cardiovascular one. Structural, metabolic and functional modifications in the myocardium under progressive radiocesium accumulation prove its toxic effects, with the energetic system and mitochondrion being violated. Deep and irreversible changes (due to the increase in Cs-137 concentration) lead to the necrobiotic processes in a cell. Suppression of the creatin phosphokinase appears as a consequence to the energetic instability.

Accumulation of the rat cardiomyocytes mitochondria with radiocesium incorporation 45 Bq/kg. Uv. 30 000.

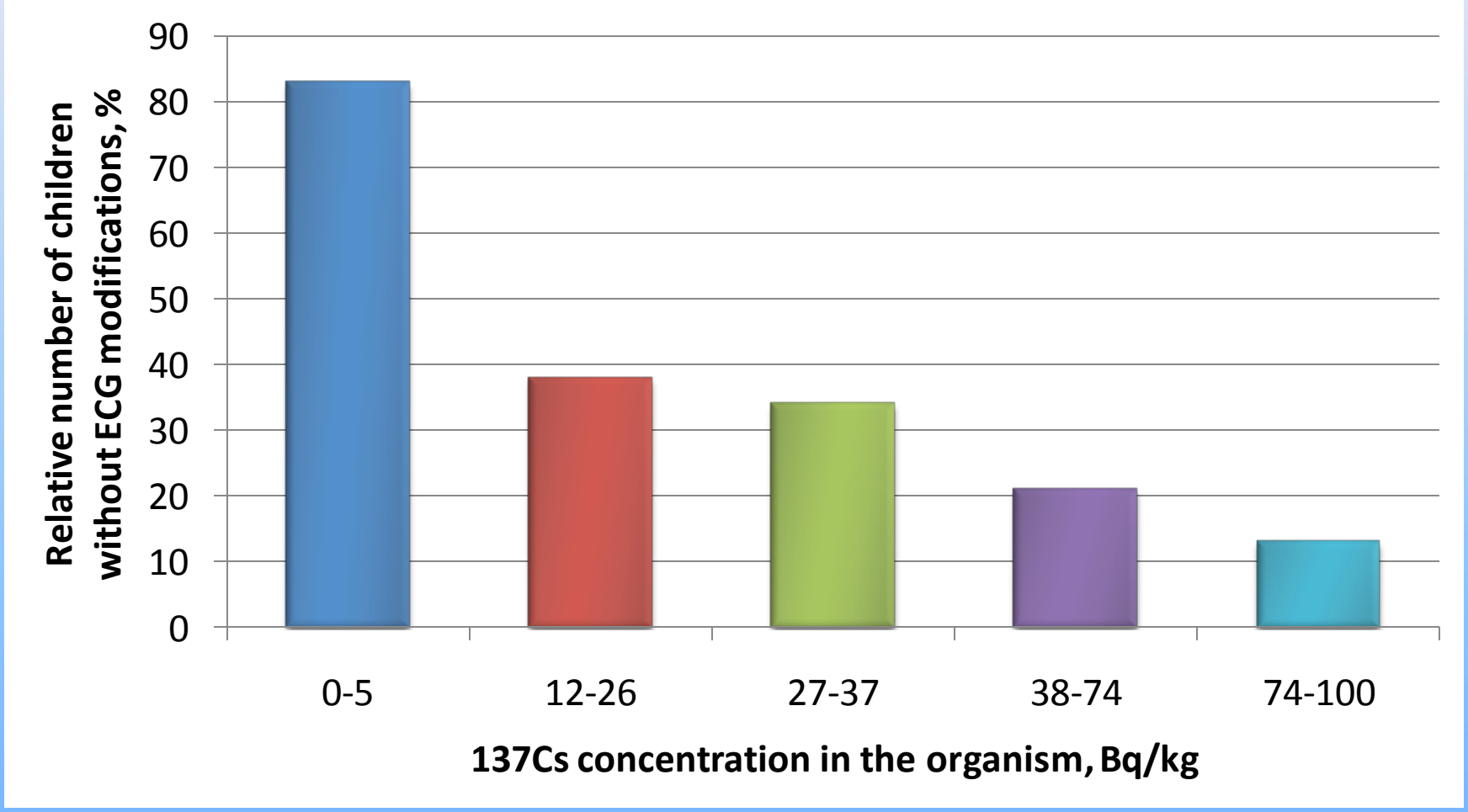
Variations of activities of enzymes in myocardium tissue among experimental animals (% versus control).



