

международный научно-практический журнал
КАРДИОЛОГИЯ
в Беларуси

cardio.recipe.by

2020, том 12, № 4

Основен в 2009 г.

Журнал зарегистрирован в Министерстве информации Республики Беларусь 4 июня 2009 года. Регистрационное свидетельство № 456

Учредители:

УП «Профессиональные издания»
ОО «Белорусское научное общество кардиологов»

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Подписка

в каталоге РУП «Белпочта» (Беларусь)
индивидуальный индекс 01079
ведомственный индекс 010792

01079 – единый индекс в электронных каталогах «Газеты и журналы» на сайтах агентств:
ООО «Информнаука» (Российская Федерация),
АО «МК-Периодика» (Российская Федерация),
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Фирма «INDEX» (Болгария)

По вопросам приобретения журнала обращайтесь в редакцию в Минске и офис издательства в Киеве

Цена свободная

Периодичность выхода – один раз в два месяца
Формат 70x100 1/16. Печать офсетная
Тираж – 1500 экземпляров
Заказ
Подписано в печать 31.08.2020

Отпечатано в типографии
Производственное дочернее унитарное предприятие
«Типография Федерации профсоюзов Беларуси».
Свидетельство о государственной регистрации издателя, изготовителя, распространителя печатных изданий
№2/18 от 26.11.2013.
пл. Свободы, 23-103, г. Минск. ЛП №02330/54 от 12.08.2013.

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Рецензируемое издание

Журнал включен в международные базы Scopus, EBSCO, Ulrich's Periodicals Directory, РИНЦ.

Журнал входит в Перечень научных изданий Республики Беларусь для опубликования результатов диссертационных исследований. Решение коллегии ВАК от 12.06.2009 (протокол № 11/6).

Электронная версия журнала доступна на сайте cardio.recipe.by, в Научной электронной библиотеке eLibrary.ru, в базе данных East View, в электронной библиотечной системе IPRbooks

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International Scientific Journal CARDIOLOGY IN BELARUS

KARDIOLOGIJA V BELARUSI

cardio.recipe.by

2020 Volume 12 Number 4

Founded in 2009

The journal is registered in the Ministry of information of the Republic of Belarus 04.06.2009. Registration certificate № 456

Founders:

UE "Professional Editions"
PA "Belarusian Scientific Society of Cardiologists"

Editorial office:

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Subscription:

in catalogue of the Republican unitary enterprise "Belposhta" (Belarus)
individual index 01079
departmental index 010792

Index **01079** in the electronic catalogs "Newspapers and Magazines" on web-sites of agencies:
LLC "Informnauka" (Russian Federation),
JSC "MK-Periodika" (Russian Federation),
LLC "Pressinform" (Russian Federation),
LLC "SPA "Inform-system" (Russian Federation),
SE "Press" (Ukraine),
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JSC "Letuvos pashtas" (Lithuania),
Kubon&Sagner (Germany),
LLC "Subscription Agency PKS" (Latvia),
INDEX Firm agency (Bulgaria)

For any inquiries about acquiring the journal please contact the Minsk reduction and the office of production in Ukraine

The price is not fixed

The frequency of journal is 1 time in 2 months
Format 70x100 1/16. Litho
Circulation is 1500 copies
Order №
Sent for the press 31.08.2020

Printed in printing house

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Peer-Reviewed Edition

The journal is included in the international databases Scopus, EBSCO, Ulrich's Periodicals Directory, RSCI.

The journal is included into a List of scientific publications of the Republic of Belarus for the publication of the results of the dissertation research.

HCC board decision of 12.06.2009 (protocol № 11/6).

The electronic version of the journal is available on cardio.recipe.by, on the Scientific electronic library elibrary.ru, in the East View database, in the electronic library system IPRbooks

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Уважаемые читатели!

В ваших руках очередной номер журнала «Кардиология в Беларуси». Миссией редакционной коллегии и издательства «Профессиональные издания» является в том числе повышение его международного рейтинга. Что нужно сделать, чтобы не затеряться в современном информационном океане тысяч публикаций по кардиологической тематике?

