THE DYNAMICS OF CONGENITAL AND HEREDITARY PATHOLOGIES IN BELARUS AFTER THE CHERNOBYL CATASTROPHE

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One of the unsolved problems following the Chernobyl disaster is an increasing number of children in Belarus born with the congenital defects of development (CDD),i.e. a most extensive group of hereditary pathologies. The popilation of Belarus have every reason for great concern. The main radionuclides (Cs 137 and Sr 90) may affect hereditary structures {mutagenous effect} as well as normal development of organs {teratogenic efffect}. According to our data, the number of adults and children in Belarus effected by radioactive contamination constitutes 120 thousand people. These are the people who used to live and have been living in the contaminated areas, which have levels of contamination exceeding 15 Ci/km^2

(555 kB/m^2), liquidators (those participating in physical clean up following the disaster), as well as people living in the lower radiation areas , which have a high ratio of transfer of long-lived radionuclides accumulated in plants from soil. During the first years after the explosion protection measures for the population living in the areas with levels of contamination not exceeding 15Ci/km^2 were not as strict and the boundaries of the areas were not determined.

Information on genetic consequences of low radiation in special literature is very controversial. United Nations Scientific Committee on the Effects of Atomic Radiation having examined this problems several times and based their research on the somatic dose,which equals 1 Sv / generation, predicts the possibility of an increase in the newborn,suffering from diseases caused by genetic and chromosome mutations, up to 1700 cases per one million newborn in the first generation. Taking into account this estimation and the natural incidence of hereditary pathologies, which constitutes 3.6-4.6 per 100 newborn, as well as the radiation doses accumulated by the population of Belarus, which are considerably lower then 1 Sv, some scientists consider it impossible to prove that ther is an increase in hereditary pathologies caused by an additional exposure to radiation as a result of the Chernobyl accident on the territory where there were 140 thousand children born annually.

The scientists from the Belarusian Institute of Hereditary and Congentinal Diseases have studied possible genetic consequences for the population of the Republic

after the Chernobyl accident. The research was carried out with the help of the Republic's monitoring of congenital defects of development and the monitoring of embryonic development of legal medical fetuses.

FAILURES OF DEVELOPMENT OF MEDICAL FETUSES

Morphogenetic changes in embryos (5-12 weeks of development) of women living in the city of Minsk (control group) and in the contaminated areas of Gomel and Mogilev were examined, caesium-137 levels being greater than or equal to 15 Ci/km^2.

The statistical data obtained and the correlative analysis (Table 1) demonstrate that there is an increase in the incidence of CDD in the contaminated areas (2578 fetuses) compared to the city of Minsk (16590 fetuses).

The mean incidence of inborn failures of development in 1986-1994 reached 7.41 per every 100 fetuses in the contaminated area and 4.66 in the control group, or 4.62 and 2.55 respectively per every 1 000 organs subjected to examination.

The occurence of various nosologic forms of inborn failures has had a tendency to grow in all contaminated areas. The highest rise was recorded in the incidence of kidney and ureter duplication, polydactilism and araphies of the nerve tube. These abnormalities had a multifactorial nature, while the role of mutations in kidney and ureter duplications has virtually been left undertermined. No significant rise was recorded in the incidence of development failures due to changes in the number of chromo-

somes (i.e. monosomy or trisomy), nor have we been able to record any direct teratogenous effects, such as mass cell death as a biological reaction of the embryos to radioactivity. This makes it difficult to achieve a clear understanding of the possible role of radioactivity in the increase of the inborn development failures in fetuses extracted medically from the residents of contaminated areas.

CHANGES IN THE INCIDENCE OF DEVELOPMENT FAILURES IN THE NEWBORN

The analysis was based on the statistical data of the National genetic monitoring. The statictics reveal that the incidence of development failures has grown not only in contaminated areas but also in the control group, especially in areas having over 15 Ci/km^2 of Cs 137 contamination. The highest rise was recorded in the occurence of polidactilism, joints underdevelopment, and development failures of a multifactorial nature.

An additional analysis was conducted in areas with strict radiation control of all forms of conspicuous development failures diagnosed during the early neonatal period. The analysis revealed similar changes in the occurence of such failures. In particular the nosologic structure of development failures has remained the same, although their occurence has grown with no untypical abnormalities recorded in the embrional development. A significant rise in the occurence of inborn development failures (from 12.5 per every 1000 newborn in 1985 to 17.7 in 1994) is also apparent from the national statistics

maintained by the Republic's natal care system (see table)

Its efficiency is demonstrated by the table, from which it follows that since 1992 the incidence of births of children with inborn development failures has stabilized at 17 cases per 1000. However, if one takes into account the number of pregnancies interrupted because of genetic evidence for the pathological development of fetuses (over 1500 pregnancies), then it turns out that the incidence of embrional development failures has not stabilized, but keeps on growing (from 18.2 in 1992 to 22.4 in 1994). All this requires further scientific studies and intensive preventive measures.