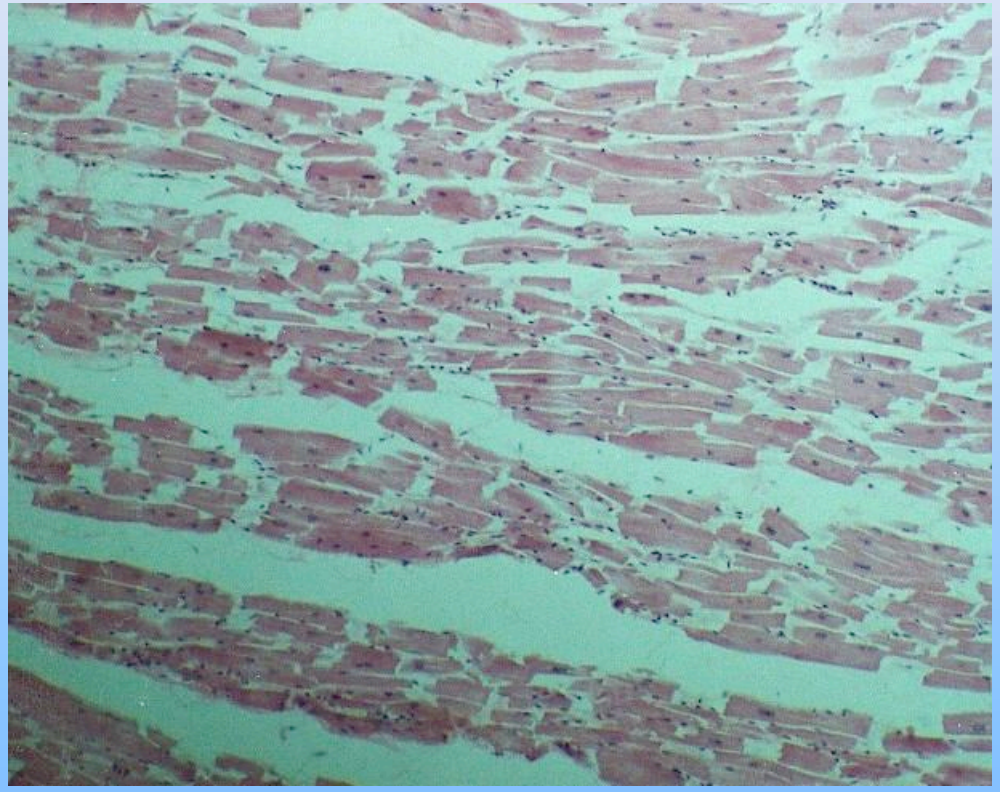
1 - alkaline phosphates;
2 - creatinphosphokinase ($p < 0,05$)

Cs-137 effect is most vivid in the cardiovascular system of a developing organism. Radiocesium concentration over 10 Bq/kg leads to the violated electrophysiological processes in the myocardium of children. Those born later 1986 and constantly living at the affected territories with Cs-137 concentration above 15 Ci/km^2 are serious pathological modifications of the cardiovascular system, they manifesting themselves both clinically and electrocardiographically. Cs-137 radionuclides incorporation in schoolchildren causes the disorder of electrophysiological processes in cardiac muscle shown by the disorder of cardiac beat rate. There was a defined dependence between the radionuclide contents in the organism and the arrhythmia rate.

Number of children without ECG modifications as a function of Cs-137 concentration in the organism.



Histological myocardium composition of a 43-year-old Dobrush resident (sudden death case). Radiocesium concentration in heart – 45,4 Bq/kg. Diffuse myocytolyse. Intermuscular oedema. Fragmentation of muscular fibers. Colored by hematoxylin and eosin. Uv. X 125.



Myocardium disorder is registered in 99% of death cases. Here, diffuse damage of muscle cells becomes obvious, which is characteristic of the toxic effect of incorporated radiocesium.

Similar modifications are registered among laboratory animals, Cs-137 penetrating their organisms with food (oats grains) or with water solution through the gastrointestinal tract.

We define the myocardium pathology stated as a cardiomyopathy, resulting from Cs-137 incorporation. It corresponds exactly to the definition of the WHO expert committee. They state the cardiomyopathy as the myocardium destruction of different genesis, but not inflammatory in morphology or coronary in origin.

