Original article

Clinical and epidemiological features of the covid-19 in children

Características clínicas y epidemiológicas de la COVID-19 en niños

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ABSTRACT

Introduction: The COVID-19 pandemic determines the relevance of the analysis of clinical and epidemiological features in various periods of the rise in morbidity among the child population.

Objective: To study of the clinical and epidemiological features of the COVID-19 in children.

Methods: The analysis of medical documents of 585 patients aged from 1 month to 17 years who were under the supervision of the district pediatric service of the city children's polyclinics in Ryazan for the period from March 2020 to December 2021 with a verified diagnosis: new coronavirus infection.

Results: There was a predominance of school-age children (68.7%). Contamination of SARS-CoV-2 most often occurred as a result of other family members (87.2%). In most cases, a mild course of the disease was noted (71.8%). Premorbid conditions was detected in 8.4% of children, it was 10.7 times more often recorded in children with a moderate course of the disease ($p<0.001$). The symptoms of intoxication (74.9%) and respiratory tract damage

(69.6%) were dominated in the clinical happening of COVID-19. Gastrointestinal manifestations were more common in children of 0 to 7 years old (p<0.001), dysosmia and dysgeusia – in school-age children (p<0.001).

Conclusion: In most of the examined children, COVID-19 proceeded in a mild form. Correlations were found between the severity of the new coronavirus infection and the presence of concomitant pathology, as well as between the age of patients and the presence of gastrointestinal symptoms, dysgeusia and dysosmia. Postcovidsyndrome were noted infrecuently; in most cases they manifested as symptoms of asthenia.

Keywords: children; COVID-19; clinical and epidemiological features.

RESUMEN

Introducción: La pandemia de COVID-19 determinó la relevancia del análisis de las características clínicas y epidemiológicas en diversos períodos del aumento de la morbilidad entre la población infantil.

Objetivo: Estudiar las características clínicas y epidemiológicas de la COVID-19 en niños.

Métodos: Se analizaron los documentos médicos de 585 pacientes de 1 mes a 17 años que estuvieron bajo la supervisión del servicio pediátrico del distrito de los policlínicos infantiles de la ciudad en Ryazan durante el período comprendido entre marzo de 2020 y diciembre de 2021 con un diagnóstico verificado de nueva infección por coronavirus.

Resultados: Predominaron los niños en edad escolar (68,7 %). La mayoría se infectaron con otros miembros de la familia con COVID-19 (87,2 %); fue más frecuente un curso leve de la enfermedad (71,8 %). La patología premórbida se detectó en el 8,4 % de los niños, se registró 10,7 veces más a menudo en niños con un curso moderado de la enfermedad (p < 0,001). Los síntomas de intoxicación (74,9 %) y daño de las vías respiratorias (69,6 %) fueron predominantes. Las manifestaciones gastrointestinales fueron más frecuentes en niños de 0 a 7 años (p < 0,001), disosmia y disgeusia en edad escolar (p < 0,001).

Conclusiones: En la mayoría de los niños examinados, la COVID-19 procedió de forma leve. Existió correlación entre la gravedad de la infección por el nuevo coronavirus y la presencia de afecciones concomitantes, así como entre la edad de los pacientes y la presencia de síntomas gastrointestinales, disgeusia y disosmia. El síndrome pos-COVID-19 fue infrecuente y se manifestó generalmente por síntomas de astenia.

Palabras clave: niños; COVID-19; características clínicas y epidemiológicas.

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Introduction

The pandemic of a new coronavirus infection (COVID-19), started in March 2020, has rapidly spread in the world, causing damage to various areas of human activity.[1] According to world statistics of February 2023, more than 670 million cases and more than 6 million deaths because of this infection were registered.[2]

At the same time, the number of cases of COVID-19 among children and adolescents in the incidence structure in different countries does not exceed 15-19%. In contrast to the adult population, the pediatric population mostly has an asymptomatic course of infection, and clinically significant forms of the disease, as a rule, have a mild or moderate course.[3]

Most researchers note much less frequently development of viral pneumonia in children than in adults, and its symptoms and severity were less expressed. Among pediatric patients, only 1-2% of them required hospitalization in the intensive care unit, and deaths were extremely rare.[4] At the same time, in sick children, as well as in adults, intoxication and respiratory syndromes dominated, hematological changes were less pronounced, but symptoms of damage to the gastrointestinal tract were more often observed.[5,6,7]

