MARIA CRISTINA BENTO SOARES

ANÁLISE DAS HOSPITALIZAÇÕES E ÓBITOS POR SÍNDROME RESPIRATÓRIA AGUDA GRAVE DEVIDO À COVID-19 ENTRE CRIANÇAS E ADOLESCENTES BRASILEIROS: 2020 E 2021

Dissertação apresentada à Universidade Federal de Viçosa, como parte das exigências do Programa de Pós-Graduação em Ciências da Saúde, para obtenção do título de *MagisterScientiae.*

Orientadora: Brunnella A. Chagas de Freitas

Coorientadores: Luana Vieira Toledo
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Brunnella Alcantara Chagas de Freitas
Orientadora

A Deus, pois tudo posso naquele que me fortalece.
Aos meus pais, meu esposo, meu irmão e meu filho.

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A Deus.

Aos meus pais, que sempre me ensinaram que uma das coisas mais importantes é a educação e o ensino.

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À Universidade Federal de Viçosa, pela oportunidade de realizar a pós-graduação.

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RESUMO

SOARES, Maria Cristina Bento, M.Sc; Universidade Federal de Viçosa, fevereiro de 2023. **Análise das hospitalizações e óbitos por Síndrome Respiratória Aguda Grave devido à COVID-19 entre crianças e adolescentes brasileiros.** Orientador: Brunella Alcantara Chagas de Freitas. Coorientadores: Luana Vieira Toledo e Bruno David Henriques.

A infecção pelo novo coronavírus é uma doença infectocontagiosa que foi responsável por uma pandemia iniciada em 2020 e com alta transmissibilidade. Os pacientes infectadosapresentavam em grande maioria sintomas gripais leves, como febre, coriza, tosse, porém, alguns apresentavam quadros exuberantes e necessitavam de internação. Os grupos de risco para complicações e óbitos constituem-se de idosos, gestantes e pacientes crônicos, pouco se conhecendo sobre a doença na população pediátrica. Nesse contexto, o presente estudo tem por objetivos analisar o perfil das hospitalizações e fatores associados aos óbitos de crianças e adolescentes com Síndrome Respiratória Aguda Grave (SRAG) por COVID-19, no Brasil, e elaborar uma cartilha educativa para a prevenção da COVID-19 em crianças e adolescentes. Foram realizados dois estudos transversais, a partir dos dados do Sistema de Informação de Vigilância Epidemiológica da Gripe (SIVEP-Gripe) dos anos de 2020 e 2021. Analisaram-se as características sociodemográficas e clínicas, as taxas de hospitalizações e letalidade e a duração da hospitalização, considerando-se como desfecho a recuperação ou óbito. No Brasil, em 2020 e 2021, as crianças e adolescentes compreenderam 1,9% e 3,6% respectivamente, dos casos de SRAG-hospitalizados por COVID-19. Destes, 57,7% evoluíram com SRAG-crítico e 90% sobreviveram. A taxa de letalidade foi de 4,0%. As comorbidades se apresentaram em 40,8%, com predomínio da asma, doença neurológica crônica, imunodepressão e doença cardiovascular crônica. A principal sintomatologia foi febre, tosse, dispneia, desconforto respiratório e baixa saturação de oxigênio. Dentre os que apresentaram SRAG-crítico, 91,4% foram a óbito. Quanto às taxas de hospitalizações, houve maior prevalência das crianças, sobretudo com idade inferior a cinco anos, e da raça/cor parda. O tempo de hospitalização foi maior para os adolescentes com a doença crítica ou comorbidade. Apesar de menores taxas de hospitalização e óbitos que os adultos, são relevantes a prevalência, complicações e mortalidade pela COVID-19 na população pediátrica. O conhecimento do perfil de crianças e adolescentes hospitalizados por COVID-19 e dos fatores associados aos óbitos permite o direcionamento de ações de enfrentamento voltadas a essa população vulnerável.

Palavras-chave: COVID-19. SARS-CoV-2. Síndrome respiratória aguda grave.

Hospitalização. Criança. Adolescente.

ABSTRACT

SOARES, Maria Cristina Bento, M.Sc., Universidade Federal de Viçosa, February 2023. **Analysis of hospitalizations and deaths from Severe Acute Respiratory Syndrome due to COVID-19 among Brazilian children and adolescents**. Advisor: Brunella Alcantara Chagas de Freitas. Co-advisors: Luana Vieira Toledo and Bruno David Henriques.

Infection with the new coronavirus is an infectious disease that was responsible for a pandemic that started in 2020 and is highly transmissible. Infected patients mostly had mild flu symptoms, such as fever, runny nose, cough, however, some had exuberant conditions and required hospitalization. The risk groups for complications and deaths consist of the elderly, pregnant women and chronic patients, little is known about the disease in the pediatric population. In this context, the present study aims to analyze the profile of hospitalizations and factors associated with the deaths of children and adolescents with Severe Acute Respiratory Syndrome (SARS) due to COVID-19, in Brazil, and to elaborate an educational booklet for the prevention of COVID-19. 19 in children and adolescents. Two cross-sectional studies were carried out, based on data from the Influenza Epidemiological Surveillance Information System (SIVEP-Flu) for the years 2020 and 2021. Sociodemographic and clinical characteristics, hospitalization and lethality rates, and duration of illness were analyzed. hospitalization, considering recovery or death as the outcome. The in-hospital lethality rate was also evaluated. In Brazil, in 2020 and 2021, children and adolescents comprised 1.9% and 3.6%, respectively, of SARS-hospitalized cases due to COVID-19. Of these, 57.7% evolved with SARS-critical and 90% survived. The lethality rate was 4.0%. Comorbidities were present in 40.8%, with a predominance of asthma, chronic neurological disease, immunosuppression and chronic cardiovascular disease. The main symptomatology was fever, cough, dyspnea, respiratory distress and low oxygen saturation. Among those with SARS-critical, 91.4% died. As for hospitalization rates, there was a higher prevalence of children, especially under five years of age, and of mixed race/color. Hospitalization time was longer for adolescents with critical illness or comorbidity. Despite lower hospitalization and death rates than adults, the prevalence, complications, and mortality from COVID-19 in the pediatric population are relevant. Knowing the profile of children and adolescents hospitalized due to COVID-19 and the factors associated with deaths allows directing coping actions aimed at this vulnerable population.

Keywords: COVID-19. SARS-CoV-2. Severe Acute Respiratory Syndrome. Hospitalization. Child. Adolescent.

SUMÁRIO

1. INTRODUÇÃO

A infecção pelo novo coronavírus é uma importante doença infecto contagiosa que se originou na cidade de Wuhan, na China em 2019, como uma pneumonia de caráter inespecífico. Se espalhou por todo o território chinês e, em 2020, foi declarada como pandemia pela Organização Mundial de Saúde (OMS, 2020; SAFADI, 2021).

Pouco se sabia sobre essa doença, no início do estado pandêmico. Causada pelo vírus SARS-COV-2, a doença pelo novo coronavírus foi motivo de preocupação em todo o mundo, devido a sua alta transmissibilidade. Sem saber de como seriam as manifestações clínicas e evolução, deixou em alerta toda a sociedade médica mundial (OMS, 2020).

Foi notado que a maioria dos infectados apresentavam sintomas leves como febre, coriza, congestão nasal, tosse, mal-estar, denominados como Síndrome Gripal. Alguns outros pacientes apresentavam sintomas mais exuberantes, que necessitavam de internação para suporte ventilatório. Os grupos de risco eram os idosos, gestantes e pacientes portadores de doenças crônicas.

Havia, inicialmente, pouca informação sobre a população pediátrica. Estudos iniciais mostraram que crianças apresentavam pouca relevância na transmissão do vírus coronavírus (SAFADI, 2021). As crianças e os adolescentes, apresentavam também assintomatologia ou sintomatologia leve, poucos deles evoluindo para casos graves. (SAFADI 2021; CDC, 2020).

A presente dissertação foi elaborada de acordo com as normas estabelecidas pela Pró-Reitoria de Pesquisa e Pós-Graduação da Universidade Federal de Viçosa – UFV. O corpo do trabalho compreende uma introdução, revisão de literatura, objetivos gerais e específicos, metodologia, dois artigos científicos, um produto técnico e conclusão.

O artigo científico intitulado "**Hospitalizations and deaths of children and adolescents with Severe Acute Respiratory Syndrome caused by COVID-19: Brazil, 2020, epidemiological weeks 01 to 53**", encontra-se publicado na Revista do Instituto De Medicina Tropical De São Paulo, (Qualis B1 – Medicina I)..

O artigo científico intitulado "**Hospitalizations and death of Brazilian children and adolescents with Severe Acute Respiratory Syndrome caused by COVID-19"**, encontra-se publicado na revistaThe Journal of Infection in Developing Countries, (Qualis A2 – Medicina I).