Diffuse destruction of muscular cells of the cardiac without the pronounced respond from the organism may serve a perfect illustration.

Cs-137 contribution to the classic myocardium infraction is also considerable, it reducing antithrombogeneous activity of the vascular wall and activating thrombocytes, coagulant and fibrinolytic chains of the haemostasic system which evidences to the blood coagulation inside the vessels.

The vascular system violation with Cs-137 manifests itself in the increasing number of people suffering from the severe pathological disease – raised arterial pressure - hypertension, arising already in the early childhood.

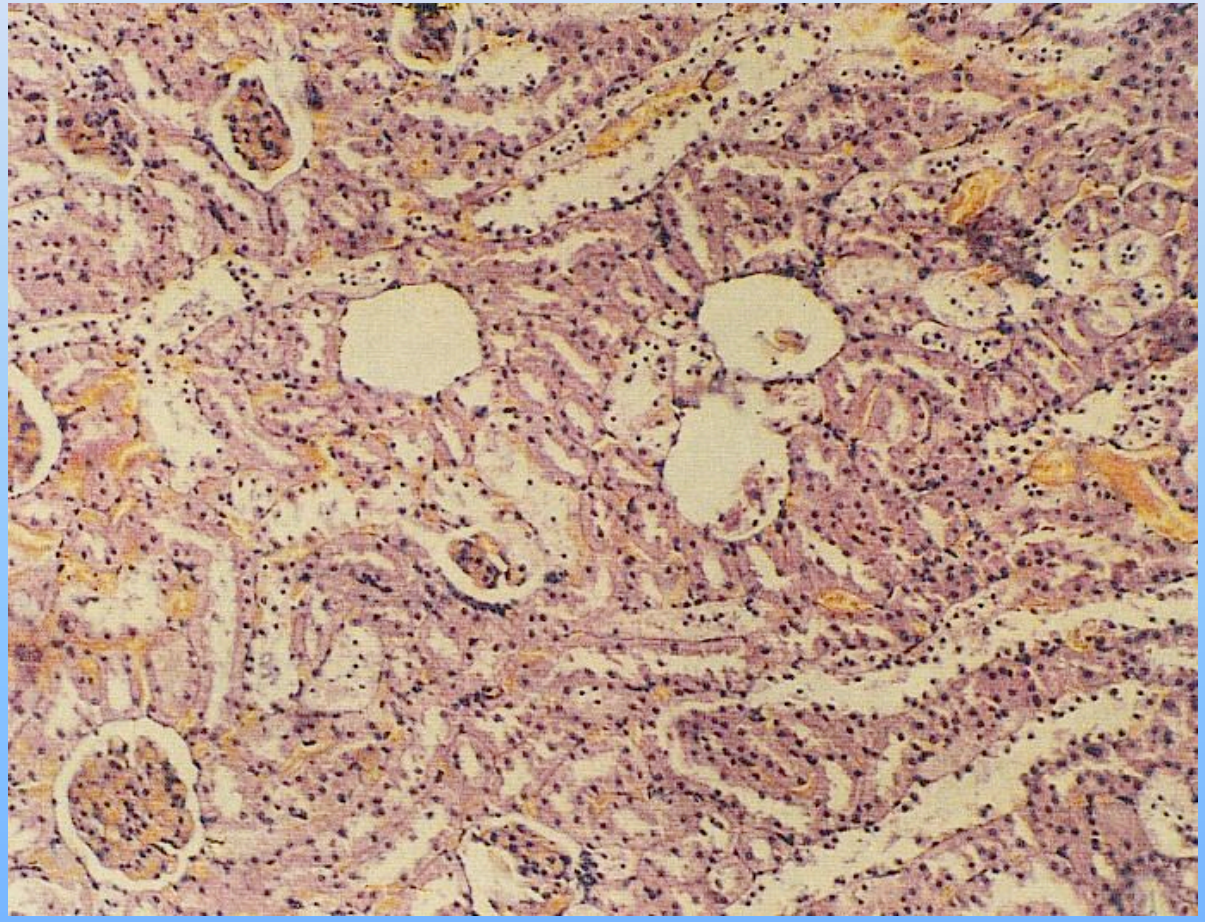
Apart from toxic effect of radiocesium, pathological modifications in the vascular system lead to the cell destruction in brain, heart, kidneys and other organs.

