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Original Article

Association between sociodemographic and epidemiological variables of children with COVID-19 and hospitalization outcome

Associação entre as variáveis sociodemográficas e epidemiológicas de crianças com COVID-19 e o desfecho internação

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ABSTRACT
Objective: to identify the association between sociodemographic and epidemiological variables in children with COVID-19 and the hospitalization outcome. **Methods:** this was a cross-sectional, analytical study using secondary data on children with COVID-19 from birth to nine years of age, reported on the Influenza Epidemiological Surveillance System and e-SUS Epidemiological Surveillance. Sociodemographic variables (age, gender, race, region of residence), epidemiological variables (diagnostic criteria, symptoms, comorbidities, evolution), and hospitalization outcomes were extracted. Descriptive statistics, inferential analysis using Chi-square test and Poisson model with robust variance, bivariate and multiple analysis were carried out. **Results:** there were a total of 1,048 cases, 37.5% up to the age of three, 96.3% laboratory-confirmed, and 58.0% symptomatic. In the final adjusted model, association was found between the variables: age group, color/race, and region of residence with the prevalence of hospitalization for COVID-19. **Conclusion:** in this study, age was a protective factor against hospitalization for COVID-19, while color/race and child's regional office of residence were factors that increased prevalence of this outcome. **Contribution to practice:** data can support and strengthen issues related to health of children with COVID-19 in both literature and practice, broadening discussions among health managers and professionals and promoting public policies to prevent the disease.
Descriptors: Child; COVID-19; Child Health; Epidemiology; Pandemics.

RESUMO
Objetivo: identificar a associação entre variáveis sociodemográficas e epidemiológicas de crianças com COVID-19 e o desfecho internação. **Métodos:** estudo transversal, analítico com dados secundários de crianças com COVID-19 do nascimento aos nove anos, notificados no Sistema de Vigilância Epidemiológica da Gripe e no e-SUS Vigilância Epidemiológica. Extraíram-se variáveis sociodemográficas (idade, sexo, raça, regional de residência), epidemiológicas (critério diagnóstico, sintomatologia, comorbidade, evolução) e desfecho internação. Realizada estatística descritiva, análise inferencial com teste de Qui-quadrado e aplicado o modelo de Poisson com variância robusta, análise bivariada e múltipla. **Resultados:** totalizaram-se 1.048 casos, apresentando 37,5% até os três anos, com confirmação laboratorial em 96,3% e 58,0% sintomáticos. No modelo final ajustado, identificou-se associação entre as variáveis: faixa etária, cor/raça e regional de residência com a prevalência de internação por COVID-19. **Conclusão:** neste estudo a idade foi fator de proteção contra a internação por COVID-19 e a cor/raça e a Secretaria Regional de residência da criança foram fatores que aumentaram a prevalência deste desfecho. **Contribuição para a prática:** os dados podem subsidiar e fortalecer na literatura e, na prática, assuntos relacionados à saúde da criança com COVID-19, ampliando discussões entre gestores e profissionais da saúde e promovendo políticas públicas para a prevenção da doença.
Descritores: Criança; COVID-19; Saúde da Criança; Epidemiologia; Pandemias.

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Introduction

COVID-19 is an infectious disease characterized by high virulence and rapid transmissibility[1]. Several variants circulate worldwide, with omicron standing out as the one responsible for the increase in cases in the last two years, justified by the high potential for transmission and dissemination by the successive mutations that have occurred, which contribute to the increase in cases in the child population[2].

In children, unspecific symptoms usually appear, such as cough, fever, runny nose, anosmia, ageusia, myalgia, fatigue, and headache, and complications such as Severe Acute Respiratory Syndrome (SARS)[3]. Younger children, especially babies, are the most vulnerable to this disease. This information is justified by the fact that younger children are at high risk of being hospitalized for serious respiratory diseases[4] and, due to their immune fragility, are more susceptible to falling ill.