O produto técnico derivado dessa dissertação foi uma cartilha **"Como Prevenir COVID- 19 nas Crianças",** produzida com o objetivo de orientar os pais sobre a infecção pelo COVID- 19 nas crianças, seus principais sintomas e orientações de prevenção.

2. REVISÃO DE LITERATURA

No Brasil, as doenças respiratórias que apresentam sintomatologia leve são denominadas de Síndrome Gripal (SG). Essa classificação engloba indivíduos que irão apresentar quadro respiratório agudo acompanhado de, pelo menos, dois dos seguintes sinais e sintomas: febre, mesmo que referida, calafrios, dor de garganta, dor de cabeça, tosse, coriza, distúrbios olfativos ou gustativos. Em crianças, soma-se aos anteriores, a presença de obstrução nasal, na ausência de outro diagnóstico específico. (BRASIL, 2020).

Há que se considerar que alguns pacientes necessitam de hospitalização, por complicações da SG. Esse quadro é caracterizado como Síndrome Respiratória Aguda Grave (SRAG) e, embora a tradução literal para o inglês seja equivalente à sigla SARS (severe acute respiratory syndrome), na verdade corresponde aos casos de severe acute respiratory infection (SARI) embora tecnicamente seja uma síndrome (CDC, 2020).

Os indivíduos acometidos com a SRAG, independentemente da idade, apresentam dispneia/desconforto respiratório ou pressão ou dor persistente no tórax ou saturação de oxigênio inferior a 95% em ar ambiente ou coloração azulada (cianose) dos lábios ou rosto. Em crianças, além dos itens anteriores, se observa batimentos de asa de nariz, cianose, tiragem intercostal, desidratação e inapetência (BRASIL, 2020). Ainda no que tange à definição de SRAG, além do quadro clínico, o indivíduo pode apresentar alterações ao exame de radiografia de tórax (infiltrado intersticial localizado ou difuso, ou área de condensação) ou alterações laboratoriais (leucocitose, leucopenia ou neutrofilia; alterações de enzimas musculares ou hepáticas) (BRASIL, 2017).

Considerando a pandemia de Influenza pelo vírus A (H1N1) em 2009, no Brasil as ações para vigilância epidemiológica de Influenza sofreram modificações, e se definiu como obrigatória a notificação universal de casos hospitalizados e óbitos em decorrência da SRAG, relacionados à influenza. A vigilância foi endossada através da Portaria Consolidada Ministerial Nº 4 de 2017, constando a SRAG associada ao Coronavírus na Lista Nacional de Notificação Compulsória de Doenças, Agravos e Eventos de Saúde Pública (LANA et al, 2020 e BASTOS et al, 2020).

A SRAG novamente passa a tomar lugar de destaque com a Pandemia pelo novo Coronavírus, no final de 2019, quando a Organização Mundial de Saúde (OMS), começa a monitorar um aumento de casos de pneumonia de causa desconhecida em Wuhan, China. No início de 2020, as autoridades chinesas informaram que a causa era um novo tipo de

Coronavírus. A OMS declara então, que o surto da doença constitui uma Emergência de Saúde Pública de Importância Internacional – o mais alto nível de alerta, conforme previsto no Regulamento Sanitário Internacional. No mês de março de 2020, a Corona Virus Disease-19 (COVID-19) foi caracterizada como uma pandemia e, desde então, todos os países, incluindo o Brasil, vêm monitorando a progressão, o comportamento e as respostas dadas à COVID-19, sendo declarado pelo Ministério da Saúde, por meio da Portaria n° 454, o estado de transmissão comunitária em todo o território nacional (BRASIL, 2020 e OMS, 2020).

O novo coronavírus designado como Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-Cov-2) é classificado como um beta Coronavírus do mesmo subgênero da Síndrome Respiratória do Oriente Médio (MERS), porém de outro subtipo. A infecção provocada pelo SARS-CoV-2 é uma zoonose, sendo uma infecção de caráter agudo. A transmissão entre humanos, seus hospedeiros naturais, ocorre principalmente, por contato com gotículas respiratórias oriundas de pacientes doentes, sintomáticos ou não. Em média, o período de incubação é estimado entre 1 a 14 dias, com mediana de 5 a 6 dias. Após isso, o vírus é eliminado e, não encontrando hospedeiro, a doença se encerra (BRASIL, 2020).

Os principais sinais e sintomas nos pacientes acometidos pelo agravo são febre, tosse, dispneia, mialgia e fadiga, sintomas respiratórios superiores e sintomas gastrointestinais, como diarreia. Configura-se como um quadro clínico típico de SG, podendo variar seus sintomas desde uma apresentação leve e assintomática, principalmente em jovens adultos e crianças, até uma apresentação grave, como SRAG, podendo incluir choque séptico e falência respiratória (BRASIL, 2020). Todos os indivíduos são susceptíveis ao COVID-19, sendo que os casos mais graves e propensos para evolução de SG para SRAG hospitalizado se associam aos pacientes idosos (> 60 anos) e/ou com comorbidades (LAI et al, 2020; GAO et al, 2020).

Há poucos estudos abordando crianças e adolescentes, e torna-se necessário rastrear o perfil epidemiológico, suas manifestações clínicas, fatores de risco para complicações, hospitalização e óbitos em crianças e adolescentes com COVID-19 (BERNARDINO et al, 2021). Também há alguns relatos de diferenças regionais importantes nas estimativas do COVID-19 para crianças no Brasil e uma relação entre taxas de mortalidade e desigualdades socioeconômicas.

Dessa forma, o conhecimento das diferenças sócio geográficas nas estimativas do COVID-19 é crucial para o planejamento de estratégias sociais e tomada de decisão local para mitigar os efeitos da doença na população pediátrica (MARTINS-FILHO et al, 2021). Um estudo brasileiro identificou maior letalidade hospitalar entre as crianças menores de 1 ano, seguidas

dos adolescentes de 15 a 19 anos. Apesar deste estudo não ter avaliado as comorbidades, os autores argumentam a possibilidade das condições crônicas preexistentes entre os adolescentes com COVID-19 hospitalizados (HILLESHEIM et al, 2020).

Considerando algumas variações de acordo com as políticas de confirmação de casos adotadas em cada país, incluindo a realização de testes de confirmação laboratoriais, estima-se que atualmente a taxa de letalidade pediatrica para COVID-19 seja de 2,2%, embora no Brasil, esteja em torno de 3,8% (BRASIL, 2020).

Também deve-se ressaltar que a Agência Nacional de Vigilância Sanitária (Anvisa) autorizou, no dia 11 de junho de 2021, o uso da vacina da Pfizer contra a Covid-19 em adolescentes a partir dos 12 anos de idade no Brasil. A vacinação para crianças de 5 a 11 anos foi liberada em caráter não obrigatório em janeiro de 2022, sendo inicialmente vacinadas com Pfizer e Coronavac. A liberação da vacinação para crianças com 3 e 4 anos, ocorreu em julho de 2022 com o imunizante Coronavac.

Ainda diante de um cenário de escassez de conhecimentos científicos robustos sobre onovo coronavírus e, considerando sua alta velocidade de disseminação e a sua capacidade de provocar mortes em populações vulneráveis, prevalecem incertezas sobre quais seriam as melhores estratégias a serem utilizadas para o enfrentamento da pandemia em diferentes partesdo mundo e no Brasil (WERNECK, CARVALHO, 2020).

O contexto da pandemia tem externado algumas fragilidades estruturais e pontos de estrangulamento do Sistema Único de Saúde (SUS). Por outro lado, também tem se revelado as potencialidades do maior sistema de saúde público e universal do mundo, de papel preponderante na vigilância em saúde e na assistência à saúde, assim como na organização e articulação das ações de enfrentamento à pandemia, nos níveis de gestão municipal, estadual e federal do SUS (CRODA, GARCIA, 2020 e RIBAS et al, 2020).

Como aspectos desafiadores estão o monitoramento e a notificação dos casos suspeitosde SRAG. As notificações dos casos hospitalizados de SRAG são incluídas em um sistema de informação, denominado Sistema de Informação de Vigilância Epidemiológica da Gripe (SIVEP-Gripe).

Esse sistema foi desenvolvido para dar suporte às ações da vigilância da influenza e vem sendo utilizado até os dias atuais. Os dados da vigilância são coletados por meio de formulários padronizados e inseridos on-line, via internet. A alimentação do sistema é realizadano nível local, nas unidades sentinelas, e pelos laboratórios de referência regionais e nacional, que preenchem dados relativos aos resultados dos exames como a caracterização antigênica dovírus. Em 2012, o sistema foi adequado ao novo modelo de vigilância, conforme a Portaria Ministerial

Nº 2.693 publicada em 26 de abril de 2012, e implementadas rotinas para monitoramento dos casos de SRAG internados em leitos clínicos e nas Unidades de Terapia Intensiva (UTI) dos hospitais e as unidades sentinelas (BRASIL, 2013).