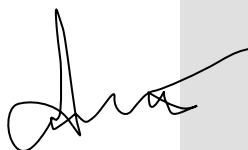
Объективной мерой оценки научного рейтинга журнала является индекс цитируемости (CiteScore). Сегодня он составляет 0,1. Это означает, что цитируется 1 статья из 10 опубликованных. Для сравнения: у родственных изданий «Кардиология» и Российского кардиологического журнала индекс цитируемости равен 0,5, то есть в 5 раз больше. Правда, «Кардиология» имеет почтенный 60-летний научный возраст, а Российскому кардиологическому журналу более 20 лет. Индекс цитируемости известного European Heart Journal уже достиг 22,7. Наше издание более молодое, так что все еще впереди.

Что следует предпринять, чтобы повысить наш индекс цитируемости? Во-первых, это публикация истинно инновационных разработок с высоким уровнем новизны. Во-вторых, оперативная публикация переводов международных Guidelines, на которые, естественно, ожидается большое количество ссылок. В-третьих, повышение культуры составления библиографических списков авторами журнала. Например, если в разделе «Материалы и методы» упоминается искусственный клапан сердца или оригинальная диагностическая компьютерная программа, желательно сослаться на разработчиков и соответствующие публикации. В-четвертых, издание электронной версии журнала, предшествующее его бумажной версии. При таком подходе авторский приоритет будет оперативно защищен online.

Таким образом, повышение научного веса журнала «Кардиология в Беларуси» является общей стратегической задачей всего нашего кардиологического сообщества.

Желаю вам достижения новых научных высот, здоровья и крепости духа в столь непростое время.

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DOI: <https://doi.org/10.34883/PI.2020.12.4.002>
UDC 616-007-053.1161:613.292:582:799

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Morbidity and Prevalence of Congenital Heart Defects Among Children of Ukraine: Influence of Environmental Factors

Заболееваемость и распространенность врожденных пороков сердца у детей Украины: влияние факторов окружающей среды

Abstract

Introduction. Congenital heart defects (CHD) with perinatal pathologic conditions and diseases of the respiratory organs are currently occupying the leading places among the causes of infant mortality and disability in Ukraine and worldwide.

Purpose. Study of the morbidity of the pediatric population of the country and the prevalence of congenital heart defects in children from the areas with radiological control territories (TRC) and other regions of Ukraine in the dynamics over the last 24 years. Our goal is to identify unfavorable trends and to develop the measures to protect the infant organism from adverse environmental factors, including radiation.

Materials and methods. We performed the analysis of the incidence and prevalence of congenital heart defects among children from different regions of Ukraine, including those contaminated after the Chernobyl accident. The methods of statistical evaluation, epidemiological analysis of materials of the Center of Medical Statistics of the Ministry of Health of Ukraine were used.

Results and discussion. The rate of growth of the incidence of congenital heart disease in the last 24 years exceeded by 5.3 times the indicator of the overall morbidity of the pediatric population of Ukraine. Thus, the increase of CHD morbidity rates in the last 24 years among children from the regions with radiological control territories was higher (+218.0%) than among children from other regions of the country (+179.2%) and higher than national incidence of children with congenital heart defects (+190.0%). The number of CHD among children affected by the Chernobyl accident was slightly lower than in other groups (+73.9%). In all 9 regions with radiological control territories, a high incidence of pediatric congenital heart disease has been observed and maintained over the last 24 years. This rate is higher by 26.1% than the corresponding incidence of CHD among children living in the areas without radiological control territories and higher by 15.9% than nationwide morbidity. At the same time, the incidence of CHD morbidity among the children affected by the Chernobyl disaster was slightly lower than the national incidence rate.

Conclusion. The results of our observations let to conclude that the embryonic period of ontogenesis of the cardiovascular system of children is sensitive to prolonged exposure to ecotoxic environmental factors, including radiation.

Keywords: children, morbidity, congenital heart defects, Chernobyl disaster, environment.

Резюме

Введение. Врожденные пороки сердца (ВПС), перинатальные патологические состояния и заболевания органов дыхания в настоящее время занимают ведущее место среди причин детской смертности и инвалидности в Украине и во всем мире.

Цель. Изучение заболеваемости детского населения страны и распространенности врожденных пороков сердца у детей из районов с территориями радиологического контроля (ТРК) и других регионов Украины в динамике за последние 24 года. Выявить неблагоприятные тенденции и разработать меры по защите детского организма от неблагоприятных факторов окружающей среды, включая радиацию.