Thus, in spite of numerous reasons presented by famous cardiologists, it is Cs-137 that we consider responsible for the cardiovascular system violation. Several practically substantiated facts should be compared. Radiocesium incorporation in food products and human organisms at the territory of the former USSR, in Belarus as well, has been registered since the 60-ies (Marey A.N. and co-authors, 1974).

The 60-ies are also marked by the steady increase of cardiovascular diseases and death rate .

Kidneys is the key organ governing the process of radiocesium excretion from the organism. According to V. Zhuravlev (1990), 6 to 9 times more Cs-137 is excreted from the organism with urine than with feces. It affects the vascular system of the tubules and glomeruli systems of the nephron structure. Destruction of the structural and functional kidney elements, first of all glomeruli, has manifested itself in the typical histological picture, called the “melting ice-floe” phenomenon. Considerable Cs-137 concentration has been registered in the organ tissue.

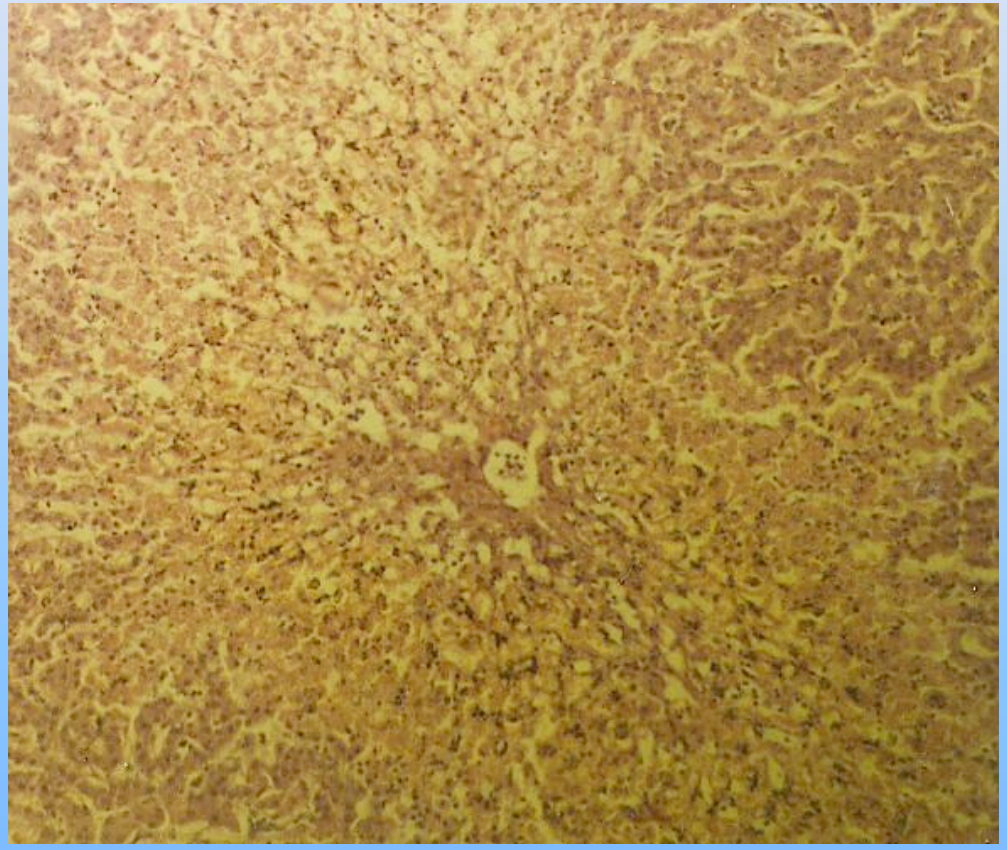
Histological kidney composition of an albino rat with radiocesium concentration 900 Bq/kg. Necrosis and glomerulus fragmentation with cavity formation. Necrosis and hyaline-dropping dystrophy of the tubule epithelium. Colored by hematoxylin and eosin. Uv. X 250.



However, due to the angio architectonics, radiation induced pathology of this organ has its own specific features. The disease is seldom accompanied with nephrotic syndroms, is more severe and quicker in character, as compared to the ordinary chronic glomerulonephritis. The latter is characterized by frequent and early development of the malignant arterial hypertension. Already in 2-3 years kidneys damage leads to the development of chronic renal failure, cerebral and cardio complications.

