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Trends and structure of infant mortality in Ukraine

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Тенденції та структура дитячої смертності в Україні

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Introduction

The leading task for all countries of the world is to prevent child mortality and promote the full development of children [1; 2]. Child mortality is influenced by many different interrelated factors, for further steps to prevent it, it is necessary to take into account those factors that determine mortality and which can be influenced [3; 4]. It should be noted that the level of infant mortality is characterized by significant differentiation, namely, more developed countries with better economic and social conditions for mothers and newborns, with an effective system of child health care, have significantly lower mortality rates [5; 6]. Also, in those countries where the health of citizens is better, infant mortality rates are 10 times lower than the world average, which indicates that a certain proportion of child deaths can be prevented [7–10].

According to the United Nations (UN) and the World Health Organization (WHO), a significant number of children in the world die before the age of 5 years, 46% of whom die in the first 28 days of life [11–14]. The World Bank, WHO and the United Nations Population Division predict that in the absence of action at both global and regional levels, about 60 million children under 5 years of age will die during 2017–2030, half of whom will be newborns [15]. During the years of independence in Ukraine, there has been a decrease in the infant mortality rate and all its components, but the level of infant mortality in Ukraine is 1.5-2 times higher than in developed countries [16–20], where conceptual approaches to the reproduction of healthy generations are closely related to socio-economic policy, to strengthening the reproductive health of women and reducing the reproductive losses [21–23].

In view of the above, studies that are aimed at studying trends of infant mortality rates in Ukraine and its components are of particular relevance.

The aim. To establish and study the main trends in mortality of children under 1 year of life in Ukraine, both general and depending on gender, region of Ukraine, place of residence (urban, rural), as well as causes of death. To conduct a comparative analysis of infant mortality rates with some developed countries of the world.

Materials and methods

The object of the study was infant mortality in Ukraine. We analyzed the general trends in infant mortality, its dynamics by sex, place of residence, region of Ukraine, by sex and place of residence, as well as the structure of causes of death by disease nosology and periods of the first year of life. We carried out a comparative analysis of infant mortality rates in Ukraine with similar indicators in some developed countries of the world. The information base was the official forms of the State Statistics Service of Ukraine, as well as the Institute for Health Metrics and Evaluation (IHME) database for 2009–2019. The following research methods were used: systemic approach and system analysis, epidemiological, biostatistical, medical-statistical. Statistical analysis and visualization of the obtained results were carried out using the Microsoft Excel-2003 application package, and the results were processed on a personal computer using the licensed Statistika 6.0 program, the STATA application package (USA). Comparison of relative values was carried out using criterion $\chi 2$ (chi-square), as well as by calculating the odds ratio (OR) and its 95% confidence interval (CI) to prove the relationship between

individual variation series. The median (Me) and quartiles (Q1–Q3) were used.

The study is a part of the scientific research of state establishment «Ukrainian Institute of strategic research of the Ministry of Health of Ukraine» commissioned by the Ministry of Health of Ukraine: «Scientific substantiation and development of a system of measures to optimize the effectiveness of medical care for mothers and newborns in the context of regionalization of perinatal care», state registration 0117U002419.

Review

In Ukraine, infant mortality plays a leading role in shaping the mortality rate of children under 5 years of age (the share in the age structure of mortality in children under 5 years of age is more than 80%) and remains one of the highest in the European region, so its analysis is important for the subsequent innovative substantiation of the system medico-social assistance for children.

During 2009–2018 the infant mortality rate significantly decreased by 25,5% (OR 0,97–95% CI 0.86–0.96), p=0,0002. Similar trends are also characteristic of the mortality rate for boys (decrease by 25,2%) and the mortality rate for girls (decrease by 23,8%). The study of the dynamics of the sex structure of mortality revealed the absence of significant dynamics for 2014–2018 – OR 0,87 (95% CI 0,81–0,93), p=0,0001) (Fig. 1).

