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CORONAVIRUS INFECTION IN CHILDREN: EPIDEMIOLOGICAL AND CLINICAL FEATURES

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Aim: To study epidemiological and clinical features of COVID-19 in children who were admitted to a hospital.

Materials and Methods. The study was conducted within April 1st and July 31st 2020. Overall 176 children aged from 0 to 17 with confirmed COVID-19 were included. These patients were divided on three clinical groups: first - patients with asymptomatic form – 49 (27.84%), second – children with mild form – 84 (47.73%), third – patients with moderate form of COVID-19 – 43 (24.43%). COVID-19 was diagnosed by PCR. Statistical analysis of the data was performed using the Statistica 10.0 package. Pearson's χ^2 was used to compare two independent groups. The criterion level $p < 0.05$ was considered statistically significant.

Study Results. COVID-19 was found more often in age groups 4-7 and 12-17, mainly in boys. Most of the children had close contact with people diagnosed with COVID-19. The average incubation period was 3.0 [1.0; 7.0] days, the average time from first symptoms to the hospitalization was 3.0 [1.0; 4.0] days. Fever, cough, weakness, runny nose, sore throat were the most common symptoms.

Conclusion. The largest number of cases of COVID-19 was registered amongst senior schoolchildren, mainly in boys. The minimal tourist activity and low level of flu vaccination were found in children with COVID-19. The widest range of clinical symptoms was more common for children with moderate form of the disease.

Keywords: coronavirus infection, COVID-19, SARS-CoV-2, children, clinic, epidemiology.

Introduction. The appearance of a new coronovirus infection (2019-nCoV) has attracted worldwide attention and WHO has declared COVID-19 as an extraordinary public health situation with international importance [7]. The fact of transmission of SARS-CoV-2 from one person to another at home and in a hospital, when moving from city to city or country to country has been confirmed as the epidemic was spreading [14]. Children form the specific group and can be potentially dangerous for infection spread, because of close family contacts and susceptibility to cross infection [14].

Some investigations reported that clinical symptoms of COVID-19 in children are less expressed and similar to ones in adults [8,11,12]. Children are infected much rarely than adults [9,17] and it explains less data about epidemiological and clinical features of COVID-19 in pediatrics.

Study Objective: To study epidemiological and clinical features of COVID-19 in children who were admitted to a hospital.

Materials and Methods. Overall 176 children aged from 0 to 17 with confirmed COVID-19 were included. These children were admitted to the first on the territory of Zabajkalskij kraj monohospital opened for patients with new coronavirus infection (COVID-19) - City Clinical Hospital № 1 in Chita.

Inclusion criteria:

- children ages from 0 to 17;
- informed consent to participate in the study signed by child's parents or by patients aged 15 and older;
- laboratory confirmation of COVID-19.

Exclusion criteria:

- absence of informed consent to participate in the study signed by child's parents or by patients aged 15 and older;
- absence of COVID-19 laboratory confirmation.

According to the guidelines "Features of clinical symptoms and management of the disease caused by new coronavirus infection (COVID-10) in children" (Version 2, 03.07.2020) [3] all patients were divided on three groups depending on the disease severity: first - patients with asymptomatic form – 49 (27.84%) [2], second – children with mild form – 84 (47.73%), third – patients with moderate form of COVID-19 – 43 (24.43%).

The median age of the patients with SARS-CoV-2 was 8,0 [4,0; 8,0] years old, there were more boys [n=98 (55,68%)] than girls [n=78 (44,32%), p=0,034].

According to the guidelines "Features of clinical symptoms and management of the disease caused by new coronavirus infection (COVID-10) in children" (Version 2, 03.07.2020) [3] the diagnosis of COVID-19 was based on the complex of clinical and epidemiological, laboratory and radiological data. The clinical examination was composed of anamnesis taking, physical examination and dynamic observation during the hospitalization. COVID-19 confirmation was carried out by isolating SARS-CoV-2 RNA in material collected from the oropharynx and nose by using PCR test systems registered in the Russian Federation, according to the manufacturer's instructions.

The study was approved by Local Ethical Committee of Chita State Medical Academy (protocol №101, 15.04.2020). All participants or their legal representatives signed the informed consent.

