COVID-19 in children in Espirito Santo State – Brazil

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Abstract

Objectives: to characterize school-aged children, adolescents, and young people's profile and their associations with positive COVID-19 test results.

Methods: an observational and descriptive study of secondary data from the COVID-19 Panel in Espírito Santo State in February to August 2020. People suspected of COVID-19, in the 0–19-years old age group, were included in order to assess clinical data and demographic and epidemiological factors associated with the disease.

Results: in the study period, 27,351 COVID-19 notification were registered in children, adolescents, and young people. The highest COVID-19 test confirmation was found in Caucasians and were 5-14 years age group. It was also observed that headache was the symptom with the highest test confirmation. Infection in people with disabilities was more frequent in the confirmed cases. The confirmation of cases occurred in approximately 80% of the notified registrations and 0.3% of the confirmed cases, died.

Conclusion: children with confirmed diagnosis for COVID-19 have lower mortality rates, even though many were asymptomatic. To control the chain of transmission and reduce morbidity and mortality rates, it was necessaryto conduct more comprehensive research and promote extensive testing in the population.

Key words *Coronavirus infections, Transmitted diseases, Child's health, Epidemiology, Adolescent's health*

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Introduction

COVID-19 is a systemic infectious disease caused by SARS-CoV-2 virus.[1] This disease emerged in China and has become a Pandemic, decreed by the World Health Organization (WHO) on March 11, 2020. It is a Public Health problem due to its rapid transmission, high rates of hospitalizations and mortality.

Coronavirus infection rates are high, with approximately 66,540,034 cases of COVID-19 infection and a total of 1,528,868 deaths worldwide as of early December 2020. According to the epidemiological bulletin on COVID-19, published on December 11, 2020, Brazil was considered the third country with the highest number of COVID-19 cases, approximately 30,943 cases for every 1 million inhabitants, and the second country with the highest death rates in the world, with 841 deaths for every 1 million inhabitants and the percentage of recovered person was 13.5%.[2]

In general, the main symptoms related to COVID-19 range from nonspecific symptoms such as adynamia, myalgias, and fever, in about 80% of the infected patients, to pulmonary phase, with proliferation of the virus to the lungs, causing pneumonia with vasodilation, increasing permeability of the endothelium, leukocyte recruitment, and lung injury with hypoxia. In the inflammatory phase, also called cytokine storm, interleukin-6 (IL-6) is the protagonist, increasing ferritin, C-reactive protein, and interleukin levels, affecting other organs, with cardiac and hepatic impairment.[3-5]

All these manifestations have affected a greater proportion of adults when compared to children, especially the elderly and adults with comorbidities, the justification is still unknown. Most children are asymptomatic, and less than 5% present severe forms of the disease.[1]

Review studies have shown that COVID-19 infection disproportionately affects children when compared to adults, but the scarcity of data on COVID-19 in children leads to imprecise information of these details. For such a situation, epidemiological studies are needed to clarify the uncertainties related to the clinical-epidemiological aspects of COVID-19 in children, providing more information about the associated complications and the severity of the disease in children in the long term.[3-7]

Thus, this study aimed to trace school-aged children, adolescents, and young people' profile and their associations with positive COVID-19 test results.

Methods

A comparative study between confirmed symptomatic cases and discarded cases for the COVID-19 diagnosis was carried out in the COVID Panel database, available on: https://coronavirus.es.gov.br/painel-covid-19-es, from the *Secretaria de Estado da Saúde do Espírito Santo* - SESA (Secretary of Health of Espírito Santo State).

The overall data from suspected COVID-19 individuals in the panel, aged 0-19 years old were evaluated, totaling 27,351 registrations in February 17 to August 20, 2020. Of these, the study population comprised individuals with a confirmed or discarded COVID-19 diagnosis, totaling 15,289 individuals.

The analyzed variables were grouped according to classification (confirmed and discarded), evolution (cure or death by COVID-19) and confirmation criteria (clinical, clinical-epidemiological and laboratorial); epidemiological variables were also analyzed, such as: city , age group, sex (male, female), race/color (Asian color skin, Caucasian , indigenous, mixed color skin , black, and unknown), schooling (illiterate, incomplete elementary school (1-4th grade), complete elementary school (4th grade), incomplete elementary school (5-8th grade), complete elementary school, incomplete high school, complete high school, incomplete higher education, complete higher education, not applicable, and unknown); and the symptom variables (with yes or no answers), such as: fever, difficulty of breathing, coughing, runny nose, sore throat, diarrhea, and headache ; in addition to the comorbidities variables (with yes or no answers): lung, cardiovascular, renal, diabetes, obesity comorbidities; among other variables, such as: hospitalization, trips (if he or she has made any trips in Brazil or internationally), and some type of disability (as defined in the law 13146/2015, which considers any person who has a long-term physical, mental, intellectual, or sensory impairment that may hinder effective participation in society on an equal basis with others).

