DOI: https://doi.org/10.30841/2786-720X.4.2025.349504
UDC 616.24-002:616.9:578]-071-053.2(477.52)

Characteristics of the clinical course of community-acquired pneumonia depending on the SARS-CoV-2 virus infection in children of the North-Eastern region of Ukraine

O. I. Smiyan, L. V. Taramak, K. O. Smiyan, O. H. Vasylieva, V. A. Horbas, Ya. S. Lopa
Academic and Research Medical Institute, Sumy State University

Pathology of the respiratory system continues to occupy a leading place among diseases of childhood, especially in economically poor countries. One of the most common respiratory diseases is community-acquired pneumonia (CAP). According to the WHO, one child dies every 43 seconds from pneumonia worldwide. Pneumonia affects the lung tissue with the development of respiratory failure, causing changes in metabolic processes in the body, including electrolyte imbalance. The disease has a diverse etiological picture, but in recent years, viral and combined forms of pathogens have prevailed, causing a long course and negative consequences for the child's body.
The objective: **to establish the features of the clinical course of CAP in children in the North-Eastern region of Ukraine (Sumy) aged 6 years to 17 years, taking into account the detected SARS-CoV-2 virus infection.**
Materials and methods**. The research was carried out on the basis of the Infectious Diseases Department of the MNPE "CCH of Saint Zinaida" Sumy City Council and MNPE "Central Primary Healthcare Centre No 1" of Sumy City Council. The total number of children who were examined was 166. Of them, 134 children are patients with CAP. The patients were divided into two groups depending on the SARS-CoV-2 virus infection. The control group consisted of 32 somatically healthy children. The patients had complete clinical, laboratory and instrumental examinations with a detailed medical history. Statistical processing was performed using Microsoft Excel 2013 software adapted for biomedical research. Reliability was determined using the two-sided independent Student's t-test, with p-values < 0.05 considered reliable.**
Results**. It was found that there was no sex difference in the incidence of pneumonia in children at the age of 6 to 17 years inclusive. In 64.1% of cases, the development of CAP occurred against the background of SARS-CoV-2 virus infection. The incidence of pneumonia increased in spring and in autumn. Most children with CAP, regardless of SARS-CoV-2 infection, were examined and treated by a family physician before hospital admission. The main clinical manifestations of CAP in both groups of children were: disturbance of general state, lack of or decreased appetite, dyspnea, cough, runny nose. In addition, children with pneumonia caused by SARS-CoV-2 virus had dyspeptic symptoms with fever. Objective examination at hospital admission showed that auscultatory and percussion changes were significantly more common in the group of patients without coronavirus. The majority of children with CAP and SARS-CoV-2 infection had bilateral interstitial lung lesions (80.2%). In patients with pneumonia and no evidence of SARS-CoV-2 virus, the pathological process was more often localized in the right lung and had a focal nature. Mean saturation levels during hospitalization were significantly lower in children with CAP and SARS-CoV-2 virus infection than in patients without coronavirus infection. The mean values of clinical blood tests in patients with pneumonia and SARS-CoV-2 virus infection were characterized by age-appropriate leukocyte counts and erythrocyte sedimentation rates. Children with CAP without SARS-CoV-2 virus infection had leukocytosis and accelerated erythrocyte sedimentation rate in the blood.**
Conclusions**. This study describes the clinical course of CAP in children at the current stage, taking into account the characteristics of the region and coronavirus infection. The results show that children with SARS-CoV-2 virus infection have milder clinical manifestations at hospital admission compared with patients without coronavirus infection. However, the instrumental and laboratory studies show that children require special approach and monitoring of their condition during the period of illness.**
Keywords: *community-acquired pneumonia, children, symptoms, clinical course, SARS-CoV-2 virus.*

Характеристика клінічного перебігу позалікарняної пневмонії залежно від ураження вірусом SARS-CoV-2 у дітей Північно-Східного регіону України

О. І. Сміян, Л. В. Тарамак, К. О. Сміян, О. Г. Васильєва, В. А. Горбась, Я. С. Лопа

Патологія дихальної системи продовжує посідати провідне місце серед захворювань дитячого віку, особливо в економічно бідних країнах. Одним із найчастіших респіраторних захворювань є позалікарняна пневмонія (ПП). За даними ВООЗ, кожні 43 с від запалення легень у світі гине одне дитя. Пневмонія уражує легеневу тканину з розвитком дихальної недостатності, викликає зміни у процесах обміну в організмі, зокрема порушення електролітного балансу. Захворювання має різноманітну етіологічну картину, але в останні роки перевагу мають вірусні та комбіновані форми патогенів, які спричинюють тривалий перебіг та зумовлюють негативні наслідки для дитячого організму.
Мета дослідження: встановити особливості клінічного перебігу ПП у дітей Північно-Східного регіону України (м. Суми) віком від 6 до 17 років включно з урахуванням виявленого ураження вірусом SARS-CoV-2.

Матеріали та методи. Робота виконана на базі інфекційного відділення КНП «ДКЛ Святої Зінаїди» та КНП «Центр первинної медико-санітарної допомоги № 1» Сумської міської ради. Загальна кількість дітей, які були обстежені, становила 167 осіб. З них у 134 дітей діагностовано ПП. Пацієнти були розділені на дві групи залежно від ураження вірусом SARS-CoV-2. Групу контролю становили 32 соматично здорові дитини. Пацієнти були ретельно обстежені клінічно, лабораторно та інструментально з детальним збором анамнезу життя й хвороби. Статистичну обробку виконано за допомогою адаптованої до медико-біологічних досліджень програми Microsoft Excel 2013. Вірогідність визначали за допомогою двостороннього незалежного критерію Стьюдента, вірогідними вважалися показники $p < 0,05$.