According to the United States Centers for Disease Control and Prevention (CDC), in the United States the rate of children under the 18 years old was 18-19% of all laboratory-confirmed cases of COVID-19, adolescents – 56%.[8] Foreign sources are actively discussing the epidemiology of a SARS-CoV-2 infection in children and adolescents, in particular, the problem of an underestimated frequency of registration of mild and asymptomatic cases of COVID-19, polymerase chain reaction (PCR) testing was not performed it.[9] According to a nationwide study, the number of seropositive children in the United States was 5 times higher than official reported cases of the disease.[10] There is evidence of the possibility of transmission of the virus by asymptomatic patients, both to children and adults.[11]

SARS-CoV-2 infection occurs more often within family foci of infection, somewhat less frequently in organized children's groups.[12,13] There are likely cases of intrauterine transmission of the infection and contamination of children during breastfeeding.[14] However, many clinical and epidemiological aspects of COVID-19 in children remain undiscovered and require further study.

The objective was to study of the clinical and epidemiological features of the COVID-19 in children of various age groups living in the city of Ryazan.

Methods

A retrospective analysis of the primary medical documentation (form No. 112-u) of 585 patients from 1 month to 17 years old, who were under the supervision of the pediatric service of the city children's polyclinics in Ryazan for the period from March 2020 to December 2021 was carried out.

The diagnosis was verified according to practical guidelines “Prevention, diagnosis and treatment of a new coronavirus infection (COVID-19). Version 14 (12/27/2021)”.[15] The selection of primary medical documentation for study was carried out by random sampling. In the study group, 562 patients received outpatient treatment and 23 children – were treated in Ryazan City Clinical Hospital No. 11.

Criteria for inclusion in the study:

1. Age from 1 month up to 17 years 11 months 29 days old.
2. Detection of SARS-CoV-2 RNA in the material of a swab from the oropharynx and nasopharynx by polymerase chain reaction (PCR) or a positive result of a rapid test for the presence of the SARS-CoV-2 antigen.

Criteria for exclusion from the study:

1. Age under 1 month or over 17 years 11 months 29 days.
2. The lack of verification of SARS-CoV-2 RNA in the oropharyngeal and nasopharyngeal smear material by polymerase chain reaction (PCR).

The whole analysis was carried out using the Statistical Package for the Social Sciences (SPSS) software, version 17, (SPSS Inc., Chicago, United States).
The severity of the disease was established in according to the current practical guidelines.[15]
According to the indications, 262 children underwent laboratory and instrumental examination, including a clinical blood test and computed tomography (CT) of the chest organs in case of suspected damage to the lung tissue.
In addition, a follow-up analysis of data from 385 patients who were underwent COVID-19 3 months after recovery we conducted. The group included patients whose parents agreed to the examination and questionnaire. The mean age of the patients was 10.9±2.5 years. The sample was dominated by school-age children – 281 (73.0%), there were 69 preschool children (17.9%), toddlers – 33 (8.6%), infants – 2 (0.5%). No gender differences were identified.
Screening assessment of the health status of patients with COVID-19, was carried out using a specially designed questionnaire consisting of 35 open and closed questions about the characteristics of the course of the rehabilitation period, the presence of complaints and specific symptoms of damage to various organs and systems, and physical examination. In the presence of

indications identified at the screening stage, this group of patients also was undergoing a laboratory and instrumental examination, including a clinical analysis of blood and urine, as well as a biochemical blood test and electrocardiography (ECG).

Statistical processing of the obtained data was carried out using the standard MS Excel 2016 package, the Pandas, SciPy libraries, and the Python programming language using parametric and nonparametric statistical methods. For quantitative variables, the median, lower and upper quartiles (Me [Q1; Q3]) were calculated; for qualitative variables, absolute values and their shares (%) were determined. Statistically significant differences in nominal parameters were judged by Pearson's goodness-of-fit test ($\chi 2$). During the correlation analysis, the Spearman's rank correlation coefficient (r) was calculated. $P \leq 0.05$ was taken as the critical level of statistical significance of differences.

Results

The average age of the examined patients was 10.3±2.6 years. The study sample was dominated by school-age children – 402 (68.8%), aged 1 to 7 years old – 174 (29.7%) and 9 infants (1.5%) of the total number of infected. There were no statistically significant gender differences in the studied groups.

According to primary medical documentation, SARS-CoV-2 infection most often occurred in family foci of infection (n=510; 87.2%) due to the contact with sick family members. In 62 (10.6%) patients, contacts with patients with COVID-19 were identified in the conditions of children's organized groups. Such contacts were significantly more often registered among patients of senior school age ($\chi 2=43.6$; $p<0.001$). In 13 (2.2%) children, the source of infection could not be identified.