The overall analyzed variables were correlated with the results of the tests to detect COVID-19 (confirmed versus discarded) which were real-time polymerase chain reaction (PCR) tests, immunological methods or antigen research.

As a result of the analyses, it was possible to elaborate frequency tables, in addition to the measurement of the association between the variables through the gross and adjusted odds ratio (OR), with the respective 95% confidence intervals (CI) (the adjusted OR was obtained from the Logistic Regression). All analyses were performed by the IBM SPSS Statistics for Windows - SPSS software, version 25.

This study was reviewed by the Research Ethics Committee at the *Centro de Ciências da Saúde da Universidade Federal do Espírito Santo* (CEP/CCS/UFES) and approved under the opinion number 3,908,434 on May 20, 2020.

Results

A total of 27,351 registrations on children, adolescents, and young people aged 0-19 years old in Espírito Santo State were considered. We found 7,153 (26.2%) in the 0-4 age group, 4,298 (15.7%) in the 5-9 age group, 4,697 (17.2%) in the 10-14 age group, and 11,203 (41.0%) in the 15-19 age group.

Figure 1 shows the percentages for the age range variable, classification (in the database there were the confirmed, discarded, and suspected categories), as well as the evolution variable (cured, died, and unknown). Of the initial population of suspects, 1,212 (16.9%) were confirmed in the 0-4 age group, 879 (20.5%) in the 5-9 age group, 1,219 (26.0%) in the 10-14 age group, and 2,789 (24.9%) in the 15-19 age group.

In this study, registration of suspected cases of COVID-19 were excluded when no confirmation test was performed, and a total of 15,289 registrations were analyzed, 6,099 (39.9%) cases were confirmed, and 9,190 (60.1%) cases were discarded for COVID-19.

Table 1 shows the sociodemographic profile of the analyzed cases in general, and the comparison of the test results (confirmed versus discarded cases); it was observed that children aged 5-9 years old (OR=1.39; CI95%=1.25-1.54) and 10-14 years (OR=1.32. CI95%=1.18-1.48) had a higher chance of case confirmation when compared to children aged 0-4 years old; as for race-color, it was observed that children declared as yellow race/color (OR=0.79; CI95%=0.66-0. 94) and indigenous (OR=0.71; CI95%=0.57-0.88) have a lower chance of having a confirmed test when compared to Caucasian children; children living in rural areas (OR=1.18; CI95%=1.09-1.28) have a higher chance of having confirmed tests and, finally, children with disabilities have 1.32 (OR=1.32; CI95%=1.10-1.59) times more chances of confirmed test.

Figure 2 shows the symptoms in the confirmed and discarded groups. Evidence of associations was tested by the chi-square test. A difference in symptoms was found. More symptoms were observed in the discarded group, such as coughing, runny nose, sore throat, difficulty of breathing, and diarrhea. Only "headache" was found to be a more frequent symptom in the confirmed group. For "fever" there was no evidence of differences between the two groups.

Table 2 shows the prevalence calculated by age groups with arespective 95% confidence intervals for the Greater Vitória Area and the countryside of Espírito Santo State. Higher prevalence was observed in all four age groups for the countryside population.

Diagnosis was confirmed by laboratorial tests in 80.6% of the confirmed cases and in 85.7% of the discarded cases. The remaining cases were confirmed by clinical and clinical-epidemiological criteria. Of the total confirmed cases, 17 (0.3%) died of COVID-19, while in the discarded cases group there were 40 deaths of other causes (0.4% of the sample).

Table 3 shows the patients' profile who died of COVID-19 in the confirmed group.

Discussion

Despite its epidemiological importance, most cases were asymptomatic, which generated a low number of diagnosed children, making it difficult to understand the behavior of the disease, its clinical manifestations, and other associations that have not yet been clarified.[3,5,8,9] However, it was possible to conduct an analysis on the sociodemographic profile and factors associated with a

Figure 1

Flowchart of the COVID-19 panel registration for age groups, according to classification and evolution in Espírito Santo, in February to August, 2020.

