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Children and adolescents hospitalized for COVID-19: epidemiological study in a municipality in the State of Mato Grosso

Crianças e adolescentes hospitalizados por COVID-19: estudo epidemiológico em um município do Estado de Mato Grosso

Niños y adolescentes hospitalizados por COVID-19: estudio epidemiológico en un municipio del Estado de Mato Grosso

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ABSTRACT

The manifestations of COVID-19 between children and adolescents and adults, although in this group, the incidence of severe cases is lower. The objective of this study was to analyze cases of hospitalizations due to COVID-19 in children and adolescents in a municipality in southeastern Mato Grosso between 2020 and 2022. An epidemiological, cross-sectional and descriptive study was conducted in Rondonópolis, Mato Grosso, between March 2020 and March 2022. This study included hospitalized children and adolescents with COVID-19, who were distributed among the age groups 0--19 years. The data were collected from the Panel of COVID-19 Indicators of the State of Mato Grosso. The variables analyzed included sociodemographic characteristics, comorbidities, type of hospitalization and outcomes. The descriptive statistical analysis was aided by the software R. The study was approved by the Research Ethics Committee. During the study period, 133 reports of COVID-19 in children and adolescents were published. There was a prevalence of cases in August 2021 and February 2022 (18.79%), those in the 12--19 years (62%), mixed race (49%), male sex (51%), without comorbidities (73.68%), those hospitalized in wards (66.17%), those in the public network (52.63%), those who did not require mechanical ventilation (94%) and 86% who recovered. This study is expected to provide health managers, other health professionals and researchers with evidence for decision-making in this population for the prevention of disease.

Keywords: COVID-19. Child. Adolescent. Hospitalization.

RESUMO

As manifestações da COVID-19 entre crianças e adolescentes e adultos, embora nesse grupo a incidência de casos graves seja menor. O objetivo deste estudo foi analisar os casos de internações por COVID-19 em crianças e adolescentes em um município do sudeste de Mato Grosso entre 2020 e 2022. Foi realizado um estudo epidemiológico, transversal e descritivo em Rondonópolis, Mato Grosso, entre março de 2020 e março de 2022. Esse estudo incluiu crianças e adolescentes hospitalizados com COVID-19, distribuídos nas faixas etárias de 0 a 19 anos. Os dados foram coletados do Painel de Indicadores COVID-19 do Estado de Mato Grosso. As variáveis analisadas incluíram características sociodemográficas, comorbidades, tipo de hospitalização e desfechos. A análise estatística descritiva foi auxiliada pelo software R. O estudo foi aprovado pelo Comitê de Ética em Pesquisa. Durante o período do estudo, foram publicados 133 relatos de COVID-19 em crianças e adolescentes. Houve uma prevalência de casos em agosto de 2021 e fevereiro de 2022 (18,79%), entre 12 e 19 anos (62%), pardos (49%), sexo masculino (51%), sem comorbidades (73,68%), internados em enfermarias (66,17%), na rede pública (52,63%), que não necessitaram de ventilação mecânica (94%) e 86% que se recuperaram. Espera-se que este estudo forneça aos gestores de saúde, outros profissionais de saúde e pesquisadores evidências para a tomada de decisões nessa população para a prevenção de doenças.

Palavras-chave: COVID-19. Criança. Adolescente. Hospitalização.

RESUMEN

Las manifestaciones de COVID-19 entre niños y adolescentes y adultos, aunque en este grupo, la incidencia de casos graves es menor. El objetivo de este estudio fue analizar los casos de hospitalizaciones por COVID-19 en niños y adolescentes de un municipio del sudeste de Mato Grosso entre 2020 y 2022. Se realizó un estudio epidemiológico, transversal y descriptivo en Rondonópolis, Mato Grosso, entre marzo de 2020 y marzo de 2022. El estudio incluyó niños y adolescentes hospitalizados con COVID-19, distribuidos en los grupos de edad de 0 a 19 años. Los datos fueron colectados del Panel de Indicadores de COVID-19 del Estado de Mato Grosso. Las variables analizadas incluyeron características sociodemográficas, comorbilidades, tipo de hospitalización y resultados. El análisis estadístico descriptivo fue auxiliado por el software R. El estudio fue aprobado por el Comité de Ética en Investigación. Durante el periodo de estudio, se publicaron 133 informes de COVID-19 en niños y adolescentes. Hubo prevalencia de casos en agosto de 2021 y febrero de 2022 (18,79%), en el grupo de 12 a 19 años (62%), mestizos (49%), sexo masculino (51%), sin comorbilidades (73,68%), hospitalizados en salas (66,17%), en la red pública (52,63%), que no necesitaron ventilación mecánica (94%) y 86% que se recuperaron. Se espera que este estudio proporcione a los gestores de salud, a otros profesionales de salud y a los investigadores evidencias para la toma de decisiones en esta población para la prevención de la enfermedad.