Por conseguinte, o principal objetivo do SIVEP-Gripe é a inserção e disseminação dosdados da vigilância sentinela de SG e SRAG, fornecendo informações em tempo real para análise e tomada de decisões pelos gestores e profissionais de saúde (BRASIL, 2013). Para queos dados possam nortear condutas nas diferentes esferas administrativas, espera-se que sejam completos e confiáveis. Um estudo realizado com os dados de notificação do SIVEP-Gripe entre o período de 2014 a 2016, indica que o sistema é capaz de fornecer informações completas,representativas e úteis sobre influenza, adequadas para balizar respostas do sistema de saúde (RIBEIRO, SANCHEZ; 2020). No entanto, com a pandemia da COVID-19 observou- se um aumento dos casos de hospitalização por SRAG e ausência de estudos que avaliem em âmbito nacional a qualidade dos dados disponíveis, bem como o comportamento da doença nas diferentes regiões do Brasil.

Nesse contexto, levantou-se o seguinte **questionamento**: *Como o conhecimento dos dados disponíveis no SIVEP-Gripe e do comportamento da SRAG nas diferentes regiões do Brasil pode colaborar para o planejamento e a gestão da assistência aos pacientes com SRAG hospitalizados?*

Em face do exposto e diante do desafio apresentado, esse estudo visa analisar o perfil das hospitalizações e os fatores associados aos óbitos de crianças e adolescentes com Síndrome Respiratória Aguda Grave (SRAG) por COVID-19, em âmbito nacional.

3. OBJETIVOS

3.1. Objetivo Geral

Analisar o perfil das hospitalizações e os fatores associados aos óbitos de crianças e adolescentes com Síndrome Respiratória Aguda Grave (SRAG) por COVID-19, em âmbito nacional

3.2. Objetivos específicos

- Analisar o perfil epidemiológico de crianças e adolescentes hospitalizados com SRAG por COVID-19, nas diferentes regiões do Brasil.
- Analisar as taxas de hospitalização, letalidade e recuperação de crianças e adolescentes

com SRAG por COVID-19, nas diferentes regiões brasileiras.

- Analisar a duração da hospitalização de crianças e adolescentes com Síndrome
- Respiratória Aguda Grave pela COVID-19.
- Analisar os fatores associados à mortalidade de crianças e adolescentes, entre os casoshospitalizados de SRAG por COVID-19.
- Elaborar uma cartilha educativa para a prevenção da COVID-19 em crianças e adolescentes.

4. METODOLOGIA

4.1. Tipo de Estudo

Para a dissertação, foram realizados dois estudos transversais. O primeiro estudo transversal foi baseado na análise de dados de crianças e adolescentes hospitalizados, com diagnóstico de COVID-19 confirmado no teste de biologia molecular e com resultado detectável para SARS-CoV- 2, tendo como desfecho a evolução, caracterizada como óbito ou recuperação.

Os dados utilizados são secundários, não nominais, de abrangência nacional, provenientes doSistema de Informação de Vigilância Epidemiológica da Gripe (SIVEP-Gripe), de domínio público, disponibilizados no sítio eletrônico do Ministério da Saúde (MS)<https://dados.gov.br/dataset/bd- srag-2020> e acessados no dia 26 de abril de 2021, que incluem os casos notificados em 2020, entreas semanas epidemiológicas 01 a 53.

O segundo estudo também se tratou de estudo transversal. Neste foi realizada a análise dos dados da vigilância epidemiológica dos casos de crianças e adolescentes hospitalizados por SRAG no âmbito nacional devido à COVID-19, em 2021. Os dados utilizados foram, novamente, de banco de dados secundários, não nominais, sem qualquer identificação dosindivíduos, proveniente do SIVEP-Gripe, referente às internações ocorridas no ano de 2021, disponível no site: <https://opendatasus.saude.gov.br/> e atualizado em 07 de fevereiro de 2022.

4.2. Local do estudo

Utilizaram-se dados secundários, não nominais, de abrangência nacional, provenientes do Sistema de Informação de Vigilância Epidemiológica da Gripe (SIVEP-Gripe), de domínio público, disponibilizados no sítio eletrônico do Ministério da Saúde (MS), incluindo os casos notificados com data de início de sinais e sintomas entre 1º de janeiro de 2020 a 31 de dezembro de 2021.

4.3. Participantes

A população de estudo foi composta pelos casos hospitalizados de SRAG registrados no Sistema de Informação Epidemiológica da Gripe (SIVEP-Gripe), entre os anos de 2020 e 2021. Foram incluídos os casos hospitalizados de SRAG entre crianças (zero a onze anos de idade) e adolescentes (doze a dezenove anos de idade), com diagnóstico de COVID-19 confirmado por critério laboratorial e notificados pelos prestadores hospitalares de diferentes regiões do Brasil, no período de 01/01/2020 a 31/12/2021.

4.4. Coleta de Dados

Foram utilizados como fontes de informação os bancos de dados secundários, não nominais, sem qualquer identificação dos indivíduos, provenientes do Sistema de Vigilância Epidemiológica da Gripe (SIVEP-Gripe) dos anos 2020 a 2021 disponíveis no site: https://opendatasus.saude.gov.br/.

O SIVEP-Gripe inclui os dados da ficha de notificação individual dos casos de SRAG-hospitalizado. A ficha de notificação de SRAG-hospitalizado inclui variáveis de caracterização sociodemográfica, clínica e de investigação diagnóstica. As variáveis são divididas entre as que possuem preenchimento obrigatório, cuja ausência de dado impossibilita a inclusão do registro no sistema; essencial, que apesar de não ser obrigatório, registra dado necessário à investigação do caso ou ao cálculo de indicador epidemiológico ou operacional e opcional, que só deve ser preenchido caso seja necessário. Além disso, o SIVEP-Gripe possui um campo interno, que apesar de não constar na ficha de notificação e não aparecer no display da tela, é preenchido automaticamente pelo sistema.

As variáveis de interesse foram: a) sociodemográficas: idade, sexo, raça/cor autodeclarada, zona geográfica e região brasileira de residência; b) clínicas: sinais e sintomas; comorbidade (doença cardiovascular crônica, doença hematológica crônica; Síndrome de Down;doença hepática crônica; asma; diabetes Mellitus; doença neurológica crônica; doença pulmonarcrônica; imunodepressão; doença renal crônica e obesidade); internação em unidade de terapia intensiva e suporte ventilatório (invasivo e não invasivo); c) desfechos: duração da hospitalização, taxas de letalidade intra-hospitalar e evolução do caso (sobrevivência ou óbito).

4.5. Análise de Dados

Os dados foram processados e analisados utilizando-se os programas estatísticos Statistical Package for Social Science (SPSS), versão 23.0, QGIS 2.18 “Las palmas” e Microsoft Excel 2016 . Realizou-se análise descritiva e inferencial. Avaliou-se a normalidade das variáveis pelo teste de Kolmogorov-Smirnov. Para a análise descritiva foram utilizadas as distribuições de frequências absoluta e relativa, medidas de tendência central e medidas de variabilidade, de acordo com o resultado do teste de normalidade.

A taxa de letalidade intra-hospitalar foi calculada considerando-se o número total dos óbitos hospitalares dividido pelo total de casos hospitalizados, multiplicado por 100.

Para a análise bivariada, quando as variáveis eram categóricas, utilizou-se o teste do Qui-quadrado de Pearson e, na comparação entre medianas, utilizaram-se os testes não paramétricos de Mann-Whitney ou Kruskal-Wallis.

A medida de associação adotada foi o Odds Ratio ajustado (ORa), com intervalo de confiança (IC) de 95% e considerou-se significativo o valor de $p < 0,05$. Verificou-se o ajuste do modelo pelo R2 de Nagelkerke e teste de Hosmer e Lemeshow.

4.6. Construção da Cartilha

Como Produto Técnico deste estudo foi elaborada uma cartilha com base na literatura científica, utilizando linguagem acessível e figuras ilustrativas. A cartilha intitulada "Como Prevenir a COVID-19 nas Crianças” contém sete páginas e foi desenvolvida em formato lúdico, tendo como público-alvo a população leiga, em particular, pais e responsáveis, com o objetivo de informar os principais sintomas, a forma de transmissão e os métodos de prevenção da COVID-19.

