

ORIGINAL ARTICLE

CLINICAL AND EPIDEMIOLOGICAL FEATURES OF COVID-19 IN CHILDREN FOR THE PERIOD 2020-2022

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Olga O. Rzhavska^{1,2}, Natalia S. Shevchenko^{1,3}, Viktoriia A. Horbas⁴, Natalia Yu. Kondratiuk^{2,5}¹V.N. KARAZIN KHARKIV NATIONAL UNIVERSITY, KHARKIV, UKRAINE²PRIVATE INSTITUTION OF HIGHER EDUCATION «KYIV MEDICAL UNIVERSITY», KYIV, UKRAINE³STATE INSTITUTION «INSTITUTE FOR CHILDREN AND ADOLESCENT`S HEALTH CARE OF THE NATIONAL ACADEMY OF MEDICAL SCIENCES OF UKRAINE», KHARKIV, UKRAINE⁴ACADEMIC AND RESEARCH MEDICAL INSTITUTE «SUMY STATE UNIVERSITY», SUMY, UKRAINE⁵STATE INSTITUTION OF SCIENCE «RESEARCH AND PRACTICAL CENTER OF PREVENTIVE AND CLINICAL MEDICINE» STATE ADMINISTRATIVE DEPARTMENT, KYIV, UKRAINE

ABSTRACT

The aim: To investigate the epidemiological and clinical characteristics of COVID-19 in children for the period 2020-2022.**Materials and methods:** A retrospective analysis of 1144 case histories of children who were hospitalized at the St. Zinaida Children's Clinical Hospital (Sumy, Ukraine) for coronavirus disease for 2020-2022 was carried out. The observed patients were divided into 3 groups corresponding to the 3 waves of the pandemic: group 1 - 120 children, group 2 - 311 children, and group 3 - 713. The diagnosis of COVID-19 was established based on clinical, medical histories, laboratory and instrumental data. The etiology of coronavirus disease was determined based on the detection of antigens of the SARS-CoV-2 virus using PCR reverse transcription of a nasopharyngeal swab.**Results:** An analysis of the clinical and epidemiological indicators of children who were treated for COVID-19 during 2020-2022 was conducted, depending on the outbreak of the pandemic. The frequency of lesions in children of different age groups was determined, and the main clinical symptoms and the frequency of complications in the form of pneumonia during different waves of COVID-19 were determined.**Conclusions:** The incidence of coronavirus infection was mainly observed in children of the younger group (0-5 years). A more severe course of the disease and a higher frequency of complications in the form of pneumonia in children were determined during the 3rd wave of the COVID-19 pandemic.**KEY WORDS:** COVID-19, SARS-CoV-2, coronavirus infection, pneumonia, children

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INTRODUCTION

The COVID-19 pandemic has prompted scientists and practitioners to rethink the epidemic danger of coronavirus infection and its role in the occurrence of diseases of varying severity in adults and children. Compared with adults, the incidence of COVID-19 in children, according to different authors, is 2-5% depending on the country [1]. In Ukraine, the proportion of children with a confirmed diagnosis of COVID-19 in relation to adult patients at the end of August 2023 is 5%, and infant mortality is 0,1% in the overall age structure of mortality [2]. The low incidence rate is explained by the reduced risk of infection in children due to less travel, communication, and movement. Also, children, as a rule, do not have chronic somatic diseases and the resistance of the protective mechanisms of the mucosa is much

stronger due to its intactness by negative impact factors (smoking, air pollution). Swedish scientist Ludvigsson J.F. suggested that exposure to the children's mucosa of pathogens of other acute respiratory viral infections activates the local immune response and limits the attachment of coronavirus [1].

According to foreign colleagues, COVID-19 in children is accompanied by the development of a mild course of the disease and only occasionally leads to death, and in 15-35% of cases it is asymptomatic [3-5]. However, it should be noted that the current course of the disease in children has changed, the percentage of severe cases of disease with the possible development of life-threatening conditions has increased (mainly in children with concomitant chronic pathology and infants) [6, 7].

