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DYNAMICS OF THE INCIDENCE RATE OF PNEUMONIA IN CHILDREN IN UKRAINE OVER THE PAST 20 YEARS

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Цитування: *Медичні перспективи. 2020. Т. 25, № 4. С. 174-181*

Cited: *Medicni perspektivi. 2020;25(4):174-181*

Key words: *children, morbidity, mortality, pneumonia*

Ключові слова: *діти, захворюваність, смертність, пневмонія*

Ключевые слова: *дети, заболеваемость, смертность, пневмония*

Abstract. Dynamics of the incidence rate of pneumonia in children in Ukraine over the past 20 years. Volosovets O.P., Bolbot Yu.K., Abaturov O.Є., Kryvopustov S.P., Besh L.V., Stoieva T.V., Khomenko V.E., Kovalchuk O.L. Pneumonia ranks third in the structure of hospital mortality in infants after perinatal pathology and congenital malformations in Ukraine. Over the past 20 years in Ukraine, there has been a 33,7% increase in the

incidence of pneumonia in children ($p < 0.01$), with the predominant detection of this pathology in children from regions of the country who have problematic issues in the proper provision of pediatric services. The highest incidence of pneumonia in all age groups was observed in children of Ivano-Frankivsk, Rivne, Kyiv and Vinnitsa regions. Thanks to the progressive development of domestic pediatrics and the introduction of modern medical and diagnostic technologies, in particular, vaccine prophylaxis, over the past 20 years, the death rate of children from acute infections of the upper respiratory tract, pneumonia and influenza has decreased by almost 5 times. Changes in recent years in the incidence of pneumonia in children correspond to the dynamics of the spread of influenza and acute respiratory viral infection, especially during the epidemics 2009-2010 and 2015-2016. Assessing the dynamics of this indicator in subsequent periods is extremely important in the context of the COVID-19 pandemic, which continues.

Реферат. Динамика показателя заболеваемости пневмонией детей Украины за последние 20 лет. Волосовець А.П., Ботьбот Ю.К., Абатуров А.Е., Кривоустов С.П., Беш Л.В., Стоева Т.В., Хоменко В.Е., Ковальчук О.Л. В Украине пневмония занимает третье место в структуре госпитальной летальности младенцев после перинатальной патологии и врожденных аномалий развития. За последние 20 лет в Украине наблюдается рост на 33,7% заболеваемости детей пневмонией ($p < 0,01$) с преимущественным выявлением этой патологии у детей из областей страны, имеющих проблемные вопросы в надлежащем обеспечении педиатрической службы. Наибольший уровень заболеваемости пневмонией во всех возрастных группах наблюдался у детей Ивано-Франковской, Ровенской, Киевской и Винницкой областей. Благодаря прогрессивному развитию отечественной педиатрии и внедрению современных лечебно-диагностических технологий, в частности вакцинопрофилактики, за последние 20 лет смертность детей от острых инфекций верхних дыхательных путей, пневмонии и гриппа снизилась почти в 5 раз. Изменения за последние годы в заболеваемости детей пневмонией соответствуют динамике распространения гриппа и ОРВИ, особенно во время эпидемий 2009-2010 гг. и 2015-2016 гг. Оценка в динамике этого показателя в последующие периоды крайне важна в контексте пандемии COVID-19, которая продолжается.

Pneumonia in children has been and remains an urgent medical and social problem for Ukraine and the world [6, 11]. Respiratory diseases are one of the most common nosologies in children, constantly grow due to the virulence of the microflora and the unsatisfactory state of the environment, despite all modern achievements of clinical pediatrics in the field of antibiotic therapy and vaccine prophylaxis [7, 13].

In developed countries, the annual incidence of pneumonia is 3.3 per 1000 in children under 5 years and 1.45 per 1000 in children aged 0 to 16 years [6]. Recently, the situation has been exacerbated by the COVID-19 pandemic, which is known to be accompanied by bilateral pneumonia in both adults and children in severe cases [8].

According to the WHO, in 2017, pneumonia caused the death of more than 800,000 children under the age of 5 worldwide, accounting for up to 15% of all child mortality [11]. The mortality rate among hospitalized children under 5 years of age with pneumonia is less than 1%, and in resource-poor countries is several times higher [9, 12]. In Ukraine, pneumonia in children in the structure of hospital infant mortality ranks third after perinatal pathology and congenital malformations [2].