4.7. Aspectos éticos

Por se tratar de uma pesquisa que inclui apenas dados de domínio público e que não identifica os participantes, não houve necessidade da aprovação por parte do Comitê de Ética em Pesquisa com Seres Humanos.

5. RESULTADOS

5.1. Artigo 1

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Hospitalizations and deaths of children and adolescents with Severe Acute Respiratory Infection due to COVID-19 during the epidemiological year of 2020

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ABSTRACT

This study aimed to analyze the profile of hospitalizations and factors associated with the deaths of children and adolescents with severe acute respiratory infection (SARI) caused by SARS-CoV-2 nationwide. The study comprised 6,843 children and adolescents hospitalized in 2020 who tested positive for COVID-19, based on data from the Influenza Epidemiological Surveillance Information System. Sociodemographic and clinical profiles, hospitalization frequency, lethality and recovery rates were analyzed. The outcome was recovery or death. The 6,843 children and adolescents comprised 1.9% of SARI hospitalized cases (n = 563,051). Of these, 57.7% developed critical SARI and 90% survived. Comorbidities were present in 40.8%, especially asthma, immunodepression, and neurological and cardiovascular diseases. The main symptoms were fever, cough, dyspnea, respiratory distress, and low oxygen saturation. Among those with critical SARI, 91.4% died. There was a higher frequency of children, especially those under five years of age and of mixed ethnicity. The highest hospitalization frequency occurred in the Southeastern and Northeastern regions, the highest recovery rates in the Southeastern and Southern regions, and the highest lethality rates in the Northern and Northeastern regions. Deaths were associated with ages ranging from 12 to 19 and being under one year of age, living in the Northern and Northeastern regions, progression to critical SARI, and having immunosuppression and cardiovascular disease. In contrast, asthma was associated with lower death rates. The frequency of complications and mortality rates caused by SARS-Cov-2 in the pediatric population are relevant, as well as the severity of the epidemic in the social inequality context and the health services' frailty.

KEYWORDS: COVID-19. SARS-CoV-2. Severe acute respiratory syndrome. Hospitalization. Children. Adolescents. Pediatric.

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INTRODUCTION

Infection by the novel coronavirus occurs in all age groups, however, it is known that adults and the elderly present higher morbidity when infected and, thus, more case reports when compared to children and adolescents. According to the Centers for Disease Control and Prevention (CDC), the pediatric population is believed to represent approximately 2 to 13% of all confirmed cases[1,2].

Worldwide, it has been noted that the vast majority of children present with mild clinical symptoms whereas moderate and severe symptoms are more common among adults. The reason for this is not yet completely clear. Some hypotheses for the lower infection rate of children by SARS-CoV-2 stem from the fact that

their humoral and cellular immune systems are still developing, the immaturity of the angiotensin-converting enzyme 2 (ACE2) receptors in the respiratory epithelium of children, and the greater integrity of the endothelium and coagulation system. However, a small fraction of the pediatric population infected with the novel coronavirus requires hospitalization for developing the severe form of the disease and presenting with severe acute respiratory infection (SARI) as the presence of comorbidities increases the risk of complications[1-6].

Brazil is a large country with great socio-economic variety. It has been suggested that COVID-19 has a disproportionate effect on the most vulnerable, considering the frailty of health services, social inequalities, and increased risks of contagion and spread of respiratory infections in crowded environments, all these factors impacting the morbidity and mortality from the disease[7-10].

This study aims to increase the knowledge about the novel coronavirus in the pediatric population. It is known that SARS-CoV-2 presents high transmissibility, morbidity, and mortality rates worldwide. However, the knowledge regarding its effects on children and adolescents is still limited, which highlights the need for further studies. In this sense, this article aims to analyze the profiles of hospitalizations and factors associated with the deaths of children and adolescents diagnosed with SARI caused by COVID-19 in Brazil.

MATERIALS AND METHODS

A cross-sectional study with hospitalized children and adolescents who tested positive for COVID-19 on molecular biology testing (reverse transcriptase followed by quantitative polymerase chain reaction – RT-qPCR) with detectable results for SARS-CoV-2 was carried out, with the outcome being either death or recovery.

Secondary, non-nominal, nationwide data from the public domain Influenza Epidemiological Surveillance Information System (SIVEP-Gripe), available on the Ministry of Health website[11] and accessed on April 26, 2021, were used to include cases reported in 2020, between epidemiological weeks 01 to 53.

All child and adolescent patients classified as having SARI caused by COVID-19, with detectable RT-qPCR results and case closure criteria defined as laboratory-based, were included. Patients diagnosed by clinical, clinical-epidemiological or clinical-imaging criteria, patients without RT-PCR results or with inconclusive results, and patients with omitted data were excluded[1,2].

Individuals aged from zero to 11 years were considered to be children, while adolescents were considered to be those aged from 12 to 19 years. Children and adolescents with COVID-19 who presented at least one of the signs and symptoms, such as dyspnea, respiratory distress, low oxygen saturation (< 95%) under room air condition, and cyanosis, were classified as SARI cases. Those with SARI who required admission to the intensive care unit (ICU) or needed invasive or non-invasive ventilatory support were classified as critical SARI. COVID-19 infection was assumed when patients tested positive on the RT-qPCR test for SARS-CoV-2 infection[1,2].

The variables of interest were as follows: epidemiological week of first symptom onset; evolution (death and recovery); Brazilian region of residence and hospitalization; gender (male, female, and undetermined); age in years; self-reported ethnicity (Caucasian, African, Asian, Mixed, and Native); signs and symptoms; comorbidity; admission to ICU; and ventilatory support (invasive and non-invasive). For the analysis of factors associated with death, secondary variables were created and added based on the main ones, namely: age in years/age group and critical SARI.

For the descriptive analysis, measures of absolute and relative frequency, central tendency, and dispersion were calculated. The intra-hospital lethality rate was calculated as the total number of inpatient deaths was divided by the total number of hospitalized cases, multiplied by 100. The recovery rate was calculated as the total number of hospital discharges was divided by the total number of hospitalized cases, multiplied by 100. For the bivariate analysis, the Pearson's Chi-squared test was applied, while the crude Odds Ratio (OR) with a Confidence Interval (CI) of 95% and $p < 0.05$ was used as a measure of association, and the nonparametric Mann-Whitney's test was used for the comparison between medians.

Multivariate statistical analysis was performed using binary logistic regression, using the backward stepwise method (Wald), considering the number of independent variables obtained by the bivariate analysis ($p < 0.10$). The association measure used was the Adjusted Odds Ratio (AOR). Nagelkerke's R^2 and Hosmer–Lemeshow's tests were used to adjust the model. A hierarchical model was built in three blocks: the first block included sociodemographic data; the second block included disease severity and the presence of morbidity; and the third block included variables related to the identified morbidities. A p-value of < 0.05 was considered significant.

The SPSS (version 23.0, IBM, NY, USA), QGIS (version 3.20, Open-Source Geospatial Foundation, Delaware, USA), and Microsoft Excel (version 2016, Microsoft Corporation, Washington, USA) were the software used for data processing and analysis.

RESULTS

During the epidemiological weeks from 1 to 53 of the year 2020, a total of 563,051 SARI-hospitalized cases due to COVID-19 were reported, of which 10,850 cases included children and adolescents (1.9%). A total of 4,007 cases were excluded, consisting of the following: 709 cases that had been confirmed only by clinical, clinical-epidemiological, or clinical imaging criteria; 3,205 cases with undetectable, inconclusive, or no RT-qPCR result at the time of hospitalization; and 93 cases with missing data. Applying this study's inclusion and exclusion criteria, the records of 6,843 children and adolescents were analyzed, whose death and recovery rates were 10% (685), and 90% (6,158), respectively.

Regarding the age group, a higher frequency of children (5,123; 74.9%) was observed, with a median age of three years (Q1: 0.8; Q3: 12.0). The age groups were distributed as follows: under one year, 29.9% (2,046); aged from one to four years, 24.1% (1,649); aged from five to 11 years, 20.8% (1,423); aged from 12 to 14 years, 8.0% (547), and aged from 15 to 19 years, 17.1% (1,170).

A higher frequency of females (3,635; 53.1%) and of self-declared Mixed ethnicity (2,809; 53.1%) was observed. With regards to locality, most individuals lived in urban areas (5,755; 93.7%), 45.8% (3,135) of the hospitalizations occurred in the Southeastern region, 26.7% (1,827) in the Northeastern region, 11% (753) in the Southern region, 8.8% (602) in the Northern region, and 7.7% (526) in the Central-western region.

Most were classified as critical SARI (3,483; 57.7%) and progressed towards the recovery of their state of health (6,158; 90.0%). Comorbidities were present in 40.8% of patients (n = 2,793) and, in descending order, the most frequent were asthma, chronic neurological disease, immunodepression, and chronic cardiovascular disease.