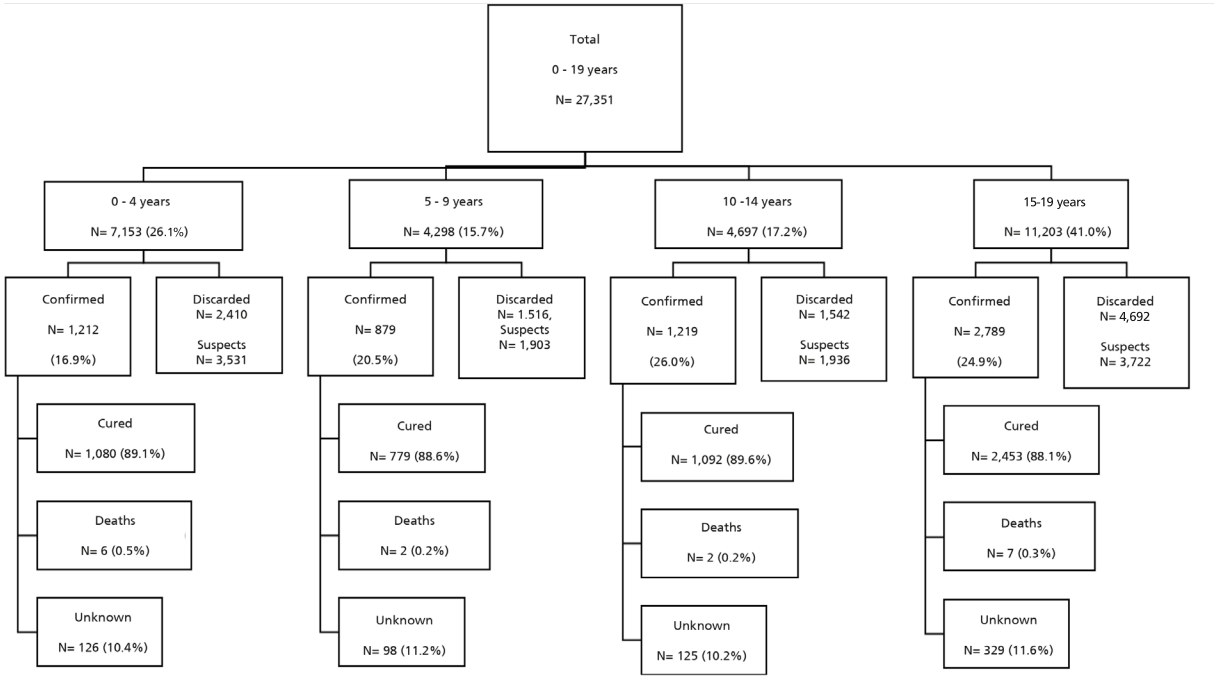


Table 1

Analysis of the sociodemographic variables profile of the total sample, according to COVID-19 test result (confirmed versus discarded) in Espírito Santo state in Brazil, in February to August, 2020.