Palabras clave: COVID-19. Niño. Adolescente. Hospitalización.

1 INTRODUCTION

In December 2019, a series of cases of pneumonia of unknown origin were reported in Wuhan, China. After investigations, the causative agent of these cases was identified as a new coronavirus, a type of RNA virus. This virus was later named severe acute respiratory syndrome coronavirus (Silva *et al*., 2021). In January 2020, the World Health Organization (WHO) recognized the seriousness of the outbreak and declared it a Public Health Emergency of International Concern (PHEIC). In March 2020, the outbreak was officially classified as a pandemic (Zhu *et al*., 2020).

In 2020, in Brazil, 14,638 cases of COVID-19 were reported in pediatric patients. These cases resulted in 1,203 deaths, culminating in a case fatality rate of 8.2%. Notably, this case fatality rate corresponds to 0.6% of the total number of deaths attributed to COVID-19 in the country. A more in-depth analysis of the data revealed that a significant proportion of these deaths occurred among

children younger than two years of age (42% of the total). In addition, approximately 43% of deaths were recorded among children and adolescents aged between 10 and 19 years. In 2021, the panorama of the pediatric situation of COVID-19 persisted, and from January to September, 17,000 new cases were reported in children. Among these cases, there were 1,180 deaths (6.9% case fatality rate) (Souza *et al*., 2022).

COVID-19 is among the ten leading causes of death in children aged between 5 and 11 years in the country, and in 2020, 10,356 children aged between 0 and 11 years were diagnosed with severe acute respiratory syndrome (SARS) related to the disease. to COVID-19, resulting in 722 fatal cases. In 2021, there was an increase in notifications to 12,921 cases in the same age group, with 727 deaths. In total, since the beginning of the epidemic, 23,277 SARS cases caused by COVID-19 have been reported, of which 1,449 resulted in death. Within this context, 2,978 cases occurred in children aged 5--11 years, with 156 deaths in 2020. In 2021, 3,185 cases were documented in this age group, with 145 deaths. This resulted in a cumulative total of 6,163 cases and 301 deaths since the beginning of the epidemic for this age group (Secretaria de Vigilância em Saúde, 2021).

In this context, the development of this study is justified by the scarcity of studies that address the profile and factors associated with cases of hospitalization due to COVID-19 in children and adolescents in the study municipality. In addition, the results of this study will make it possible to understand the factors that contribute to the vulnerability of this population and may suggest control measures to avoid the severity of cases and deaths from infection in the municipality under study. Therefore, this study aims to analyze the factors associated with cases of hospitalizations for COVID-19 in children and adolescents in a municipality in southeastern Mato Grosso between 2020 and 2022.

2 MATERIALS AND METHODS

This was a cross-sectional and descriptive epidemiological study covering the period from March 2020 to March 2022. Importantly, March 2020

refers to the first month of notification of COVID-19 cases at the study site (Rondonópolis, state of Mato Grosso).

The population object of analysis consists of children (under 1 year to 9 years old) and adolescents (10--19 years, 11 months and 29 days old), according to the categories defined by the World Health Organization (WHO) (Brazil, 2018). These individuals reported having COVID-19 and were subsequently hospitalized in the inpatient units of the municipality during the study period. For a more detailed analysis, the age groups were stratified into neonatal and infant (0 to 1 year old), preschool (2 to 4 years old), school (5 to 9 years old) and adolescent (10 to 19 years old) groups.

The secondary data source was the Panel of COVID-19 Indicators of the State of Mato Grosso, accessed through the public domain link (http://sistemas.saude.mt.gov.br/PainelIndicadorPulico). Data collection was performed in January 2024.