Результати. У ході проведеного дослідження встановлено, що захворюваність на пневмонію у дітей віком від 6 до 17 років включно не мала статевої відмінності. У 64,1% випадках розвиток ПП відбувався на тлі ураження вірусом SARS-CoV-2. Захворюваність на запалення легень зростала у весняний та осінній періоди. Більшість дітей, хворих на ПП, незалежно від ураження вірусом SARS-CoV-2 до моменту надходження до стаціонару були оглянуті сімейним лікарем та отримували лікування. Основними клінічними проявами ПП у дітей обох груп були: порушення загального стану, відсутній або знижений апетит, задишка, кашель, нежить. Крім того, у дітей, хворих на пневмонію з ураженням вірусом SARS-CoV-2, мали місце диспептичні симптоми на тлі підвищеної температури. Проведене при госпіталізації об'єктивне обстеження показало, що аускультативні та перкуторні зміни виявлялися вірогідно частіше у групі пацієнтів без коронавірусу. У більшості дітей, які мали ПП та ураження вірусом SARS-CoV-2, було виявлено двобічне ураження легень інтерстиціального характеру (80,2%). У пацієнтів із пневмонією без виявленого вірусу SARS-CoV-2 патологічний процес частіше локалізувався у правій легені та мав вогнищевий характер. Середні рівні сатурації в дітей із ПП та ураженням вірусом SARS-CoV-2 при госпіталізації вірогідно мали нижчі цифри порівняно з пацієнтами без коронавірусної інфекції. Середні показники клінічного аналізу крові пацієнтів із запаленням легень та ураженням вірусом SARS-CoV-2 характеризувалися значеннями лейкоцитів і швидкості осідання еритроцитів референтними відповідно до віку. У дітей, хворих на ПП без ураження вірусом SARS-CoV-2, відзначали лейкоцитоз та збільшення швидкості осідання еритроцитів у крові.

Висновки. Це дослідження описує клінічний перебіг ПП у дітей на сучасному етапі з урахуванням особливостей регіону та коронавірусного ураження. Результати доводять, що діти з ураженням вірусом SARS-CoV-2 при госпіталізації мають невиражені клінічні прояви порівняно з пацієнтами без коронавірусної інфекції. Проте проведені інструментальні та лабораторні дослідження показують, що діти потребують особливого підходу та моніторингу стану протягом періоду захворювання.

Ключові слова: *позалікарняна пневмонія, діти, симптоми, клінічний перебіг, вірус SARS-CoV-2.*

Pneumonia is one of the most common respiratory diseases and causes of children' hospitalization [1–6]. The etiological factors of the disease are bacteria, viruses, fungi and their combinations. The pathogens cause an inflammatory process in the lung tissue with the subsequent development of respiratory failure [7–11]. The introduction of preventive measures using conjugate vaccines in recent decades has changed the etiological structure of the disease from bacterial to viral. It has contributed to a 30% reduction in morbidity and a 51% reduction in mortality [4, 7, 8, 10]. However, there are still more than 1,400 cases of pneumonia per 100,000 children worldwide each year. The epidemiological picture varies according to region, living conditions, air pollution, access to food and clean water [2, 4, 12, 13]. In European countries, about 300 cases per 100,000 people aged 0–17 years are registered annually [1]. According to studies by domestic authors, the incidence of community-acquired pneumonia (CAP) in our country has increased by 33% in recent years [14–18]. In Ukraine, according to the Ministry of Health, more than 80,000 cases of pneumonia are registered among children of all ages. Of these, more than 40% are in children aged 6–17 years [14, 16, 17]. The incidence rates in children aged 5–9 years and 9–15 years are 20 and 10 cases per 1,000 children, respectively [17]. It is important to note that the significance of the pneumonia problem is not only the high incidence rates, but also the high mortality rates among children and the unwarranted prescription of antibiotic therapy [1, 11, 18, 19].

Statistical data for recent years indicate that the growth of viral forms of pneumonia prevails among the children of Ukraine. In 2022–2023, almost 80% of CAPs were of viral origin [15, 17, 20]. Typically, CAP is caused by rhinovirus, influenza A virus, adenovirus and others. The global Covid-19 pandemic also contributed to the increase in the proportion of childhood viral pneumonia. At the beginning of the coronavirus outbreak, it was thought that children were not susceptible to severe disease. However, as the incidence of childhood CAP increased, it became clear that the virus affected all age groups and did not just cause the rapid development of bilateral pneumonia. The viral pathogen caused damage to other organs with the possible subsequent development of a multisystem inflammatory syndrome [17, 21, 22]. The introduction of quarantine measures and subsequent vaccination of the pediatric population resulted in a decrease in the incidence and severity of coronavirus infection with development of pneumonia [22–24]. According to statistics, more than 150,000 confirmed cases of coronavirus infection and about 1,000 deaths among children were registered in Ukraine during the 2023–2024 epidemic season [15]. In addition, we should not forget about bacterial and combined etiological factors of CAP, the proportion of which has been 8–40% in recent years [5, 17, 18].

All of the above confirms the importance and need for further research into the clinical manifestations of CAP, taking into account current symptoms. This is the key to improving the diagnosis, treatment and prevention of pneumonia and contributes to the overall health of children and society as a whole.

The objective: to determine the clinical characteristics of CAP in children aged 6 years to 17 years 11 months 29 days in the northeastern region of Ukraine (Sumy), taking into account SARS-CoV-2 virus infection.

MATERIALS AND METHODS

During the study in 2021–2024, it was examined 166 children aged 6 years to 17 years 11 months 29 days inclusive. Of these, 134 children were diagnosed with CAP and treated at the Infectious Diseases Department of the Municipal non-profit enterprise "Children's Clinical Hospital of Saint Zinaida" Sumy City Council.

According to gender, there were 71 girls and 63 boys among the children with CAP ($p > 0.05$). All patients had severe CAP according to the criteria of the "Standards of Care for Community-Acquired Pneumonia in Children" (2022) [1, 25]. The children studied were divided into two groups according to SARS-CoV-2 virus infection. Group I consisted of 86 patients with severe CAP and SARS-CoV-2 infection. The second group included 48 patients with severe CAP without evidence of SARS-CoV-2 virus. Group II consisted of 32 somatically healthy children of matched age and gender.

All children examined had a detailed life and medical history, and their complaints were analyzed. Physical and laboratory examinations were also performed according to current clinical guidelines. Laboratory tests were performed according to generally accepted methods. Instrumental examinations were carried out using X-ray and ultrasound equipment according to their instructions.