Characteristics	Total		Confirmed		Discarded		Gross OR		Adjusted OR*	
	N	%	n	%	n	%	OR	CI95%	OR	CI95%
Sex										
Female	7957	52.1	3188	40.0	4769	60.0	1.02	0.95 - 1.08		
Male	7329	47.9	2909	39.7	4420	60.3	1.00			
Age group (years)										
0 - 4	3622	23.7	1212	33.0	2410	67.0	1.00		1.00	
5 - 9	2395	15.7	879	36.7	1516	63.3	1.49	1.37 - 1.62	1.39	1.25 - 1.54
10 - 14	2761	18.1	1219	44.1	1542	55.9	1.29	1.17 - 1.42	1.32	1.18 - 1.48
15 - 19	6511	42.5	2789	42.8	3722	57.2	0.95	0.87 - 1.04	0.93	0.84 - 1.04
Race/color										
Caucasian	5097	41.5	2141	42.0	2956	58.0	1.00		1.00	
Asian skin color	948	7.7	439	46.3	509	53.7	0.77	0.65 - 0.92	0.79	0.66 - 0.94
Indigenous	46	0.4	18	39.2	28	60.8	0.65	0.53 - 0.80	0.71	0.57 - 0.88
Mixed color skin	5577	45.3	2114	38.0	3463	62.0	0.87	0.47 - 1.61	0.93	0.48 - 1.79
Black	630	5.1	226	35.9	404	64.1	0.92	0.77 - 1.09	0.89	0.75 - 1.07
Schooling										
Illiterate	1359	14.0	449	33.0	910	67.0	1.00			
Incomplete Elementary School 1st-4th grade	1345	13.8	502	37.3	843	62.7	1.16	0.80 - 1.68		
Complete Elementary School 4th grade	348	3.6	151	43.4	197	56.6	0.96	0.66 - 1.39		
Incomplete Elementary School 5th-8th grade	1821	18.7	776	42.6	1045	57.4	0.75	0.49 - 1.13		
Complete Elementary School	781	8.0	306	39.2	475	60.8	0.77	0.53 - 1.11		
Incomplete High School	1776	18.2	779	43.8	997	56.2	0.89	0.61 - 1.30		
Complete High School	1806	18.5	746	41.3	1060	58.7	0.73	0.51 - 1.06		
Incomplete Higher Schooling	367	3.8	151	41.2	216	58.8	0.81	0.56 - 1.17		
Complete Higher Education	132	1.4	48	36.3	84	63.7	0.82	0.54 - 1.23		
City										
Greater Vitória Area	6295	41.2	2312	36.7	3983	63.3	1.00			
Countryside	8941	58.5	3771	42.1	5170	57.9	1.26	1.18 - 1.34	1.18	1.09 - 1.28
Other states	53	0.3	16	30.2	37	69.8	-			
Comorbidities										
Lung	1312	86.0	402	30.6	910	69.4	0.65	0.57 - 0.73		
Cardiovascular	178	11.0	63	35.4	115	64.6	0.83	0.61 - 1.13		
Renal	40	0.3	17	42.5	23	57.5	1.12	0.60 - 2.10		
Diabetes	64	0.4	28	43.7	36	56.3	0.85	0.52 - 1.39		
Obesity	213	1.3	81	38.0	132	62.0	0.93	0.70 -1.23		
Was hospitalized										
No	7507	97.1	3042	40.5	4465	59.5	1.00			
Yes	223	2.9	50	22.4	173	77.6	0.42	0.31 - 0.58		
Trips in Brazil										
No	9542	93.8	3841	40.2	5701	59.8				
Yes	626	6.2	230	36.8	396	63.2	1.16	0.98 - 1.37		
International Trips										
No	8279	99.6	3320	40.1	4959	59.9				
Yes	33	0.4	2	6.1	31	93.9	0.10	0.02 - 0.40		
Has a disability										
No	13321	96.2	5425	40.7	7896	59.3				
Yes	521	3.8	252	48.4	269	51.6	1.36	1.14 - 1.62	1.32	1.10 - 1.59

*Included variables (age group, race/color, city and disabilities).