The variables included in the study included health region, municipality of Rondonópolis (MT), date of notification, type of hospital (public, private or philanthropic), age (years), sex (female or male), race/color (mulatto, white, black and yellow), comorbidity (yes or no), hospitalization (yes or no), type of bed (clinical or intensive care unit) and outcome (recovered or death). Patients with unknown/blank data and those transferred from other municipalities of the health region and hospitalized in Rondonópolis (MT) were excluded.

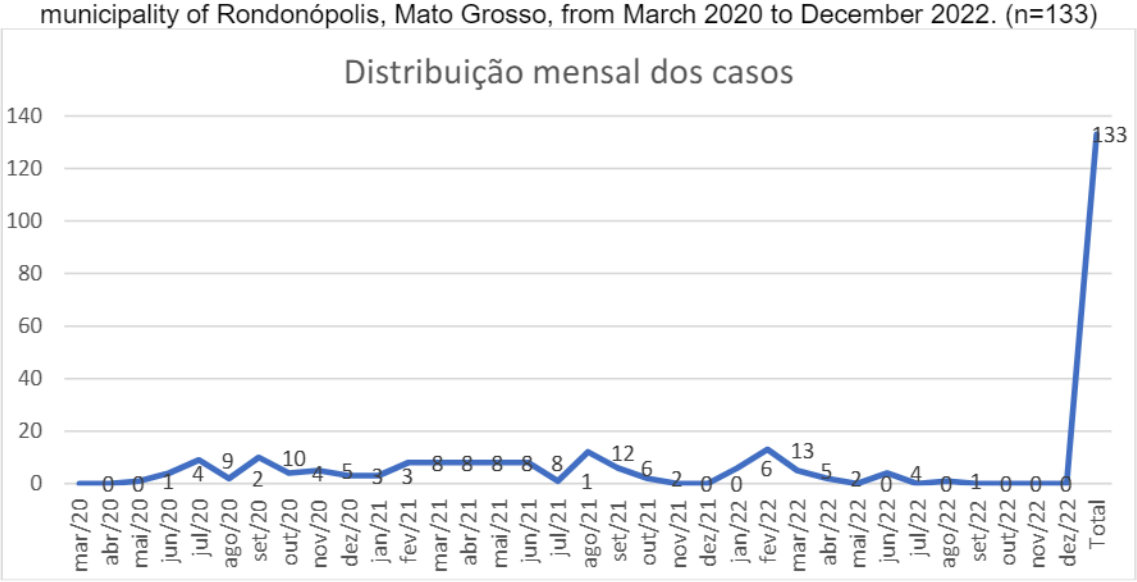
Quantitative data were presented, and descriptive analysis was performed in terms of the number of cases and percentages via graphs and tables via R statistical software (R Core Team, 2023).

Notably, the data collected for this study are in the public domain, and the participants were not identified. Thus, this study received approval from the Ethics Committee for Research with Human Beings according to CNS Resolution 466/2012 through the Matrix Project entitled COVID-19 pandemic in the municipality of Rondonópolis: analysis of epidemiological aspects and medication use" (CAAE 39427420.1.0000.5541 and opinion 4,418,798) (Brazil, 2012).

3 RESULTS

In Rondonópolis, Mato Grosso, in the period from March 2020 to December 2022, there were a total of 133 notifications of COVID-19 in children and adolescents. The first case in this age group was recorded in May 2020. Notably, throughout 2020, the month with the highest prevalence was September (n = 10; 7.52%), and in 2021, there was a peak of cases in August (n=12; 9.02%), whereas in 2022, February had the highest prevalence (n=13; 9.77%). In the periods March/2020, April/2020, November/2021, December/2021, May, July, September, October, November and December 2022, there were no reports of cases in this population (n=13; 10%) (Graph 1).

Graph 1. Monthly distribution of reported COVID-19 cases in children and adolescents in the municipality of Rondonópolis, Mato Grosso, from March 2020 to December 2022. (n=133)



Source: Panel of COVID-19 indicators of the state of Mato Grosso.
Prepared by the authors.

With respect to the sociodemographic characteristics of the cases analyzed, the most prevalent age group was 12--19 years (n=83; 62%), mixed race/color (n=65; 49%) and sex. male (n=68; 51%) (Table 1).

