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Disease incidence for first-generation offspring individuals born from residents of radiation contaminated territories of Ukraine as a result of the Chernobyl accident. The observation period is 18 years from the date of birth

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Abstract

There was conducted an epidemiological study of the health of the first-generation offspring born by residents of radioactively contaminated territories from 1987 to 1999 years until they reached 18 years. The total cohort was 35893 individuals, among whom male offspring constituted 18138 individuals, while female offspring constituted 17755 individuals. There were created 4 groups to study offspring aged 0-3 years, depending on the time of birth of offspring after an accident with a three-year observation period.

During the observation period, for the first time there were detected 21344 individuals (100%) with non-tumour diseases by certain classes of diseases ICD-10, of whom male offspring

were 10,696 (49.9%), and female offspring – 10738 (50.09%). The main components in the structure of the initially detected non-tumour disease were respiratory diseases (34.45%), diseases of the endocrine system, eating disorders and metabolic disorders (16.27%), digestive organ diseases (15.58%). Together they make up 66.87%. The incidence of diseases among the FGOs of all study groups, respectively, is the following: respiratory diseases – ID by 10^3 man-years \pm m - $59,59 \pm 0,65$; 25.06 ± 0.43 by 10^3 ; 24.23 ± 0.42 .

In the structure of diseases of the endocrine system, eating disorders and metabolic disorders (E00.0 - E90.9) total incidence of thyroid diseases (E00.0 - E07.0) – 96,6%. The incidence of respiratory disease in all study groups mainly emerged due to acute respiratory infections of the upper respiratory tract, namely: acute nasopharyngitis, sinusitis, pharyngitis, tonsillitis and other diseases in the group upper respiratory tract – chronic diseases of the tonsils and adenoids, among others acute respiratory infections of the lower respiratory tract – acute bronchitis and bronchiolitis.

The pathology of the digestive system of the FGOs of all four study groups emerges through "Gastritis and duodenitis, K29-K29.9", "gallbladder and biliary diseases pathways, K80-K83.9 "and" hernias, K40-K46.9 ", " diseases of the mouth, salivary glands and jaws, K00.0-K14.9".

Respiratory disease rates are higher among offspring of first and second groups in (born in the period of 01.03.1987-28.02.1993) compared to the third and fourth groups (years of birth 01.03.1993-28.02.1999). The lowest levels are relevant for the fourth group.

The highest incidence rates of thyroid disease are relevant for offspring of the first group compared to the other subject groups. At the same time, the incidence rates among the offspring of the second group are evidently higher than of the third and fourth groups. The lowest levels are by the fourth group.

The development of thyroid disease during the 18 years of observations of each study group is characterized by the appearance of more complex nosological forms of thyroid pathology starting from 7 - 9 years.

The incidence rates of digestive diseases are the highest by the first study group, the lower – by the second, and the lowest – by the fourth.

The most vulnerable to the development of morbidity in the above classes of diseases among the FGOs is the life span from 7 to 15 years. This is evidenced by the increased incidence

of respiratory diseases with maximum indicator at the age of 13-15 years, of thyroid diseases - at the age of 7-9 years, of digestive organs - at the age of 10-12 years.

Keys words: First-generation offspring, radioactively contaminated territories, diseases, structure.

Due to the greatest tragedy of the twentieth century during the peacetime, which took place on April 26, 1986, on the 4th block of the Chernobyl FGO, there occurred radioactive contamination of territories in Ukraine. The most polluted areas are Kyiv, Zhytomyr, Rivne, Chernihiv and Volyn regions. Among them, 15 towns have critical levels of contamination, with the gross activity of ^{137}Cs affecting agricultural products produced in households and exceeding the current hygiene standards and norms, which dose was temporary after the accident, and the radiation dose of the population reaches 5 mSv [5- 8]. The long-living radionuclides ^{137}Cs , ^{90}Sr continue to pose a threat to the health of adults and especially children and the environment nowadays. Radioactive cesium becomes accumulated in the body mainly in soft tissues replacing potassium, whilst strontium does so in the bones, replacing calcium [1-4].