In this context, a review shows that the number of hospitalizations of children due to COVID-19 varies according to the country of origin of the study. For example, in the United States (US), this figure is considered low, but 32.7% of children under the age of two were hospitalized. In Italy, 57.7% were hospitalized[5]. Another study developed with secondary data in the USA shows that 2,293 children hospitalized between March 2020 and May 2021 had SARS caused by COVID-19. Of this number, 745 (32.5%) were under 2 years old[6].

Thus, more than 775 million cases of COVID-19 have been recorded worldwide[7]. In Brazil, more than 38 million cumulative cases of the disease have been recorded until January 2024, of which more than 7.3 million cases occurred in the Northeast region. Of these, 1.4 million are from Ceará[8], where 67,758 cases were recorded in children aged zero to nine by January 2024[9]. In Fortaleza, in the same period, more than 12,000 cases were reported in children up to the age of nine[10].

Despite preliminary scientific evidence identifying that children have a milder clinical picture of COVID-19, in 2020, the Paediatric Society of the United Kingdom issued an alert reporting new clinical presentations in children and adolescents, possibly related to COVID-19, characterized as a worsening of the case: Paediatric Multisystem Inflammatory Syndrome with a broad spectrum of signs and symptoms. Following this alert, other countries such as Spain, France, the United States, and Brazil also reported cases[11].

In addition, another factor that deserves attention is the presence of comorbidities before infection with the virus, making it a risk factor for more severe cases of the disease in children[12], highlighting the need for more specialized health care for this population.

Thus, even among children, there are groups with a higher risk of progressing to severe cases and, consequently, hospitalization or death, such as children under two years of age; those diagnosed with chronic lung diseases; those with heart disease; those with diabetes; those who are immunosuppressed; and patients with kidney failure[11].

Despite the vast number of publications on the disease, there is still a need for more studies related to children regarding the hospitalization profile of children with COVID-19, as well as their sociodemographic and epidemiological characteristics. Given the above, to contribute to promoting the health of pediatric patients in the research municipality, it is necessary to carry out studies aimed at analyzing the factors that influence the hospitalization of this public.

This study aimed to identify the association between sociodemographic and epidemiological variables in children with COVID-19 and the hospitalization outcome.

Methods

This is a cross-sectional, analytical and exploratory study carried out between February 2020 and February 2021. The research report was guided by the Strengthening the Reporting of Observational Studies

in Epidemiology (STROBE) tool. It took place in Fortaleza, the capital of Ceará, in the Northeast region of Brazil.

The municipality of Fortaleza has around 2,703,391 inhabitants, and 121 neighborhoods, distributed in seven Regional Executive Secretariats (SER), ranging from I to VI, in addition to the Regional Secretariat of the Centre[13], organized according to the territorial division of the research period (Figure 1).

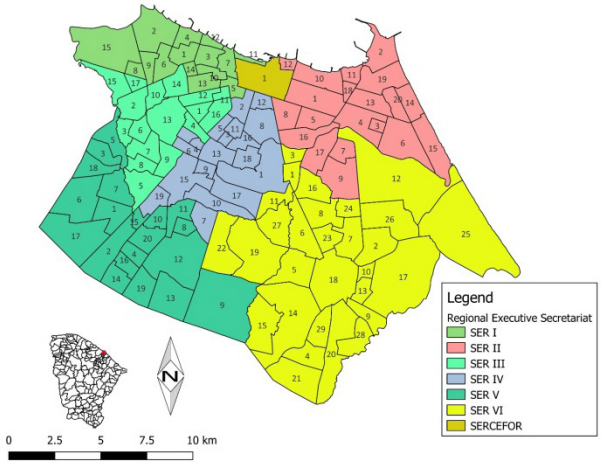

Figure 1 – Map of the territorial division of the municipality of Fortaleza according to neighborhood and Regional Executive Secretariat. Fortaleza, CE, Brazil, 2020-2021

The study population consisted of children with COVID-19 from birth to nine years of age, notified in the Influenza Epidemiological Surveillance System (SIVEP Gripe) and e-SUS (Brazilian National Health System) Epidemiological Surveillance (e-SUS-VE), from February 2020 to February 2021, totaling 1048 cases. This period was defined. It was the beginning of the pandemic in Brazil and the age group up to nine years old because it represents the high concentration of cases in children in the study municipality.