Statistical processing of the results was performed on a personal computer using an online calculator and Microsoft Excel software adapted for biomedical research. The mean (M) and its error (m) were calculated. The reliability of the results was determined using the two-tailed independent Student's t-test, and the data were considered reliable at $p < 0.05$.

All stages of the work were carried out with the consent of the parents of the patients and in accordance with the bioethical criteria of the Declaration of Helsinki.

RESULTS AND DISCUSSION

The results of the study showed that there was no gender difference in the incidence of CAP among all children. Among all patients, there were 47% of boys and 53% of girls ($p > 0.05$). The detailed distribution of children with CAP by gender and presence of SARS-CoV-2 virus infection is shown in Table 1.

Thus, the overall incidence of CAP among all children studied did not differ by gender. SARS-CoV-2 virus infection among hospitalized patients was more common in females. No gender difference was observed in group II.

When the seasonality of pneumonia incidence was examined, most cases were observed in autumn (36.5%). In spring and in winter, 29.1 and 26.1% of the episodes were recorded, respectively, and 8.3% in summer. In group I, patients were equally frequent in autumn and spring (30 episodes each) ($p > 0.05$). Children in group II were more often ill in autumn and winter, with 19 and 16 cases respectively ($p > 0.05$). The increase in morbidity in spring and in autumn can be explained by impaired protective functions of the body due to variable weather conditions and insufficient consumption of fresh vegetables and fruits. Details of the seasonality of the incidence of CAP are shown in Fig. 1.

After analyzing the medical history, it was found that 76.8% of all patients had previously been seen by a general practitioner. Of the children in group I, 77.9% were treated as outpatients. Antibacterial drugs were administered during outpatient treatment to 40.2% of all patients seen, including 29.1% of patients in group I. After confirmation of the diagnosis of CAP, all children were prescribed antibiotic therapy. Detailed characteristics of the patient groups according to outpatient care and antibiotic therapy before hospital admission are shown in Fig. 2.

When analyzing the duration of hospitalization, the mean duration of illness before hospitalization for all children with CAP was 6.90 ± 0.46 days, with no significant difference between groups I and II. Thus, in the group with SARS-CoV-2 virus infection, the duration before hospitalization was 6.74 ± 0.54 days, and in patients with CAP without detected SARS-CoV-2 virus, the duration before hospitalization was within 7.18 ± 0.84 days ($p > 0.05$).

A detailed review of the medical history revealed that the vast majority of patients in both groups were admitted to hospital on days 4–5 and 6–7 of illness, 37 and 34 patients, respectively. There were 25 patients in group I who were admitted to hospital on the 4th–5th day of illness and 12 children

Table 1

Distribution of children with CAP by gender and SARS-CoV-2 virus infection

Characteristics / Group	Female patients, n (%)	Male patients, n (%)	Reliability, p_{1-2}
I, n = 86	50 (58.1)	36 (41.9)	< 0.01
II, n = 48	21 (43.8)	27 (56.2)	> 0.05

Notes: p – significance of data differences; p_{1-2} – difference between the gender of heart groups of patients.

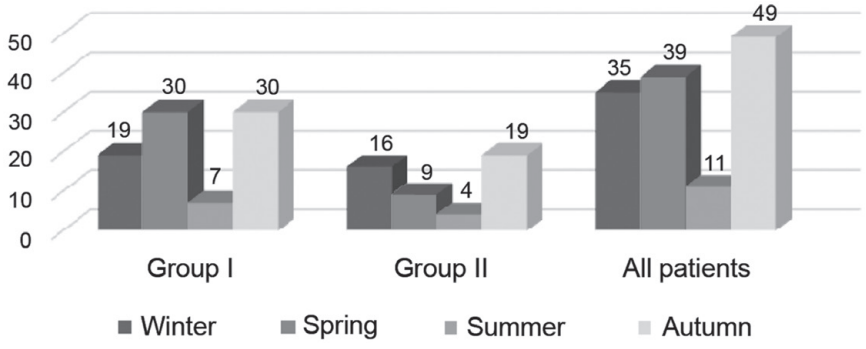

Fig. 1. Seasonality of children with CAP

FAMILY MEDICINE. EUROPEAN PRACTICES / СІМЕЙНА МЕДИЦИНА. ЄВРОПЕЙСЬКІ ПРАКТИКИ • ISSN 2786-7218 (Online) | ISSN 2786-720X (Print) №4 (114)/2025

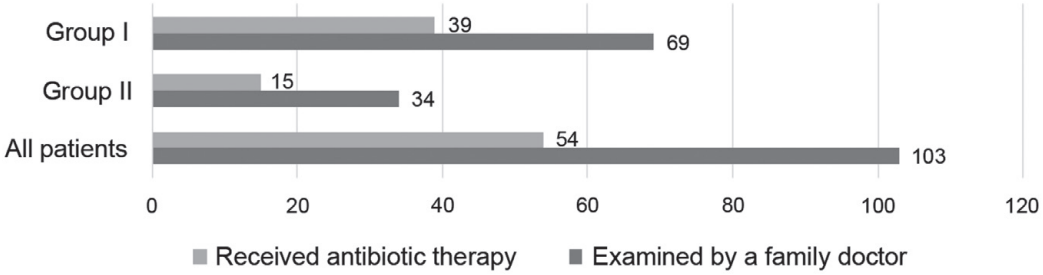

Fig. 2. Receipt of outpatient care and antibiotic therapy by the studied children with CAP

in group II. Five patients were admitted on the 1st day of illness, including 3 children in group II. Before admission, 14 children in group I and 8 patients in group II had been ill for more than 10 days. Eight patients had been treated previously and transferred from another medical institution.

Thus, the vast majority of children had been seen and treated prior to admission, indicating the availability of medical care and parental awareness. The high frequency of antibiotic prescriptions in group I children at the prehospital stage may be due to difficulties in early diagnosis of co-infections and a high risk of bacterial complications from viral infection due to a weakened organism.