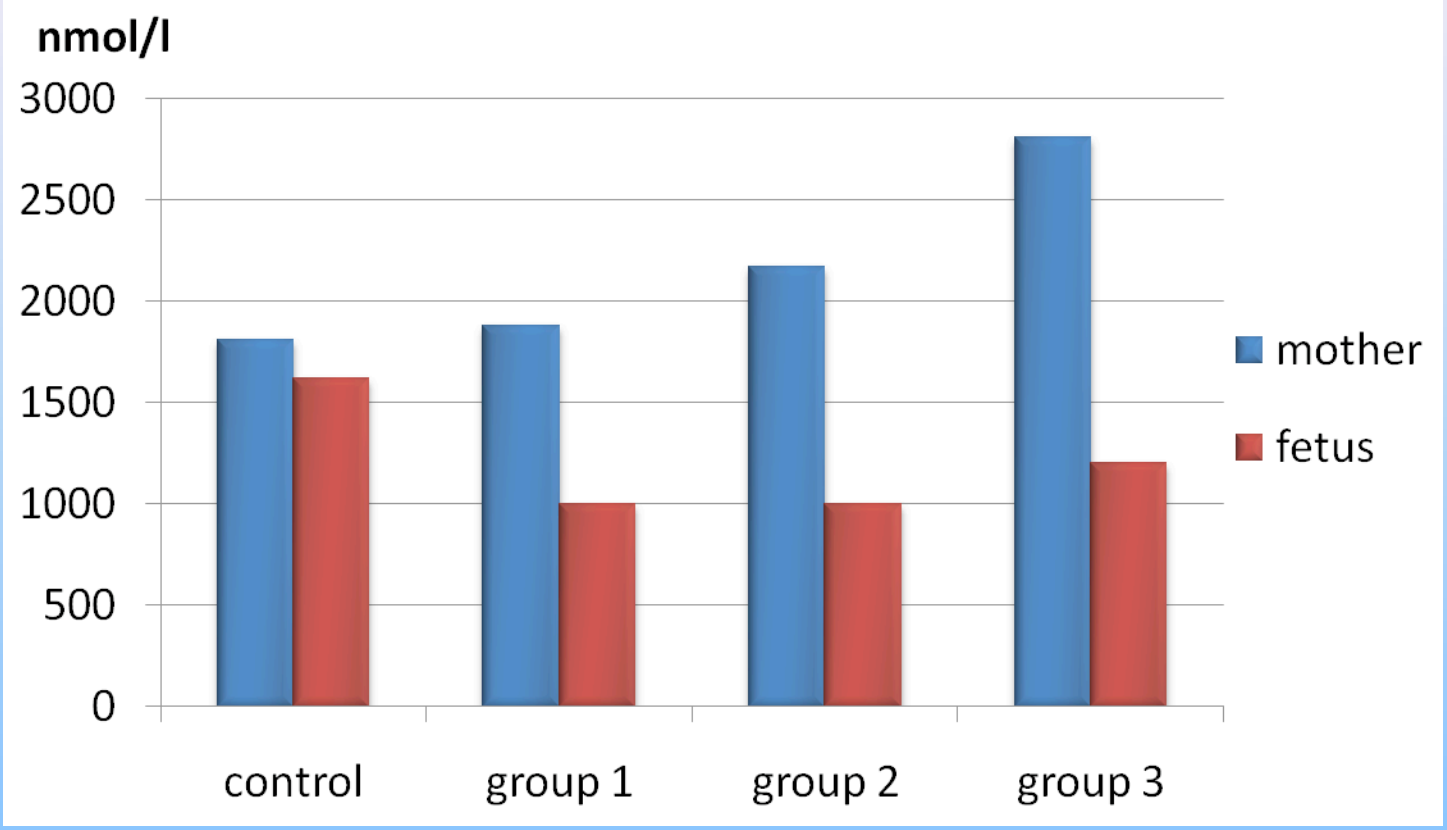
Kidneys destruction is one of the main reason of Cs-137 and the products of metabolism accumulation in the organism and their toxic effect upon the myocardium and other organs and also of the arterial hypertension. If the cases of sudden death in Gomel are considered, 89% of the cases are accompanied by this organ destruction, this state being not registered during their life time.