The inclusion criteria were being a confirmed case of COVID-19, aged between zero and nine years old, living in the municipality of Fortaleza-Ceará, notified on SIVEP Gripe and e-SUS-VE, with a record of onset of symptoms between February 2020 and February 2021.

Confirmed cases of the disease were children who tested positive for Reverse Transcription followed by Polymerase Chain Reaction (RT-PCR) or whose final diagnosis was COVID-19, either by clinical, epidemiological, or imaging criteria.

The variables used were sociodemographic data (gender, race/skin color, age group, region of residence), epidemiological data (diagnostic criteria, type of test, symptoms, morbidity, evolution, place of hospitalization), and hospitalization outcome, extracted from the eSUS-VE and SIVEP-Gripe Information Systems, made available by the Fortaleza Epidemiological Surveillance Cell, in a Microsoft Excel program. The data was collected in May 2022 by undergraduate and postgraduate nursing students at the institution where the study was carried out.

After organizing and consolidating the databases, a descriptive statistical analysis was carried out with absolute and percentage frequency distribution of the sociodemographic and epidemiological variables. To identify the factors associated with COVID-19 hospitalization, the prevalence of the outcome was first estimated according to the research variables using Pearson's chi-square test, with a significance level of 5%.

Subsequently, the Poisson model with robust variance was applied, both bivariate and multivariate. In this analysis, the dependent variable hospitalization was filtered to remove the ignored variables and then the ignored data from the independent variables was removed, resulting in 521 children with COVID-19, of whom 188 were hospitalized. Finally, the crude and adjusted prevalence ratios (PR) of the data were estimated, with their respective 95% confidence intervals (95% CI). The data was subjected to statistical treatment in R version 4.3.3.

The study was approved by the Ethics and Research Committee of the Federal University of Ceará under opinion number 4,663,788/2021 and Certificate of Submission for Ethical Appraisal 42815121.0.0000.5054. The Informed Consent Form was waived, considering that only secondary data obtained from health information systems was used.

Results

Concerning sociodemographic characteristics, Table 1 shows that the sample was made up of children with COVID-19 from birth to nine years of age, mostly female, of brown race/color, aged between one and three years, and living in Regions V and VI.

Table 1 – Sociodemographic characteristics of children confirmed with COVID-19 (n=1,048). Fortaleza, CE, Brazil, 2020-2021

Variables	n (%)
Gender	
Female	524 (50.0)
Male	522 (49.8)
Ignored	2 (0.2)
Race / Color	
White	138 (13.2)
Black	10 (1.0)
Yellow	16 (1.5)
Brown	605 (57.7)
Ignored	279 (26.6)
Group age (years)	
< 1	213 (20.3)
1 to 3	394 (37.6)
4 to 6	226 (21.6)
7 to 9	215 (20.5)
Executive Regional Office of Residence	
I	121 (11.5)
II	202 (19.3)
III	118 (11.3)
IV	102 (9.7)
V	228 (21.8)
VI	277 (26.4)

Source: SIVEP and e-SUS

Of the entire sample, most children had no comorbidities, but the main ones were respiratory disease (1.9%), neurological disease (1.9%), heart disease (1.8%), diabetes (0.9%), immunodeficiency (0.6%) and obesity (0.3%), with an emphasis on the prevalence of respiratory and neurological diseases.

In terms of epidemiological characteristics, most of the children were diagnosed with COVID-19 by laboratory tests, especially the RT-PCR test. The presence of more than one symptom of the disease was predominant and among the children who presented only one symptom, fever, cough, and dyspnea were the most prevalent symptoms. Most of the children were cured. Of those hospitalized, the majority were admitted to the wards. There were a total of 17 deaths (three deaths without hospitalization and 14 (6.3%) deaths after hospitalization) as shown in Table 2.