The aim of this study was to determine the changes in the incidence of pneumonia in children of Ukraine over the past 20 years in age cohorts of children from different regions of Ukraine depending on the state of the environment.

MATERIALS AND METHODS OF RESEARCH

A study of changes in the incidence of pneumonia in children aged 0-17 years living in different regions of Ukraine was carried out. Methods of statistical assessment and epidemiological analysis of data of the Center for Medical Statistics of the Ministry of Health of Ukraine from 1993 to 2019 were used [3].

Volumes of pollutant emissions from stationary and mobile sources into the atmosphere in 2015 were established in accordance with the data of the annual statistical reference book of the collection of the State Statistics Service of Ukraine [10].

Statistical estimation methods were used, in particular the U-criterion of sign ranks (Wilcoxon-Mann-Whitney test) to compare the incidence of pneumonia in children from the same regions of Ukraine at different times [5].

To establish a linear relationship, to determine the correlation and possible relationship between the volume of pollutant emissions into the atmosphere from stationary sources of pollution (hereinafter – the volume of pollutant emissions) and the incidence of pneumonia in children from different regions, Spearman's rank correlation coefficient was used [5]. Statistical processing of the study results was performed using the software product STATISTICA 6.1 (StatSoftInc., Serial № AGAR909E415822FA) and Excel-2010.

RESULTS AND DISCUSSION

According to the Center for Medical Statistics of the Ministry of Health of Ukraine, the incidence of pneumonia in children aged 0-17 years in 2017 was 62,470 new cases, or 8.2 per 1 thousand of population. For comparison, in 1996 76598 cases of pneumonia were detected for the first time, or 6.13 per 1,000 children.

As can be seen from Table 1, over the past 20 years, the incidence of pneumonia in children of the

country has probably increased by 33.7% ($p < 0.01$), as the U-criterion of Mann-Whitney rank has reached a correspondingly critical value – 178 which is in the zone of significance at a certain number of comparable groups of indicators. These data are in line with the global trend of pneumonia growth in the world, especially in countries with low per capita incomes and health care systems with limited resources [8].

Table 1

Dynamics of change in the incidence of pneumonia (ICD - J12-J16, J18) in children of Ukraine (0-17 years) from 1996 to 2017 according to the Center for Medical Statistics of the Ministry of Health of Ukraine *

Regions of the country	Incidence of pneumonia in children in 1996		Incidence of pneumonia in children in 2017		Dynamics of changes in comparison with 1996
	absolute numbers	per 1000 children	absolute numbers	per 1000 children	
Ukraine	76598	6.13	62 470	8.20	+33.7%
Vinnitsia	2 780	6.41	3 338	11.48	+79.1%
Volyn	2 552	8.07	2 098	8.77	+8.7%
Dnepropetrovsk	3 261	6.96	3 084	5.36	-23.1%
Donetsk	4 727	4.64	3 218	10.48	+125.8%
Zhytomyr	1 871	5.30	2 224	9.20	+73.5%
Transcarpathian	3 299	9.23	2 317	7.93	-14.1%
Zaporizhzhia	2 224	4.14	2 189	7.44	+79.7%
Ivano-Frankivsk	6 446	17.80	4 868	17.46	-0.07%
Kyiv	6 640	18.47	4 426	13.47	+72.9%
Kirovohrad	1 435	4.70	1 535	9.00	+91.5
Luhansk	1 379	2.12	1 206	11.12	+424.5%
Lviv	6 450	10.72	2 458	5.07	-52.7%
Mykolayiv	1 784	4.71	1 411	6.77	+43.7%
Odessa	3316	4.91	4 256	9.27	+88.8%
Poltava	3 629	10.07	2 375	10.12	+0.05%
Rivne	2 708	8.19	4 035	14.50	+77.05%
Sumy	936	2.57	1 780	10.27	+299.2%
Ternopil	2 323	8.6	2 377	11.92	+38.6%
Kharkiv	3 101	4.26	3 841	9.01	+111.5%
Kherson	2 049	6.45	2 181	11.02	+70.8%
Khmelnitsky	1 401	3.27	1 552	6.51	+99.1%
Cherkasy	2 200	4.49	1 019	5.02	+11.8%+
Chernivtsi	753	2.02	889	4.82	+138.6%
Chernihiv	3 605	13.9	1 714	10.42	-25.1%
City of Kyiv	3155	4.17	2 079	3.96	-4.04%

Note. * Data on the Autonomous Republic of Crimea and the city of Sevastopol are not included due to their absence.