Материалы и методы. Мы провели анализ заболеваемости и распространенности врожденных пороков сердца у детей из разных регионов Украины, в том числе и тех, которые пострадали в результате Чернобыльской аварии. Используются методы статистической оценки, эпидемиологического анализа материалов Центра медицинской статистики Министерства здравоохранения Украины за 24 года.

Результаты и обсуждение. Темпы роста заболеваемости врожденными пороками сердца за последние 24 года превысили в 5,3 раза показатель общей заболеваемости детского населения Украины. Так, прирост заболеваемости ВПС за последние 24 года среди детей из регионов с территориями радиологического контроля был выше (+218,0%), чем среди детей из других регионов страны (+179,2%), и выше, чем уровень заболеваемости детей в стране по врожденным порокам сердца (+190,0%). Число ВПС среди детей, пострадавших в результате Чернобыльской аварии, было несколько ниже, чем в других группах (+73,9%). Во всех 9 регионах с территориями радиологического контроля в последние 24 года наблюдалась и поддерживалась высокая частота врожденных пороков сердца у детей. Этот показатель выше на 26,1%, чем соответствующая заболеваемость ВПС среди детей, проживающих в районах, не имеющих территорий радиологического контроля, и на 15,9% выше, чем в целом по стране. В то же время заболеваемость ВПС среди детей, пострадавших от Чернобыльской катастрофы, была несколько ниже, чем в национальном масштабе.

Заключение. Результаты наших наблюдений позволяют сделать вывод о том, что эмбриональный период онтогенеза сердечно-сосудистой системы детей чувствителен к длительному воздействию экотоксичных факторов окружающей среды, в том числе радиации.

Ключевые слова: дети, заболеваемость, врожденные пороки сердца, Чернобыльская катастрофа, окружающая среда.

■ INTRODUCTION

Congenital heart defects (CHD) together with perinatal pathological conditions and diseases of the respiratory organs, currently occupying leading places among the causes of infant mortality and disability of the child population of Ukraine, which unfortunately corresponds to world trends [1]. According to the European Registration of Congenital Abnormalities and Twins (EUROCAT), the prevalence of all CHD in the period from 2010 till 2014 was 8.1 babies, and if we perform analysis of their complex and combined forms, it's prevalence will be 2.2 babies per 1000 newborns [2].



The prevalence of congenital heart defects in the world is increasing over time, which may be chained with implication of improved methods of diagnosis of the CHD and higher rate of prevention of infant mortality. Probably the prevalence of CHD among children may be significantly higher than their detection [3]. The leading role in the development of pediatric pathology in Ukraine belongs to the influence of the polluted environment, including the consequences of the Chernobyl nuclear power plant accident in 1986 [4].

As a result of the Chernobyl catastrophe in Ukraine an anomalous radioactive chemically wasted zone has been formed. It had covered 9 regions of the country with more than 8 million inhabitants, including almost 1.8 million children. This zone had a long-term external and internal radiation source due to pollution of these territories by radionuclides. Radioactive milk, meat and berries from those territories may easily enter the body of children that live there.

According to the order No. 441 of the Ministry of Health of Ukraine from 14.06.2012 congenital defects (CD) including the most common congenital heart defects and congenital defects of the nervous system in children (22–25% of all CD) were included in the List of diseases and pathological conditions, the risk of which is increased as a result of exposure of the child's body to ionizing radiation and other harmful factors due to the accident at the Chernobyl.

Although H. Dolk has demonstrated data about absence of effect of Chernobyl disaster on the incidence of congenital anomalies in Europe [5]. A comparative analysis of the prevalence of different classes of diseases among the children from radioactive areas and rates of similar diseases among children from other areas has shown that 7 out of 9 territories under radiological control (TRC) were included in top ten regions with the highest prevalence of childhood illnesses.

This data has far exceeded the nationwide disease prevalence rate (1777.16 per 1,000 children). Most prevalent classes of diseases were oncologic malformations, diseases of the endocrine system, cardiovascular pathology, congenital defects, diseases of the respiratory system, diseases of the ear, diseases of the nervous system, diseases of the blood and hematopoietic organs [5].