An interesting established fact is the increase in the number of manifest forms of COVID-19, depending on the increase in the age of children. According to WHO data for the period 2019-2021, the incidence of COVID-19 was observed mainly in children of the older age group: children under 5 y.o. – 1,8% (mortality rate 0,1% in the world), from 5 to 14 y.o. – 6,3% (mortality 0,1%), from 15 to 24 years – 14,5% (mortality 0,4%) [8]. The Chinese scientist Dong Y. explains the increase in the number of cases of COVID-19 with increasing patient age by the difference in the functioning and maturity of the immune system of patients of different age categories [7]. Scientist Held L. has a slightly different opinion and sees the reason for the growth according to the age of the viral load on the child's body [9]. Infection of children usually occurs in families.

It is known that the SARS-CoV-2 virus is characterized by the emergence of its new strains, which caused the undulating course of the pandemic. For convenience, variants of SARS-CoV-2 strains are labeled with Greek letters. Depending on the time of occurrence in Ukraine, 3 waves of COVID-19 were identified. The first wave (second half of 2020) was characterized by the circulation of the alpha strain, the second (first half of 2021) by the dominance of the beta and gamma strains, and the third wave (end of 2021-beginning of 2022) by the delta and omicron strains. It was the delta strain that caused the greatest concern of the medical community, since, according to the British scientist Lewis T., it was characterized by 40-60% greater contagiousness and severity of the course, 2,5 times more often led to hospitalization, and complications of the disease [10, 11].

Given the differences in the susceptibility of children to different strains of SARS-CoV-2, the variety of clinical symptoms in different waves of the pandemic, the characteristics of the course of COVID-19 in children need further study and comparison.

THE AIM

The purpose of our work is to investigate the epidemiological and clinical characteristics of COVID-19 in children for the period 2020-2022.

MATERIALS AND METHODS

A retrospective analysis of 1144 case histories of children who were hospitalized at the Children's Clinical Hospital of St. Zinaida (Sumy, Ukraine) for the period from November 2020 to August 2022 was performed. The ages of the patients ranged from 4 months to 17 years. No deaths were registered in 2020 and 2021. In

2022, in 2 children with comorbidities, the disease was complicated by the development of acute respiratory failure and the patients died: (1) Patient N., 15 y.o., diagnosed with COVID-19, acute respiratory failure. Degenerative disease of the nervous system, focal epilepsy. (2) Patient E., 16 y.o., diagnosis: COVID-19, acute respiratory failure. Progressive Duchenne muscular dystrophy).

The diagnosis of COVID-19 was established based on clinical, medical history findings, laboratory and instrumental data. The etiology of coronavirus disease was determined based on the results of the detection of antigens of the SARS-CoV-2 virus by reverse transcription polymerase chain reaction (PCR) (RT-PCR) of a nasopharyngeal swab. Testing was carried out according to clinical and epidemiological indications.

Statistical analyses in this study were conducted using MS Excel and STATISTICA 8.0 (Tulsa, OK) software. The mean M for each indicator was used to determine the difference between the values of the indicators in the comparison groups. The difference between groups was considered statistically significant when $p < 0,05$.

RESULTS

Depending on the time of onset of the coronavirus disease, we divided all patients into 3 groups: Group I (120 children) was hospitalized during the 1st wave of the pandemic (November, and December 2020), Group II (311 patients) belonged to during the 2nd wave of the pandemic (February - August 2021) and group III (713 patients) fell ill during the 3rd wave (September 2021 - May 2022). In most cases, those strains of coronavirus were determined in hospitalized children that corresponded to those circulating in a certain period. Each group of patients, in turn, was divided into 4 age categories (0-12 mo.o., 1-5 y.o, 6-9 y.o. and 10-18 y.o.) (Fig. 1).