At the outpatient stage, 51 (38%) of all children were diagnosed with CAP. On admission to hospital, 32 (24%) of all patients were diagnosed with CAP. Of these, a significant majority of patients were in group II, 24 (17.9%) ($p < 0.001$). Confirmed SARS-CoV-2 virus infection and CAP were present in 14 (10.5%) children on admission to hospital. Acute respiratory infection (ARI) was diagnosed in 32 (24%) patients and a further 16 (12%) children were referred to the unit with a diagnosis of bronchitis. Coronavirus disease was the diagnosis on admission to the Infectious Diseases Unit for 38 (28%) patients in group I. The distribution of patients by diagnoses made during hospitalization is shown in Table 2.

A significant number of differences in diagnosis at hospital presentation may be due to non-specific symptoms of pneumonia and the absence of severe clinical symptoms characteristic of CAP in the first days of illness with SARS-CoV-2 virus infection.

According to the analyzed medical history data, fever, runny nose, cough and sore throat were the first symptoms of CAP in 70 (52.2%) children ($p > 0.05$). Of these, there were 39 from the group I of patients. The onset of pneumonia with fever and general condition without respiratory symptoms was observed in 36 (26.9%) of all children examined, including 29 CAP patients with SARS-CoV-2 virus infection and 7 children without SARS-CoV-2 virus infection. 23 (17.1%) of the examined children with CAP had respiratory symptoms without fever, including 13 patients in group I and 10 children in group II. Nonspecific dyspeptic symptoms with fever to febrile body temperature were present in 5 (3.8%) of the children studied.

Thus, the majority of patients presenting to the hospital were characterized by a typical onset of illness with fever, deterioration of health and respiratory symptoms.

The general condition on admission to hospital was assessed as severe in all patients and 11 (8.2%) children were admitted to intensive care.

In case of hospitalization, all children with CAP complained of fever. Thus, 73 (54.5%) of the patients examined had a temperature rise to subfebrile levels, including 45 children in group I. Febrile temperatures were present in 35 (26.1%) children, including 24 patients with coronavirus infection. A rise in body temperature to pyretic parameters was observed in 26 (19.4%) patients, including 18 children with SARS-CoV-2 virus infection. The distribution of children according to temperature parameters is shown in Fig. 3.

Thus, the vast majority of children in both groups had a subfebrile temperature on admission, which can be explained by previous outpatient treatment.

Analysis of the data from the patients' admission examination showed that general weakness and malaise were reported by all patients with CAP, regardless of SARS-CoV-2 virus infection. Sleep disturbance and drowsiness were reported by 39 (29.1%) of the patients included in the study. It was anorexia in 89 (66.4%) children, including 54 children in group I and 35 patients in group II. The appetite reduced in 36 (26.8%) children. This complaint was significantly more

Table 2

Diagnosis of children with CAP during hospitalization

Group / Diagnosis	I, n = 86		II, n = 48		Total children, n = 134	
	n	%	n	%	n	%
Pneumonia	8	9.3	24	50	32	24
Coronavirus illness	38	44.2	0	0	38	28
Pneumonia with SARS-CoV-2 infection	14	16.3	0	0	14	10.5
ARI, upper respiratory tract	21	24.4	11	23	32	24
ARI, bronchitis	3	3.5	13	47	16	12
Bronchitis, SARS-CoV-2 virus infection	2	2.3	0	0	2	1.5

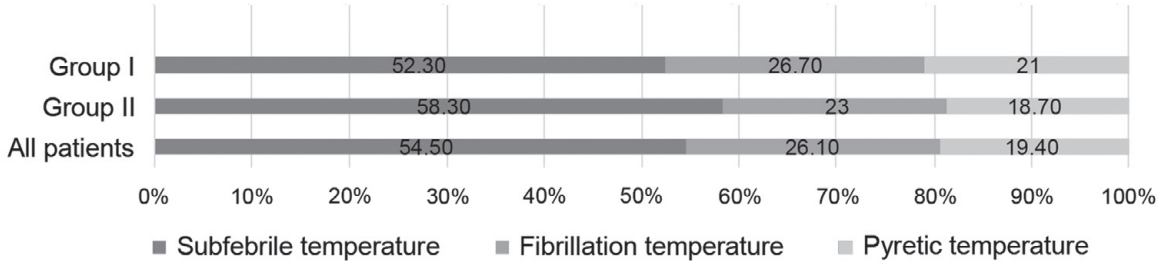

Fig. 3. Distribution of patients with CAP by temperature level on admission

common in patients with SARS-CoV-2 virus infection ($p < 0.01$). Loss of sense of smell and taste was observed in 3 children in group I. Chest pain was reported by 11 (8.2%) of the patients examined.

The most common respiratory symptom was cough in 109 (81.3%) of the children studied. Dry and wet cough were equally frequent in both groups of children studied ($p > 0.05$). In group I, dry and wet cough were present in 32 (37.2%) and 31 (36%) episodes, respectively ($p > 0.05$). 25 (18.6%) of the children studied had no cough during the examination. Of these, 23 (26.7%) were in group I, significantly more than 2 (4.1%) in group II ($p < 0.001$).

Among other clinical manifestations of the disease, patients reported gastrointestinal disturbances. Complaints of abdominal pain, nausea, vomiting and stool disturbance were reported by 11 (12.7%) patients in group I and 5 (10.4%) children in group II ($p > 0.05$).

Objective examination revealed pallor of the skin in 32 (24%) patients, including 22 (68.7%) children in group II ($p < 0.001$). At the initial examination, the tongue was covered with white plaque in 39 (45.3%) patients in group I and 11 (23%) children in group II ($p < 0.01$). Signs of respiratory failure, mostly of a mixed nature, were observed in 56 (65.1%) patients in the SARS-CoV-2 infection group and in 43 (89.5%) children in group II. Table 3 shows the main clinical features of CAP.

Thus, the most common clinical symptoms when children in both groups visited a health facility were general complaints, sleep and lack of or reduced appetite. Respiratory symptoms were dominated by cough, shortness of breath and nasal obstruction. In addition, non-specific dyspeptic symptoms were noted in children with CAP.