CONCLUSION

1. The three sources of information (monitoring of morphogenetic changes in embryos and fetuses, development failures of the newborn and the official statistics) demonstrate that in post-Chernobyl Belarus there has been a considerable increase in the congenital defects of development, legal medical fetuses, and the newborn.
2. The increase of newborn development failures has occurred on the whole territory of Belarus, the incidence of these failures being much higher in the contaminated areas with cesium-137 levels over 15 Ci/km^2
3. Defects due to dominant mutations « de novo», such as multiple developmental defects, defects of extremities and polydactylia, accounted for the most significant increase in the congenital defects of development. The incidence of chromosome diseases (e.g. Down's syn-

drome) has not changed.

4. Preventive measures have stabilized the rates of inborn failures of development, but they have not held up the increasing frequency of embrional development deficiencies.

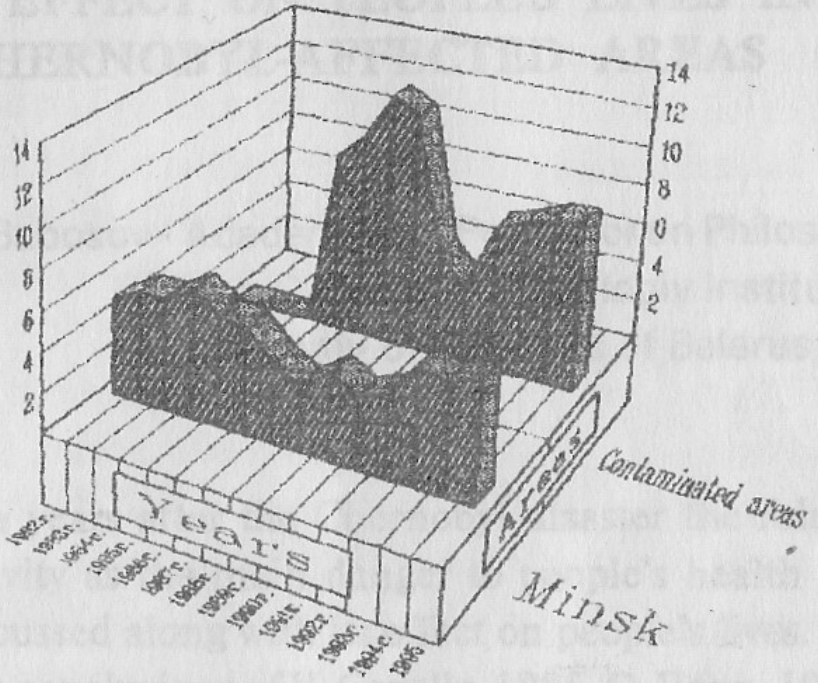
ABSOLUTE NUMBER AND FREQUENCY OF CONGENITAL DEFECT OF DEVELOPMENT (CDD) IN THE CHILDREN OF BELARUS (OFFICIAL STATISTICS DATA)

Years	Absolute number CDD	Frequency per 1000 births
1985	2101	12.5
1986	2273	13.2
1987	2262	13.8
1988	2276	13.9
1989	2273	14.8
1990	2395	16.8
1991	2146 (261)	16.2 (18.2)
1992	2180 (367)	17.0 (19.9)
1993	2009 (400)	17.0 (20.4)
1994	1968 (523)	17.7 (22.4)

261, 367, 400, 523 - the number of abortions due to genetic reasons

18.2, 19.9, 20.4, 22.4 - general frequency of CDD (the data is provided by the institute)

FREQUENCY OF MALFORMATIONS IN HUMAN EMBRYOS



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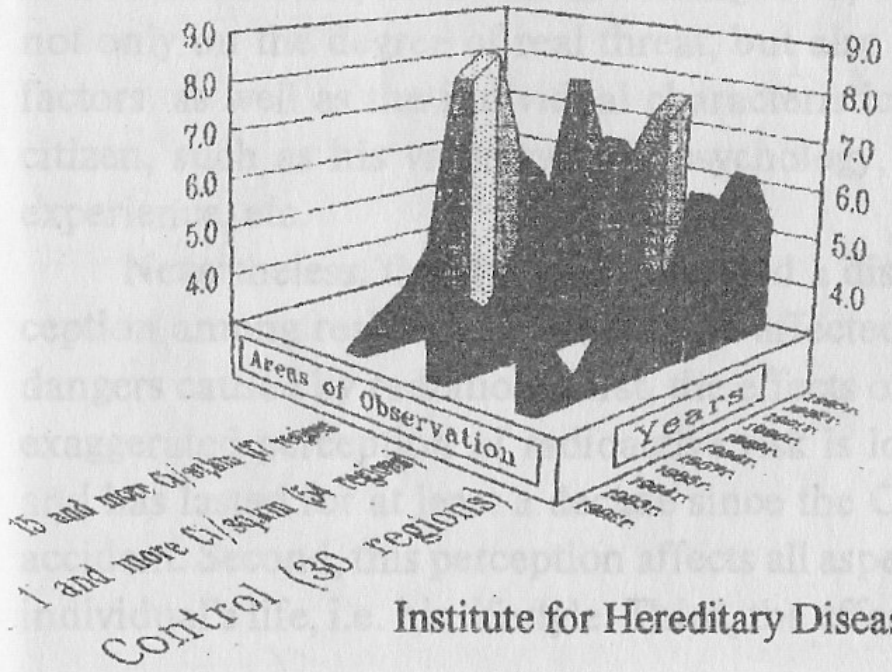
FREQUENCY OF CMS AND CS-137 CONTAMINATION DENSITY IN BELARUS