During the 1st wave of COVID-19, the following distribution of sick children by age was observed: 0-1 y.o. – 20,7% (25/120), 1-5 y.o. – 29,2% (35/120), 6-9 y.o. – 15,8% (19/120), 10-18 y.o. – 34,3% (41/120). The distribution of the incidence rate of children by age during the 2nd wave of the pandemic: children 0-1 y.o. – 24,1% (75/311), 1-5 y.o. – 43,4% (135/311), 6-9 y.o. – 15,0% (47/311), 10-18 y.o. – 17,5% (54/311). During 2022, the following age distribution trend was noted: 0-1 y.o. – 24,0% (171/713), 1-5 y.o. – 45,0% (321/713), 6-9 y.o. – 15,0% (107/713), 10-18 y.o. – 16,0% (114/713). As can be seen from Fig. 1, over the course of all 3 years, the incidence of COVID-19 diseases prevailed in the age groups of 0-5 years, and during the 1st wave, also in children aged 10-18.

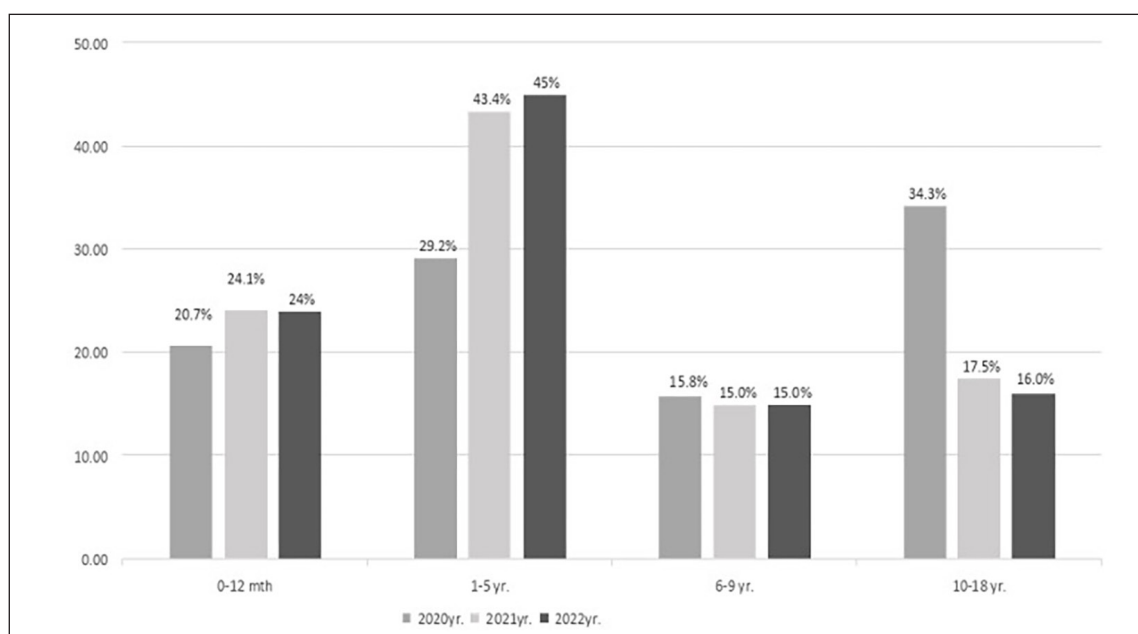


Fig. 1. Distribution of patients with COVID-19 by age during 2020-2022

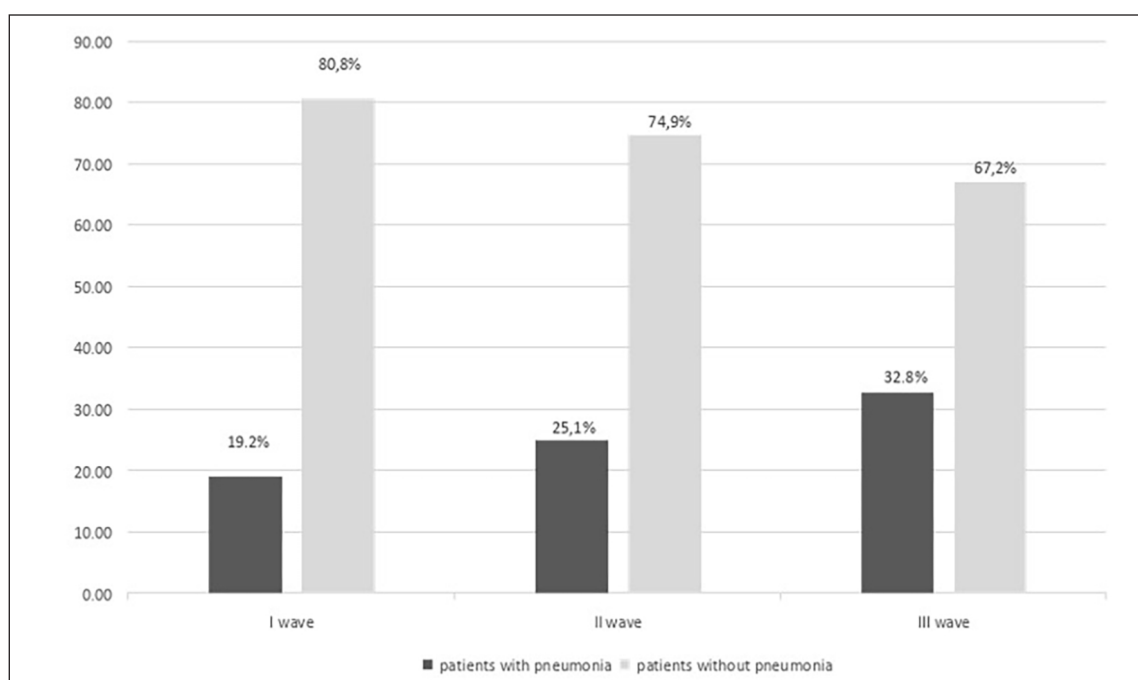


Fig.2. Distribution of children with COVID-19, depending on the fact of pneumonia for the period 2020-2022

For the period 2020-2022, two dominant symptom complexes were determined: upper respiratory tract symptoms (such as acute nasopharyngitis) and lower respiratory tract symptoms with the development of pneumonia. The diagnosis of pneumonia was confirmed by X-ray. Depending on the diagnosis of pneumonia, the patients of each group were divided into 2 subgroups: with and without pneumonia (Fig. 2).

During the first wave of COVID-19, 23 out of 120 children were diagnosed with pneumonia, which accounted for 19,2%, during the second wave - 78 out of 311 (25,1%)