Regarding the magnitude of SARI caused by COVID-19 among children and adolescents in different regions of Brazil (Figure 1), the Southeastern and Northeastern regions, however, presented the highest hospitalization

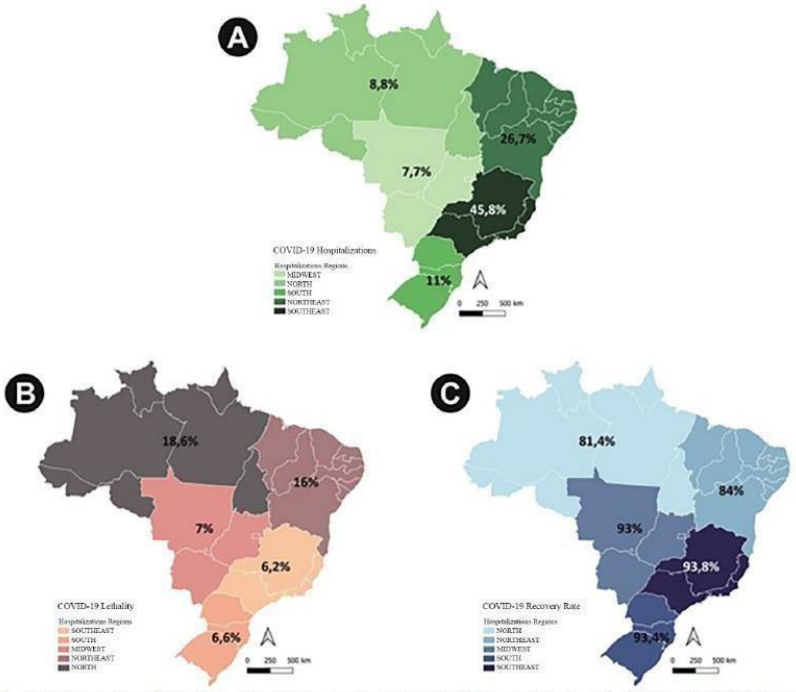

Figure 1 - Prevalence of hospitalizations, lethality and recovery rates of children and adolescents diagnosed with SARI caused by COVID-19, according to Brazilian regions. SIVEP-Gripe, 2020, Brazil (n = 6,843). Source: Brasil. Ministério da Saúde. DATASUS[11].

frequency (45.8% and 26.7%, respectively). Lethality rates were higher in the Northern and Northeastern regions (18.6% and 16%). In contrast, the recovery rates were predominant in the Southeastern (93.8%) and Southern (93.4%) regions.

The main signs and symptoms observed among the hospitalized children and adolescents, in decreasing order of frequency, were the following: fever (4,548; 73.9%), cough (3,953; 66.3%), dyspnea (3,401; 58.9%), respiratory distress (3,236; 56.9%), and low oxygen saturation (2,412; 43.9%). As presented in Figure 2, according to the outcomes of either recovery or death, the symptoms were as follows: a) among those who recovered from COVID-19, fever (74.0%), cough (67.1%), dyspnea (56.6%), and respiratory distress (54.3%); b) among those who died, respiratory distress (79.7%), dyspnea (78.6%), low oxygen saturation (73.9%), and fever (73.7%). It is noteworthy that the development of critical SARI occurred in 91.4% of the patients who died. Other symptoms such as anosmia, ageusia, fatigue, abdominal pain, and odynophagia were less frequent.

Based on the data in Table 1, of the patients who died compared to those who recovered, the distribution of deaths showed a higher concentration among the age groups under one year of age (35.5%) and adolescents aged 15 to 19 years (23.4%), among individuals of Mixed ethnicity (53.3%), rural residents (10.8%), and inhabitants of the Northeastern and Northern regions (42.6% and 16.4%, respectively). The median length of hospitalization was longer among the patients who died (7 days). Moreover, of the patients who died, a higher proportion of them presented critical SARI (91.4%) and comorbidities (64.8%), especially chronic neurological disease (12.7%), immunodepression (12.7%), chronic cardiovascular disease (10.8%), chronic kidney disease (4.5%), and chronic liver disease (1.8%). It should be noted that asthma was found in a higher proportion among the recovered patients (8.6%).

Table 2 presents the analysis results of the factors associated with death among the studied population: children under one year of age (OR = 1.806; p = 0.028); adolescents aged 12 to 14 years (OR = 2.039; p = 0.029) and adolescents aged 15 to 19 years (OR = 2.360; p = 0.001); residents of the Northern (OR = 3.100; $p < 0.001$) and Northeastern (OR = 2.523; $p < 0.001$) regions; cases classified as critical SARI (OR = 9.668; $p < 0.001$); and also the presence of immunosuppression (OR = 2.747; $p < 0.001$) and chronic cardiovascular disease (OR = 1.726; p = 0.028). However, asthma was considered a protective factor, and the death ratio was lower among the children and adolescents who had this comorbidity (OR = 0.318; $p < 0.001$).

It should be noted that, despite not being confirmed in the multivariate analysis, the mixed and native ethnicities had a higher chance of death in the bivariate analysis (OR = 1.689; $p < 0.001$ and OR = 6.204; $p < 0.001$, respectively).

DISCUSSION

This study aimed to analyze the profile of hospitalizations and the factors associated with the deaths of children and adolescents with SARI caused by SARS-CoV-2, nationwide, during a 12-month period.

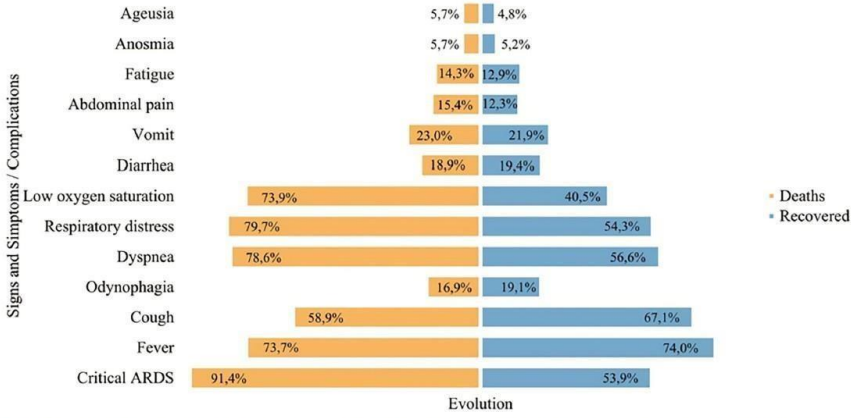

Figure 2 - Signs, symptoms, and complications according to the outcome of either death or recovery, among children and adolescents hospitalized with SARI caused by COVID-19. SIVEP-Gripe, 2020, Brazil (n = 6,843). Source: Brasil. Ministério da Saúde. DATASUS[11].

Table 1 - Development of hospitalized cases due to COVID-19 according to the children and adolescents' profiles. SIVEP-Gripe, 2020, Brazil (n = 6,843).

Profile	Deaths (n = 685)		Recoveries (n = 6,158)		p-value
	n or med	% or Q_1–Q_3	n or med	% or Q_1–Q_3	
Age (years)					< 0.001
< 1	243	35.5	1,805	29.3	
1–4	103	15.0	1,549	25.2	
5–11	105	15.3	1,318	21.4	
12–14	74	10.8	476	7.7	
15–19	160	23.4	1,010	16.4	
Gender					0.719
Female	325	47.4	2,881	46.8	
Male	359	52.4	3,276	53.2	
Self-declared ethnicity					<0.001
Caucasian	176	25.7	1,991	32.3	
African	20	2.9	213	3.5	
Asian	3	0.4	31	0.5	
Mixed	365	53.3	2,444	39.7	
Native	17	2.5	31	0.5	
Geographical residence area					<0.001
Urban	526	76.8	5,229	84.9	
Rural	74	10.8	265	4.3	
Peri-urban	3	0.4	45	0.7	
Country macro-region					<0.001
North	112	16.4	490	8.0	
Northeast	292	42.6	1,532	24.9	
South	50	7.3	705	11.4	
Southeast	194	28.3	2,941	47.8	
Central-west	37	5.4	490	8.0	
Critical SARS	560	91.4	2,923	53.9	< 0.001
Length of hospitalization (days)	7	2–20	5	3–11	< 0.001
Comorbidity	444	64.8	2,349	38.1	< 0.001
Asthma	23	3.4	527	8.6	< 0.001
Chronic neurological disease	87	12.7	316	5.1	< 0.001
Immunodepression	87	12.7	281	4.6	< 0.001
Chronic cardiovascular disease	74	10.8	212	3.4	< 0.001
Chronic hematological disease	29	4.2	141	2.3	0.539
Chronic lung disease	26	3.8	137	2.2	0.772
Diabetes Mellitus	23	3.4	128	2.1	0.975
Chronic kidney disease	31	4.5	83	1.3	< 0.001
Obesity	17	2.5	80	1.3	0.530
Down Syndrome	18	2.6	71	1.2	0.170
Chronic liver disease	12	1.8	28	0.5	0.009

SARI = severe acute respiratory infection; ICU = intensive care unit; SIVEP-Gripe = Influenza Epidemiological Surveillance Information System; n = absolute frequency; % = relative frequency; med = median; Q1 = 1st quartile (25%); Q3 = 3rd quartile (75%); SpO2 < 95% = Oxygen saturation lower than 95%; p-value from Pearson's Chi-squared test; the values refer to the total valid answers; missing data were disregarded.