The highest incidence of pneumonia is observed among the age group of children 0-6 years – 34,117 cases (10.8 per 1,000 population and 54.5% of the total number of cases), then among children aged 7-14 years – 22 449 cases (6.69 per 1000 and 35.9%) and 15-17 years – 5904 (5.47 per 1000 and 9.45%). It should be noted that the incidence of pneumonia in young children in Ukraine was three times higher than in developed countries.

The age distribution of children with pneumonia in 1996 was somewhat different. Early childhood children also dominated – 55.2% of diagnosed pneumonia, schoolchildren – 38.3% and adolescents – 6.4%. That is, over 20 years, pneumonia began to be detected 1.5 times more often in children aged 15-17 years with a corresponding decrease in its detection in young children and schoolchildren.

The highest incidence of pneumonia in all three age groups was observed in children of Ivano-Frankivsk, Rivne, Kyiv and Vinnytsia regions. It should be noted that all four region, according to the current legislation, are referred to regions with radiological control territories, which were formed as a result of the Chernobyl accident in 1986. There were also high rates of pneumonia in children aged 0-6 years from Donetsk and Luhansk regions and schoolchildren of Ternopil region. In 1996, the highest incidence of pneumonia in children was in Kyiv, Ivano-Frankivsk, Chernihiv and Lviv regions.

The lowest incidence of pneumonia in children of all age cohorts was in the city of Kyiv, Chernivtsi, Cherkasy and Lviv regions (Table 2).

Table 2

Distribution of regions of Ukraine by levels of pneumonia in children

The incidence of pneumonia in children	Regions of the country
Very high incidence of pneumonia in children	Ivano-Frankivsk Rivne Kyiv
The incidence of pneumonia in children is higher than the national average	Ternopil Vinnytsia Kherson Donetsk Luhansk Chernihiv Poltava Sumy
The incidence of pneumonia in children is close to the national average	Odessa Kharkiv Zhytomyr Transcarpathian Luhansk Zaporizhzhia Kirovohrad Mykolayiv Khmelnysky
Low incidence of pneumonia in children	Lviv Dnepropetrovsk Cherkasy Chernivtsi City of Kyiv

The specific weight of pneumonia among all newly registered diseases of the pediatric population in Ukraine today is only 0.64% (in 1996 – 0.76%), but this can not diminish the importance of this dangerous disease, especially for infants and young children.

Thus, respiratory diseases now account for 58.14% of all infant diseases (in 1996 – 45.4%).

Among respiratory diseases, acute infections of the upper respiratory tract, pneumonia and influenza in 2019 accounted for 96.3% of all respiratory diseases, or in numerical terms 232,715 cases – 779.9 per 1,000 population (in 1996 – 779.6 per 1000). As a result of these pathological conditions in 2019, 69 children died in the first year of life, including 31

children in hospital (0.23 per 1,000 population). This is 9.79% of all registered causes of infant mortality last year. The highest incidence of pneumonia in infants was observed in Zhytomyr, Zaporizhzhia, Ivano-Frankivsk regions and Kyiv. The lowest incidence of pneumonia in children of the first year of age was in Ternopil, Volyn and Kharkiv regions.

Due to the progressive development of domestic pediatrics and the introduction of modern medical and diagnostic technologies, including vaccination, over the past 20 years, infant mortality from acute upper respiratory tract infections, pneumonia and influenza has been reduced almost by 5 times (Fig. 1).