children had pneumonia, during the third wave - 234 out of 713 children, which amounted to 32,8%. As can be seen from Fig. 2, the disease COVID-19 predominantly (67-80% of cases) proceeded as an acute respiratory infection with symptoms of damage to the upper respiratory tract, and only 19-33% of children developed pneumonia. Comparing the incidence of pneumonia in 2020-2022, it should be noted that a higher number of pneumonia developments occurred in 2021-2022 when the 2nd and 3rd waves of the pandemic were observed, which is explained by the circulation of more aggressive strains.

Table I. Features of the clinical symptoms of COVID-19 in children for the period 2020-2022

Symptom	2020	I semester of 2021	II semester 2021 – I semestr 2022
Number of children (n)	120	311	713
Fever, abs. (%)	114 (95,0)	305 (98,1)	711 (99,7)
Weakness, abs. (%)	106 (88,3)	303 (97,4)	706 (99,0)
Symptoms of the upper respiratory tract affecting Rhinitis, abs. (%)	58 (48,3)	228 (73,3)	571 (80,1)
Sore throat, abs. (%)	34 (28,3)	93 (29,9)	482 (67,6)
Symptoms of the lower respiratory tract affecting Cough, abs. (%)	78 (65,0)	178 (57,2)	592 (83,0)
Shortness of breath, abs. (%)	6 (5,0)	29 (9,3)	207 (29,0)
Gastrointestinal symptoms			
Decreased appetite, abs. (%)	90 (75,0)	308 (99,0)	706 (99,0)
Abdominal pain, abs. (%)	4 (3,3)	25 (8,0)	53 (7,4)
Diarrhea, abs. (%)	9 (7,5)	26 (8,5)	91 (12,8)
Anosmia, abs. (%)	9 (7,5)	12 (3,9)	62 (8,7)
Skin rash, abs. (%)	6 (5,0)	13 (4,2)	12 (1,7)