A more detailed analysis of infant mortality in terms of administrative territories revealed the absence of a significant decrease in the infant mortality rate over the past 5 years (2014–2018). Thus, in 2014 the median value of this indicator was 7,59 (Q1=7,01; Q3=8,48), and in 2018 it was 7,0 (Q1=6,2; Q3=7,9) per 1000 live births, (p=0,859). During this period, an increase in the interquartile interval (1,7 versus 1,47) was noted, which indicates the presence of disproportions in the values of this indicator in certain administrative territories. Thus, in 2018, higher indicator of child mortality under the age of 1 year of life (7,0‰) than the all-Ukrainian one was observed in 12 regions of Ukraine, the highest levels were registered in Zakarpattia (10,4‰), Cherkasy (9,1‰), Dnipropetrovsk (9,0‰), Kherson (8,4‰) and Zaporozhye (8,2‰) regions. The lowest levels of the indicator were registered in Sumy (4,5‰), Kiev (4,7‰), Poltava (5,0‰) regions and Kiev (5,3‰), and its growth compared to 2014 occurred in 9 regions of Ukraine: Volyn (by 28,8%), Dnipropetrovsk (by 16,2%), Zakarpattia (by 15,%), Zaporozhye (by 24,2%), Mykolaiv (by 7,5%), Odessa (by 8,4%), Kherson (by 0,4%), Cherkasy (by 1,2%), Chernivtsi (by 8,6%) regions (Table 1).

An analysis of the infant mortality rate depending on the place of residence showed that among children in rural areas it tends to decrease (Fig. 2) and the chances of a child in rural areas to die in 2018 compared to 2014 remain the same – OR 0,94 (95% CI 0,87–1,02), p=0,1919. However, the infant mortality rate among city children has significantly decreased and the chances of a child living in the city are OR 0,88 (95% CI 0,82–0,94), p=0,0003. At the same time, in 2018, the chances of a rural child dying before the age of 1 year are significantly higher than the chances of a child living in the city – OR 1,16 (95% CI 1,07–1,26), p=0,0004.

The study found that the highest levels of infant mortality are observed among boys from rural areas (8,56‰ in 2018), boys from urban areas (7,32‰) and girls from the village (7,28‰). At the same time, in 2018, the infant mortality rate of boys in rural areas is higher than the all-Ukrainian indicator of mortality of boys under 1 year of life by 11,9%, by 16,9% higher than the mortality rate of boys under 1 year of life living in cities, and by 17,6% higher than the infant mortality of girls in rural areas, a similar situation was observed during the previous years of observation.