Histological liver composition of a 40-year-old Gomel resident (sudden death rate). Radiocesium concentration in the liver – 142,4 Bq/kg. Fatty and protein dystrophy, hepatocytes necrosis. Colored by hematoxylin and eosin. Uv. X 125.



Serious pathological modifications of the liver are also noteworthy. The progress in toxic dystrophy of the liver with prevailing destruction of the cellular protein and metabolism transformations, resulting in fat-like substances formation, contributes to such severe pathological processes like fatty hepatosis and cirrhosis.

Cortisol concentration in mother and fetus blood in control and test groups



Cs-137 concentration in placenta:

1 group – 1-99 Bq/kg;
2 group – 100-199 Bq/kg;
3 group – >200 Bq/kg.

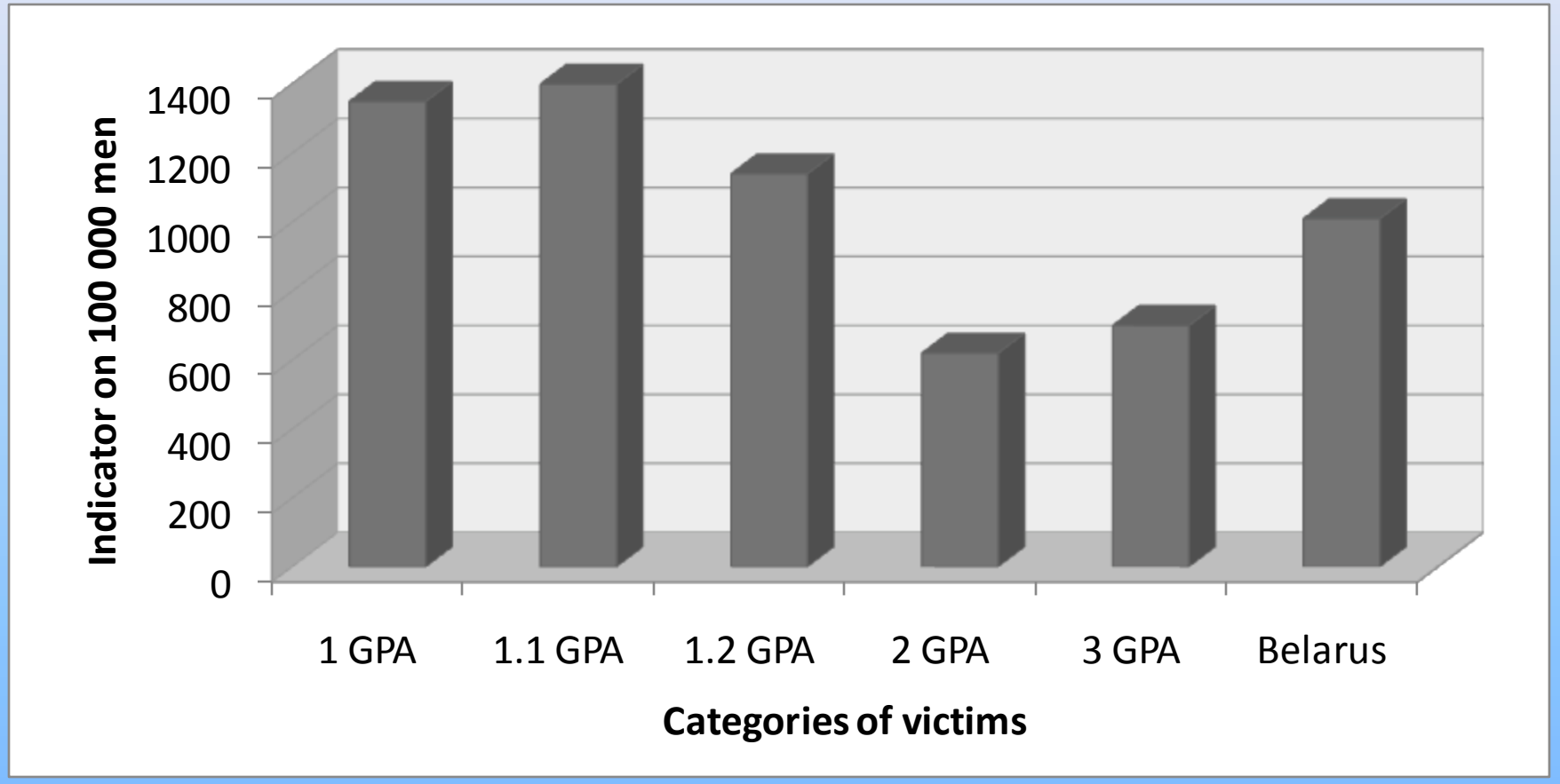
The endocrine system is exposed to influence incorporated Cs-137. The epinephros also appear affected by the incorporated radiocesium, the level of cortisol being a function of the radiocesium concentration in the organism. The modifications in the cortisol production are especially noticeable for the neonates, their mothers having accumulated the considerable Cs-137 concentration in the organisms (mainly in placenta). Hence, these children are famous with their ill-adaptation to the intrauterine existence.