Most of the examined patients had a mild course of the disease (n=420, 71.8%). Moderate course of COVID-19 was observed in 31 (5.3%) patients. There were no cases of severe disease or death in this sample. The diagnosis of «community-acquired pneumonia» was verified in 24 patients (4.1%).

The main rate of requests for medical care for infants, toddlers and preschool children (n=146, 79.7%) fell on the 3rd day from the moment the manifestation of symptoms of the disease appeared (Me=3[1; 4]). School-children went to the medical care, as a rule, on the 5th day of illness (Me=5 [4; 7]).

During the study of the medical documentation was found, that 49 (8.4%) of the examined children were observed by a pediatrician for various chronic diseases. In 420 patients with mild COVID-19, background pathology was quite rare (in 0.2-2.6% of cases). They had chronic pathology of the cardiovascular system (CVS) (n=11, 2.6%), pathology of the central nervous system (CNS) (n=3, 0.7%), obesity (n=2, 0. 5%), pathology of the urinary system (n=2, 0.5%), allergic diseases (n=1, 0.2%), chronic diseases of the upper respiratory tract (n=1, 0.2%), chronic pathology of the bronchopulmonary system (1 person, 0.2%), rheumatic diseases (n=1, 0.2%), thyroid pathology (n=1, 0.2%).

Among patients with a moderate course of COVID-19 (n=31), chronic CV pathology (n=8, 35.5%), obesity (n=3, 9.7%), and allergic diseases (n=, 9.7%), chronic diseases of the upper respiratory tract (n=2, 6.5%), chronic pathology of the bronchopulmonary system (n=2, 6.5%). In children with a burdened premorbid background, a more severe course of the disease was significantly more often observed compared to patients without concomitant pathology ($\chi 2=73.9$; $p<0.001$). There were no significant differences in the incidence of comorbidity in sick children of different age groups.

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The first clinical manifestations of COVID-19 in children developed within a week from the moment of contact with infected persons (Me=6 [3; 10]). At the same time, the clinical manifestations of the disease did not differ in specificity

(Table). Symptoms of intoxication were noted in 438 (97.1%) patients, catarrhal inflammation of the upper respiratory tract – in 407 (90.2%) children, anosmia – in 95 (21.1%), dysgeusia – in 81 (17.9%), gastrointestinal symptoms – in 55 (12.2%) patients (diarrhea, abdominal pain etc.).

Table - The main clinical manifestations of COVID-19 in children according to the severity of the disease

Symptoms	**Easy course of COVID-19 (n=420) abs. (%)**	**Moderate course of COVID-19 (n=31) abs. (%)**	**Total (n=585) abs. (%)**
Symptoms of intoxication			
Fever	355 (84,5)	27 (87,1)	382 (65,3)
General weakness	163 (38,8)	27 (87,1)***	190 (32,5)
Decreased appetite	119 (28,3)	25 (80,6) ***	144 (24,6)
Headache	144 (34,3)	18 (58,1) *	162 (27,7)
Myalgia	28 (6,7)	2 (6,5)	30 (5,1)
Respiratory tract symptoms			
Cough	207 (49,3)	28 (90,3) ***	235 (40,2)
Pain and sore throat	181 (43,1)	20 (64,5) *	201 (34,4)
Nasal congestion	183 (43,6)	21 (67,7) *	204 (34,9)
Rhinorrhea	159 (37,8)	11 (35,5)	170 (29,1)
Dyspnea	-	13 (41,9) ***	13 (2,2)
Auscultatory changes in the lungs	-	20 (64,5) ***	20 (3,4)
Gastrointestinal symptoms			
Nausea	22 (5,2)	9 (29,0) ***	31 (5,3)
Vomiting	9 (2,1)	6 (19,4) ***	15 (2,6)
Abdominal pain	21 (5,0)	3 (9,7)	24 (4,1)
Defecation disorders	18 (4,3)	5 (16,1) *	23 (3,9)

Other			
Anosmia	87 (20,7)	8 (25,8)	95 (16,2)
Ageusia/dysgeusia	79 (18,8)	2 (6,5)	81 (13,8)
Rash	-	1 (3,2)	1 (0,2)

Significance level p was calculated using Pearson's goodness-of-fit test - $\chi 2$

* - $p \leq 0,05$; ** - $p \leq 0,01$; *** - $p \leq 0,001$

With a mild severity of COVID-19 (n=420), the disease proceeded mainly in the form of acute nasopharyngitis, rhinitis and laryngo-tracheitis. At the same time, symptoms of damage to the upper respiratory tract came to the fore: dry cough, nasal congestion, rhinorrhea, pain and sore throat. The phenomena of intoxication were expressed insignificantly. The fever most frequently recorded was subfebrile (Me=37.4°C [37.2;37.6]). Every third patient has weakness, loss of appetite, headache was noted. Approximately 20% of those surveyed patients had impaired sense of smell and taste.