Statistical analysis of the data was performed using the Statistica 10.0 package. Pearson's χ^2 was used to compare two independent groups. The criterion level $p < 0.05$ was considered statistically significant. Descriptive statistics are presented as a median (Me) indicating the 25th and 75th percentiles.

Results and discussion. In figure 1 the age and gender composition of participants is shown. There was a prevalence of teenagers (59 participants – 33.52%) and children aged 4 to 7 (42 participants – 23.86%) amongst those who were admitted to a hospital with COVID-19. There also were 38 junior school children (21.59%), 20 children aged younger 1 year (11.36%) and 17 toddlers (aged 1 to 3; 9.67%). However, M.A. Shackmaeva et all. have noticed that there was a prevalence of children aged younger 1 year

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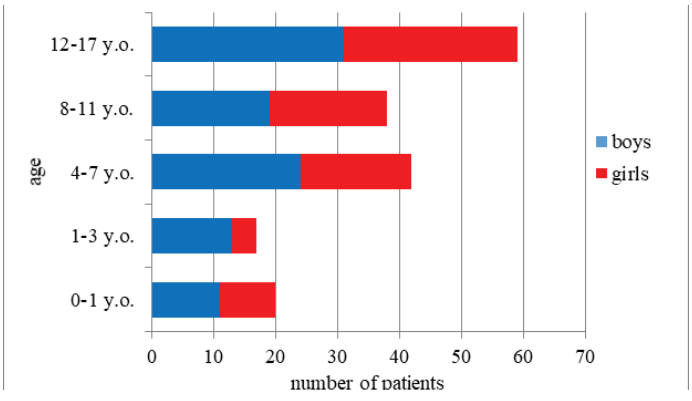
(56.5%) with COVID-19 and the infection was registered less frequently amongst children aged 1 to 3 (17.4%), 3 to 7 and 7-14 (10.1% both) and 14 to 17 (20.3%) [4]. The study of Y. Dong showed average age of patients as 7 [2; 7; 13]. According to the study of S.A. Evseeva et all. there were 53.6% of children aged older 7 [1].

Regarding the gender there was shown a prevalence of boys (55.68% of boys and 44,32% of girls, p=0,034) that matches with the results of other authors [7]. The boys aged 0 to 1 and 1 to 3 more often had asymptomatic form of 2019-nCoV (p<0,05), while teenage boys 12 to 17 were 3.4 and 2.6 times more likely to have mild form of the disease (p<0,05).

More than 80% of the children had confirmed contact with people with identified COVID-19 infection. Only two children amongst 176 ones admitted to the hospital had travelled abroad two weeks before the symptoms of the disease appeared. 39 patients (22.16%) could say the exact date of the contact with people with identified or suspected COVID-19. 27 patients (15.34%) have not had any epidemiological features that is 3% more of published data [15]. According to published data family cases of contacts were73,3% [10]. In another study there were registered 89% cases of family transmission of the disease and 33% cases were the result of contacts in epidemic zone.

The average incubation period was three days [1,0; 7,0], the average period from first symptoms appearance till the admission to the hospital was three days [1,0; 4,0]. V. De Sanctis [6] showed the longer incubation period for teenagers that was 6.5 days [2,0; 10].

There were vaccinated against the flu only 29 (16.48%) of children and there were 147 (83.52%) unvaccinated children (p<0,001).



Gender and age of children with COVID-19, abs.

98 children (55.68%) had the acute beginning of the COVID-19 with fever. The comprehensive analysis showed that 51 participant (28.98%) had fever lower than 38°C and 47 children (26.70%) were registered with fever higher than 38°C. This data matches with the results of Tung Ho CL. et al. who found that the fever was frequent symptom (53.9%) amongst included patients [16]. Chinese researchers also concluded that the fever is one of the main symptoms while a child is admitted to a hospital [13].

The disease was also characterized by the presence of catarrhal symptoms such as cough (66 patients, 37.50%), running nose (28 children, 15.91%), sore throat (26 patients, 14.77%), difficulty in nasal breathing (18 participants, 10,23%), weakness (45 children, 25.57%), fatigue (11 participants, 6.25%), loss of appetite (8 patients, 4.55%), headache (5 children, 2.84%) and drowsiness (2 participants, 1.14%).

In general, the clinical symptoms of 2019-nCoV amongst the children admitted to a hospital have not differed from the symptoms showed in other similar studies [1,5,6].