With sufficient adaptive capacity of the human body, under conditions of continuous long-term effect of small doses of ionizing radiation, protective capabilities become depleted. This leads to instability of the genome. Therefore, children who were not directly exposed to radiation but were born of parents affected by the Chernobyl accident, may suffer from the consequences of genetic changes in pathological processes in their bodies that can occur throughout their lives and later on affect the next generations [9-11].

Goal. Epidemiological analysis of the development of firstly detected non-tumour diseases among first-generation offspring individuals (FGO) born of residents of radiation-contaminated territories of Ukraine (hereinafter referred to as RCT) from the date of birth until their becoming 18 years old.

Materials and methods. According to the medical and social information of the State Institution "Ukrainian Centre for Information Technology and the National Register of the Ministry of Health of Ukraine" (DRU), the registered number of FGOs born of the RCT residents from 01.03.1987 to 28.02.1999 is 99732 (100%), of which 50615 (62.5%) are male offspring individuals (MOI), 491117 (37.5%) are female offspring individuals (FOI). This number also includes a total cohort of FGOs aged to 18 years old (17 years 11 months 29 days), from the

number of RCT residents in 12 districts of 4 regions of Ukraine, namely: Kyiv region (Ivankivsky district), Zhytomyr region (Naroditsky, Ovrutsky, Olevsky, Korostensky districts), Rivne region (Rokytnovsky, Dubrovytskyy, Sarnensky districts), Chernihiv region (Ripkinsky, Kozeletsky districts) for the observation period of 1987–2016 in the number of 35893 individuals, of which 18138 represent MOI, 17755 – FOI. The parents who gave birth to FGO varied from 18 to 49 years.

The formation factor of the overall cohort was to exclude effect of ionizing radiation of the short-living ^{131}I , ^{132}Te , ^{140}Ba , ^{140}Ba on fetal development "in utero" – the period of the early phase of the nuclear reactor accident.

The middle and late stages of the nuclear reactor accident (stabilization and recovery phases) begin 1-2 years after the accident. This period encompasses the effect on the body of the internal ionizing radiation of cesium (^{137}Cs) and strontium (^{90}Sr) due to their inflow with the food produced in the RCT [12,13]. The radioactive substances enter the body mainly with meat, dairy products and products of plant and partially wild origin (berries, mushrooms).

Based on the total cohort and considering the Quinn age periodization [14], there were made 4 study groups of offspring individuals aged 0-3 years depending on the time of birth of the offspring individuals after the accident with a three-year observation period (Table 1). The age-related periodization, which is the basis of an epidemiological research, is used in practical health care and pedagogy.

Table 1. Number of persons by sex-age groups by dates of birth of offspring individuals of the first generation of RCT residents, gross number.

Date of Birth	Total	MOI	FOI
First Study Group			
01.03.1987-28.02.1990	9634	4901	4733
Second Study Group			
01.03.1990 - 28.02.1993	9415	4765	4650
Third Study Group			
01.03.1993 - 28.02.1996	8818	4428	4390
Fourth Study Group			
01.03.1996 - 28.02.1999	8026	4044	3982

An epidemiological study of the development of the first identified non-tumour morbidity was conducted over three annual periods in accordance with the above-mentioned age-related periodization from the date of birth to the age of 18. The health assessment included 6 observation periods: the first – childhood, from birth to 3 years, the second – early childhood, from 3 to 6 years, the third – childhood of the 1st period, from 6 to 12 years, the fourth – adolescent (young), from 12 to 18 years. The list of non-tumour diseases was compiled according to the International Statistical Classification of Diseases (ICD-10).

The indicators of FGO morbidity were the following: an extensive indicator indicating the priority of a particular nosological form (group) in the structure (C) of the morbidity of a given cohort and determined by gross share (%) among other diseases; intensive index, (ID – Incidence density by 10^3 man-years with an average inaccuracy ($\pm m$) for quantitative assessment of morbidity levels in FGO cohorts).

The statistical significance of the difference of morbidity indicators between the studied sex-age groups during the study was established based on table indicators of the Student's t-test (*t*).