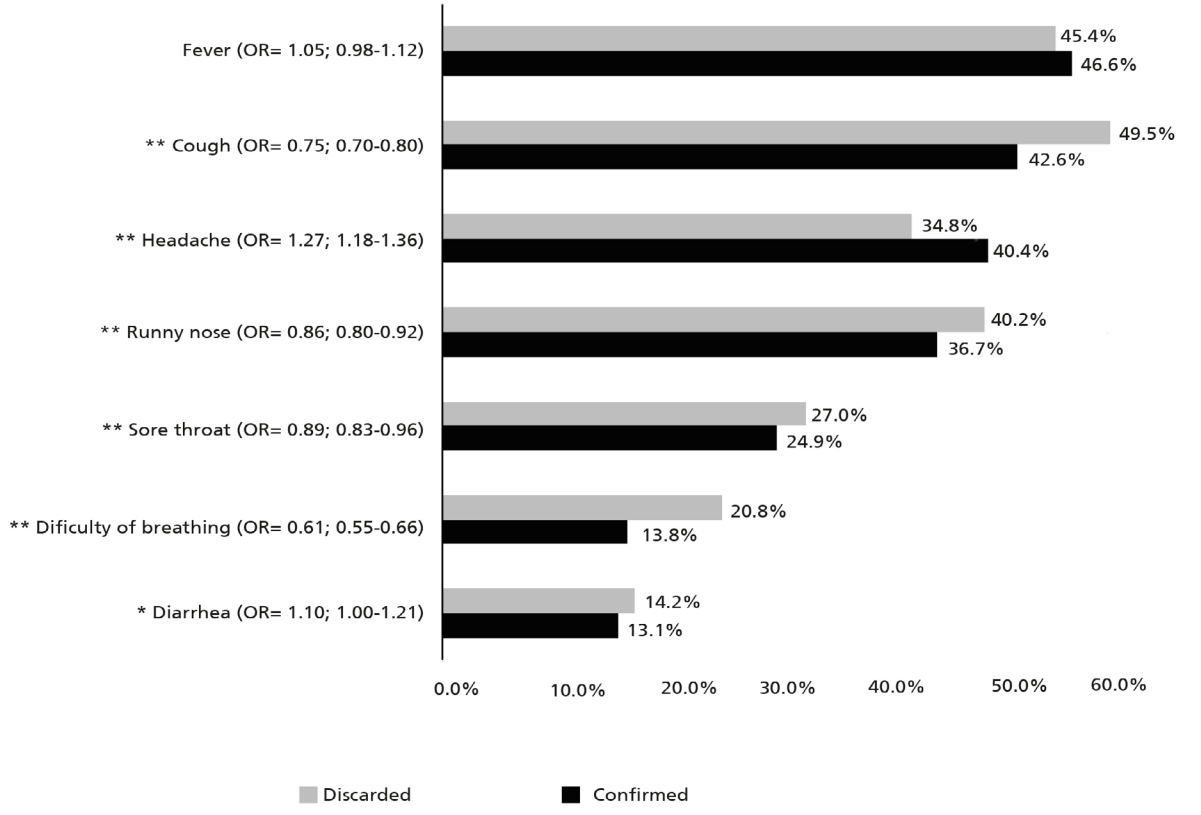
positive COVID-19 test result in Espírito Santo State, Southeast of Brazil. The evaluation showed a higher chance of test confirmation among children aged 5 to 14 years old living in the countryside of the state and have some type of disability. In turn, children declared /Asian color skin and indigenous had a lower chance of test confirmation. In addition, there was a higher chance of test confirmation in people with headaches.

The limitations found in this study refer to the use of secondary data and the fact that not all asymptomatic patients may have been identified due to the testing policy in Brazil which, given the possibility of underreporting, may have underestimated the real epidemiological situation of COVID-19 among the youngest. Despite these limitations, the size of the study population was large, and, to our knowledge, this is the first large observational study on the epidemiological childhood characteristics of COVID-19 in Espírito Santo State in Brazil.[2,7]

This study showed that children of all ages were affected by COVID-19, which consists with other studies.[6,8] However, a higher proportion of confirmed tests was observed among the 5-14-years old age group.

Figure 2

Presentation of the percentage of COVID-19 symptoms in the discarded and confirmed groups, with the respective odds ratio (OR) and 95% confidence interval, in Espirito Santo state in Brazil in February to August, 2020.



* p<0.05;** p=0.001.

Table 2

Percentage of positive results for COVID-19 by age group for Greater Vitória area and Countryside in Espirito Santo State in Brazil in February to August, 2020.

Population	0 - 4 years old	5 - 9 years old	10 - 14 years old	15 - 19 years old
Greater Vitoria Area	140,668	136,980	137,973	148,782
Positive	433	327	446	1,106
Prev. (%)	0.308	0.239	0.323	0.743
CI95%	0.279 - 0.337	0.213 - 0.265	0.293 - 0.354	0.699 - 0.787
Countryside of E.S.	147,081	142,033	136,922	146,835
Positive	775	550	771	1675
Prev. (%)	0.527	0.387	0.563	1,140
CI95%	0.490 - 0.564	0.355 - 0.420	0.523 - 0.603	1,090 – 1,200

A study from South Korea analyzed data with 59,073 contacts of 5,706 patients with COVID-19. Of 10,592 household contacts, 11.8% had COVID-19, and the household transmission of SARS-CoV-2 was higher in 10-19-year-old individuals (18.6% [CI95%=14.0-24.0]) than the 0-9-year-old children (5.3% [CI95%=1.3-13.7]) at the time when schools were closed.[8,10]

This result from South Korea underscores the important role of household transmission of SARS-CoV-2 by children, especially those at school age (aged 7-17 years old). Furthermore, added to our results, in Espírito Santo State in Brazil, we reinforced the importance of the public health measures and non-pharmaceutical intervention strategies against COVID-19, including counseling on social distancing and closing schools.