■ PURPOSE OF THE STUDY

To research of the morbidity of the child population in Ukraine and to define the prevalence of congenital heart defects among children from the radiological control territories and other regions of Ukraine over the last 24 years in purpose of identifying unfavorable trends and developing measures to protect children from adverse environmental factors of radiation.

■ MATERIALS AND METHODS

We have performed an comparative analysis of the incidence and prevalence of congenital heart defects among children (0–14 years old) living in 9 regions (Vinnytsia, Volyn, Ivano-Frankivsk, Kyiv, Rivne, Sumy, Chernihiv and Cherkasy) with radioecological control territories (according to the legislation of Ukraine) and among children, who lived in in relatively non-wasted regions without radioecological control.

A separate group for analysis was consisted of more than 386 thousand children who were born in families that permanently residing or living in the radiological control zones, affected by the Chernobyl accident.

The research was performed in compliance with the main policies of the GCP ICH and the Helsinki Declaration on Ethical Principles for Medical Research Involving Human Subjects, and its subsequent revisions (Seoul, 2008), the Council of Europe Convention on Human Rights and Biomedicine (2007) and the recommendations of the Committee on Bioethics at the Presidium of the NAMS of Ukraine (2002).

Statistical evaluation was performed using the Wilcoxon W rank criterion for comparing the incidence rates of CHD among children from the same regions of Ukraine at different time intervals. Also we have made epidemiological analysis of data from the Statistical Center of Ministry of Health of Ukraine for the past 24 years. The clustering of the regions of Ukraine according to the CHD incidence among infant population was made according to the correlation of CHD incidence rates of infant population and the presence of radioactive contaminated areas in regions.

■ RESULTS AND DISCUSSION

According to the data provided by Health Statistics Center of the Ministry of Health of Ukraine, the incidence of congenital heart defects among children aged 0–14 years in 2017 has reached 9498 new cases (1.45 per 1000 children). 273 cases of the CHD were firstly diagnosed among children affected by the Chernobyl accident (1.27 per 1000 children). Those numbers were less than the average CHD incidence among children in Ukraine. Overall increasing rate of children`s CHD incidence has 5.6 times exceeded the overall morbidity incidence of the infant population.

4606 cases of CHD (12.87 per 1000 children) were registered among children in the first year of life. This is better data in comparison with previous year CHD incidence (4995 infants). The prevalence of CHD among children (0–17 years) has reached 68.4 thousand cases (8.98 per 1000 children), which corresponds to the global prevalence rates of these conditions [2]. Incidence of CHD among children affected by the Chernobyl accident has reached 3246 cases (10.39 per 1,000 children), which was far above the average CHD incidence level in Ukraine.

Therefore it is important to include the fact of the possible radioactive exposure of the child's parents in a list of possible risk factors of congenital heart disease.

Most of the children who died as a result of complex and combined forms of CHD has died in the neonatal period or during the first year of life (93 or 0.26 per 1,000 population). That was 11.26% from all registered causes of infant death.

Comparative analysis of the CHD incidence among Ukrainian children from TRC and other regions has shown that CHD incidence has exceeded the national median level in 5 out of 9 regions with TRC (Table 1). The CHD incidence was below the national level in Chernihiv, Volyn, Ivano-Frankivsk and Cherkasy regions.

Highest children CHD rates were observed in Kharkiv, Vinnytsia, Zaporizhzhia, Kyiv, Dnipropetrovsk regions. It is necessary to admit that among the ten regions with leading rates of childhood morbidity five of

Table 1

Comparative analysis of the incidence of congenital heart defects in children of Ukraine from ecologically wasted regions and areas with the territories of radioecological control in 2017 (according to the Health Statistics Center of the Ministry of Health of Ukraine)

TRC regions	Incidence		Non-TRC regions	Incidence	
	N	N per 1000		N	N per 1000
Ukraine	60251	9,2	Ukraine	60251	9,2
Vinnitsia	3672,0	14,89	Kharkiv	6 024,0	16,33
Kyiv	3681,0	12,82	Zaporizhia	3168,0	12,48
Rivne	2436,0	10,22	Dnipropetrovsk	5888,0	11,78
Chernihiv	1410,0	10,09	Kyiv city	4958,0	10,72
Cherkasy	1533,0	9,79	Mykolaiv	1695,0	9,47
Zhytomyr	1930,0	9,35	Donetsk	2 469	9,41
Sumy	1327,0	9,07	Lviv	3623,0	8,78
Volyn	1676,0	8,16	Kherson	1691,0	8,45
Ivano-Frankivsk	1389,0	5,88	Odessa	3085,0	7,73

them were belonged to TRC (Table 2). Interesting fact that CHD prevalence rates among children from the Kyiv, Cherkasy and Sumy regions exceeded rates of the children of Zaporizhzhya, Mykolaiv, and Lviv regions, which are known as regions with unfavorable environmental conditions.