Findings. The study of the structure of the firstly detected non-tumour morbidity in FGOs according to the eighteen-year epidemiological observation revealed registration of 21344 (100%) individuals of the first cases of non-tumour diseases according to certain classes of diseases under ICD 10. Among those, 49.9%, or 10696 in numerical terms, represent male offspring individuals, while 10738 (50.09%) represent the female offspring individuals.

In the structure of the firstly detected non-tumour morbidity the first place is taken by respiratory diseases, the second – by diseases of the endocrine system, eating disorders and metabolic disorders, and the third – by diseases of the digestive system. Together, they account for 66.87% (Table 2).

Table 2. Structure of the firstly detected non-tumour diseases of FGOs – RCT residents of the total cohort for the years of observation (upon their reaching 18 years), based on sex, in percentage terms

Classes of Diseases by ICD – 10 (ICD-10)	First Generation Offspring Individuals		
	Total	Male	Female
All diseases, including (D50.0-R79.9)	100	100	100
Blood-related and blood-producing diseases and certain disorders involving immune mechanism (D50-D89)	2,65	2,23	3,06
Endocrine system diseases, eating disorders and metabolic disorders (E00.0-E90.9)	15,38	14,49	16,27
Psychological and behavioural disorders (F00.0-F99.0)	0,48	0,54	0,41
Nervous system diseases (G00.0-G99.9)	4,74	4,17	5,32
Eye-related diseases and of adnexa (H00-H59.9)	2,37	2,24	2,50
Ear-related diseases and of nipple appendage (H60.0-H95.9)	0,69	0,65	0,72
Blood circulation system diseases (I00.0- I99.9)	8,21	8,28	8,13
Respiratory diseases (J00.0- J99.9)	36,61	38,78	34,45
Digestion diseases (K00.0- K93.9)	14,88	14,18	15,58
Bone and muscle system related diseases and of connection tissue (M00.0- M99.9)	6,86	7,03	6,70
Urine system diseases (N00-N99.9)	2,00	1,80	2,20
Congenital abnormalities, development disorders (Q00.0 - Q99.9)	0,65	0,78	0,52
Symptoms, features, and deviations from the norm detected during clinical and laboratory studies and not elsewhere classified (R00.0 - R99.0)	4,00	4,28	3,72

Significant proportions are indicated by diseases of the circulatory system, musculoskeletal and connective tissue, organs of the nervous system and symptoms, signs and deviations from the norm, found in clinical and laboratory studies, not elsewhere classified. The proportion of other diseases in the structure is less than four percent. The structure of the cohort of offspring male and female individuals is similar to the overall cohort. As regards MOI, respiratory diseases prevail by 1.13 times, while in case of FOI, endocrine diseases, eating disorders and metabolic disorders prevail by 1.4 times and by 1.1 times – the digestive system diseases.

Thus, in the four study groups, the formation of the structure of the firstly detected non-tumour morbidity occurred at the expense of the main three classes of diseases: respiratory diseases, endocrine diseases and digestive organ diseases. These diseases in the structure of the pathology of the FGO of the first study group constitute together 73.99%, the second group – 66.94%, the third group – 70.1%, and the fourth group – 63.1%. The classes that occupy the first three places are formed by "acute upper respiratory tract disease (J00-J18.9)" (acute upper respiratory tract infection (J00-J06.9) and influenza and pneumonia (J10-J18.9), "Other upper respiratory tract diseases (J30.0-J39.9)" and "other acute respiratory tract infections (J20-J22)", "thyroid disease (E00.0 - E07.0)", "bile disease bladder, biliary tract, and pancreas (K80.0 - K87.9)", "esophagus, stomach, and duodenum (K20.0 - K31.9)."

The study of morbidity levels and the dynamics of their changes during the 18 years of observation of each study group and the cohort as a whole, was conducted in three classes, which are the main components in the structure of the first detected non-tumour morbidity of FGOs, namely: respiratory diseases, endocrine diseases and digestive system diseases.

The incidence rate of respiratory disease among FGOs of all study groups – ID at 10^3 person-years \pm m - 59.59 ± 0.65 .

Figure 1 shows the rates of respiratory disease in the dynamics of observation from birth to FGOs' 18th birthday.