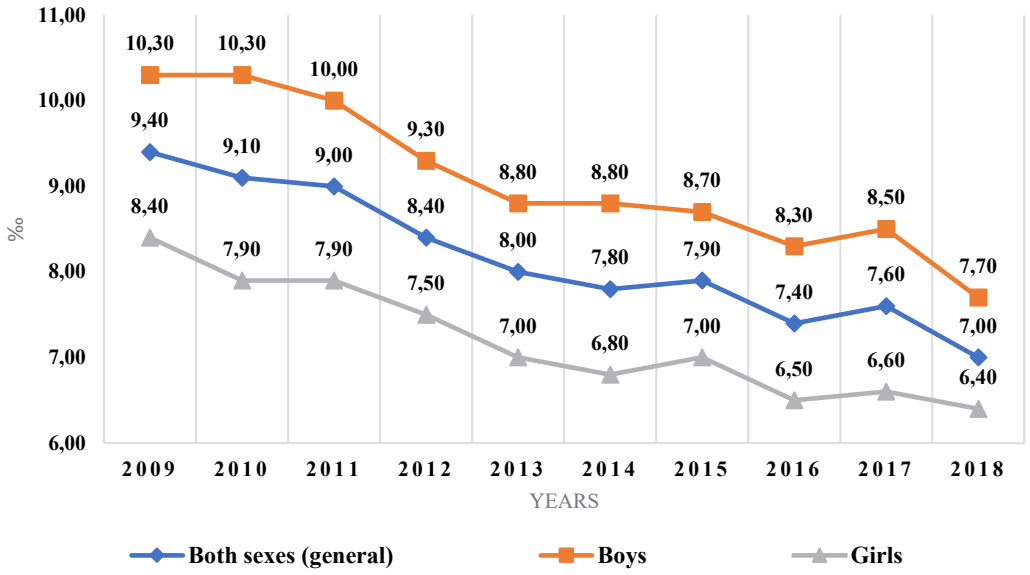
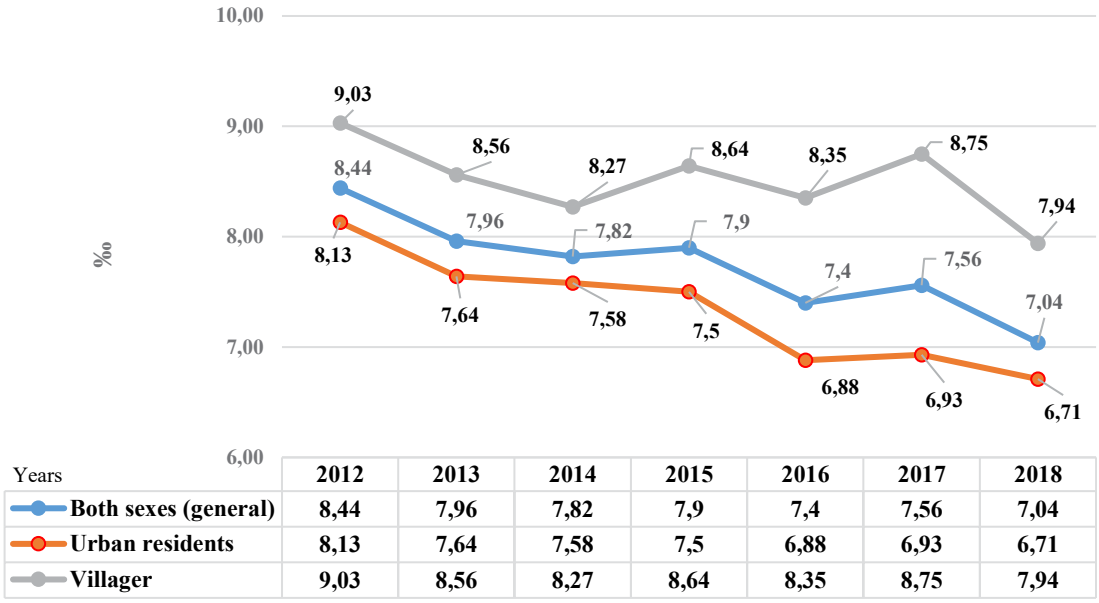


Fig. 1. Dynamics (2009–2018) of infant mortality in Ukraine (per 1000 live births, ‰)

Table 1

Dynamics of the level of infant mortality by regions of Ukraine (per 1000 live births, ‰) during 2014–2018 years

Administrative territory of Ukraine	2014	2015	2016	2017	2018
Vinnitsa region	6,50	7,21	6,6	7,2	6,0
Volyn region	5,99	6,35	7,0	6,2	7,6
Dnipropetrovsk region	7,74	8,49	8,0	7,5	9,0
Donetsk region	1,01	8,73	8,8	8,2	7,2
Zhytomyr region	7,42	7,28	7,9	6,8	6,9
Zakarpattia region	8,97	1,53	1,4	1.,1	10,4
Zaporizka region	6.,60	7,77	6,6	6,5	8,2
Ivano-Frankivsk region	6,35	6,84	6,7	6,6	6,2
Kyiv region	5,18	5,36	5,1	5,1	4,7
Kirovohrad region	9,07	9,27	9,4	11,6	7,9
Lugansk region	9,62	9,78	9,0	9,3	6,2
Lviv region	8,48	8,25	6,7	9,2	7,0
Mykolaiv region	7,35	6,21	8,1	6,0	7,9
Odessa region	7,01	8,24	7,9	8,6	7,6
Poltava region	7,52	5,81	5,9	4,1	5,0
Rivne region	8,02	8,51	8,3	8,3	6,4
Sumy region	6,66	7,71	6,5	6,7	4,5
Ternopil region	7,59	7,51	5,2	8,7	6,3
Kharkiv region	9,73	9,78	7,4	7,5	7,0
Kherson region	8,37	8,36	9,9	7,7	8,4
Khmelnitsky region	8,35	8,32	6,6	9,1	6,4
Cherkasy region	8,85	7,48	8,4	8,0	9,1
Chernivtsi region	7,46	8,64	8,9	9,9	8,1
Chernigiv region	8,35	8,30	9,2	6,4	7,6
Kyiv	7,02	7,47	5,5	5,7	5,3
Ukraine, total:					
Median	7,59	8,24	7,9	7,5	7,0
Q_1	7,01	7,28	6,6	6,5	6,2
Q_3	8,48	8,51	8,8	8,7	7,9
Interquartile interval	1,47	1,26	2,2	2,2	1,7