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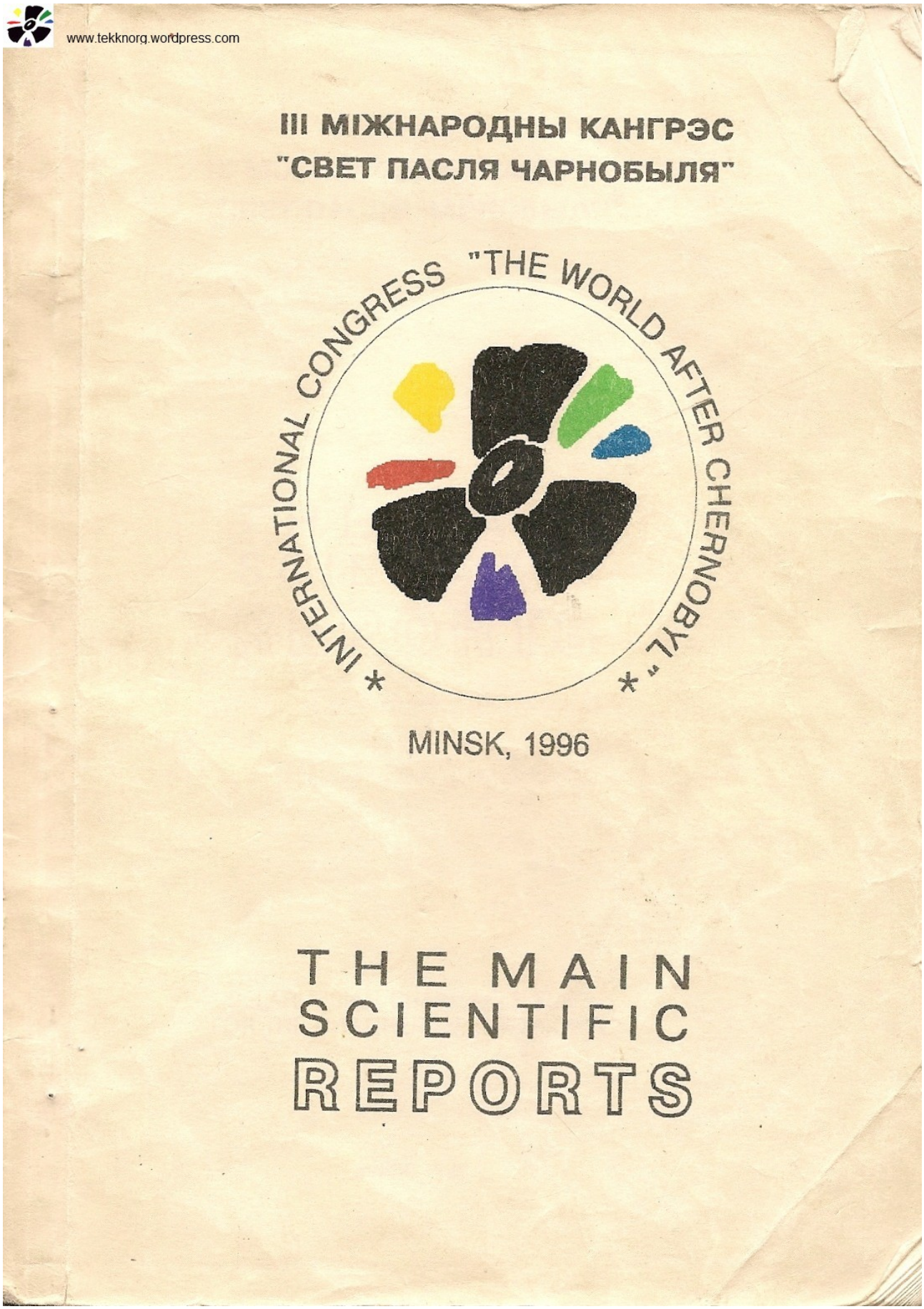

More: http://www.rri.kyoto-u.ac.jp/NSRG/reports/kr21/kr21pdf/Lazjuk.pdf