A study that analyzed contact survey data for Wuhan and Shanghai before and during the outbreak, and with contact tracing information from Hunan province, built a transmission model to study the impact of social distancing and school closure on the transmission; showing that school closure could reduce peak incidence by 40% to 60%, and that social distancing alone was able to control COVID-19.[11]

It is plausible that as a result of social isolation and school closure, the incidence and mortality of COVID-19 were minimized. However, it is possible that the findings are associated with other non-pharmacological interventions that were not listed.[12] As of school closure, there was increased risk in child development and social complications related to social phobia and psychosocial disorders.[12-14]

Table 3

Clinical epidemiological profile of deaths that had a confirmed diagnosis for COVID-19 in Espirito Santo, Brazil, in February to August, 2020.

Variable	N	%
Sex		
Female	9	52.9
Male	8	47.1
Age group (years)		
0 - 4	6	35.3
5 - 9	2	11.8
10 - 14	2	11.8
15 - 19	7	41.1
Race/Color		
Asian color skin	1	6.3
Caucasian	4	25.0
Mixed color skin	10	62.5
Black	1	6.3
City		
Greater Vitória Area	8	50.0
Countryside	8	50.0
Fever		
Yes	9	52.9
Difficulty of breathing		
Yes	12	70.6
Coughing		
Yes	6	35.3
Runnynose		
Yes	2	11.8
Sore throat		
Yes	0	0.0
Diarrhea		
Yes	1	5.9
Headache		
Yes	2	11.8
Lungcomorbidity		
Yes	3	17.6
Cardiocomorbidity		
Yes	3	17.6
Renal comorbidity		
Yes	1	5.9
Diabetes comorbidity		
Yes	1	5.9
Was hospitalized		
Yes	9	81.8
Has a disability		
Yes	4	23.5

A systematic review and meta-analysis study of 90 scientific articles showed that children being infected in school settings was lower compared to adults, making the school environment unbiased in the transmission of the virus.[15]

Children who were Caucasian and aged 5-14 years old had a higher chance of testing positive for COVID-19 than children under 4 years of age, and a lower chance of test confirmation in children declaring Asian color skin and indigenous. On the other hand, mortality among blacks/mixed color skin was higher than among Caucasians. This disparity in racial fatality due to COVID-19 has been reported in Brazilian and international studies among adults.[4,16,17]

A prospective cohort study conducted in the United Kingdom associated black race/color significantly with admission to intensive care; likewise, a U.S. crossover study on 12,306 black race/color children were associated with a hospitalization increase for COVID-19.[18,19] These studies corroborate the information found in the study about the disparity of complications in blacks compared to Caucasians.[18,19]

Although the reasons for most black children dying of COVID-19, may be related to living in families whose adults are essential workers and are exposed to the virus at work, as well as, it can potentially be attributed to social and health inequities as a function of exposure to the social determinants of health.[5,20,21,22]

Similarly, people with disabilities had worse levels of response to the treatment against COVID-19. Overall, people with disabilities belong to a population with a higher prevalence of multiple chronic conditions, lower economic status, and healthcare disparities.[23]

The study showed a higher chance of test confirmation in cities in the countryside of the state when compared to the metropolitan region. This finding may be linked to a greater underreporting effect in cities with fewer resources and difficult access for testing, according to studies conducted in Brazil and India.[24,25]

Finally, the proportion of deaths of COVID-19 was 0.3% among the youngest. This proportion is similar to other studies.[4,16,17] Mild symptoms in children may be related to decreased immune dysregulation in children, with normal lymphocyte counts, as well as less altered C-reactive protein, D-dimer, and probably due to the association of low expression or immaturity of angiotensin-converting enzyme 2 (ACE-2) in children, making it difficult for the virus to enter the cell cytoplasm.[3,24-27]

In order to ensure greater coverage of epidemiological surveillance actions, it is essential to promote massive testing of the population, including children, in order to obtain more quantitative data to base and plan actions to control this disease and promote scientific studies to expand vaccination in children.

Authors' contribution

Maciel ELN and Jabor PM: planning, interpretation, data collection, preparation of the manuscript, compilation and analysis of results, drafting and formatting the manuscript. Gonçalves Jr E: interpretation, data collection, preparation of the manuscript, compilation and analysis of results. Soares KKS: drafting the manuscript, analysis of results, critical review of content. Prado TN: planning, writing of the manuscript, analysis of results, critical revision of

the content. Zandonade E: planning, supervision, drafting of the manuscript, critical revision of the article content.

All authors approved the final version of the article and declared that there is no conflict of interest.

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