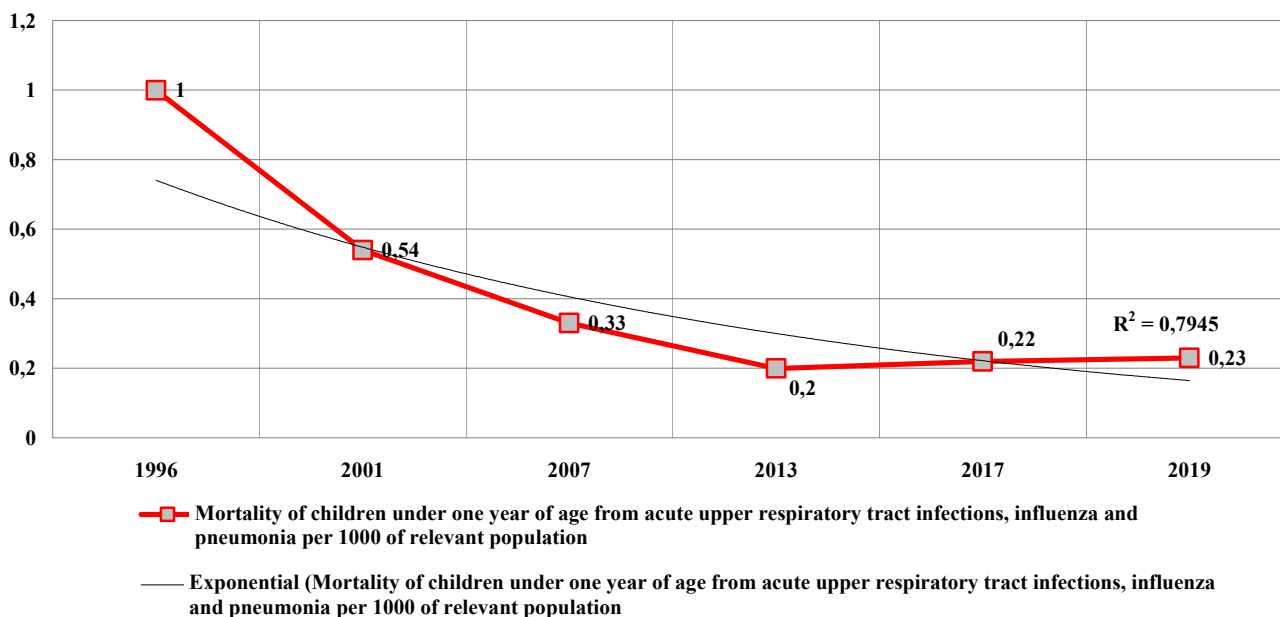


Fig. 1. Dynamics of mortality of children under one year of age from acute upper respiratory tract infections, influenza and pneumonia from 1996 to 2019 and the trend of its exponential decrease (per 1000 of relevant population)

Among children of Kherson, Sumy, Vinnytsia, Zhytomyr, Kirovohrad regions in 2019 there were no fatalities caused by acute upper respiratory tract infections, influenza and pneumonia. Particular attention should be paid to the Transcarpathian, Donetsk and Odessa regions, where the highest mortality rates of children under 1 year of age from acute respiratory infections, pneumonia and influenza is 1.08, 0.48 and 0.46, respectively, per 1,000 of the relevant contingent with a national rate of 0.23 per 1,000 children. 20 years ago, high mortality from these conditions was in Ivano-Frankivsk, Donetsk and Transcarpathian regions.

As can be seen from Figure 2, the first wave of pneumonia incidence increased by 52.2% from 1996 to 2001, then the incidence of pneumonia began to decline, reaching relative minimum in 2003 (7.25 per 1,000 children).

The increase in the incidence of pneumonia in 2005-2006 took place against the background of another epidemic outbreak of measles. The maximum incidence of pneumonia in children was

observed in 2009-2010 (10.89 per 1000 children), which coincides in time with the epidemic of pandemic "swine" flu in Ukraine, one of the main clinical variants of which was viral pneumonia in adults and children [1].

A similar increase in the incidence of pneumonia in children was also observed in 2015-2016, which could also be associated with an increase in the incidence of influenza and SARS in children during this period [4]. The rise in pneumonia incidence in 2014-2016 could also be linked to the fighting in the east of the country and the large number of internal refugees from the war zones, including more than 200,000 children left homeless and in need of medical care due to the war. This can be evidenced by the high level of pneumonia in children from Donetsk and Luhansk regions, which was not observed 20 years ago.

In general, since 2011 there has been a wave-like trend to reduce the incidence of pneumonia to 8.32 per 1000 children in 2017 – the last year of statistical analysis of the incidence of children

aged 0-17 years, which was conducted by the Ministry of Health of Ukraine.

It should be noted that over 20 years the growing pneumonia incidence in children did not fully

correspond to the relative decrease in the overall morbidity of children in Ukraine, which in recent years has stabilized at the level of 1291.7 per 1000 of children [7].