Highest incidence of children CHD in the non-TRC regions was observed in Kharkiv, Zaporizhia and Dnipropetrovsk regions. Most of these areas have a powerful industrial and agro-industrial complex with significant ecotoxic effects on the environment and a corresponding negative impact on the health of the population, especially children.

It should be noted that such ecologically wasted industrial regions as Donetsk, Dnipropetrovsk and Zaporizhya were among the 9 non-TRC regions with the highest incidence of children chronic cardiovascular pathology (Figure). Clustering of regions of Ukraine, depending on the incidence rates of congenital heart defects among children presented in Table 2.

In general, the highest incidence rates of children CHD were observed in Kharkiv, Vinnitsia, Zaporizhia, Kyiv, Dnipropetrovsk regions. The low levels of CHD morbidity in Ivano-Frankivsk and Cherkasy regions can be explained by the significant remoteness from the source of radioactive contamination and relatively small number of areas with enhanced radiological control.

During the past 24 years, the incidence of children CHD in Ukraine has been almost doubled (Table 3). Increase of the CHD incidence was observed in both the areas with radioecological control territories and in non-TRC areas.

Over the past 24 years the incidence of birth defects among children has increased by 190% ($p < 0.01$). In particular we have discovered an increase of the incidence by 218.9% ($p < 0.01$) in areas with radioecological control territories and by 179.2% in non-TRC regions ($p < 0.01$). At the same time, the rate of increase of the incidence of CHD morbidity of children, affected by the Chernobyl accident, was slightly lower (+73.9%) than in other groups of children.

This disturbing tendency of increased incidence of congenital heart defects among children of Ukraine will likely be present in future.

Note that in 1994 high CHD incidence among the children from 5 regions have exceeded the national rates by 1.2-1.4 times, except for the

Table 2
Clustering of regions of Ukraine by morbidity levels for pediatric congenital heart defects

CHD incidence rate	TRC regions	Non-TRC regions
Regions with the highest incidence rates of pediatric (и далее) CHD	Vynnytsia Kyiv	Kharkiv Zaporizhia
Regions with the high incidence rates of children CHD	Rivne	Dnipropetrovsk
Regions with the moderate incidence rates of children CHD	Sumy Zhytomyr Chernihiv Volyn	Kherson Mykolaiv Khmelnysky Donetsk Kyiv city Kirovohrad Odessa
Regions with the low incidence rates of children CHD	–	Zakarpattia Luhansk Lviv Ternopil
Regions with the very low incidence rates of children CHD	Cherkasy Ivano-Frankivsk	Chernivtsi Poltava

Table 3
Incidence of congenital heart defects among Ukrainian children in 1994 and 2017 (according to the Health Statistics Center of the Ministry of Health of Ukraine)

№	Name of region	Morbidity in 1994*		Morbidity in 2017		Dynamic (%) from 1994 to 2017
		N	N per 1000	N	N per 1000	
	Ukraine	5350,0	0.5	9498	1.45	+190,0%
	Kharkiv	249,0	0.4	1237,0	3.35	+737,5%
	Vynnytsia**	220,0	0.6	796,0	3.22	+436,7%
	Zaporizhia	194,0	0.5	652,0	2.57	+414,0%
	Kyiv**	151,0	0.4	699,0	2.44	+510,0%
	Dnipropetrovsk	305,0	0.4	914,0	1.83	+357,5%
	Rivne**	204,0	0.7	397,0	1.66	+137,1%
	Kherson	116,0	0.4	265,0	1.56	+280,0%
	Mykolaiv	154,0	0.4	271,0	1.52	+280,0%
	Sumy**	159,0	0.6	219,0	1.50	+148,3%
	Zhytomyr**	185,0	0.6	308,0	1.49	+148,3%
	Chernihiv*	119,0	0.5	175,0	1.37	+174,0%
	Volyn**	220,0	0.6	268,0	1.31	+118,3%
	Khmelnysky	145,0	0.5	266,0	1.31	+162,0%
	Donetsk	447,0	0.4	335,0	1.30	+225,0%
	Kyiv city	211,0	0.4	577,0	1.25	+212,5%
	Kirovohrad	161,0	0.6	187,0	1.21	+101,6%
	Odessa	229,0	0.4	475,0	1.19	+197,5%
	Zakarpattia	177,0	0.5	272,0	1.08	+116,0%
	Luhansk	270,0	0.5	87,0	0.95	+90,0%
	Lviv	339,0	0.6	374,0	0.91	+51,67%
	Cherkasy**	146,0	0.5	154,0	0.89	+78,0%
	Ternopil	184,0	0.7	144,0	0.85	+21,4%