Table 2 - Univariate and multivariate analysis of factors associated with the risk of progression towards death by COVID-19 in children and adolescents hospitalized with SARI caused by COVID-19, 2020, Brazil.

Variable	Crude OR			Adjusted OR		
	OR	CI 95%	p-value	AOR	CI 95%	p-value
Age (years)						
< 1	2.025	1.592–2.574	< 0.001	1.806	1.064–3.064	0.028
1–4	1.000	-	-	1.000	-	-
5–11	1.198	0.904–1.588	0.208	1.093	0.613–1.951	0.762
12–14	2.338	1.705–3.206	< 0.001	2.039	1.075–3.868	0.029
15–19	2.382	1.837–3.090	< 0.001	2.360	1.390–4.006	0.001
Self-declared ethnicity						
Caucasian	1.000	-	-	1.000	-	-
African	1.062	0.655–1.723	0.807	-	-	-
Asian	1.095	0.331–3.617	0.882	-	-	-
Mixed	1.689	1.398–2.042	< 0.001	-	-	-
Native	6.204	3.366–11.432	< 0.001	-	-	-
Geographical residence area						
Urban	1.509	0.467–4.872	0.492	-	-	-
Rural	4.189	1.266–13.862	0.019	-	-	-
Peri-urban	1.000	-	-	1.000	-	-
Country macro-region						
North	3.465	2.695–4.456	< 0.001	3.100	1.779–5.399	< 0.001
Northeast	2.889	2.385–3.500	< 0.001	2.523	1.666–3.821	< 0.001
South	1.075	0.780–1.483	0.659	1.435	0.857–2.401	0.169
Southeast	1.000	-	-	1.000	-	-
Central-west	1.145	0.795–1.648	0.467	0.926	0.458–1.869	0.829
Critical SARI	9.055	6.798–12.061	< 0.001	9.668	5.461–17.117	< 0.001
Comorbidity	2.987	2.533–3.523	< 0.001	-	-	-
Asthma	0.198	0.127–0.307	< 0.001	0.31	0.174–0.582	< 0.001
Chronic neurological disease	1.669	1.263–2.207	< 0.001	1.477	0.978–2.231	0.064
Immunodepression	1.979	1.492–2.625	< 0.001	2.74	1.763–4.280	< 0.001
Chronic cardiovascular disease	2.102	1.557–2.838	< 0.001	1.726	1.061–2.809	0.028
Chronic kidney disease	2.135	1.383–3.296	0.001	-	-	-
Chronic liver disease	2.426	1.218–4.833	0.012	-	-	-

SARI = severe acute respiratory infection; OR = Odds Ratio; CI = confidence interval; AOR = Adjusted Odds Ratio; Nagelkerke's R^2: 0.253; Hosmer–Lemeshow's test (adjustment quality): p = 0.934; Variables included in the multivariate logistic regression: 1st Block = age, ethnicity, geographical area, country macro-region; 2nd Block = critical SARI, morbidity; 3rd Block = asthma, chronic neurological disease, immunodepression, chronic cardiovascular disease, chronic kidney disease, chronic liver disease; Significant p < 0.05. Source: Brasil. Ministério da Saúde. DATASUS[11].

In 2020, children and adolescents comprised 1.9% of SARI-hospitalized cases due to COVID-19 in Brazil. It is noteworthy that, among the hospitalized children and adolescents, although 57.7% of them developed critical SARI, 90% survived. Moreover, in the present study, 40.8% had comorbidities, especially asthma, chronic neurological disease, immunodepression, and chronic cardiovascular disease.

The present study's findings are corroborated by other studies demonstrating that children and adolescents represent 2 to 13% of all confirmed COVID-19 cases and that most of them present less severe forms, although a significant number of hospitalized patients require intensive care, but with improved prognosis and lower occurrence of deaths when compared to the adult population[1,4,12-14]. An association exists between the severity of the disease and

the presence of comorbidities, such as immunodepression, cardiovascular diseases, and neuropathies, along with clinical manifestations, such as fever, dyspnea, and respiratory distress[1,10,15].

Recent evidence is available in the literature that the cellular ACE2 receptor and TMPRSS2 protease, required for SARS-CoV-2 entry into cells and tissue distribution, may differ between the pediatric and adult populations, and that in the former, ACE2 receptors are distinct in their configuration, concentration, or ability to bind to the virus. In addition, other viruses present in children's airway mucosa may limit SARS-CoV-2 replication by direct competition[12,13,16,17].

The main symptomatology found in hospitalized children and adolescents included fever, cough, dyspnea, respiratory distress, and low oxygen saturation. Other studies also report fever and cough as the most frequent symptoms, with the presence of some associated gastrointestinal symptoms[12,15,18]. When analyzing the patients who died, the main signs and symptoms found were respiratory distress, dyspnea, and low oxygen saturation. It should be noted that 91.4% of those who progressed to critical SARI died. Among the hospitalized patients, a significant number required ICU treatment, and there was an association between the severity of the disease and the presence of clinical manifestations such as fever, dyspnea, and respiratory distress[1,14,15]. The association of critical SARI with mortality or death risk should be highlighted and is explained by the need for ventilatory support or intensive care. Children and adolescents with more severe respiratory system impairment, septic shock, or organ dysfunction, with a consequent need for invasive or non-invasive ventilatory support and ICU admission, develop more severity and mortality[19].

When analyzing the hospitalization frequency, a higher occurrence was observed in the children's age group, especially those under five years of age and among those of self-reported Mixed ethnicity. Respiratory diseases are among the leading causes of hospitalizations for Brazilian children in the first five years of life, and Mixed ethnicity is frequent in the Brazilian population, especially those with low income. Thus, it is possible to suggest a disproportionate effect of COVID-19 among the most vulnerable, when considering social inequalities and the increased risks of contagion and spread of respiratory infections[7-10].

In this study, adolescents and children under one year of age presented a higher death rate when compared to the other age groups. Thus, despite the higher hospitalization frequency in children under five years of age, adolescents presented higher death rates, followed by children under one year of age. It is possible that the presence of comorbidities among adolescents hospitalized with COVID-19 is associated with greater severity and mortality from the disease. There is evidence that the occurrence of chronic diseases such as obesity, congenital heart disease, immunosuppressive diseases, and diabetes mellitus among adolescents may explain these findings[20-23]. In addition, the incidence of complications such as congenital heart disease and those related to prematurity may progress to death in children under one year of age[20]. A recent systematic review also associates a propensity for greater severity and mortality among children under one year of age and adolescents[24].

Although this study showed an association between death and ethnicity among the mixed and native groups in the bivariate analysis, this association was not confirmed after adjustment in the multivariate analysis. Missing data may have led to a study bias, as there seems to be an intertwining between race, social inequality and health care disparity, with a greater risk of unfavorable outcomes among patients from the poorest regions of the country and certain ethnic groups[25].

In our study, the comorbidities that remained associated with a higher death rate were immunodepression and chronic cardiovascular disease. The data found are supported by a recent systematic review, which associates propensity to greater severity or mortality among children under one year of age and adolescents, among those with cardiac or neurological conditions, with two or more comorbidities, and those with obesity[24]. Another study also converges in this sense and reports age and pre-existing comorbidities as the main risk factors[26]. In contrast, a study conducted in a tertiary care hospital in India found no associations between the presence of comorbidities in pediatric patients hospitalized with COVID-19 and disease severity, length of hospitalization, need for ventilation, or mortality. However, the authors report the small sample size and the retrospective design as limitations[18].

In this study, asthma was considered a protective factor, that is, death rates were lower among children and adolescents with this comorbidity. A case-control study identified asthma as a risk factor for hospitalization in children with COVID-19, but not as a risk factor for worse disease outcomes[27]. In this light, the literature provides mechanisms that justify asthma not being a risk factor for severity or mortality in patients with COVID-19. Some of the hypotheses would be that patients with asthma are under adequate disease control at the time of infection with SARS-CoV-2, that the presence of asthma upon hospitalization leads to differential care during hospital treatment, or that they were under corticosteroid treatment before becoming infected with SARS-CoV-2[1,5].