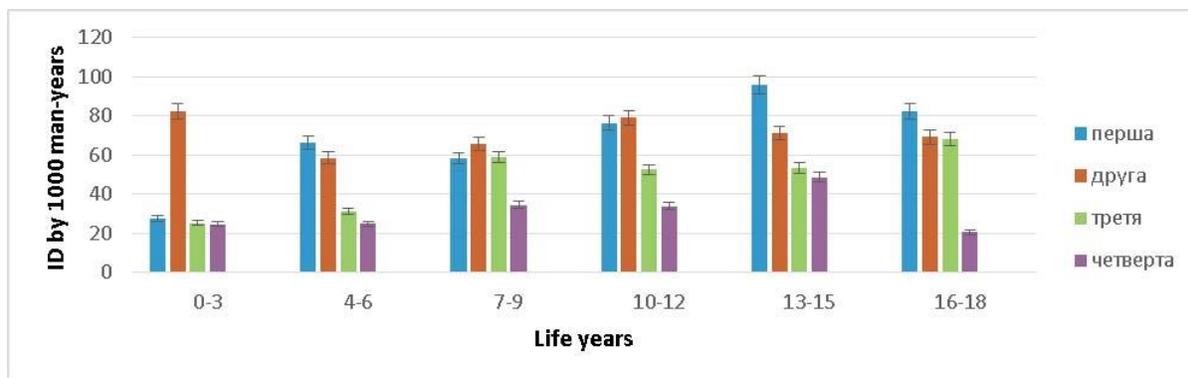


Figure 1. Respiratory disease rates among FGOs of the four studied groups in the dynamics of 18 years of observation.

The study of respiratory disease rates in first-generation offspring individuals during 18 years of life, depending on their time of birth after the Chernobyl accident, showed that the highest disease incidence of the first three years of life are among the offspring individuals of the second group. The disease incidence levels of the other groups are significantly lower, but they do not differ from each other by the indicator. At the age of 4-6 years, a significant difference in the incidence rates is observed among all groups, with the highest value being in the first group and the lowest in the fourth group. At the age of 7-9 years, there are the highest levels among the offspring of the second group compared to others. There are high levels in the first and third groups without significant difference, and the fourth group boasts the lowest incidence. At 10-12 years of life, the highest levels apply to the first and second groups without significant difference. There is a significant difference in levels between the third and fourth groups between them and other groups. The age of 13-15 years boasts the highest levels in the first group with a significant consistent decrease in levels in the second, third, and fourth groups. At the age of 16-18 years, there is the highest incidence in the first group, the high levels remain in the second and third, the lowest - in the fourth group.

Respiratory morbidity in all study groups was mainly due to groups of diseases - "acute upper respiratory tract diseases (J00-J18.9)" (acute respiratory tract upper respiratory tract infection (J00-J06.9) and influenza and pneumonia (J10-J18.9), "Other upper respiratory tract diseases (J30.0-J39.9)" and "Other acute respiratory tract infections (J20-J22)." The morbidity is mainly expressed in the acute upper respiratory tract by acute nasopharyngitis, sinusitis,

pharyngitis, tonsillitis and others, in the group of other upper respiratory tract diseases, by chronic diseases of the tonsils and adenoids, and among other acute respiratory infections of the lower respiratory tract – acute bronchitis, bronchiolitis.

By three-year observation periods of FGOs from birth to the age of 18 as to respiratory diseases in all study groups, there were detected acute upper respiratory tract diseases. The peculiarity of the morbidity of the offspring of the first and second groups is the manifestation of chronic diseases of the tonsils and adenoids in the first three years of life, and the offspring of the third and fourth groups in the same period – the presence of acute bronchitis and bronchiolitis. For the first time, acute bronchitis and bronchiolitis among the offspring of the first and second groups are diagnosed at the age of 4-9 years. The incidence of acute lower respiratory tract disease has a constant value during the life of FGOs aged 10-18 years. During 18 years of life of FGOs, the incidence of acute upper respiratory tract disease has increased in all study groups. At the same time, the frequency of manifestation of the first chronic diseases of the tonsils and adenoids gradually decreases as the offspring reaches the age of 18.