Table 1. Sociodemographic characteristics of COVID-19 cases reported in children and adolescents in the municipality of Rondonópolis, Mato Grosso, between March 2020 and December 2022. (n=133)

Variables	**Cases COVID-19 in children and adolescents**	
Age group	**n**	**%**
0 – 1	21	16
2 -11	29	22
12-19	83	62
Total	133	100
Race/color	**n**	**%**
Brown	65	49
White	39	29
Black	4	3
Yellow	1	1
Empty/ignored	24	18
Total	133	100
Sex	**n**	**%**
Male	68	51
Female	65	49
Total	133	100

Source: Panel of COVID-19 indicators of the state of Mato Grosso.
Prepared by the authors.

Regarding the clinical characteristics, most patients (n=98; 73.68%) had no comorbidities. However, among those who had some type of previous condition, 10 (23.81%) were obese. With respect to hospitalization beds, most (n = 88; 66.17%) were allocated to wards and were hospitalized in public health units (n = 70; 52.63%), not requiring hospitalization. mechanical ventilation (n=125;94%). With respect to beds, the majority (n = 94; 70.68%) were not in agreement with the SUS, and the majority of cases in terms of outcome were recovered cases (n = 115; 86%) (Table 2).

Table 2. Clinical characteristics of COVID-19 cases reported in children and adolescents in the municipality of Rondonópolis, Mato Grosso, from March 2020 to December 2022. (n=133)

Variables	**COVID-19 in children and adolescents**	
Comorbidity	n	%
Yes	35	26,32
No	**98**	**73,68**
Total	133	100
Type of comorbidity	**n**	**%**
Systemic arterial hypertension	3	7,14
Pulmonary	3	7,14
Diabetes mellitus	8	19,05
Kidney	2	4,76
Cardiovascular	4	9,52
Obesity	10	23,81
Other comorbidities	12	28,47
Total	42	100
Bed type at admission	**n**	**%**

Infirmary	88	66, 17
Clinical isolation	12	9,02
Intensive complementary	14	10,53
Complementary isolation	1	0,75
Complementary semi-intensive	17	12,78
Ignored/empty	1	0,75
Total	133	100
Hospital	**n**	**%**
Audience	70	52,63
Private	42	31,58
Philanthropic	21	15,79
Total	133	100
Use of mechanical ventilation	**n**	**%**
Yes	7	5
No	125	94
empty	1	1
Total	133	100
Bed agreed by SUS	**n**	**%**
Yes	34	25,56
No	94	70,68
Empty	5	3,76
Total	133	100
Outcome	**n**	**%**
Recovered	115	86
Death	1	1
Death from other causes	1	1
Transferred/regulated	16	12
Total	133	100

Source: Panel of COVID-19 indicators of the state of Mato Grosso.
Prepared by the authors.

4 DISCUSSION

According to the Ministry of Health, on April 27, 2020, there were 63,328 cases of COVID-19 in children and adolescents (Brasil, 2020). In addition, the present study conducted in Rondonópolis (MT), despite having registered a total of 133 notifications of COVID-19 in this age group from March 2020 to December 2022, reflects this national scenario.

In a study conducted at a tertiary-level pediatric medical center in the city of Chicago, United States, in 2020, 145 individuals who developed moderate symptoms approximately one week after infection by the virus were analyzed. The analyzed group consisted of children under five years of age (n=46), children and adolescents between 5 and 17 years of age (n=51) and adults between 18 and 65 years of age (n=48). The results revealed that, compared with older children and adults, children under five years of age had a viral load between 10 and 100 times

greater in the upper respiratory tract. This study suggests a greater capacity for transmission among children under five years of age (Sargent *et al*., 2020).

In the state of Espírito Santo, in 2020, a survey was conducted with a sample of 18,791 individuals. A subsample of 1,693 (9.0%) children aged between 2 and 22 years was analyzed, and 104 (6.1%) tested positive for antibodies against the SARS-CoV-2 virus. (Maciel *et al*., 2021).

In the present study, a higher prevalence was observed in the 12--19 years (62%) and male (51%) age groups. In a study conducted in Ceará, 48,002 cases of COVID-19 were reported in children and adolescents aged 0 to 19 years, representing 9.9% of the cases. Among these cases, 18,180 (8.9%) were positive, with a mean age of 12 years. In terms of age group, 1,900 (0.9%) were newborns, 1,938 (1.0%) were preschool-aged children (2--4 years old), 3,853 (1.9%) were schoolchildren (5--9 years old), and 10,489 (5.2%) were adolescents aged 10--19 years. A greater proportion of cases was observed in female children (n=9,536; 52.4%), with statistical significance ($_{male}$ CI: 46.8–48.3) (Cavalcante *et al*., 2021).