In 10% of patients with mild severity of COVID-19, from the 1st days of the disease, symptoms of lesions of the gastrointestinal tract were noted: nausea, vomiting, abdominal pain, diarrhea up to 3-4 times a day. In 4 patients (0.9%) gastrointestinal symptoms were the only manifestation of infection.

In patients with a mild form of COVID-19 a favorable course of the disease was observed, the main symptoms stopped within 12–17 days (Me=14.2 days [14; 16]). The majority of patients (418 people, 99.5%) received outpatient treatment, 2 (0.5%) were hospitalized to the infectious disease hospital for epidemiological and social reasons.

Patients with a moderate course of COVID-19 (n=31) had symptoms of catarrhal inflammation of upper respiratory tract and damage of lower respiratory tract. The defeat of the respiratory system was manifested by cough, auscultatory changes in the lungs, nasal congestion, pain and sore throat, mixed dyspnea, rhinorrhea. Cough in these patients was almost 2 times more common than in children with mild disease ($p<0.001$), and its duration was 10.2±2.5 days longer. Also, in the moderate course of the disease, complaints of sore throat ($p=0.033$) and nasal congestion ($p=0.015$) were more often noted.

Clinical manifestations of infectious toxicosis in patients with moderate COVID-19 were more pronounced than in patients with mild severity of the disease: 1.5 times more frequent complaints of headache (p=0.014), more than 2 times more of weakness (p <0.001) and decreased appetite (p<0.001). The fever was more pronounced than in mild cases of COVID-19: in 17 cases (54.8%), febrile fever was recorded, an increase in body temperature above 39.1°C occurred in 3 children (9.7%), in 7 patients (22.6%) had subfebrile fiver. Median of the fiver was 38.1°C [37.6; 38.7].

In addition, in patients with moderate COVID-19, the incidence of gastrointestinal symptoms was significantly higher than in patients with mild disease. Nausea was noted 5 times more often, vomiting 9 times more often than in mild disease (p<0.001). Gastrointestinal symptoms in all patients were combined with respiratory disorders.

In 24 (77.4%) patients with moderate severity of COVID-19, according to CT scan of the chest, there were changes typical of pneumonia of viral etiology in the form of areas of ground glass infiltration of the lung tissue and consolidation in combination with reticular changes. The lung damage corresponded to the 1st degree of severity in 21 cases (87.5%), the 2nd degree – in 3 cases (12.5%) according to CT data.

The majority of children with a moderate course of COVID-19 (n=21, 67.7%) had treatment in infection hospital, 10 patients (32.3%) were treated on an outpatient basis. Adolescents with concomitant diseases ($\chi 2$=47.67; p<0.001) and infants ($\chi 2$=3.92; p=0.04) were hospitalized significantly more often. The average duration of inpatient treatment was 16.2±3.5 days, outpatient – 14.3±2.5 days. Recovery and disappearance of the main symptoms occurred at 3-4 weeks from the onset of the disease (Me = 23 days [19; 30]).

There was a dependence of the development of some clinical symptoms in accordance with the age of the patients. Smell and taste disorders were noted mainly in children older than 8 years and were not recorded in the younger age group (p<0.001). Also, in school-age children, complaints of decreased appetite (p=0.004) and headache (p=0.027) were much more common. Gastrointestinal

symptoms were presence significantly higher in children of 0 to 7 years old (p<0.001).

Correlation analysis revealed statistically significant direct correlations of moderate intensity between the severity of the course of COVID-19 and the presence of concomitant pathology (r=0.33, p<0.001). Similar relationships were established between the patient's age and the presence of complaints of impaired taste (r=0.44, p<0.001) and smell (r=0.46, p<0.001). A negative correlation was noted between of the patient's age and the presence of gastrointestinal symptoms (r=-0.48, p<0.001).

Questioning of children, who had COVID-19, 3 months after recovery revealed the presence of complaints in 11.7% (n=45). Among them, school-age children (n=26, 57.8%) and preschool children (n=11, 24.4%) prevailed, toddlers accounted for 17.8% (n=8). No gender differences were identified.