The main clinical symptoms of children with coronavirus disease are listed in Table. The main symptoms of children from the general cohort were most often: fever (97,6%), weakness (94,9%), decreased appetite (91,0%), cough (68,4%), symptoms of rhinitis (67,2%), pain or discomfort in the throat (in 41,9%).

During 2020, the leading clinical symptoms of COVID-19 in children were: fever (114/120, 95,0%), weakness (106/120, 88,3%), decreased appetite (90/120, 75,0%), cough (78/120, 65,0%). About half of the patients had symptoms of rhinitis (58/120, 48,3%), less often – pain (discomfort) in the throat (34/120, 28,3%). Dyspnea was observed in only 5,0% (6/120) of patients, which indicated the severity of the course of the respiratory disease. Gastrointestinal symptoms such as diarrhea (9/120, 7,5%) and abdominal pain (4/120, 3,3%) were occasionally noted. Anosmia and skin rash were determined in 7,5% and 5,0% respectively (Table I).

During the first half of 2021 (second wave of coronavirus infection) almost all patients experienced a decreased appetite (308/311, 99,0%), fever (305/311, 98,1%), significant weakness (303/31, 97,4%) and rhinitis phenomena (228/311, 73,3%). Compared to 2020, cough was slightly less common (178/311, 57,2%), but the percentage of dyspnea almost doubled (9,3% vs. 5,0%), indicating an increase in the severity of the disease during the 2nd wave of the pandemic. Compared to 2020, gastrointestinal symptoms were more common: abdominal pain (8,0% vs. 3,3%), diarrhea (8,5% vs. 7,5%), anosmia, and skin rash were determined occasionally and with about the same frequency (3,9% and 4,2%, respectively).

The course of the coronavirus disease for the second half of 2021 - the first half of 2022 was characterized by a predominance of such symptoms as fever (711/713, 99,7%), general weakness, and loss of appetite (706/713,

99,0% in each case). Among the catarrhal symptoms, cough (592/713, 83,0%) and rhinitis (571/713, 80,1%) came to the fore, and sore throat (482/713, 67,6%) gave way to them. The incidence of dyspnea in patients of this group increased (107/713, 15,0%) compared to the previous groups. Signs of damage to the gastrointestinal tract were more common (abdominal pain – 7,4%, diarrhea – 12,8%). The incidence of skin rash has significantly decreased compared to previous years (1,7% versus 5,0% and 4,2%, respectively).

DISCUSSION

The COVID-19 pandemic has been characterized by an undulating course due to the constant mutation of the virus and the emergence of new strains. During the 1st wave of the pandemic, the circulation of the alpha strain was predominantly observed [10]. We found that in the 1st wave of incidence, children of the older age group (10-18 y.o.) and the younger group (0-5 y.o.) were predominantly affected, which correlates with the data of foreign authors [12].

British scientists Erica Molteni et al. also investigated the course of coronavirus infection caused by the alpha strain in children. According to their data, the 1st wave of a pandemic in 80% of cases has an uncomplicated course and is mainly accompanied by the development of fever, general weakness, rhinitis, and sore throat [12]. Our studies have shown that the COVID-19 disease in the 1st wave proceeded as an ARVI in 80.8% of children and was accompanied by the development of pneumonia in only 19.2% of cases, which fully confirms the data of British researchers. According to our results, the leading clinical symptoms of the 1st wave of COVID-19 in children were: fever (95,0%), general weakness (88,3%), loss of appetite (75,0%), and cough (65,0%) .