Years	2012	2013	2014	2015	2016	2017	2018
Both sexes (general)	8,44	7,96	7,82	7,9	7,4	7,56	7,04
Urban residents	8,13	7,64	7,58	7,5	6,88	6,93	6,71
Villager	9,03	8,56	8,27	8,64	8,35	8,75	7,94

Fig. 2. Dynamics of the mortality rate of children under the age of 1 year depending on the place of residence (per 1000 live births, ‰)

Infant mortality rates by sex and place of residence during 2012–2018 significantly decreased: among boys in rural areas by 11,6% (OR 0,89 [95% CI 0,79–1,00], p=0,048); among boys in urban areas by 20,1% (OR 0,86 [95% CI 0,78–0,94], p=0,0008), but remained at the same level among girls in rural areas (OR 1,01 [95% CI 0,89–1,15], p=0,816) and urban girls (OR 0,92 [95% CI 0,83–1,02], p=0,1007) (Fig. 3).

The study of mortality rates for children under 1 year of life, depending on the place of residence, found that in 19 regions of Ukraine the level of infant mortality in rural areas is higher than in urban areas, and in 11 regions it exceeded the all-Ukrainian indicator of infant mortality. The growth of this indicator was observed in 12 rural areas of Ukraine.

The study of the causal structure of the infant mortality rate showed that during 2014-2018. the first ranking places in the structure of causes of infant mortality have not changed and belong to certain conditions that occur in the perinatal period, congenital malformations, deformities and chromosomal abnormalities, external causes of the disease, respiratory diseases. An increase in infant mortality was also revealed, in particular, for diseases of the endocrine system. , eating disorders and metabolic disorders and respiratory diseases. For other leading reasons, there was a decrease in the indicator (Table 2).

Infant mortality by causes of death, taking into account the place of residence (urban, rural) has certain features, namely: infant mortality in rural areas for all leading causes is higher than in urban areas; an increase in mortality rates for children under 1 year of age in urban areas occurred from diseases of the blood and hematopoietic organs and individual disorders involving the immune mechanism by 48,1% (Chapter III, from 0,27 to 0,40 per 10 thousand live births), from diseases of the respiratory system by 50,5% (Chapter X, from 1,91 to 1,94, respectively), from diseases of the digestive system by 7,4% (Chapter XI, from 0,27 to 0,29, respectively), from diseases genitourinary system by 33,3% (Chapter XIV, from 0,03 to 0,04, respectively). The increase in infant mortality in rural areas was due to diseases of the blood and blood-forming organs and individual disorders involving the immune mechanism by 35,0% (Chapter III, from 0,40 to 0,54 per 10 thousand live births), respiratory diseases by 41,5% (Chapter X, from 2,78 to 3,92 per 10 thousand live births), from individual conditions that occur in the perinatal period by 7,2% (Chapter XVI, from 40,61 to 43,54 per 10 thousand births born live), congenital malformations, deformities and chromosomal abnormalities by 9,1% (Chapter XVII, from 20,03 to 21,85 per 10 thousand live births).