Percussion revealed that 82 (61.1%) of the patients included in the study had no changes in lung sounds ($p < 0.001$). In group I, there was a significant preponderance of no percussion changes at the initial examination, which was 68 (79%) cases ($p < 0.001$). At the same time, in group II, in 32 (66.7%) episodes of CAP, changes in the percussion sound (shortening and boxy lung sound) were detected significantly more often during the examination ($p < 0.001$) (Table 4).

Auscultation revealed that 109 (81.3%) patients with CAP had changes in lung sounds in the form of rigid breathing with prolonged exhalation ($p < 0.001$). Decreased breath sounds over the lesion were found in 25 (18.8%) patients. Auscultation of pleural rub was found in 10 (7.4%) of the children included in the study, with no significant difference between the groups ($p > 0.05$). Rough breathing was significantly more common in patients in group I – 74 (86%), and decreased breathing was observed in 12 (14%) children ($p < 0.001$). In group II, rigid breathing was characteristic

Table 3

Comparative characteristics of clinical symptoms of CAP

Group / Symptom	I, n = 86, N (%)	II, n = 48, N (%)	Reliability, p_{1-2}
Violation of the general condition	86 (100)	48 (100)	< 0.05
Lack of appetite	54 (62.7)	35 (73)	> 0.05
Reduced appetite	29 (33.7)	7 (14.5)	< 0.01
Dyspeptic symptoms	11 (12.7)	5 (10.4)	> 0.05
Drowsiness	24 (27.9)	15 (31.2)	> 0.05
Shortness of breath	56 (65.1)	43 (89.5)	< 0.001
Wet cough	31 (36)	21 (24.4)	> 0.05
Dry cough	32 (37.2)	25 (29)	> 0.05
No cough	23 (26.7)	2 (4.1)	< 0.001
Pain, irritation in the throat	22 (25.5)	15 (31.2)	> 0.05
Nasal congestion, runny nose	53 (61.6)	37 (77)	> 0.05
Huskiness of the voice	3 (3.4)	0	> 0.05
Pallor of the skin	10 (11.6)	22 (45.8)	< 0.001
Pain in the chest	6 (6.9)	5 (10.4)	> 0.05

Notes: p – reliability of data discrepancies; p_{1-2} – reliability of the difference between the manifestation of clinical symptoms in groups of patients.

FAMILY MEDICINE. EUROPEAN PRACTICES / СІМЕЙНА МЕДИЦИНА. ЄВРОПЕЙСЬКІ ПРАКТИКИ •
ISSN 2786-7218 (Online) | ISSN 2786-720X (Print)
№4 (114)/2025

Table 4

Percussion changes in patients with pneumonia

Characteristic \ Group	I, (n = 86)	II, (n = 48)
Shortening of the lung sound	17.44 ± 4.12 $p_{1-2} < 0.001$	56.25 ± 7.24
Box shade of the lung sound	3.49 ± 1.99 $p_{1-2} > 0.05$	10.42 ± 4.46
Clear lung sound	79.07 ± 4.41 $p_{1-2} < 0.001$	29.17 ± 6.63

Notes: p – reliability of data discrepancies; p_{1-2} – reliability of the difference between lung sound changes in patients of groups I and II.

in 35 (73%) patients and decreased breathing in 13 (25%) children ($p < 0.001$) (Fig. 4).

Auscultatory wet and dry rales were heard in 56 (41.7%) and 16 (11.9%) patients with CAP included in the study groups, respectively. The absence of wheezing on auscultation was observed in 62 (46.2%) children. In group I, 52 (60.5%) patients had no wheezing ($p < 0.001$) (Fig. 5). In group II, 33 (68.8%) children had wet rales ($p < 0.001$) (Fig. 6).

Thus, the vast majority of children with CAP with SARS-CoV-2 virus infection had mild percussion changes and auscultatory changes in breathing, without wheezing, on admission to the hospital. In patients of group II, percussion changes were in the form of a dull lung sound, and auscultation was characterized as rigid breathing with moist rales.

Assessing the localization of the pathological process, it was found that in 85 (63.4%) patients included in the study, pneumonia affected both lungs. Right-sided and left-sided localization of the pathological process was observed in 30 (22.4%) and 19 (14.1%) children, respectively. In group I, 74 (86%) patients had bilateral lung involvement ($p < 0.001$). In group II, the pathological process was more often unilateral in 37 (77%) children ($p < 0.001$). Thus, the localization of inflammation in the right and left lungs was detected in 22 (45.8%) and 15 (31.2%) patients, respectively ($p > 0.05$) (Fig. 7).

Pneumonia was more likely to be interstitial in nature in 81 (60.5%) of the patients studied ($p < 0.001$). In group I, 71 (82.5%) children had interstitial lung inflammation, which was significantly more than in group II with 10 (20.8%) patients ($p < 0.001$). Focal pneumonia was present in 50 (37.3%) children. There were significantly more focal episodes in group II – 38 (79.2%) cases ($p < 0.001$). Segmental and lobar CAP were observed in 2 (1.5%) and 1 (0.7%) patients in group I, respectively.