Furthermore, the reduced levels of ACE2 in the nasal and bronchial cells of atopic patients may explain the peculiarities in the immune response of atopic patients when exposed to SARS-CoV-2 infection[4,6].

In this study, regarding the Brazilian regions, the highest hospitalization frequency occurred in the Southeastern and Northeastern regions, the highest recovery rates occurred in the Southeastern and Southern regions, and the highest lethality rates occurred in the Northern and Northeastern regions. Furthermore, an association effect between living in the Northern and Northeastern regions and a higher death rate was shown. Regarding hospitalizations due to SARI in different Brazilian regions, a recent study assessed the participation of health units of different administrative spheres and showed the important role of the Brazilian public health system in the Northern and Northeastern regions, which is of paramount importance, especially for those living in economically disadvantaged situations[28]. Brazil is a continental-sized country with social inequalities, and the differences in rates of infection and mortality from COVID-19 emerge as a result of concurrent non-communicable diseases, social vulnerability, and the frailty of health services. The economically disadvantaged population is prone to sharing a household with more people and having comorbidities, which represent risk factors for the greater severity of COVID-19[10,29,30]. However, it is worth noting that even so, cases of SARS-CoV-2 infection are subject to underreporting[30]. A Brazilian study demonstrates the challenge of regionalized organization of health services during pandemics, especially when great distances are involved for patients, as observed in the Northern, Northeastern, and Central-western regions[31].

According to the 2016 Brazilian ICU Census, issued by the Brazilian Intensive Care Medicine Association, there are, on average, 2.84 pediatric ICU beds for every 10,000 pediatric residents in Brazil[32]. When analyzing the distribution of pediatric ICU beds by Brazilian region, the distribution is as follows: North 1.1; Northeast 1.60; Central-west 2.80; Southeast 4.07; South 3.22. It is also noteworthy that the number of pediatric ICU beds in the Southeastern region (2,296 beds; 52%) is already equivalent to the sum of the other Brazilian macro-regions. In addition, it is worth questioning the impact that access to health care in the Northern and Northeastern regions had on the higher lethality rates, especially in the inland cities, since 70% of the pediatric intensive care unit beds are located in the state capitals. It would also be interesting to consider, in addition to health care inequalities, the socioeconomic aspects and social vulnerability in these regions, since these can also impact the mortality rates[10,30,32].

Strengths and weaknesses of this study

Using a rich dataset covering children and adolescents nationwide, comprising 6,843 RT-qPCR-confirmed COVID-19 hospitalizations over a 12-month period, or 53 epidemiological weeks, this study has provided a profile of sociodemographic and clinical characteristics and the factors associated with mortality from the disease.

Some limitations in this study should also be acknowledged. Firstly, there are low data about epidemiological information on pre-existing comorbidities, as this information is not mandatory. On this basis, estimates from these variables should be interpreted with caution due to the potential underreporting bias. Secondly, these data do not enable analyzing the effects of intra-hospital quality of care from the perspective of physical infrastructure or human resources. And finally, the data only assessed the hospitalized population, not allowing inferences on the cases of COVID-19 that had no record of hospital admission.

Implications for clinical practice and health policies

Since the pandemic outbreak, concerns have been raised by health authorities regarding the collapse of health care systems and the shortage of clinical hospital and ICU beds for patients with moderate and severe forms of COVID-19. This study's findings suggest that, nationally, regional differences in the survival rates of hospitalized pediatric patients may be explained by geographic access to hospital and ICU beds.

From this study's results, it is possible to highlight the factors related to the Brazilian pediatric population that led to greater rates of intra-hospital death: age (12 to 19 years and less than one year old), the macro-region of residence in the country (Northern and Northeastern regions), the most severe clinical progression, which requires ventilatory assistance and/or ICU (critical SARI) and the presence of certain comorbidities (immunodepression and chronic cardiovascular disease). In contrast, asthma was associated with lower death rates, that is, it worked as a protective factor.

It is important to state that this study did not evaluate the effects of a novel SARS-CoV-2 variant, which caused a resurgence of cases and deaths in Brazil as of December 2020, nor the impact of COVID-19 vaccination, which started in January 2021 and whose impact deserves to be analyzed.

CONCLUSION

By using a dataset that includes children and adolescents nationwide, comprising 6,843 hospitalizations due to

COVID-19 confirmed by RT-qPCR testing in a 12-month period, or 53 epidemiological weeks, a profile of socio-demographic and clinical characteristics and factors associated with mortality from the disease was provided. Deaths were associated with age (12 to 19 years old and under one year old), the macro-region of residence in the country (Northern and Northeastern regions), more severe clinical progression requiring ventilatory assistance and/or ICU (critical SARI), and the presence of certain comorbidities (immunodepression and chronic cardiovascular disease). In contrast, asthma was associated with lower mortality rates, in other words, it worked as a protective factor.

Despite presenting lower hospitalization frequency and deaths than adults, the frequencies of complications and mortality from COVID-19 in the pediatric population are relevant. Furthermore, this study's findings expose the severity of the epidemic in the context of social inequality and fragility of health services, especially in impoverished areas, where the impact of the pandemic on mortality is pronounced. Thus, children and adolescents should not be neglected in the context of COVID-19 infection, and it is paramount to develop studies that clarify the mechanisms that influence COVID-19 mortality. Finally, the knowledge of the profile of children and adolescents hospitalized due to COVID-19 and the factors associated with deaths enables the direction of response actions for assisting this vulnerable population.

REFERENCES

1. Gomes NT, Haslett MI, Alves AJ, Percio J, Duarte MM, Malta JM, et al. Retrospective cohort of children and adolescents hospitalized by COVID-19 in Brazil from the beginning of the pandemic to August 1st, 2020. Rev Bras Epidemiol. 2021;24:e210026.
2. Leidman E, Duca LM, Omura JD, Proia K, Stephens JW, Sauber-Schatz EK. COVID-19 trends among persons aged 0–24 years: United States, March 1–December 12, 2020. MMWR Morb Mortal Wkly Rep. 2021;70:88-94.
3. Kabarriti R, Brodin NP, Maron MI, Guha C, Kalnicki S, Garg MK, et al. Association of race and ethnicity with comorbidities and survival among patients with COVID-19 at an urban medical center in New York. JAMA Netw Open. 2020;3:e2019795.
4. Ludvigsson JF. Systematic review of COVID-19 in children shows milder cases and a better prognosis than adults. Acta Paediatr. 2020;109:1088-95.
5. Liuzzo Scorpo M, Ferrante G, La Grutta S. An overview of asthma and COVID-19: protective factors against SARS-COV-2 in pediatric patients. Front Pediatr. 2021;9:661206.
6. Beken B, Ozturk GK, Aygun FD, Aydogmus C, Akar HH. Asthma and allergic diseases are not risk factors for hospitalization in children with coronavirus disease 2019. Ann Allergy Asthma Immunol. 2021;126:569-75.
7. Pedraza DF, Araujo EM, Pedraza DF, Araujo EM. Hospitalizations of Brazilian children under fiver years old: a systematic review. Epidemiol Serviços Saude. 2017;26:169-82.
8. Instituto Brasileiro de Geografia e Estatística. Diretoria de Pesquisas. Coordenação de População e Indicadores Sociais. Desigualdades sociais por cor ou raça no Brasil. Rio de Janeiro: IBGE; 2019. [cited 2022 Dec 14]. Available from: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=2101681
9. Silva Filho EB, Silva AL, Santos AO, Dall'acqua DS, Souza LF. Infecções respiratórias de importância clínica: uma revisão sistemática. Rev FIMCA. 2017;4:7-16.
10. Sanchez-Piedra C, Gamiño-Arroyo AE, Cruz-Cruz C, Prado-Galbarro FJ. Impact of environmental and individual factors on COVID-19 mortality in children and adolescents in Mexico: an observational study. Lancet Reg Health Am. 2022;8:100184.
11. Brasil. Ministério da Saúde. DATASUS. SRAG 2020: Banco de Dados de Síndrome Respiratória Aguda Grave: incluindo dados da COVID-19. [cited 2022 Dec 14]. Available from: https://opendatasus.saude.gov.br/dataset/srag-2020
12. Martins MM, Prata-Barbosa A, Magalhães-Barbosa MC, Cunha AJ. Clinical and laboratory characteristics of sars-cov-2 infection in children and adolescents. Rev Paul Pediatr. 2020;39:e2020231.
13. Nye S, Whitley RJ, Kong M. Viral infection in the development and progression of pediatric acute respiratory distress syndrome. Front Pediatr. 2016;4:128.
14. Toba N, Gupta S, Ali AY, ElSaban M, Khamis AH, Ho SB, et al. COVID-19 under 19: a meta-analysis. Pediatr Pulmonol. 2021;56:1332-41.
15. Graff K, Smith C, Silveira L, Jung S, Curran-Hays S, Jarjour J, et al. Risk factors for severe COVID-19 in children. Pediatr Infect Dis J. 2021;40:e137-45.
16. Hoffmann M, Kleine-Weber H, Schroeder S, Krüger N, Herrler T, Erichsen S, et al. SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 and is blocked by a clinically proven protease inhibitor. Cell. 2020;181:271-80.
17. Nickbakhsh S, Mair C, Matthews L, Reeve R, Johnson PC, Thorburn F, et al. Virus-virus interactions impact the population dynamics of influenza and the common cold. Proc Natl Acad Sci U S A. 2019;116:27142-50.
18. Kapoor D, Kumar V, Pemde H, Singh P. Impact of comorbidities on outcome in children with COVID-19 at a tertiary care pediatric hospital. Indian Pediatr. 2021;58:572-5.
19. Sociedade Brasileira de Pediatria. COVID-19: protocolo de diagnóstico e tratamento em unidade de terapia intensiva pediátrica. [cited 2022 Dec 14]. Available from: https://www.sbp.com.br/fileadmin/user_upload/22487d-NA_-_COVID-_Protoc_de_Diag_Trat_em_UTI_Pediatrica.pdf