Thus, for all years of observation among the study groups, the highest rates of respiratory disease in each three-year period are by the first or second group, and the lowest are by the fourth group.

The incidence rate of diseases of the endocrine system, eating disorders and metabolic disorders among the FGOs of all study groups is 25.06 ± 0.43 per 10^3 man-years. The major contribution to the development of endocrine diseases was mainly due to "thyroid disease, E00-E07.9" - 24.19 ± 0.42 for 10^3 man-years, namely "thyroid disease associated with iodine failure, E00-E02.9", "hypothyroidism, E03-E03.9", "other forms of nontoxic goiter (nodal), E04-E04.9", "thyrotoxicosis (hyperthyroidism), E05-E05.9", "other Thyroid Disease, E07- E07.9" - Calcitonin hypersecretion, dyshormonal goiter, other specified and unspecified thyroid diseases.

Among thyroid diseases in the first three years of life, the incidence is manifested by "other thyroid diseases, E07" in the offspring of the second, third and fourth groups with the highest ID in 10^3 man-years $\pm m$ - $50,63 \pm 24,66$ by the third group, and at the age of 4 - 6 years - among the offspring of the first group (Fig. 2).

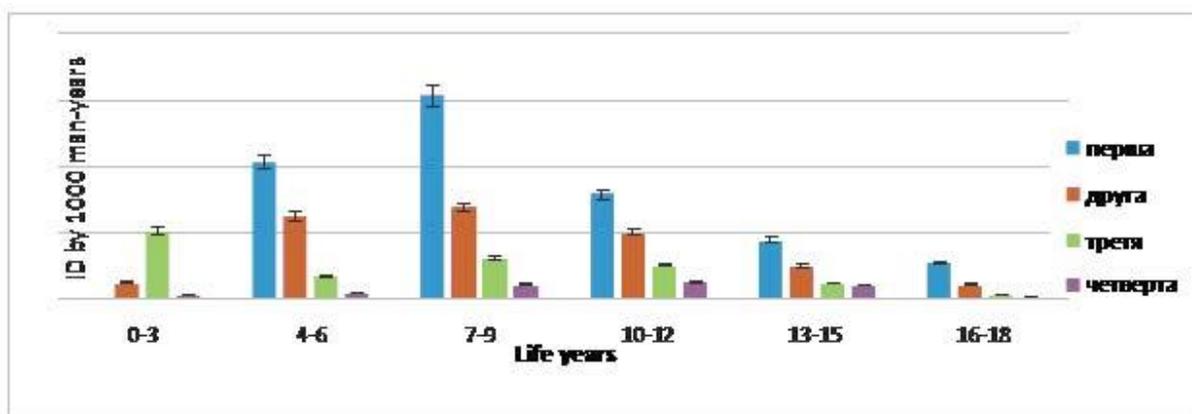


Figure 2. Thyroid disease incidence rates among FGOs of the four study groups in the dynamics during 18 years of observations.

At the age of 4-6 years, the offspring of all study groups were first diagnosed with "thyroid disease associated with iodine deficiency, E 02" with the highest rate in the first group, 74.27 ± 13.5 per 10^3 man-years and "hypothyroidism, E03" – only among the offspring of the second and fourth groups and "thyrotoxicosis, E05" among the offspring of the third and fourth groups with low values of the index. At the age of 7-9 years, the nosological form - "other forms of non-toxic goiter, E04" - appeared insignificantly for the first time among the offspring of the second, third and fourth groups. During the same life period, "other thyroid diseases, E07" increase to maximum levels, 89.00 ± 8.8 per 10^3 man-years among the offspring of the first group. At the age of 10-12 years, the nosological form "thyroiditis, E06" was diagnosed for the first time with low levels of 1.16 ± 0.36 per 10^3 man-years among the offspring of the third and fourth groups.

In the period of 13-18 years, the presence of all these pathological forms with different manifestation of levels is traced among the FGOs of the studied groups. At the same time, it should be noted that the highest levels are at the age of 10-15 years, the highest levels for "hypothyroidism, E03", "other forms of non-toxic goiter, E04" "thyrotoxicosis, E05", while high levels remain for "thyroid diseases associated with iodine failure, E 02".