With respect to the profile of patients diagnosed with COVID-19 in this study, the highest prevalence was associated with mixed race/color (n=65; 49%). According to a study conducted in Rio Grande Sul, from January to September 2022, of the 2,611 cases reported in children, 430 (16.4%) were diagnosed with COVID-19. The highest prevalence was observed in January and February (19.5%). The greatest number of cases occurred in boys (56%), those aged 1 year (39.5%) and those belonging to the white ethnic group (81%). Approximately 26% of those hospitalized required admission to intensive care units (ICUs). Among these patients, 56.3% received noninvasive ventilatory support, whereas 40% required intubation (Souza & Rabello, 2022).

In Feira de Santa (BA), of the 200 pediatric patients hospitalized, 23.5% required intensive care unit (ICU) care, and the mean age at admission was 5.5 years. In addition, the age with the highest prevalence at ICU admission was patients younger than 1 year (n=14; 29.8%). Importantly, with respect to race/color (n=35; 74.5%), the participants were black, mixed-race and male (n=28; 59.6%). These results are also similar to ours, where the prevalence of blacks and browns was 52%, whereas that of males was 51% (Silva *et al*., 2022).

In Wuhan, China, in 2020, children and adolescents infected with the SARS-CoV-2 virus, although they usually have mild or moderate manifestations, can also develop cases that require hospitalization or intensive care (Wang *et al*., 2020). In the municipality of this study, there was a prevalence of hospitalizations in ward beds, which demonstrates the need for more intensive care in this group of patients diagnosed with COVID-19.

In Europe, a study conducted in April 2020 with 582 children, with a mean age of five years, revealed that COVID-19 usually manifests itself in a mild manner in children, including infants. However, a small portion presented severe conditions that required hospitalization in intensive care units (ICUs) (n=48; 8%) and prolonged use of ventilation (n=25; 4%). However, fatal outcomes are infrequent (n = 4; 0.69%, 95% CI 0.20--1.82) (Gotzinger *et al*., 2020).

In the state of Rio de Janeiro, in 2020, data from 10 children admitted to the ICU due to COVID-19 were analyzed. Among these children, 70% (n = 7) were male, and the most prevalent age group was 0 to 1 year 50% (n = 5), followed by 6 to 10 years, 40% (n = 4) and 1 year 5 years, with 10% (n=1). Most children (40%, n=4) were under semi-intensive care in the ICU. Another 30% (n=3) required highly dependent care, whereas 30% (n=3) also required intensive care (Araújo *et al*., 2023).

Regarding the type of comorbidity in the investigated group, obesity (23.81%), *diabetes mellitus* (19.5%) and cardiovascular disease (9.52%) were prevalent in this study. In contrast, a study was conducted in the city of Paris to describe the severe forms of COVID-19 in children, analyzing data from a group of 27 children. Among these patients, 19 (70%) had comorbidities, most of which were related to neurological (7), respiratory (4) and sickle cell disease (4) conditions (Oualha *et al*., 2020).

In the state of Mato Grosso do Sul, from March 2020 to December 2022, the analysis of the epidemiological profile of pediatric multisystem syndrome (P-MIS) was similar to the findings of this study. Among the 17 confirmed cases of SIM-P (48.6%), the highest prevalence was in male children (53%), mixed-race children (52.9%) and those aged 1--5 years (47%). It was necessary to hospitalize 58.8% of the patients in an intensive care unit (ICU). Regarding

preexisting medical conditions, four patients reported the presence of comorbidities, including heart disease and *diabetes mellitus*. Regarding the evolution of the cases, two resulted in death, representing a case fatality rate of 11.7%, whereas 15 patients managed to recover completely (Arja *et al*., 2023).

In this study, most reported cases of COVID-19 in children and adolescents recovered (86%), and only one case died (1%). In a study conducted to characterize the epidemiological profile of COVID-19 cases among residents of the city from March 2020 to October 2021, Pernambuco reported 10,499 cases (6.7%) of COVID-19 in children and adolescents between 0 and 19 years old. A proportional increase in the number of deaths was also observed with increasing age. Importantly, there are also reports of deaths from COVID-19 in this group, with 23 deaths (0.4%) (Moreira *et al*., 2023).