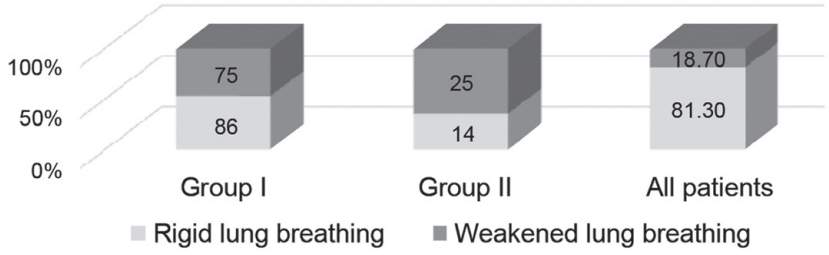

Fig. 4. Characteristics of auscultatory sounds in patients with CAP

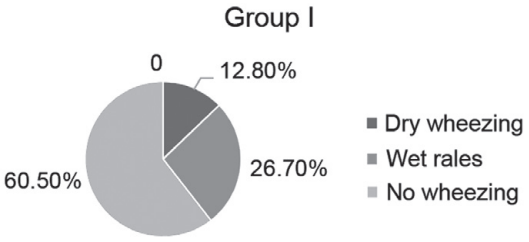

Fig. 5. Auscultatory changes in patients of group I

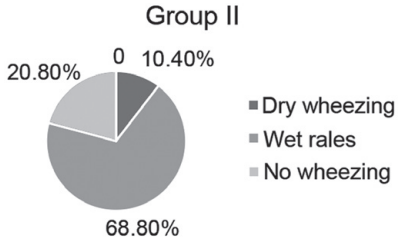

Fig. 6. Auscultatory changes in patients of group II

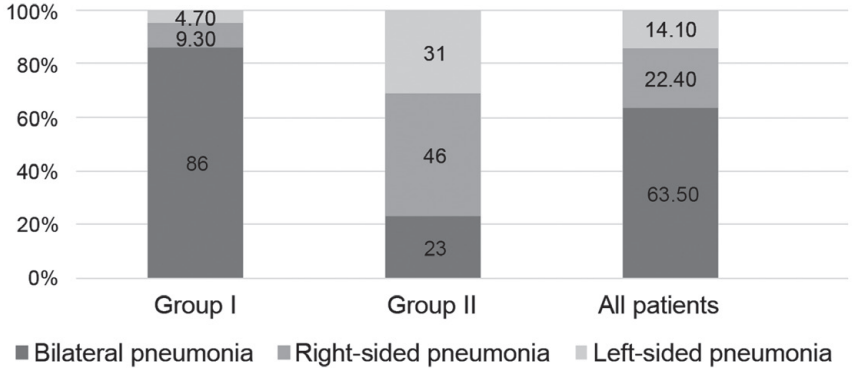

Fig. 7. Localization of the pathological process in children with CAP

Table 5

Saturation level in children with CAP in the acute period

Sign \ Group	I, n = 86	II, n = 48	Healthy children, n = 32
Saturation level, %	93.91 ± 0.12 $p_{1-2} < 0.001$ $p_{1-3} < 0.001$	94.47 ± 0.19 $p_{2-3} < 0.001$	98.97 ± 0.14

Notes: p – reliability of data discrepancies; p_{1-2} – reliability of the difference in saturation in patients of groups I and II; p_{1-3} – reliability of the difference in saturation indices between patients of group I and control group; p_{2-3} – reliability of the difference in the saturation of patients of group II and control group.

During hospitalization, all patients underwent measurement of blood oxygen saturation using a pulse oximeter. The mean level of blood oxygen saturation in the children with pneumonia included in the study was 94.11 ± 0.10% and was significantly lower than in the control group (98.97 ± 0.14%) ($p < 0.001$). The detailed characteristics of the saturation level in the studied children are shown in Table 5.

Thus, in the vast majority of patients in group I, CAP was interstitial and involved both lungs. In group II, unilateral lesions and focal changes predominated. Blood oxygen saturation was reduced in all patients with pneumonia and was significantly lower in group I.

The following changes were noted in the clinical blood tests of the children studied. It was found that the average erythrocyte and hemoglobin levels in all patients were within the reference values for children of the same age. Decreased hemoglobin levels were found in 27 (20.1%) children with CAP, including 23 children in group I. The leukocyte counts of patients in group I were within the reference values for their age, while the values for lymphocytes and monocytes were higher, which may indicate a viral etiology of the disease. In children in group II, leukocytosis with a shift of the leukoformula to the left and an increase in the erythrocyte sedimentation rate (ESR) were observed in comparison with group I and controls ($p < 0.001$), which may indicate a bacterial cause of the disease (Table 6).

Thus, the clinical blood test of patients in group I was characterized by leukocyte and ESR levels within the reference values for children of the same age, an increase in monocytes and lymphocytes. In children in group II, laboratory changes were manifested by an increase in leukocyte and ESR levels, as well as a shift of the leukoformula to the left.

CONCLUSIONS

The article presents the main clinical features of pneumonia in children, taking into account the current epidemiological and regional situation. It was found that in most cases (64.1%) the development of pneumonia occurred in association with SARS-CoV-2 virus infection. The main clinical manifestations of CAP in children, regardless of established SARS-CoV-2 virus infection, were fever, general condition and respiratory symptoms. In addition, CAP with SARS-CoV-2 virus infection was characterised by dyspeptic manifestations in children. The saturation level was reduced in all patients with CAP and was significantly lower in children with SARS-CoV-2 virus.

Table 6

Complete blood count indicators in children with CAP in the acute period

Indicator \ Group	I, n = 86	II, n = 48	Healthy children, n = 32
Hemoglobin, g/L	129.60 ± 1.95 $p_{1-2} > 0.05$ $p_{1-3} < 0.01$	131.00 ± 2.27 $p_{2-3} < 0.05$	136.3 ± 1.2
Red blood cells, x/L	4.20 ± 0.04 $p_{1-2} > 0.05$ $p_{1-3} > 0.05$	4.23 ± 0.04 $p_{2-3} > 0.05$	4.30 ± 0.07
White blood cells, x/L	4.20 ± 0.04 $p_{1-2} > 0.05$ $p_{1-3} > 0.05$	4.23 ± 0.04 $p_{2-3} > 0.05$	5.95 ± 0.23
Eosinophils, %	2.61 ± 0.10 $p_{1-2} > 0.05$ $p_{1-3} > 0.05$	2.77 ± 0.20 $p_{2-3} > 0.05$	3.09 ± 0.23
Stick neutrophils, %	2.41 ± 0.14 $p_{1-2} < 0.001$ $p_{1-3} < 0.001$	8.72 ± 0.33 $p_{2-3} < 0.001$	4.18 ± 0.26
Segmented neutrophils, %	53.96 ± 0.41 $p_{1-2} < 0.001$ $p_{1-3} < 0.001$	59.43 ± 0.48 $p_{2-3} < 0.01$	57.10 ± 0.65
Lymphocytes, %	31.10 ± 0.45 $p_{1-2} < 0.001$ $p_{1-3} < 0.05$	24.91 ± 0.52 $p_{2-3} > 0.001$	29.51 ± 0.67
Monocytes, %	10.05 ± 0.24 $p_{1-2} < 0.001$ $p_{1-3} < 0.001$	4.18 ± 0.26 $p_{2-3} < 0.01$	5.39 ± 0.30
Erythrocyte sedimentation rate, mm/h	9.39 ± 0.83 $p_{1-2} < 0.001$ $p_{1-3} < 0.001$	15.41 ± 0.94 $p_{2-3} < 0.001$	4.9 ± 0.3

Notes: p – reliability of data discrepancies; p_{1-2} – reliability of the difference in blood parameters of patients of groups I and II; p_{1-3} – reliability of the difference in blood parameters between patients of group I and control group; p_{2-3} – reliability of the difference in blood parameters of patients of group II and control group.