Thus, the development of thyroid pathology for these diseases among the offspring of all study groups mainly begins from 4 to 6 years with "thyroid diseases associated with iodine deficiency, E 02". The highest incidence rates in all four groups are reported for thyroid disease

associated with iodine deficiency, especially in the first two groups. Starting from 7-9 years, the pathology of the thyroid gland becomes complicated, as evidenced by the development of hypothyroidism, thyrotoxicosis, thyroiditis, other forms of non-toxic goiter (diffuse and nodular).

The incidence rate of digestive diseases among the FGOs of all study groups during the 18 years of life of ID by 10^3 man-years \pm m - $24,23 \pm 0,42$. The development of digestive diseases begins in the first three years of life among the offspring of all but the first group (Fig. 3).

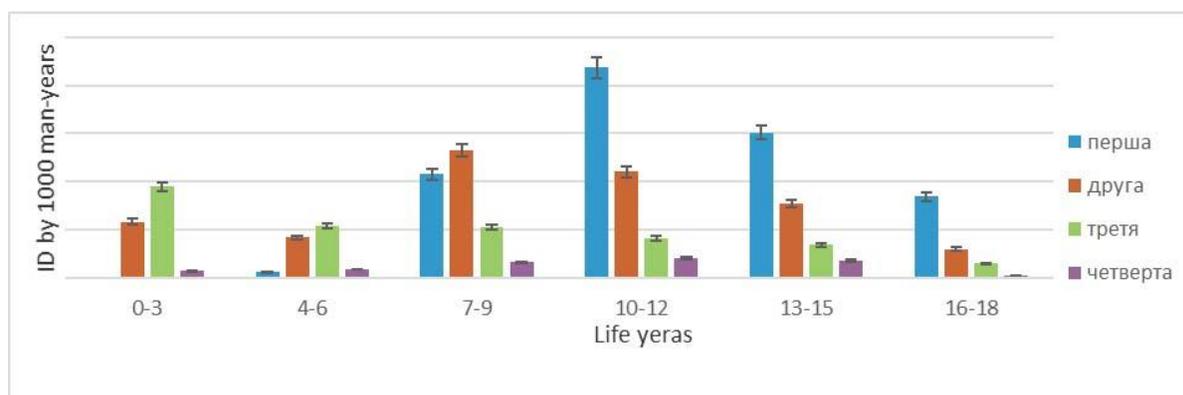


Figure 3. Digestive disease rates of the first-generation offspring of all study groups during the 18 years of life, ID \pm m.

At this stage of the study, there is a significant difference between the indicators, with the highest being by the third group, and the lowest – by the fourth group. At 4-6 years, this pathology is also recorded among the first group offspring and a significant difference in levels between the groups is maintained. FGOs aged 7-9 years share a significant difference between groups with high incidence of the first and second groups, with the lowest level being applicable to the fourth group. This feature of the disease development at the next stages of observation is identical.

The main nosological forms that cause the digestive tract disease are "gastritis and duodenitis, K29-K29.9", "gallbladder and biliary tract, K80-K83.9" and "hernia, K40-K46.9", "oral cavity, salivary glands and jaws diseases, K00.0-K14.9".

At the age of 0 - 3 years, only the offspring of the third group suffer from high levels of gastritis and duodenitis and are affected by low levels of the gallbladder and biliary tract diseases,

while the second group is diagnosed with hernias with small levels. At the age of 4-6 years, offspring of all study groups are diagnosed with digestive diseases in the. At the age of 7 - 9, among the descendants of all the studied groups there appear diseases of the mouth, salivary glands and jaws for the first time. The manifestation of gastritis and duodenitis and diseases of the gallbladder and biliary tract is also traced in the first group FGOs. The 10-18 year period is characterized by the similarity of disease development in all four groups: first, there is a significant difference in levels between all groups at each stage of observation, and secondly, the highest levels apply to the first group, characterised by a gradual decrease in levels in each subsequent group compared to the level of the previous group. Particular attention is drawn to the high incidence rates of 10-12 years of age among the offspring of the first group, which is due to an increase in the development of diseases of the oral cavity, salivary glands and jaws, gastritis and duodenitis, diseases of the gall bladder and biliary tract. At the age of 16 - 18 years, the incidence rates for all digestive tract groups decreased significantly compared to 10-12 years.