Table 2 – Clinical and epidemiological characteristics of resident children aged zero to nine years with COVID-19 (n=1,048). Fortaleza, CE, Brazil, 2020-2021

Variables	n (%)
Diagnostic criteria	
Laboratory	1,009 (96.3)
Clinical-epidemiological	37 (3.5)
Imaging	1 (0.1)
Clinical	1 (0.1)
Type of test (n=1,009)	
RT-PCR*	436 (43.2)
Rapid antibody test	419 (41.5)
Rapid-antigen test	122 (12.1)
Unspecified rapid test	10 (1.0)
RT-PCR + Rapid-antibody test	1 (0.1)
RT-PCR + Rapid-antigen test	2 (0.2)
Serology test	3 (0.3)
Electrochemiluminescence	2 (0.2)
Tracheal aspiration	1 (0.1)
Unknown	13 (1.3)
Symptomatology	
Asymptomatic	287 (27.4)
Only one symptom	102 (9.7)
More than one symptom	607 (58.0)
Unknown	52 (4.9)
Comorbidity	
None	752 (71.7)
One comorbidity	59 (5.6)
More than one comorbidity	7 (0.7)
Has comorbidity, but not specified	20 (2.0)
Unknown	210 (20.0)
Evolution	
Cured	507 (48.4)
Death without hospitalization	3 (0.3)
Hospitalization	223 (21.3)
Home treatment	39 (3.7)
Ignored	276 (26.3)
Place of hospitalization (n=223)	
Ward	188 (84.3)
Intensive Care Unit	35 (15.7)

*RT-PCR: Reverse Transcription–Polymerase Chain Reaction
Source: SIVEP and e-SUS

There was a statistically significant association between the variables age, color/race, comorbidity, and Regional Executive Secretariat of residence with the investigated outcome (Table 3).

Table 3 – Association between sociodemographic and epidemiological variables of children with COVID-19 and the prevalence of hospitalization (n=188). Fortaleza, CE, Brazil, 2020-2021

Variable	Percentage of total sample	Prevalence of hospitalization for COVID-19	p-value*	Crude analysis Hospitalization PR† (‡CI95%)
	n (%)	n (%)		
Age group				
0-3	351 (67.4)	169 (48.1)		1.0
4-6	87 (16.7)	14 (16.1)	<0.001	0.21(0.11-0.37)
7-9	83 (15.9)	5 (6.0)	<0.001	0.07(0.02-0.16)
Color/Race				
White	95 (18.2)	12 (12.6)		1.0
Brown	426 (81.8)	176 (41.3)	<0.001	4.87(2.68-9.64)
Gender				
Female	252 (48.4)	85 (33.7)		1.0
Male	269 (51.6)	103 (38.3)	0.300	1.22(0.85-1.75)
Comorbidity				
No	459 (88.1)	153 (33.3)		1.0
Yes	62 (11.9)	35 (56.5)	<0.001	2.59(1.52-4.47)
Regional Executive Secretariat of residence				
II	74 (14.2)	40 (58.8)		1.0
I	68 (13.1)	16 (21.6)	<0.001*	5.18(2.53-11.0)
III	46 (8.8)	21 (45.7)	<0.010*	3.05(1.38-6.89)
IV	46 (8.8)	16 (34.8)	0.120*	1.93(0.85-4.43)
V	136 (26.1)	43 (31.6)	0.130*	1.68(0.88-3.32)
VI	151 (29.0)	52 (34.4)	0.051*	1.90(1.01-3.72)

*p-value of Pearson's Chi-square test; †RP: Prevalence Ratio; ‡CI: Confidence Interval

In the final adjusted model, the variables age, color/race, and SER of residence continued to explain the occurrence of the outcome investigated. There was a 62% and 86% reduction in hospitalization when the children were aged 4 to 6 and 7 to 9, respectively, compared to those who were younger. The prevalence of the outcome in children with brown skin color was 2.67 times that of those with white skin. Living in SER I increased the prevalence of hospitalization by 106% compared to those in SER II (Table 4).