Also, when analyzing infant mortality by sex, it was found that the leading cause of death in boys under the age of 1 year of life, as well as in girls, is certain conditions that occur in the perinatal period. The rate for boys is higher by 23,3% than for girls (Chapter XVI, boys – 47,85 per 10 thousand live births, girls – 36,71, respectively). The second leading cause of infant mortality by sex is congenital malformations, deformities and chromosomal abnormalities (Chapter XVII), the frequency of which during the study period among

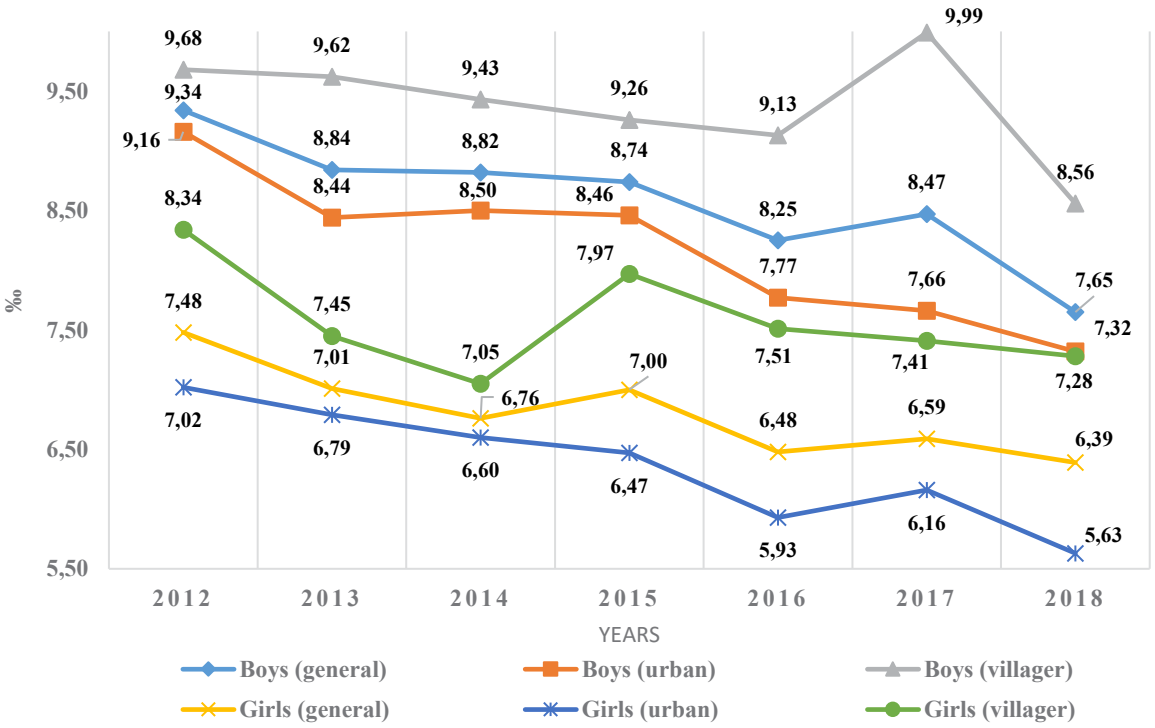


Fig. 3. Dynamics of the mortality rate of children under the age of 1 year of life, depending on gender and place of residence (per 1000 live births, ‰)

Table 2

The causal structure of infant mortality in Ukraine for 2014–2018

International Classification of Diseases 10 chapters	per 10,000 people of the corresponding age				
	2014	2015	2016	2017	2018
I. Certain infectious and parasitic diseases	2,12	2,23	2,16	1,84	1,6
II. Neoplasms	0,74	0,96	0,79	0,63	0,5
III. Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	0,450	0,71	0,37	0,45	0,7
IV. Endocrine, nutritional and metabolic diseases	0,79	0,63	1,02	0,61	1,0
VI. Diseases of the nervous system	2,73	2,52	2,36	2,12	2,0
VIII. Diseases of the ear and mastoid process	0,02	–	–	–	–
IX. Diseases of the circulatory system	1,15	1,04	1,07	1,02	1,0
X. Diseases of the respiratory system	2,38	2,86	2,97	2,63	3,0
XI. Diseases of the digestive system	0,36	0,24	0,22	0,29	0,33
XIV. Diseases of the genitourinary system	–	–	0,13	0,03	–
XVI. Certain conditions originating in the perinatal period	41,99	41,78	39,45	42,45	37,8
XVII. Congenital malformations, deformations and chromosomal abnormalities	17,80	19,25	17,56	17,71	17,2
XVIII. Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	2,92	2,3	1,79	2,14	2,0
XX. External causes of morbidity and mortality	4,69	4,45	4,08	3,73	3,3