Thus, for the first time the pathology of the digestive system among the offspring of the studied groups is diagnosed in different ages of life. The main manifestation of this pathology occurs at the age of 7-9 years with the highest level applicable to the first group, high levels applicable to the second group, and lower levels – to the third, and the tiniest level applicable to the fourth group. This causes a significant difference in levels between groups. The main diseases that form the pathology of the digestive system are diseases of the oral cavity, salivary glands and jaws, gastritis and duodenitis, diseases of the gallbladder and biliary tract.

Conclusion

The above findings of the study of the development of the first detected non-tumour morbidity in the 18-year observation period of the four study groups FGOs, depending on their date of birth after the Chernobyl accident, enabled to establish the following:

In the structure of all first-identified non-tumour diseases by fourteen ICD classes - the 10 largest components apply to respiratory diseases (J00.0 - J99.9) - 36.61%, diseases of the endocrine system, eating disorders and metabolic disorders (E00.0 - E90.9) – 15,38%, digestive diseases (K00.0 - K93.9) – 14,88%.

The peculiarity of the development of endocrine diseases, eating disorders and metabolic disorders (E00.0 - E90.9) is that 96.6% of these diseases are occupied by thyroid diseases (E00.0 - E07.0), hence, only thyroid disease were further analysed.

The epidemiological analysis of the dynamics of the development of non-tumour morbidity in the above three classes of diseases during the 18 years of the life of the FGOs was carried out by six three-year observation periods.

Respiratory disease rates are higher among the offspring of the first and second groups compared to the third and fourth three-year observation periods for 18 years. The lowest levels are among the fourth group.

Respiratory morbidity in all study groups was mainly due to acute respiratory infections of the upper respiratory tract, namely: acute nasopharyngitis, sinusitis, pharyngitis, tonsillitis, etc., in the group of other diseases of the upper respiratory tract and chronic diseases, among other acute respiratory infections of the lower respiratory tract – acute bronchitis and bronchiolitis.

Thyroid disease incidence rates are higher among the offspring of the first group compared to the other study groups. At the same time, the incidence rates among the offspring of the second group are significantly higher than the levels of the third and fourth groups. The lowest levels are among the fourth group.

In the first three years of life of the FGOs among the “thyroid disease (E00.0 - E07.0)” - the calcification of hypersecretion of calcitonin, dyshormonogenetic goiter, other specified and not specified diseases of the thyroid gland are diagnosed. From 4-6 years, the incidence of thyroid disease associated with iodine deficiency has increased. In 7-9 years of life of FGO thyroid pathology is complicated by the development of hypothyroidism, thyrotoxicosis, thyroiditis, other forms of non-toxic goiter (diffuse and nodular). At the age of 10-12 years, the life of the offspring is for the first time diagnosed with "thyroiditis, E06" among the offspring of the third and fourth groups. Among the FGOs of all study groups aged 13-18 years, thyroid disease is traced according to all these nosological forms.

It should be noted that the development of thyroid diseases during the 18 years of observation of each study group is characterized by the emergence of more complex nosological forms of thyroid pathology from 7 to 9 years.

Digestive morbidity rates are highest in the first study group, lower in the second, and lowest in the fourth. The pathology of digestive organs among FGOs of all four study groups is manifested by "gastritis and duodenitis, K29-K29.9", "diseases of the gallbladder and biliary tract, K80-K83.9" and "hernias, K40-K46.9", "diseases of the cavity mouth, salivary glands and jaws, K00.0-K14.9".

The most vulnerable to the development of morbidity for the above-mentioned classes of diseases among FGOs is the life span of 7 to 15 years. This is evidenced by an increase in the incidence of respiratory diseases with a maximum value of the indicator at the age of 13-15 years, the thyroid gland - at the age of 7-9 years, the digestive system - at the age of 10-12 years.