Pathology of the female reproductive system is a product of endocrine functions violation. Radiocesium is responsible for the imbalance in the correlation progesterone-estrogen with the women of the fertile age in different phases of the estral cycle, being a key factor for the infertility. The radiocesium incorporation in placenta and other endocrine organs during pregnancy gives rise to hormone disorders both in the mother organism and fetus. In particular, the Cs-137 concentration rising, the testosterone contents increases as well as the thyroid gland hormones and cortisol in blood.

Distortion of the hormone statues in the mother-fetus system due to radiocesium leads to the extended pregnancy time, childbirth and postnatal child evolution complications. In case of natural feeding radiocesium penetrates the child's organism. Thus, the mother's organism purifies itself, while that of a child's becomes Cs-137 contaminated. Many systems being formed in this period, radiocesium has an extremely negative effect upon the child's organism.

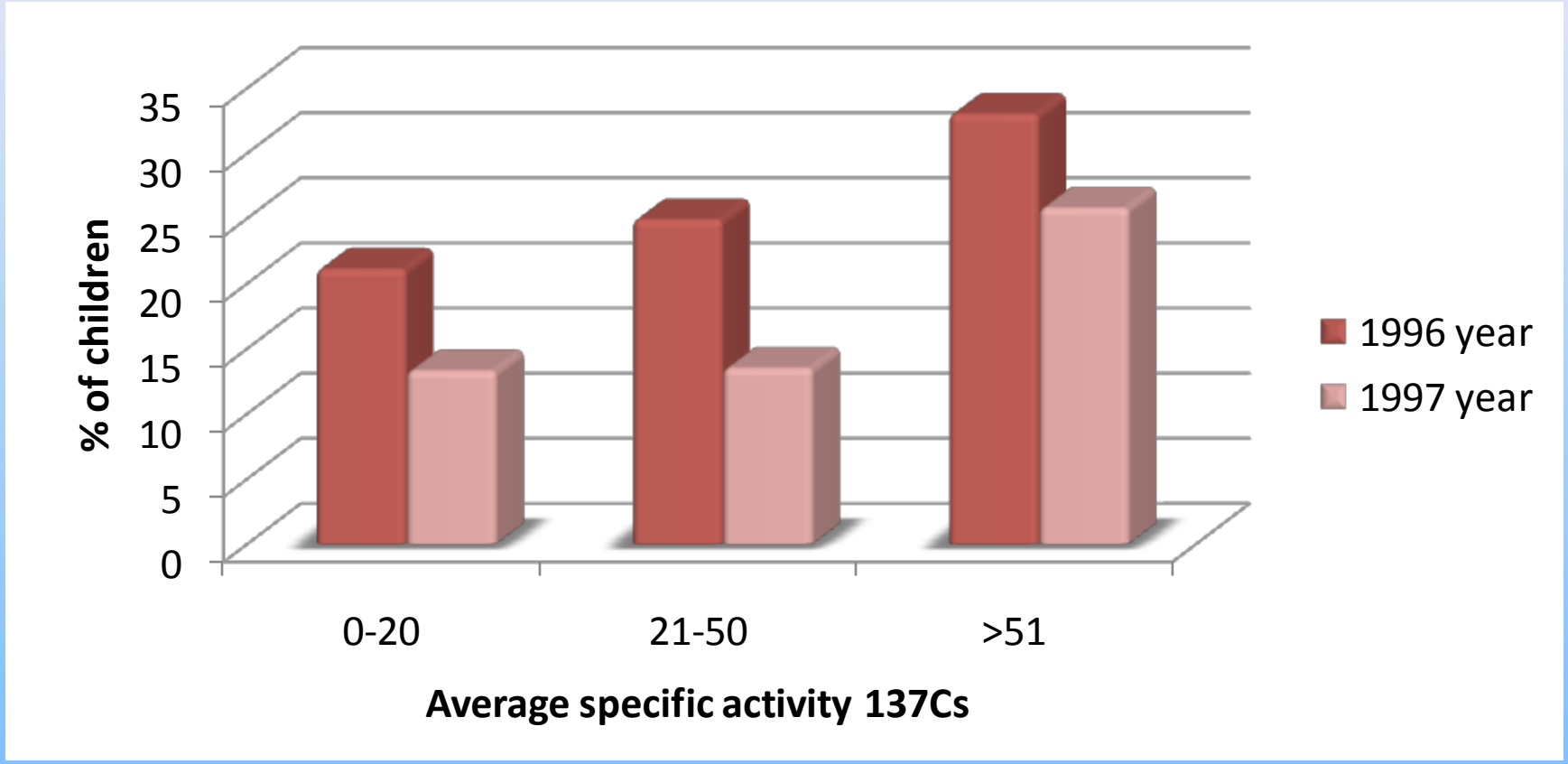
The nervous system is the first to respond to the radioisotopes incorporation. Cs-137 incorporation within 40-60 Bq/kg, which is due to the 28-days animals feeding with oats, causes distinct imbalance between the biogeneous monoamines and neuroactive aminoacids in different compartments of the brain, in particular, in the cerebral hemispheres, which is characteristic of average lethal and super lethal radiation dozes. This is reflected in time of various vegetation disorders.