In a study that described cases, deaths and mortality due to COVID-19 in children and adolescents in Brazil, infants and preschoolers were the most commonly hospitalized (62.8%). In addition, in the two years of study, there were 4,471 deaths. Adolescents had the highest hospital mortality (6%), followed by infants (4.8%). These findings reinforce the importance of correct management of the disease and quality care provided to this group (Silva *et al*., 2023).

In Belém (PA), a study aimed at describing the epidemiological profile and clinical manifestations of children infected with COVID-19 highlighted that of 139 cases, there was a prevalence of females (n = 72; 52%). With respect to hospitalization, children who had mild and moderate forms of the disease (n = 53; 39%) were discharged; however, 13% of the 20 children who were hospitalized with the critical form of the disease died (Morais *et al*., 2023).

According to a study that aimed to describe the profile of deaths and lethality due to COVID-19 in children and adolescents in the country, in 2020, there were 6,989 hospitalizations for severe acute respiratory syndrome (SARS) caused by COVID-19 in the age group 0--19 years. Most of these hospitalizations occurred in the Southeast Region, accounting for 35.2% of the total, followed by the Northeast Region (27.5%). Those aged 1 to 4 years and 15 to 19 years had the highest number of hospitalizations, corresponding to 27.5% and 24.4%, respectively. With respect to the profile of hospitalized patients, more female

children and adolescents were hospitalized (51.6%) and had a mixed race/color (50.8%). The proportions of deaths were similar for those younger than 1 year (28.9%) and adolescents aged 15--19 years (28.4%). Once again, there was a predominance of females (52.9%), mixed races/colors (54.1%) and residents of urban areas (84.6%) (Hillesheim *et al*., 2020).

Although the focus of this study was not on the mortality rate, it is important to contextualize these data because it is a municipality in the interior of the state. A study conducted to evaluate the hospital mortality rate in the interior and metropolitan regions of Brazil revealed that, in the metropolitan region, there was a notable increase in the hospital mortality rate (HMR) in 2021 for patients who were admitted to intensive care units (ICUs) in two specific age groups: 0--28 days and 6--9 years. On the other hand, for those who did not require the ICU, there was a significant increase in HMRs in two different groups: children aged between 24 months and 5 years and adolescents aged 10--14 years. In the countryside, there was a notable increase in the HMRs of ICU patients aged 6--9 years, which jumped from 10.89% in 2020 to 20.97% in 2021. Furthermore, in the countryside, there was an increase in HMRs among patients who used invasive ventilatory support in various age groups: 24 months to 5 years, 6 to 9 years, 10 to 14 years and 15 to 19 years (Araújo *et al*., 2023a).

5 CONCLUSION

Through this study, it was possible to identify the clinical and epidemiological profiles of children and adolescents hospitalized for COVID-19 in the municipality. The findings revealed a prevalence of cases in February 2022, followed by a decrease throughout the months of the year, coinciding with the advance of vaccination coverage in adults. Adolescents aged 12--19 years were the most affected, followed by individuals of mixed race/color and males, which suggests possible low adherence to social distancing. With respect to clinical characteristics, most patients had no comorbidities, with obesity being the most prevalent. Most hospitalizations occurred in wards and public hospitals, and most patients recovered, although there was one fatal case.

These results will help academia and society in different ways. For academia, this study offers a comprehensive basis for future research, such as the conduct of other epidemiological studies comparing the differences between regions of the State and municipalities whose health reference is the municipality of study, aiming at the effectiveness of preventive interventions. For society, it is expected to provide managers and health professionals with a detailed view of the vulnerability of the groups studied, and thus allow the creation and implementation of effective public policies with better targeting for this population.

A limitation of this study is the analysis of cases in this specific group in only one municipality of the regional health department, which reinforces the need for further investigations to understand the dynamics of the disease in this age group, in addition, it is a research with secondary data, subject to underreporting. In this way, this study provides health managers, other health professionals and researchers with evidence for decision-making in this population for the prevention of disease. It is recommended that future studies be developed that can explore the associated factors of COVID-19 in children and adolescents.

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