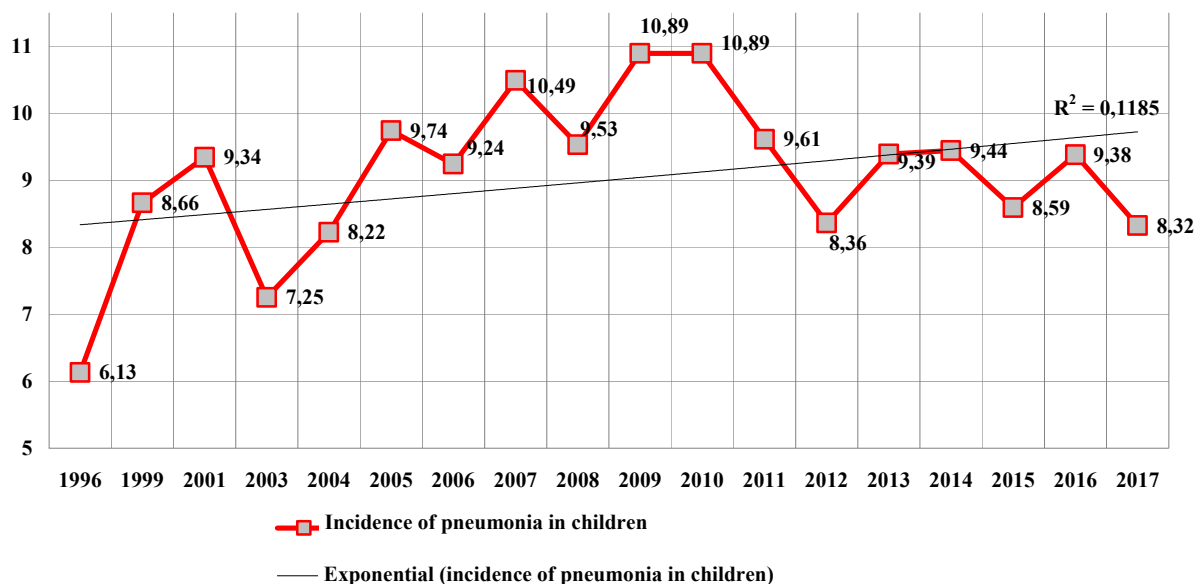


Fig. 2. Dynamics of pneumonia incidence in children of Ukraine in 1996-2017 and the trend of its exponential growth (per 1000 children)

Given the role of environmental ecology and housing in the possible development of pneumonia in children, we conducted an appropriate correlation-regression analysis between the incidence of pneumonia in children and the amount of pollutant emissions from stationary and mobile sources into the atmosphere in 2015 per capita. The established critical value of the Spearman correlation coefficient (ρ) reached the level of only 0.038, which testified to the absence of a relationship between these features ($p > 0.05$). It is of interest, in general as for respiratory diseases in children, we proved the direct effect of moderate force ($r_s = 0.578$) of the relationship between pollutant emissions from stationary and mobile sources into the atmosphere per person and the incidence of pneumonia in children.

Revealed increased incidence of pneumonia in children over the past 20 years has been due to a set of factors and, above all, in our opinion, due to advanced training of pediatricians and family physicians, improved diagnosis and application of modern guidelines and methodological approaches to diagnosis.

Of course, to analyze the possible increase in the incidence of pneumonia in adults and children

against the background of the COVID-19 pandemic in 2020, it is necessary to restore a comprehensive statistical assessment of the health of children in the country.

CONCLUSIONS

Over the last 20 years, in Ukraine there is an increase by 33.7% in the incidence of pneumonia with the predominant detection of this pathology in children from regions of the country in which there are problems in the proper provision of pediatric services. Changes in recent years in the incidence of pneumonia in children correspond to the dynamics of the spread of influenza and SARS, especially during the epidemics of 2009-2010 and 2015-2016. Tracking this indicator in the dynamics in subsequent periods is extremely important in the context of the COVID-19 pandemic that continues.

Conflict of interest. The authors declare no conflict of interest.

Financing from the state budget. Implementation of research work of the Department of Pediatrics N 2 "Diagnosis of disorders of the cardiovascular, respiratory and

digestive systems in newborns and children with advanced non-infectious pathology and their therapy" (2012-2016) of O.O. Bogomolets Na-

tional Medical University. State registration code 0112U001772.

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The article was received
2020.09.09