boys is 16,6% higher than among girls (boys – 19,3 per 10 thousand born alive, girls – 16,02, respectively), and the third most common cause of infant mortality is external causes of morbidity and mortality (Chapter XX), the mortality rate from which in boys is also higher than in girls by 32,7% (boys – 4,43 per 10 thousand live births, girls – 2,98, respectively).

For the period 2009–2018 the vast majority of children from the total number of dead children under the age of 1 year of life (more than 60%) die in the neonatal period, among which 42,5–45,0% of deaths occur in the early neonatal period (0–6 days). With each month of a child's life, the frequency of child deaths gradually decreases by the year. So, if by the 1st month of life 64,5% of children under one year of age die, at the age of 1 month of life – 10,5%, 2 months of life – 6,1%, 3 months of life – 3,2%, etc.

It should be noted that the infant mortality rate, as well as the mortality rate of children under 5 years of age, remains one of the highest in the European region: in 2019 – 696,70 per 100 thousand of the corresponding population (95% CI 857,57–576, 09) and exceeds that of France (2,3 times), Hungary (2,1 times), Poland (2,1 times), Germany (2.6 times), Spain (2,8 times), Slovakia (by 1,6 times) and the USA (by 1,2 times). At the same time, it should be noted that according to the results of calculations, during 2010–2019. there is a slight fluctuation in the infant mortality rate for all causes of death in Ukraine with a tendency to decrease by – 0,18 (with a fluctuation range of 0,01 to -0,32) [24–26]. (Table 3).

Prospects for further research are related to studying the impact of the war with the russian federation on child mortality in Ukraine.

Table 3

Dynamics of the level of infant mortality in some countries of the world and Ukraine for all causes of death (2009–2019, per 100 thousand people of the corresponding age)

Year	Poland	Slovakia	Hungary	Germany	France	Spain	USA	Ukraine
2009	548,13	592,27	502,42	346,43	357,71	330,28	647,61	899,50
2010	498,09	557,31	491,82	336,85	354,07	324,52	624,76	853,14
2011	463,63	519,23	479,78	333,70	338,99	315,66	617,69	813,19
2012	456,58	540,60	470,08	315,64	340,26	302,29	610,81	779,50
2013	441,85	541,78	468,49	313,07	343,04	283,17	604,98	724,29
2014	419,09	558,82	447,91	308,33	334,19	288,40	596,90	736,64
2015	396,13	540,50	442,06	312,77	337,44	273,39	596,93	802,39
2016	392,30	525,87	389,98	322,65	333,56	272,79	597,04	778,72
2017	367,03	488,62	360,57	293,28	316,97	262,70	587,31	744,16
2018	346,57	462,57	347,28	280,63	308,27	254,54	571,03	720,01
2019	328,20	440,49	330,88	269,24	300,46	246,87	558,44	696,70

Conclusions

A significant decrease in the overall mortality rate of children by 25,5% (HR 0,97 95% CI 0,86–0,96), p=0,0002) and the mortality rate of boys by 25,2% (OR 0,87 (95% CI 0,81–0,93), p=0,0001), both among boys in rural areas (OR 0,89 [95% CI 0,79–1,00], p=0,048) and urban (OR 0,86 [95% CI 0,78–0,94], p=0,0008), but remained at the same level among rural girls (OR 1,01 [95% CI 0,89–1,15], p=0,816) and girls in urban areas (OR 0,92 [95% CI 0,83–1,02], p=0,1007), and, accordingly, among girls in general (OR 0,95 (95% CI 0,88–1,03), p=0,2524). The infant mortality rate remains one of the highest in the European region, since in 2019 it exceeded that of France (2,3 times), Hungary (2,1 times), Poland (2,1 times), Germany (2,6 times), Spain (2,8 times), Slovakia (1,6 times) and the USA (1,2 times).