The organ of vision is extraordinary sensitive to influence of the incorporated radiocaesium. From 1993 to 2003 the annual increase of the incidence with cataract (6% in the mean) was detected in the male liquidators of the accident at the Chernobyl nuclear power plant. It is authentically higher in comparison with the same figures among the men of other categories of the affected population.



Incidence with cataract among the men affected by accident at the Chernobyl nuclear power plant from 1993 to 2003.

There should be mentioned the increase of the cases of cataract in schoolchildren living in the radiocontaminated territory. At that the frequency of detecting this pathology of eyesight organs is in direct relation to the quantity of ^{137}Cs radionuclides in the organism.



The dynamics of the increase of the cases of cataract in the children of Vetka district of Gomel region depending on the level of the average specific activity of Cs-137 (Bq/kg) in the organism (Yu.I. Bandazhevsky and co-authors, 1997, 1999)

Thus, penetrating the organism, a long-living radioisotope of Cs-137 affects a number of the vital organs and systems. As a result, highly differentiated cells are violated, the process being dependent on the radiocesium concentration. The destruction of the energetic mechanism lies in the basis of the process, leading to the protein destruction. In this connection, characteristic feature of the Cs-137 effect upon the human organism appears the depressed metabolic processes in the cells of vital organs and systems, due to the direct influence and the effects of the toxic tissues (nitrogen compounds), violation of the tissue trophy due to the vascular system disorder.

The pathological modifications in the human and animals organisms caused by Cs-137 may be joined together into the syndrome of the long-living incorporated radioisotopes. (SLIR). The syndrome appears in the cases of radiocesium incorporation in the organism (its degree being the function of the incorporation quantity and time) and is characterized by the metabolism pathology, stipulated for the structural and functional modifications in the cardiovascular, nervous, endocrine, immune, reproductive, digestive, urinary excretion and hepatobiliar system. The quantity of the radiocesium, SLIR inducing, may vary, depending on age, sex and the functional organism condition.

Children have been registered to have considerable pathological modifications in the organs and systems with the incorporation level over 50 Bq/kg. At the same time, metabolic discomfort in the individual systems, primarily in the myocardium, has been registered with Cs-137 concentration amounted to 10 Bq/kg.

C O N C L U S I O N:

1. After 23 years after the accident at the Chernobyl nuclear power plant the inhabitants of the Republic of Belarus, living in the territory contaminated by radioactive elements and consuming these radionuclides for a long time, run the risk of the incidence by cardiovascular diseases and malignant neoplasms.
2. The steady rise of this pathology within 23 years after the accident at the Chernobyl nuclear power plant leads to the situation that is close to the demographic catastrophe when a death-rate of the population has begun to exceed a birth-rate in two times.
3. The current situation requires the immediate decisions at state and international levels directed to the solution of the arisen problem – protection of the state of health of the citizens living in the territories affected by the accident at the Chernobyl.