It is discovered that the development of endocrine diseases, in particular, thyroid pathology, respiratory organs and digestion in the first generation of the victims of the Chernobyl accident is manifested at an early age, with further complication being in place upon their reaching 18 years. Continuous differentiated health monitoring throughout their lives is required to maintain FGOs' health and to prevent their disability during adulthood.

References

1. Norms of radiation security of Ukraine; Public hygienic norms. - Kyiv: Polygraph department of the Ukrainian centre for State Sanitary and Epidemiology Supervision of the Ministry of Healthcare of Ukraine, 2000. – 121p.
2. Publication 103 of International Commission on Radiation Protection (ICRP). Translated from English / Generally supervised by M.F. Kiselev, N.K. Shandala, Moscow: Editorial PKF Alana LLC, 2009. – 312 p.
3. Principal International Security Norms (GSR, part 3 (Interim). Radiation Protection and Security of Sources of Radiation: Principal International Security Norms. Basic Security Requirements. – Vienna, International Atomic Energy Agency, 2011. – 311 p.
4. Law of Ukraine "On Basic Fundamentals (Strategy) of Public Ecology Policy of Ukraine by 2020." Kyiv, 21 December 2010 No. 2818-VI.2. Hygiene of Infants and Teenagers: Book. - M.: Medicine, 2004 – 384 p.
5. V.G. Bebeshko, B.S. Prister, M.I. Omelianets, Radio-biophysical and medical and hygienic implications of the Chernobyl Accident: study tools and solutions. Practical manual for a family doctor. Uzhgorod, 2017. 502 p.

6. Norms of Radiation Safety of Ukraine; Supplements: Radiation Protection Against Sources of Potential Exposure (INSCU-97/Д-2000). Resolution of the Chief State Sanitary Doctor of Ukraine dated 12.07.2000 No. 116.

7. Studies of mortality of atomic bomb survivors. Report 13 Solid cancer and non-cancer disease mortality 1950 – 1997 / D.Preston. Y. Shimizu. D. Pierce et al. // Radiat. Res. – 2003. – Vol. 160. No 3/ - P. 381 – 407.

8. Zh.N. Minchenko, Genetic Blood Systems and Radio Sensitivity of Human Body. International Journal of Radiation Medicine. 2006. Published. 5. p. 128 – 138.1.

9. Miousse I.R., Kutanzi K.R., Koturbash I. Effects of ionizing radiation on DNA methylation: From experimental biology to clinical applications. Int. J. Radiat. Biol. 2017;93:457–469. doi: 10.1080/09553002.2017.1287454. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

10. Yahyapour R., Motevaseli E., Rezaeyan A., Abdollahi H., Farhood B., Cheki M., Najafi M., Villa V. Mechanisms of Radiation Bystander and Non-Targeted Effects: Implications to Radiation Carcinogenesis and Radiotherapy. Curr. Radiopharm. 2018;11:34–45. doi: 10.2174/1874471011666171229123130. [PubMed] [CrossRef] [Google Scholar]

11. L.S. Baleva, A.E. Sipiashina, N.M. Karakhan, The State of Health of the Russian Infant Population exposed to radiation due to the Chernobyl Accident. The Conclusions of the 29-year observations of the Infant Science and Practical Centre for Anti-Radiation Protectio, Ros Vestn Perinatol Pediat 2015; 4:6–10

12. Hygiene of children and adolescents [Text] : textbook for med. students of higher educational institutions of IV level of accreditation / [I. T. Matasar et al.] ; Bogomolets nat. med. univ., Nat. research centre for radiation medicine. - Kyiv : [s. n.], 2015. - 351 p. : tab. - 500 pieces. - ISBN 978-966-432-145-4

13. V.V. Chumak, I.A. Likhtiarov, V.S. Repin, Radiation Doses of the Evacuated Population. The Chernobyl Accident. – Kyiv: Scientific Opinion, 1996. Sect.1.3. p. 420 – 424.

14. Hygiene of Infants and Adolescents: Textbook. – M.: Medicine, 2004. p. 384.