Table 4 – Poisson regression with robust variance of the demographic and epidemiological variables of children with COVID-19 and the prevalence of hospitalization (n=188). Fortaleza, CE, Brazil, 2020-2021

Variable	Adjusted Analysis Hospitalization PR* (95%CI)	p-value
Age group		
0-3	1.0	
4-6	0.38(0.21-0.63)	<0.001
7-9	0.14(0.05-0.31)	<0.001
Color/Race		
White	1.0	
Brown	2.67(1.54-5.10)	0.001
Gender		
Female	1.0	
Male	1.23(0.92-1.65)	0.200
Comorbidity		
No	1.0	
Yes	1.40(0.95-2.02)	0.080
Regional Executive Secretariat of Residence		
II	1.0	
I	2.06(1.17-3.81)	0.016
III	1.26(0.65-2.48)	0.500
IV	1.23(0.61-2.50)	0.600
V	1.17(0.67-2.15)	0.600
VI	1.36(0.79-2.47)	0.300

*PR: Prevalence Ratio; CI: Confidence Interval

(the Table 3 continue...)

Discussion

As a result of this research, children aged four to six and seven to nine years showed a protective factor for reducing hospitalization outcomes. Focusing on hospitalization for COVID-19 and age group, 115 children and adolescents were evaluated, identifying that the median age of hospitalized children was lower than that of non-hospitalized children, with emphasis on those up to three years of age who were subjected to more hospitalizations, requiring more frequent care in the Intensive Care Unit (ICU)[14]. This finding corroborates a study in European countries that explored factors associated with hospital admissions in children, showing that those aged between two and 10 were less ill with COVID-19, with a lower percentile of hospitalizations in intensive care units[15].

The rate of pediatric hospitalization tends to increase with younger age groups. In hospitalizations of children and adolescents, aged zero to 17, in the Italian region, during the three waves of the pandemic (2020-2021), most hospitalizations were among patients aged four and under[16]. Other evidence showed that COVID-19 confirmation was higher in schoolchildren (5 to 9 years old) and adolescents (10 to 19 years old), but concerning hospitalization, newborns/infants had a higher percentage of hospitalization[17].

The proportion of severe and critical cases of Chinese pediatric patients infected with Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) was progressively lower as the age group increased, with 10.6% in children under one year old, 7.3% between 1 and 5 years old, 4.2% between 6 and 10 years old, 4.1% between 11 and 15 years old and 3.0% in those over 16 years old[18]. From this perspective, it was found that 10% of seriously ill children hospitalized with the virus in North American, Latin American, and European countries died, with an association being identified among those under two years old[19].

While some ages can confer protective factors, racial differences are also associated with hospitalization for COVID-19, in which the brown race contributes to the higher prevalence of this outcome in children when compared to the white race. In a study of 136 children hospitalized for COVID-19 in northern Brazil, 117 were black/brown[20]. A similar result was found in a sample of 6,989 Brazilian children and adolescents hospitalized with Severe Acute Respiratory Syndrome due to the disease, indicating a higher prevalence of browns in 3,335 of the cases, also representing the majority of deaths. However, in terms of lethality, the indigenous population stood out[21]. In addition, hospitalized pediatric patients of the same nationality, black or brown, have a high odds ratio for death from COVID-19[22], validating data from the mortality rate of children from the disease in Brazil, in which the highest frequency occurred in the brown population[23].

However, when evaluating cases with children from England, Asians were more likely to be admitted to hospitals, including the ICU, when compared to whites. However, black, mixed, or other race children were more likely to be hospitalized for 36 hours or more[24]. In the United Kingdom, most children are white, but there has been an association with a higher risk of hospitalization in intensive care units due to COVID-19 in black children[25]. Thus, race may be a determining factor in the hospitalization profile, progression to a more severe clinical condition, and, consequently, a higher risk of mortality. In addition, disparities involving hospitalizations linked to children from racial minorities have important implications for the management of hospitalized patients[24].