Ivano-Frankivsk **	163,0	0.5	178,0	0.75	+50,0%
Chernivtsi	140,0	0.6	113,0	0.72	+20,0%
Poltava	216,0	0.6	135,0	0.67	+11,6%
Crimea*	330,0	0.7	0	0	0
Sevastopol city*	21,0	0,3	0	0	0

Notes: * information is absent; ** TRC regions.

Ivano-Frankivsk, Cherkasy and Chernihiv regions. In 1994 the leaders in the incidence of children CHD were the following TRC regions: Rivne, Ternopil, Vinnitsa, Zhytomyr, Sumy and Volyn. Nowadays, the leading positions have obtained such TRC regions as Vinnytsia, Kyiv, Rivne, Sumy and Zhytomyr regions. The slightest increase of the incidence of congenital diseases was observed among children of Cherkasy and Ivano-Frankivsk region.

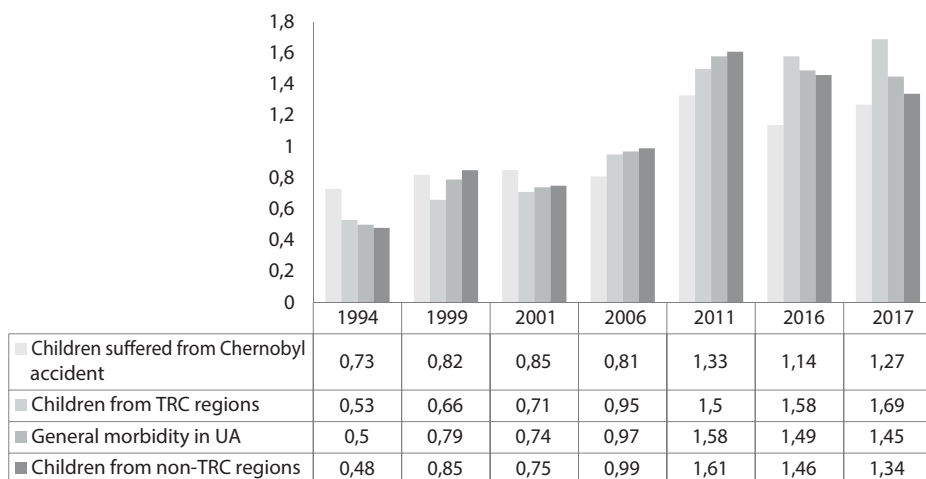
During the 24 years of children observation in the Kyiv and Vinnytsia regions, the highest incidence of CHD have increased up to +510.0% and 436.7%, respectively, compared to the incidence level in 1994 (+44, 0% to +174.0%).

Among the areas not contaminated by the Chernobyl disaster, the leaders in increasing of the incidence of the CHD were Kharkiv and Zaporizhzhia regions – 737.5% and 414.0% respectively. The Dnipropetrovsk region had same tendency with an increase of 357.5%. The smallest increase in the incidence of CHD among children was observed in Poltava and Chernivtsi region.

The incidence rates of children congenital heart defects in areas with TRCs exceeded the national rates by 15.9% ($p>0.05$). In other regions such incidence rates of children CHD exceeded the national rates by 26.1% ($p>0.05$). The incidence of heart diseases among children, affected by the Chernobyl accident, was lower than the national incidence of this pathology (Figure).