Among the respondents, 36 patients (80.0%) had a mild form of the disease, 9 (20.0%) had a moderate form. Outpatient treatment was received by 39 patients (86.7%), inpatient – 6 (13.3%).

The structure of complaints was dominated by symptoms characteristic of asthenic syndrome. Thus, headache, weakness and drowsiness occurred with the same frequency and were observed in 15 patients (33.3%), impaired memory and attention – in 3 (6.7%). There were complaints of palpitations (1 person, 2.2%), increased blood pressure (BP) (1 person, 2.2%), chest pain (1 person, 2.2%).

Five patients (11.1%) had progression of myopia was observed, in 2 (4.4%) – exacerbation of atopic dermatitis. One patient had a debut of asthma in 8 years old.

During the laboratory and instrumental examination, changes were detected in 17 patients (37.8%). Four patients (8.8%) had changes in the blood test: mild anemia – 2 (4.4%), neutropenia – 1 (2.2%), eosinophilia – 1 (2.2%). Changes in the electrocardiogram were detected in 5 children (11.1%): AV block – in 1 (2.2%), sinus tachycardia – in 2 (4.4%), sinus arrhythmia – in 2 (4.4%).

Discussion

Thus, in the study sample of children, who in children who have had the disease of COVID-19, school-age children predominated (68.7%), most of whom had a mild course of the disease, which is consistent with the results of studies in various regions of the world.

Dong et al,[3] in a study of 2,135 children with COVID-19, demonstrated that the median age of patients was 7 years, in 94.1% the disease was asymptomatic or had a mild severity.

Bondarenko et al.,[16] in a study of 812 children with COVID-19 aged 1 month to 17 years in children's polyclinic in Kirov (Russia) in 2021, it was noted that the average age of patients was 5.9±1.1 years, 16% were of teenagers. In 76% contact with COVID-19 patients was detected, mainly in the family, as well as in educational institutions. In 89% of patients, the disease was mild with subfebrile fever and pharyngitis, rhinitis; 7% of children complained of a dry cough, and lung damage was detected in 5% of patients, and the gastrointestinal tract – in 5%. In adolescents, the symptoms of rhinitis, pharyngitis, and dry cough were less common than in other age groups. Only 11% of the patients were hospitalized.

In a Malaysian study of *Ng et al*.,[17] 261 children were included (Median age was 6 years [IQR: 3-10 years]. In 57.9% of children, the disease was asymptomatic. Among the clinical manifestations, the most common symptom was fever. 92.3% of patients had contact with infected household members or distant relatives. Radiological signs of lung damage were observed in 4.7% of patients. All patients were discharged without needing additional oxygen therapy or any specific treatment during hospitalization.

The review of *Belyh et al*.,[4] indicates that children are less likely to develop severe COVID-19 than adults, and 95% of all cases range from asymptomatic to clinical manifestations of mild to moderate severity, about 2% of pediatric patients need hospitalization in the intensive care unit or ventilator.

Toba et al.,[5]make a meta-analysis that included 31 articles and 1816 patients, the majority of pediatric patients with COVID-19 were asymptomatic or had mild manifestations.

Maltezou et al.,[7] in a study of 203 children SARS-CoV-2-infected children (median age: 11 years; range: 6 days to 18.4 years); 111 (54.7%) had an asymptomatic infection. Among the 92 children (45.3%) with coronavirus disease 2019 (COVID-19), 24 (26.1%) were hospitalized. Among the 92 children (45.3%) with coronavirus disease 2019 (COVID-19), 24 (26.1%) were hospitalized. There was no significant difference between viral load and age, sex, underlying condition, fever and hospitalization, as well as between type of SARS-CoV-2 infection and age, sex, underlying condition and viral load.

The Indian study, included 50 children (56% boys), with an average age of 6 years, 56% were from families belonging to the lower socio-economic class of Kuppuswami. In 58% of children, the disease was asymptomatic, and in 40% it was mild. Fever, cough and sore throat were the most common symptoms.[18]

It was concluded that in most of the examined children, COVID-19 proceeded in a mild form. Correlations were found between the severity of the new coronavirus infection and the presence of concomitant pathology, as well as between the age of patients and the presence of gastrointestinal symptoms, dysgeusia and dysosmia. Postcovid syndrome were noted infrecuently; in most cases they manifested as symptoms of asthenia.

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Conflict of interest

The authors declare no conflict of interest.

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