Anosmia/hyposmia was registered in 16 children (7.95%) in the beginning of the disease that again matches with the results of other studies [4].

The symptoms from digestive system (stomach pain, diarrhea, nausea) and myalgia were seen equally often (6.25%). Taste problems (2.27%), joint pain (1.70%) and dizziness (1.14%) were rare symptoms.

The physical examination found paleness in 21 children (11.93%), hyperemia of the oropharynx in 112 patients (63.64%), and difficulty in nasal breathing in 22 participants (12.5%). The auscultation showed the shortening of percussion sound in 4 children (2.27%), hard breathing in 38 patients (21.59%) and weakened breathing in 3 cases (1.70%).

The analysis of epidemiological and clinical data in children with mild and moderate COVID-19 was done on the next step.

Table1

Epidemiological characteristic of COVID-19 in children

Epidemiological characteristics	Children with COVID-19							
	Group 1 (n=49)		Group 2 (n=84)		Group 3 (n=43)		In all (n=176)	
	abs.	%	abs.	%	abs.	%	abs.	%
Contact with people with identified COVID-19 infection	44	89.80	69	82.14	36	83.73	149	84.66
Exact contact date	15	30.61[1]	13	15.48	11	25.58	39	22.16
Travelling abroad two weeks before	1	2.04	0	0	1	2.33	2	1.14
Did not have any certain epidemiological features	5	10.20	15	17.86	7	16.28	27	15.34
Vaccination against flu	4	8.16	13	15.48	12	27.91	29	16.48
The average incubation period	4.0 [1.0; 8.0]		2.5 [2.0; 7.0]		2.0 [1.0; 5.0]		3.0 [1.0; 7.0]	
The average period from first symptoms appearance till the admission to the hospital	1.0 [1.0; 4.0]		3.0 [1.5; 4.0]		3.0 [2.0; 6.0]		3.0 [1.0; 4.0]	

Notes: n – number of cases; p1 – statistical significance of differences (p<0,05) between groups 1 and 2; p2 – statistical significance of differences between groups 1 and 3; p3 – statistical significance of differences between groups 2 and 3 (Pearson's χ^2).

Table2

Clinical characteristic of COVID-19 in children

Symptom \ Groups of patients		Group 1 (n=49)		Group 2 (n=84)		Group 3 (n=43)		In all (n=176)	
		abs	%	abs	%	abs	%	abs	%
Fever		-	-	63	75	35	81.4	98	55.68
Cough		-	-	36	42.86	30[3]	69.77	66	37.50
Weakness		-	-	22	26.19	23[3]	53.49	45	25.57
Running nose		-	-	20	23.81	8	18.60	28	15.91
Sore throat		-	-	19	22.62	7	16.28	26	14.77
Difficulty in nasal breathing		-	-	12	14.29	6	13.95	18	10.23
Anosmia/hyposmia		-	-	8	9.52	8	18.60	16	9.09
Fatigue		-	-	3	3.57	8[3]	18.60	11	6.25
Myalgia		-	-	4	4.76	7[3]	16.28	11	6.25
Loss of appetite		-	-	3	3.57	5	11.63	8	4.55
Diarrhea		-	-	3	3.57	1	2.33	4	2.27
Headache		-	-	2	2.38	3	6.98	5	2.84
Drowsiness		-	-	2	2.38	-	-	2	1.14
Stomach pain		-	-	1	1.19	4[3]	9.30	5	2.84
Dysgeusia		-	-	1	1.19	3	6.98	4	2.27
Joint pain		-	-	1	1.19	2	4.65	3	1.70
Nausea		-	-	1	1.19	1	2.33	2	1.14
Dyspnea		-	-	0	0	1	2.33	1	0.57
Dizziness		-	-	0	0	2[3]	4.65	2	1.14
Algidity		-	-	0	0	1	2.33	1	0.57
PHYSICAL EXAMINATION									
Skin	pale	3	6.12	6	7.14	12[2.3]	27.91	21	11.93
	pale pink	44	89.80	78	92.86	31[2.3]	72.09	153	86.93
	marble	2	4.08	0	0	0	0	2	1.14
Oropharynx	clean	49[1]	100	1	1.19	14[2.3]	32.56	64	36.36
	hyperemia	0[1]	0	83	98.81	29[2.3]	67.44	112	63.64
Nasal breathing	free	49[1.2]	100	69	82.14	36	83.72	154	87.5
	difficult	0[1.2]	0	15	17.86	7	16.28	22	12.5
Percussion of lungs	pulmonary	49	100	84	100	39[2.3]	90.70	172	97.73
	dullness	0	0	0	0	4[2.3]	9.30	4	2.27
Auscultation of lungs	vesicular	49[1.2]	100	75	89.29	11[3]	25.58	135	76.70
	hard	0[1.2]	0	9	10.71	29[3]	67.44	38	21.59
	diminished	0	0	0	0	3[3]	6.98	3	1.71