On initial objective examination, the majority of children with SARS-CoV-2 virus infection had no percussion changes. Auscultation revealed rigid breathing, mostly without wheezing. In patients without SARS-CoV-2 virus infection, CAP was characterized by shortened percussion and wet rales against a background of rigid breathing in the vast majority of episodes.

The instrumental data showed that in children with confirmed SARS-CoV-2 virus, both lungs were more often affected, and the inflammation was interstitial. In contrast, in patients with CAP without SARS-CoV-2 virus infection, the inflammatory process was characterized by unilateral involvement and focal changes in most of the cases studied.

Laboratory parameters in patients diagnosed with CAP with SARS-CoV-2 infection were characterized by leukocyte counts within age-appropriate reference values, whereas an increase in leukocyte counts was observed in children without coronavirus infection. In addition, children with CAP without SARS-CoV-2 virus had an increase in ESR and a leftward shift in leukocyte count.

FAMILY MEDICINE. EUROPEAN PRACTICES / СІМЕЙНА МЕДИЦИНА. ЄВРОПЕЙСЬКІ ПРАКТИКИ •
ISSN 2786-7218 (Online) | ISSN 2786-720X (Print)
№4 (114)/2025

Conflict of interest. The authors declare no conflicts of interest and have no financial gain related to this article.

Funding information. No funding has been received.

Acknowledgements. The authors would like to thank all the study participants, including the children and their parents, for their cooperation. Special thanks are due to the administration and staff of the Infectious Diseases Department of the Saint Zinaida Children's Clinical Hospital for their help in organizing and carrying out the study. We are also grateful to our colleagues for their valuable advice and scientific consultation.

Information about the authors

Smiyan Oleksandr I. – Academic and Research Medical Institute, Sumy State University; tel.: (054) 266-23-18. *E-mail: ped@med.sumdu.edu.ua*
ORCID: 0000-0001-8225-0975

Taramak Liudmyla V. – Academic and Research Medical Institute, Sumy State University; tel.: (099) 302-32-49. *E-mail: l.taramak@med.sumdu.edu.ua*
ORCID: 0009-0005-1802-892X

Smiyan Kateryna O. – Academic and Research Medical Institute, Sumy State University; tel.: (050) 958-55-57. *E-mail: smiyan-gorbunova@med.sumdu.edu.ua*
ORCID: 0000-0002-8030-6418

Vasylieva Olena H. – Academic and Research Medical Institute, Sumy State University; tel.: (066) 734-23-08. *E-mail: ol.vasilyeva@med.sumdu.edu.ua*
ORCID: 0000-0003-4470-8740

Horbas Viktoriia A. – Academic and Research Medical Institute, Sumy State University; tel.: (095) 595-74-26. *E-mail: v.gorbays@med.sumdu.edu.ua*
ORCID ID: 0000-0002-7455-6875

Lopa Yana S. – Academic and Research Medical Institute, Sumy State University; tel.: (067) 126-78-46. *E-mail: yanalopa2770@gmail.com*

Відомості про авторів

Сміян Олександр Іванович – Навчально-науковий медичний інститут Сумського державного університету; тел.: (054) 266-23-18. *E-mail: ped@med.sumdu.edu.ua*
ORCID: 0000-0001-8225-0975

Тарамак Людмила Вікторівна – Навчально-науковий медичний інститут Сумського державного університету; тел.: (099) 302-32-49. *E-mail: l.taramak@med.sumdu.edu.ua*
ORCID: 0009-0005-1802-892X

Сміян Катерина Олександрівна – Навчально-науковий медичний інститут Сумського державного університету; тел.: (050) 958-55-57. *E-mail: smiyan-gorbunova@med.sumdu.edu.ua*
ORCID: 0000-0002-8030-6418

Васильєва Олена Геннадіївна – Навчально-науковий медичний інститут Сумського державного університету; тел.: (066) 734-23-08. *E-mail: ol.vasilyeva@med.sumdu.edu.ua*
ORCID: 0000-0003-4470-8740

Горбась Вікторія Анатоліївна – Навчально-науковий медичний інститут Сумського державного університету; тел.: (095) 595-74-26. *E-mail: v.gorbays@med.sumdu.edu.ua*
ORCID: 0000-0002-7455-6875

Лопа Яна Сергіївна – Навчально-науковий медичний інститут Сумського державного університету; тел.: (067) 126-78-46. *E-mail: yanalopa2770@gmail.com*

REFERENCES

1. Ministry of Health of Ukraine. On approval of the Standards of medical care "Communicable diseases pneumonia in children" [Internet]. 2022. Order No. 1380; 2022 Aug 02. Available from: https://www.dec.gov.ua/mtd/pozalikarnyani-pnevmoniyi-u-ditej/.

2. Roh EJ, Shim JY, Chung EH. Epidemiology and surveillance implications of community-acquired pneumonia in children. Clin Exp Pediatr. 2022;65(12):563-73. doi: 10.3345/cep.2022.00374.

3. Meyer Sauteur PM, Seiler M, Tilen R, Osuna E, von Wantoch M, Sidorov S, et al. A randomized controlled non-inferiority trial of placebo versus macrolide antibiotics for Mycoplasma pneumoniae infection in children with community-acquired pneumonia: trial protocol for the MYTHIC Study. Trials. 2024;25(1):655. doi: 10.1186/s13063-024-08438-6.