Regarding the gender variable, which was not statistically significant, it is important to note that the profile data is like that found in another Brazilian study, which showed that most children and adolescents in a sample of 18,180 confirmed COVID-19 cases were female[17]. As for data from China[18], out of a total of 2,135 children, 1,208 (56.6%), and England[24], out of a population of 2,576,353 aged zero to 18, 1,318,747 (51.2%) were male, and of these, only 192 (0.01%) were hospitalized. These results suggest that, in the population studied, gender was not a determining factor for SARS-CoV-2 infection.

Another association found in this study was

the place of residence, where children living in SER I when compared to those living in SER II, had a higher prevalence of hospitalizations. Regarding place of residence, a study on the impacts of the pandemic in Ceará highlighted that SER II had a greater distribution of COVID-19 cases[26], certifying the spatiotemporal spread in the neighborhoods of Fortaleza. In these neighborhoods, there was a shift in the number of COVID-19 cases from the more affluent neighborhoods, concentrated in SER II, to the more vulnerable ones, with a low or very low Human Development Index. It can be inferred, then, that the rates of confirmed cases were due to the transmission of the virus from the population with the highest purchasing power to the poorest.

In addition, areas of greater social vulnerability can lead to a higher rate of hospitalization, since unequal access to health services affects the clinical outcome of the disease[27], mainly because they concentrate on a population dependent on the public health system. Although many cases are concentrated in upscale neighborhoods, these have a lower number of deaths, unlike peripheral neighborhoods, where it becomes higher, requiring urgent measures in regions with a high rate of COVID-19 infection and poor living conditions[28]. Socio-economic characteristics are therefore related to the increase in COVID-19 mortality among children, with low income and living in vulnerable areas being important factors in the pandemic context[29].

The COVID-19 pandemic has had a greater impact in regions with greater social and economic inequality, so tackling it goes beyond the biological field and health sectors, having repercussions on the economy, politics, and society, requiring attention to the factors that intensify the population's health vulnerability[27].

Study limitations

Limitations include the study design and the use of secondary data from Health Information Systems, which have gaps in the information, interfering with the processing and debugging of the databases collected.

Contributions to practice

It is important to highlight, in the literature and practice, issues related to children's health in the context of COVID-19, which will increase discussions among health managers and professionals, involving public health policies at the local and national level, especially about nursing, to monitor children and their families to prevent the disease and minimize the damage caused by the pandemic.

In this way, this study can contribute to improving health care for the child population, which was initially underestimated because it was less affected when compared to other age groups. In addition, it may reinforce the relevance of investing in research that focuses on the previous health, social, and economic conditions of children with COVID-19, considering the vulnerabilities that exist in Brazil.

In this way, it will be possible to mitigate transmission, prevent the development of the severe form of the disease, hospitalizations, and deaths among children, and consequently establish measures to control, prevent, and combat the disease.

Conclusion

In this study, age was a protective factor against hospitalization for COVID-19 and color/race and Regional Executive Secretariats of the child's residence were factors that increased the prevalence of this outcome. There was a reduction in the hospitalization of children aged between 4 and 9 when compared to those aged younger; the prevalence of the hospitalization outcome in children with brown skin color was higher than in those with white skin. Living in Regional Secretariat I, which concentrates on neighborhoods with a lower human development index, increased the prevalence of hospitalization compared to Regional Secretariat II.

Thus, this study reinforces the need for future

studies to deepen the association between the sociodemographic and epidemiological variables of children with COVID-19 and the hospitalization outcome.

Authors' contribution

Conception and design or analysis and interpretation of the data and writing of the manuscript or relevant critical review of the intellectual content: Castro IAL, Santos JEP, Santos DAS, Vargas JRG, Oliveira RKL, Mayorga FDO, Cardoso MVLML. Final approval of the version to be published: Mayorga FDO, Cardoso MVLML. Agreement to be responsible for all aspects of the manuscript relating to accuracy or completeness being properly investigated and resolved: Cardoso MVLML.