Notes: n – number of cases; p1 – statistical significance of differences ($p<0,05$) between groups 1 and 2; p2 – statistical significance of differences between groups 1 and 3; p3 – statistical significance of differences between groups 2 and 3 (Pearson's χ^2).

89.80% of children with an asymptomatic form were in close contact with people with confirmed SARS-CoV-2, the same showed 82.14% patients in the second group and 83.73% participants in the third group (respectively, p = 0.234, p = 0.389, p = 0.825). The patients with an asymptomatic form of 2019-nCoV were twice as likely to provide the exact date of their contact with the patients with confirmed or suspected cases of COVID-19 as the patients with mild form of the disease (p=0,039). Despite the fact that there was noted a tendency to shortening of incubation period along with worsening of COVID-19 statistically significant difference between studied groups was not found (p>0,05). The average period from the first clinical symptoms to the hospital admission was not correlated to the disease severity (p>0,05).

The fever was found as often amongst children of the second group as amongst those of the third group (75,00%, 79,07%; p=0,610). The patients with moderate form of COVID-19 coughed 1.6 times more frequently than the ones with the mild form (respectively, 69,77%, 42,86%; p=0,005). Half of the participants of the third group (53,49%) had the weakness comparing to the children of the second group, who were found with this symptom twice less (26,19%, p=0,003). Running

nose (p=0,504), sore throat (p=0,403) and difficulty in nasal breathing (p=0,960) appeared as often in children with mild form of COVID-19 as in children with moderate form.

Fatigue (18,6% against 3,57%) and myalgia (16,28% against 4,76%) were presented more often in patients of the third group comparing to the second one (respectively, p=0,005 and p=0,029). Such symptoms as stomach ache and dizziness mainly appeared in single cases amongst participants with moderate form of COVID-19 (respectively, p=0,027 and p=0,047). The rate of other clinical symptoms has not differed between the groups (p>0,05).

In children of the third group paleness (p=0,002) and hyperemia of the oropharynx (p<0,001) were seen more often. The shortening of percussion sound and weakened breathing were presented only in children with moderate form of the disease (respectively, p=0,005 and p=0,015).

Conclusion. The main way of the transmission of SARS-COV-2 was close contact with the people with confirmed or suspected COVID-19 infection. Only two patients had travelled abroad two weeks before the first symptoms of the disease appeared. Amongst all patients with 2019-nCoV only 16.48% were vaccinated against flu. COVID-19 infection was mainly found in senior school age children with the male gender prevalence and was characterized by asymptomatic form. Most of the cases of SARS-COV-2 in children began with fever, were followed by cough and different catarrhal symptoms. Weakness, fatigue, myalgia, stomach ache and dizziness were noted for the moderate form of COVID-19.

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RESULTS OF THE SURVEY OF PATIENTS WHO UNDERWENT COVID-19

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Sources indicate that being infected with COVID-19 leaves patients with undesirable symptoms that form a new disease – post-covid syndrome. We examined the health status of 155 people who suffered a coronavirus infection. Informed consent to the study was obtained from all participants. They were interviewed, asked to fill out a series of questionnaires to assess symptoms and quality of life, and underwent a medical examination.

Our results showed that after 8 months, people who have had COVID-19 complain about the symptoms of post-covid syndrome. At the same time, the most common clinical manifestations were sleep disorders (50.9%), hypertension (47.7%), weakness (33.5%), dizziness (32.9%), shortness of breath (27.7%), headaches (24.5%), gastrointestinal disorders (diarrhea, abdominal pain) (18.7%). Our statistical analysis showed a significant dependence of increased blood pressure (1.7 times higher) with the degree of lung damage.

Keywords: COVID-19, SARS-CoV-2, post-covid syndrome, long-term clinical manifestations.