It has been established that the causal structure of the infant mortality rate during 2014–2018 remained almost unchanged, since the first ranking places are occupied by certain conditions that occur in the perinatal period, congenital malformations, deformities and chromosomal abnormalities, external causes of morbidity and mortality, and respiratory diseases. An increase in the infant mortality rate occurred by classes: diseases of the endocrine system, malnutrition and metabolic disorders (by 26,6%) and respiratory diseases (by 26,1%).

It has been established that the predominant proportion of children from the total number of deceased children under the age of 1 year of life (more than 60%) die in the neonatal period, among which 42,5–45,0% of deaths occur in the early neonatal period (0–6 days).

A significant disproportion in the infant mortality rate in certain administrative territories of Ukraine was revealed, which is confirmed by an increase during 2014–2018. interquartile interval (from 1,47 to 1,7), against the background of the absence of a significant decrease in the median value of this indicator (7,59 (Q .01; Q3 = 8,48) to 7,0 (Q1 = 6,2; Q3 = 7,9) per 1000 live births, p=0,859).

The conducted research indicates the importance of a more detailed analysis of the causes of death by analyzing the structural, functional and organizational processes, in particular, in the obstetric-neonatal service.

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The aim: To establish and study the main trends in mortality of children under 1 year of life in Ukraine, both general and depending on gender, region of Ukraine, place of residence (urban, rural), as well as causes of death. To conduct a comparative analysis of infant mortality rates with some developed countries of the world.

Materials and methods. The data of the state statistical reporting for the period 2009–2018 and data of the Institute for Health Metrics and Evaluation for the period 2009–2019 were used as the materials of study. The following research methods were used: a systematic approach and system analysis, epidemiological, biostatistical, medical-statistical methods.

Results. The mortality rates of children in the age category up to 1 year of life were analyzed in order to establish: its main trends in Ukraine as compared to the referential countries; features of age, sex, causal and regional structure of mortality rate by analyzing the statistical data of the Ministry of Healthcare and State Statistics Service of Ukraine for 25 regions of Ukraine and the global electronic database of the Institute for Health Metrics and Evaluation.

Conclusions. The conducted research indicates the importance of a more detailed analysis of the causes of death by analyzing the structural, functional and organizational processes, in particular, in the obstetric-neonatal service.

Key words: mortality of children under 1 year of life, infant mortality, infant mortality rate, structure of infant mortality.

Мета: Встановити та вивчити основні тенденції смертності дітей віком до 1 року життя в Україні, як загальні, так і залежно від статі, регіону України, місця проживання (міське, сільське), а також причин смерті. Провести порівняльний аналіз показників дитячої смертності з деякими розвиненими країнами світу.

Матеріали та методи. *Матеріали дослідження:* дані державної статистичної звітності за період 2009–2019 рр. *Методи дослідження:* системний підхід та системний аналіз, епідеміологічний, біостатистичний, медико-статистичний методи.

Результати. Проаналізовано показники смертності дітей вікової категорії до 1 року життя з метою встановлення: її основних тенденцій в Україні порівняно з референтними країнами; особливості вікової, статевої, причинно-наслідкової та регіональної структури смертності шляхом аналізу статистичних даних Міністерства охорони здоров'я та Державної служби статистики України за 25 областей України та загальносвітової електронної бази даних Інституту показників та оцінки здоров'я.

Висновки. Проведене дослідження свідчить про важливість більш детального аналізу причин смерті шляхом аналізу структурних, функціональних та організаційних процесів, зокрема, в акушерсько-неонатальній службі.

Ключові слова: смертність дітей до 1 року життя, дитяча смертність, показники дитячої смертності, структура дитячої смертності.

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