The 2nd and 3rd waves of the pandemic were characterized by an increase in the incidence of diseases exclusively in children of the first 5 years of age and a significant decrease in the number of affection older children, which coincides with the data of other researchers [10].

The 2nd wave was characterized by a more severe course of the disease and an increase in the number of cases of pneumonia (25,1%). Compared with the patients of the previous group, it can be argued that the symptoms of loss of appetite (99,0%), fever (98,1%), weakness (97,4%), and rhinitis (73,3%) were more common and more pronounced. Cough was observed in more than half of the patients (57.2%), but it was less common than in the previous group. It should be noted that the percentage of dyspnea almost doubled (9,3% vs. 5,0%), indicating an increase in the severity of the disease during the 2nd wave of the pandemic. More often than in the previous group, there were symptoms of GIT lesions: abdominal pain (8,0% vs. 3,3%), and diarrhea (8,5% vs. 7,5%). Our results are consistent with the data of other researchers, who noted a more severe course of the 2nd wave of the pandemic and more frequent development of complications, which is explained by the circulation of more aggressive beta and gamma strains [13].

One of the most severe periods of the incidence of COVID-19 falls on the 3rd wave of the pandemic, due to the circulation of the most aggressive strains of delta and omicron. According to Li B. et al. delta virus is 40–60% more contagious than the alpha variant [14] and is characterized by a more severe course of the disease and

the development of complications [15, 16]. We found that the number of pneumonia development was significantly higher during the 3rd wave compared to the previous ones (32.8% in accordance with 19,2% and 25,1%). Also, 2 deaths in older children were observed during the 3rd wave. Clinical symptoms in the form of fever (99,7%), weakness (99,0%), loss of appetite (99,0%), cough (83,0%), and rhinitis (80,1%) were significantly pronounced and were observed almost in all patients. The sore throat was less common (67,6%), but the incidence of shortness of breath (15,0%) in patients of this group increased significantly - 3 times compared with the 1st wave (15,0% and 5,0%, respectively) and almost doubled compared with the 2nd wave (15,0% and 9,5% respectively). It should be noted that during the 2nd and 3rd waves of the disease, signs of GIT damage were more common than during the 1st wave (abdominal pain – 7,4% and 8,0% versus 3,3%, diarrhea – 12,8% and 8,5% versus 7,5%, respectively). The data obtained by us completely coincides with the data of Canadian scientists [15].

CONCLUSIONS

An analysis of the clinical and epidemiological indicators of children with COVID-19 during 2020-2022 was carried. The incidence of coronavirus infection was mainly observed in children of the younger group (0-5 years). A more severe course of the disease and a higher frequency of complications in the form of pneumonia in children were determined during the 3rd wave of the COVID-19 pandemic.

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The authors adhered to the principles contained in the 1964 Declaration of Helsinki and their latest amendments. All the patients gave oral and written voluntary informed consent for examination, tests, treatment, operation, analgesia and data processing. The work with patients was prepared and carried out in accordance with the principles of ethics. The permission to conduct the study and the study protocol were approved of by the bioethics committee of the institution. The work is a fragment of research work of the Pediatrics Department of Academic and Research Medical Institute «Sumy State University» «Infectious and somatic diseases in children: features of the current course and ways to improve their treatment» (№ state registration 0120U102150; deadline: 2020-2025).

ORCID and contributionship:

Olga O. Rzhavska: 0000-0002-6410-7769^{B,D}

Natalia S. Shevchenko: 0000-0003-4407-6050^{A,E}

Viktoriiia A. Horbas: 0000-0002-7455-6875^{C,F}

Natalia Yu. Kondratiuk 0000-0002-6669-7619^{C,F}

Conflict of interest:

The Authors declare no conflict of interest.

CORRESPONDING AUTHOR

Olga O. Rzhavska

V.N. Karazin Kharkiv National University
52a, Yuvileyny Ave., 61024 Kharkiv, Ukraine
tel: + 380984054143
e-mail: rzhavskaolga@ukr.net

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