References

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;395(10223):497-506. doi: http://doi.org/10.1016/S0140-6736(20)30183-5
2. Torjesen I. Covid-19: peak of viral shedding is later with omicron variant, Japanese data suggest. BMJ. 2022;376:089. doi: http://doi.org/10.1136/bmj.o89
3. She J, Liu L, Liu W. COVID-19 epidemic: disease characteristics in children. J Med Virol. 2020;92(7):747-54. doi: http://doi.org/10.1002/jmv.25807
4. Rosi A, Van Vugt FT, Lecce S, Ceccato I, Vallarino M, Rapirsada, F, et al. Risk perception in a real-world situation (COVID-19): how it changes from 18 to 87 years old. Front Psychol. 2021;12:646558. doi: https://doi.org/10.3389/fpsyg.2021.646558
5. World Health Organization (WHO). Number of COVID-19 cases reported to WHO [Internet]. 2024 [cited Apr 8, 2024]. Available from: https://data.who.int/dashboards/covid19/cases?n=c
6. Woodruff RC, Campbell AP, Taylor CA. Chaj SJ, Kawasaki B, Meek J, et al. Risk factors for severe COVID-19 in children. Pediatr. 2021;149(1):e2021053418. doi: https://dx.doi.org/10.1542/peds.2021-053418
7. Nikolopoulou GB, Maltezou HC. COVID-19 in children: where do we stand? Arch Med Res. 2022;53(1):1-8. doi: https://doi.org/10.1016%2Fj.arcmed.2021.07.002
8. Ministério da Saúde (BR). Covid-19 no Brasil [Internet]. 2023 [cited Mar 5, 2024]. Available from: https://infoms.saude.gov.br/extensions/covid-19_html/covid-19_html.html
9. Secretaria da Saúde do Estado do Ceará. Integra-SUS Transparência da Saúde do Ceará. Boletim Covid-19 [Internet]. 2024 [cited Jan 20, 2024]. Available from: https://integrasus.saude.ce.gov.br/#/indicadores/indicadores-coronavirus/coronavirus-ceara
10. Secretaria Municipal da Saúde de Fortaleza. Boletins epidemiológicos: Informe semanal da COVID-19 [Internet]. 2024 [cited Jan 20, 2024]. Available from: https://coronavirus.fortaleza.ce.gov.br/boletim-epidemiologico.html
11. Kabeerdoss J, Pilania RK, Karkhele R, Kumar TS, Danda D, Singh S. Severe COVID-19, multisystem inflammatory syndrome in children, and Kawasaki disease: immunological mechanisms, clinical manifestations and management. Rheumatol Int. 2021;41(1):19-32. doi: https://doi.org/10.1007/s00296-020-04749-4
12. Shekerdemian LS, Mahmood NR, Wolfe KK, Riggs BJ, Ross CE, McKiernan CA, et al. Characteristics and outcomes of children with coronavirus disease 2019 (COVID-19) infection admitted to US and Canadian Pediatric Intensive Care Units. JAMA Pediatr. 2020;174(9):868-73. doi: https://doi.org/10.1001/jamapediatrics.2020.1948
13. Instituto Brasileiro de Geografia e Estatística (IBGE). Censo Brasileiro de 2022 [Internet]. 2022 [cited Apr 29, 2023]. Available from: http://www.ibge.gov.br
14. Rabha AC, Oliveira Junior FI, Oliveira TA, Cesar RG, Fongaro G, Mariano RF, et al. Clinical manifestations of children and adolescents with COVID-19: report of the first 115 cases from Sabará Hospital Infantil. Rev Paul Pediatr. 2021;39:e2020305. doi: https://doi.org/10.1590/1984-0462/2021/39/2020305
15. Götzinger F, Santiago-García B, Noguera-Julián A, Lanaspa M, Lancella L, Carducci FIC, et al. COVID-19 in children and adolescents in Europe: a multinational, multicentre cohort study. Lancet Child Ad-

olesc Health. 2020;4(9):653-61. doi: https://doi.org/10.1016/s2352-4642(20)30177-2

16. Martella M, Peano A, Politano G, Onorati R, Gianino MM. Paediatric hospitalizations over three waves of COVID-19 (February 2020 to May 2021) in Italy: determinants and rates. PeerJ. 2023;11:e15492. doi: http://doi.org/10.7717/peerj.15492