4. Ravindran A, Sowmiya S. Acute pneumonia in children. In: Proceedings of the 15th International Scientific and Practical Conference "Scientific Horizon in the Context of Social Crises". 2024 Apr 26-28; Tokyo. Tokyo; 2024, p.15-7.

5. Tsoumani E, Carter JA, Salomonsson S, Stephens JM, Bencina G. Clinical, economic, and humanistic burden of community acquired pneumonia in Europe: a systematic literature review. Expert Rev Vaccines. 2023;22(1):876-84. doi: 10.1080/14760584.2023.2261785.

6. Shoar S, Musher DM. Etiology of community-acquired pneumonia in adults: a systematic review. Pneumonia. 2020;12(1):11. doi: 10.1186/s41479-020-00074-3.

7. Meyer Sauteur PM. Childhood community-acquired pneumonia. Eur J Pediatr. 2024;183:1129-36. doi: 10.1007/s00431-023-05366-6.

8. McAllister DA, Liu L, Shi T, Chu Y, Reed C, Burrows J, et al. Global, regional, and national estimates of pneumonia morbidity and mortality in children younger than 5 years between 2000 and 2015: a systematic analysis. Lancet Glob Health. 2019;7(1):e47-57. doi: 10.1016/S2214-109X(18)30408-X.

9. Rueda ZV, Aguilar Y, Maya MA, López L, Restrepo A, Garcés C, et al. Etiology and the challenge of diagnostic testing of community-acquired pneumonia in children and adolescents. BMC Pediatr. 2022;22(1):169. doi: 10.1186/s12887-022-03235-z.

10. Pneumonia Etiology Research for Child Health (PERCH) Study Group. Causes of severe pneumonia requiring hospital admission in children without HIV infection from Africa and Asia: the PERCH multi-country case-control study. Lancet. 2019;394(10200):757-79. doi: 10.1016/S0140-6736(19)30721-4.

11. Yun KW. Community-acquired pneumonia in children: updated perspectives on its etiology, diagnosis, and treatment. Clin Exp Pediatr. 2024;67(2):80-9. doi: 10.3345/cep.2022.01452.

12. Rees CA, Kuppermann N, Florin TA. Community-Acquired Pneumonia in Children. Pediatr Emerg Care. 2023;39(12):968-76. doi: 10.1097/PEC.000000 0000003070.

13. United Nations International Children's Emergency Fund [Internet]. Pneumonia. UNICEF; 2023. Available from: https://data.unicef.org/topic/child-health/pneum onia/.

14. Volosovets O, Bolbot Y, Abaturov O, Kryvopustov S, Besh L, Stoieva T, et al.

Dynamics of the incidence rate of pneumonia in children in Ukraine over the past 20 years. Med Perspekt. [Internet]. 2020;25(4):174-81. Available from: https://journals.uran.ua/index.php/2307-0404/article/view/221680.
15. Center for Public Health of the Ministry of Health of Ukraine. Coronavirus infection Covid-19. Kyiv: MHU; 2024. Available from: https://phc.org.ua/kontrol-zakhvoryuvan/inshi-infekciyni-zakhvoryuvannya/koronavirusna-infekciya-covid-19.
16. Zabolotko VM. Provision of medical care to children aged 0-17 in healthcare institutions under the management of the Ministry of Health of Ukraine: Statistical and Analytical Handbook 1996-2019 [Internet]. Kyiv; 2020. Available from: https://www.ukrmedstat@medstat.gov.ua.
17. Zabrodska O. Viral pneumonia in children. Health Ukr 21 History. 2023;554(18):27-35.
18. Chee E, Huang K, Haggie S, Britton PN. Systematic review of clinical practice guidelines on the management of community acquired pneumonia in children. Paediatr Respir Rev. 2022;42:59-68. doi: 10.1016/j.prrv.2022.01.006.
19. Mathur S, Fuchs A, Bielicki J, Van Den Anker J, Sharland M. Antibiotic use for community-acquired pneumonia in neonates and children: WHO evidence review. Paediatr Int Child Health. 2018;38(1):66-75. doi: 10.1080/20469047.2017.1409455.
20. Khomenko V, lemets O, Volosovets O, Kryvopustov SP, Mozyrska OV. Etiological spectrum of pneumonia in children in Kyiv, Ukraine. Child's Health. 2023;18(2):73-9. doi: 10.22141/2224-0551.18.2.2023.1565.
21. Burrell R, Saravanos G, Britton PN. Unintended impacts of COVID-19 on the epidemiology and burden of paediatric respiratory infections. Paediatr Respir Rev. 2023 Aug 3:S1526-0542(23)00044-1. doi: 10.1016/j.prrv.2023.07.004.
22. Götzinger F, Santiago-García B, Noguera-Julián A, Lanaspa M, Lancella L, Calò Carducci FI, et al. COVID-19 in children and adolescents in Europe: a multinational, multicentre cohort study. Lancet Child Adolesc Health. 2020;4(9):653-61. doi: 10.1016/S2352-4642(20)30177-2.
23. Nejad Biglari H, Sinaei R, Pezeshki S, Khajeh Hasani F. Acute transverse myelitis of childhood due to novel coronavirus disease 2019: The first pediatric case report and review of literature. Iran J Child Neurol. 2021;15(1):107-12. doi: 10.22037/ijcn.v15i1.31579.
24. Nikolopoulou GB, Maltezou HC. COVID-19 in Children: Where do we Stand? Arch Med Res. 2022;53(1):1-8. doi: 2310.1016/j.arcmed.2021.07.002.
25. World Health Organization. Revised WHO classification and treatment of pneumonia in children at health facilities: Evidence summaries. Geneva: WHO; 2014. 34 p. Available from: http://apps.who.int/iris/bitstream/10665/137319/1/9789241507813_eng.pdf.

Стаття надійшла до редакції 20.01.2025. – Дата першого рішення 23.01.2025. – Стаття подана до друку 28.02.2025