The difference between the incidence rates of circulatory system diseases in favor of the incidence rates of children from the TRC regions was observed in 1994 as well. It was significantly less (+10.3%) compared to incidence in other regions (+6%) and to the national incidence rate at the time.

CHD morbidity of children affected by the Chernobyl accident was differed 1.5 times in comparison with the indicators of children from the not contaminated areas. Their incidence rates also exceeded the national level of CHD incidence of children living in regions with radioecological control territories in 1994. However, we are now seeing the opposite tendency, which is related to the influence of the radiation factor on both parents and their offspring in the same time. Over the past 24 years, the incidence of CHD among children from the provinces with the TRC and other regions has increased by 2.5 times, and if we compare it to the national rates – by 2.65 times. It is important to note that the trend of morbidity of children CHD from the TRC regions during past 24 years from 1995 to 2016 did not exceed the corresponding morbidity rates from other regions and national indicators. The disease prevalence among children from radioactively contaminated areas has been observed during the last two years. The incidence rates of victims of the Chernobyl accident were 12.5% lower than the national rate of CHD morbidity (Figure).



Incidence rates of congenital heart defects of children affected by the Chernobyl accident and children from the TRC and non-TRC regions (1994–2017)

We have reported earlier that the incidence of circulatory diseases in the last three years has decreased in all regions [5]. Unfortunately the incidence of children CHD in different regions of Ukraine continues to grow (Figure).

A moderate decrease in the incidence of CHD in recent years may be associated with a decrease in the children population and a decrease of the alertness of pediatricians and family physicians to diagnose congenital heart defects. Only 87.1% of children with CHD are under observation (in 2016 – 86.4%). Obviously, in areas with territories of radioecological control and areas with significant contamination of the environment, there is a clear negative dynamic of increasing of infant population with congenital heart defects. CHD incidence rates among children permanently residing in Chernobyl-contaminated regions, may indicate a negative impact of the ecotoxic environmental factors, including radiation.

The reasons for the prevalence of congenital heart defects and deterioration of the health of Ukrainian children in general have strong connection with the consequences of the Chernobyl accident. Nonetheless, this question requires further investigation since the role of radiation is still debatable. This is largely due to the lack of long-term monitoring studies of the health status of the Chornobyl disaster and limited use of epidemiological methods to analyze such studies, recommended by the International Atomic Energy Agency for the Governments of Belarus, Ukraine and Russia. This problem requires continued systematic research of the health of children who continue to be negatively impacted by the environment, in order to determine the weight of the impact of each of these factors.

■ CONCLUSION

The rate of growth of the incidence of congenital heart disease in the last 24 years exceeded 5.3 times the indicator of the overall morbidity of the child population of Ukraine. Thus, the increase of CHD morbidity rates in the last 24 years among the children from the regions with radiological control



territories was higher (+218.0%) than among children from other regions of the country (+179.2%). Also we have observed the increase of the national incidence of children in congenital heart defects (+190.0%). The number of children with CHD affected by the Chernobyl accident was slightly lower than in other groups (+73.9%). High incidence of pediatric congenital heart disease has been observed and maintained over the last 24 year in all 9 regions with radiological control territories. This rate was higher by 26.1% than the corresponding incidence of CHD among children living in areas without radiological control territories and higher by 15.9% than nationwide morbidity rate. At the same time, the incidence of CHD morbidity among the children affected by the Chernobyl disaster was slightly lower than the national incidence rate. The results of our research of morbidity of children of Ukraine, who suffered from prolonged negative influence of environmental factors, including radiation, allow us to conclude that the embryonic period of ontogeny of the cardiovascular system in such children is sensitive to the prolonged harsh environmental effects.

Funding from the state budget

Implementation of the initiative-search research work of the Department of Pediatrics No. 2 Bohomolets National Medical University "Diagnostic and therapy of cardiovascular, respiratory and digestive disorders in newborns and children with common non-infectious pathology" (2012–2016). Code of state registration 0112U001772.

Authors' Participation

Concept and design of the study, editing – O. Volosovets; research design, material collection – S. Kryvopustov; collection of material and its processing – G. Beketova, L. Ovcharenko; text writing and statistical data processing – G. Beketova, A. Volosovets.

The authors declare no conflict of interests.

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Received/Поступила: 07.05.2020
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