17. Cavalcante ANM, Tavares LVS, Bastos MLA, Almeida RLF. Clinical-epidemiological profile of children and adolescents with COVID-19 in Ceará. Rev Bras Saúde Matern Infant. 2021;21(suppl 2):5437-43. doi: https://doi.org/10.1590/1806-9304202100S200006

18. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, Tong S. Epidemiology of COVID-19 Among Children in China. Pediatrics. 2020;145(6):e20200702. doi: https://doi.org/10.1542/peds.2020-0702

19. Gonzalez-Dambrauskas S, Vasquez-Hoyos P, Camporesi A, Cantillano EM, Dallefeld S, Dominguez--Rojas J, et al. Paediatric critical COVID-19 and mortality in a multinational prospective cohort. Lancet Reg Health Am. 2022;12:100272. doi: https://doi.org/10.1016/j.lana.2022.100272

20. Santos JC, Koga RCR, Prudêncio LS, Pureza DY, Volpe MIC, Silva V, Silva SR. Clinical and epidemiological characteristics of pediatric hospitalizations due to COVID-19 in the Brazilian Amazon: an observational study. Online Braz J Nurs. 2024;23:e20246702. doi: https://dx.doi.org/10.17665/1676-4285.20246702

21. Hillesheim D, Tomasi YT, Figueiró TH, Paiva KM. Severe Acute Respiratory Syndrome due to COVID-19 among children and adolescents in Brazil: profile of deaths and hospital lethality as at Epidemiological Week 38, 2020. Epidemiol Serv Saúde. 2020;29(5):e2020644. doi: https://dx.doi.org/10.1590/s1679-49742020000500021

22. Santos IL, Mendes EDT, Franciosi RB. Comorbidades pediatricas, raça, faixa etária em COVID-19 no Brasil: um estudo coorte retrospectivo. Braz J Infect Dis. 2022;26(suppl 1):102021. doi: https://doi.org/10.1016/j.bjid.2021.102021

23. Faria RM, Jantsch LB, Neves ET, Hausen CF, Barros APZ, Sehnem GD, et al. Social and territorial inequalities in the mortality of children and adolescents due to COVID-19 in Brazil. Rev Bras Enferm. 2022;75(6):e20210482. doi: https://doi.org/10.1590/0034-7167-2021-0482

24. Saatci D, Ranger TA, Garriga C, Clift AK, Zaccardi F, Tan PS, et al. Association between race and COVID-19 outcomes among 2.6 million children in England. JAMA Pediatr. 2021;175(9):928-38. doi: https://10.1001/jamapediatrics.2021.1685

25. Swann OV, Holden KA, Turtle L, Pollock L, Fairfield CJ, Drake TM, et al. Clinical characteristics of children and young people admitted to hospital with covid-19 in United Kingdom: prospective multicenter observational cohort study. BMJ. 2020;370:m3249. doi: https://doi.org/10.1136/bmj.m3249

26. Silva JB, Muniz AMV. Conoravirus Pandemic in Brazil: impacts in the Territory of Ceará. Rev Bras Geogr Econ. 2020;9(17):1-19. doi: https://dx.doi.org/10.4000/espacoeconomia.10501

27. Cestari VRF, Florêncio RS, Sousa GJB, Garces TS, Maranhão TA, Castro RR, et al. Social vulnerability and COVID-19 incidence in a Brazilian metropolis. Ciênc Saúde Coletiva. 2021;26(3):1023-33. doi: https://dx.doi.org/10.1590/1413-81232021263.42372020

28. Carvalho TM, Silva SMO, Araújo CB, Frota R, Xavier LC, Bezerra B, et al. Vulnerability index to COVID-19: Fortaleza, Brazil study case. Eng Sanit Ambient. 2021;26(4):731-9. doi: https://dx.doi.org/10.1590/S1413-415220200242

29. Silva BC, Ribeiro AC, Uehara SCSA. Influence of socioeconomic factors on COVID-19 mortality in children: a scoping review. Rev Rene. 2023;24:e91-978. doi: https://dx.doi.org/10.15253/2175-6783.20232491978