20. Perrin JM, Anderson LE, Van Cleave J. The rise in chronic conditions among infants, children, and youth can be met with continued health system innovations. Health Aff (Millwood). 2014;33:2099-105.
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 Saude. 2020;29:e2020644.
22. Feng Y, Ling Y, Bai T, Xie Y, Huang J, Li J, et al. COVID-19 with different severities: a multicenter study of clinical features. Am J Respir Crit Care Med. 2020;201:1380-8.
23. Tsankov BK, Allaire JM, Irvine MA, Lopez AA, Sauvé LJ, Vallance BA, et al. Severe COVID-19 infection and pediatriccComorbidities: a systematic review and meta-analysis. Int J Infect Dis. 2021;103:246-56.
24. Harwood R, Yan H, Da Camara N, Smith C, Ward J, Tudur-Smith C, et al. Which children and young people are at higher risk of severe disease and death after hospitalisation with SARS-CoV-2 infection in children and young people: a systematic review and individual patient meta-analysis. EClinicalMedicine. 2022;44:101287.
25. Oliveira EA, Colosimo EA, Silva AC, Mak RH, Martelli DB, Silva LR, et al. Clinical characteristics and risk factors for death among hospitalised children and adolescents with COVID-19 in Brazil: an analysis of a nationwide database. Lancet Child Adolesc Health. 2021;5:559-68.
26. Zhang JJ, Dong X, Liu GH, Gao YD. Risk and protective factors for COVID-19 morbidity, severity, and mortality. Clin Rev Allergy Immunol. 2022 In Press.
27. Gaietto K, Freeman MC, DiCicco LA, Rauenswinter S, Squire JR, Aldewereld Z, et al. Asthma as a risk factor for hospitalization in children with COVID-19: a nested case-control study. Pediatr Allergy Immunol. 2022;33:e13696.
28. Silva AD, Veiga AB, Cruz OG, Bastos LS, Gomes MF. Severe acute respiratory infection surveillance in Brazil: the role of public, private and philanthropic healthcare units. Health Policy Plan. 2022;37:1075-85.
29. Martins-Filho PR, Quintans-Júnior LJ, Souza Araújo AA, Sposato KB, Souza Tavares CS, Gurgel RQ, et al. Socio-economic inequalities and COVID-19 incidence and mortality in Brazilian children: a nationwide register-based study. Public Health. 2021;190:4-6.
30. Orellana JD, Cunha GM, Marrero L, Horta BL, Leite IC. Explosion in mortality in the Amazonian epicenter of the COVID-19 epidemic. Cad Saude Publica. 2020;36:e00120020.
31. Noronha KV, Guedes GR, Turra CM, Andrade MV, Botega L, Nogueira D, et al. The COVID-19 pandemic in Brazil: analysis of supply and demand of hospital and ICU beds and mechanical ventilators under different scenarios. Cad Saude Publica. 2020;36:e00115320.
32. Associação de Medicina Intensiva Brasileira. Censo AMIB. [cited 2022 Dec 14]. Available from: https://www.amib.org.br/censo-amib/

5.2. Artigo 2

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Coronavirus Pandemic

Hospitalizations and deaths of Brazilian children and adolescents with Severe Acute Respiratory Syndrome caused by COVID-19

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Abstract

Introduction: Since the onset of the pandemic, COVID-19 has affected the entire world population, however, data on child morbidity and mortality are scarce. This study aimed to analyze the profile of hospitalizations and factors associated with the deaths of Brazilian children and adolescents with Severe Acute Respiratory Syndrome caused by COVID-19.

Methodology: This cross-sectional study uses public domain data from the Influenza Epidemiological Surveillance System in 2021. The prevalence rates, lethality, and duration of hospitalization of children and adolescents with Severe Acute Respiratory Syndrome caused by COVID-19 were analyzed. Logistic regression and adjusted Odds Ratio were used. A $p < 0.05$ was considered significant.

Results: The prevalence of hospitalization among children and adolescents was 3.6%, and the case lethality rate was 4.0%. Higher lethality rates occurred among adolescents, natives, rural residents, those living in Brazil's northern and northeastern regions, and those who became critically ill and had comorbidities. Hospitalization time was longer for adolescents who became critically ill or had comorbidities. The highest chance of death was associated with: children under one year of age and adolescents, natives, and residents from the North, Northeast, and Southeast regions, who became critically ill and had comorbidities.

Conclusions: Despite lower hospitalization and death rates than adults, the prevalence, complications, and mortality from COVID-19 in the pediatric population are relevant. Knowledge of the profile of children and adolescents hospitalized due to COVID-19 and the factors associated with these deaths allows the guidance of response efforts directed to assist this vulnerable population.

Key words: COVID-19; Severe Acute Respiratory Syndrome; hospitalization; children; adolescents; pediatric.

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Introduction

The coronavirus disease 2019, or COVID-19, has spread rapidly worldwide, being classified by the World Health Organization (WHO) as a pandemic on March 11, 2020 [1,2]. Although it affects all age groups, the disease develops with more reserved outcomes in individuals aged over 60, and/or with underlying comorbidities [3]. In different countries, based on the analysis of the first epidemiological data, it was observed that children and adolescents were not the main transmission and disease agents [4,5]. Data from a systematic review, including 18 studies describing the clinical characteristics and management of children and adolescents with COVID-19, evidenced that the main route through which children were contaminated was their family members [6].

Regarding the disease's behavior, the pediatric population corresponds to the minority of symptomatic cases, presenting milder evolution of COVID-19, with reduced need for hospitalization and mortality compared to the adult population [7,8]. In this population, mild symptoms are prevalent when clinical manifestations occur, with a positive evolution, and recovery occurs in up to two weeks [6]. However, it cannot be ignored that asymptomatic or oligosymptomatic cases also impact the chain of infection transmission, and should be the target of preventive measures [9].

SARS-CoV-2 transmission occurs from an infected person to someone susceptible through droplets and aerosols produced by sneezing, coughing, speaking, and other actions that produce these particles [10]. Asymptomatic individuals are important disease carriers, as they can transmit the virus without being aware of their condition, especially when considering the gradual return to on-site activities and the greater

flexibility regarding preventive measures [11]. Although efforts are being employed worldwide by the scientific community to understand the disease dynamics and establish forms of prevention, several aspects of COVID-19 still need to be evidenced, especially in the pediatric population [7,12,13].

Considering that the disease behavior is not equally manifested among the countries worldwide, and considering the heterogeneity of the Brazilian population and the challenges in access to, and the quality of the different health services, it is believed that the consequences of the COVID-19 pandemic on the health of children and adolescents in Brazil are still uncertain. In this context, it becomes relevant to evaluate the epidemiological context experienced in the national scenario, to identify those most susceptible to severe disease cases, such as Severe Acute Respiratory Syndrome (SARS), to subsidize the planning of future measures.

Therefore, the present study aims to analyze the profile of hospitalizations and factors associated with the deaths of Brazilian children and adolescents with SARS caused by COVID-19.

Methodology

This is a cross-sectional study related to the epidemiological surveillance of children and adolescent patients hospitalized for SARS caused by COVID-19 in 2021. The source of information was the non-nominal secondary database, without any identification of the individuals, from the Influenza Epidemiological Surveillance System (SIVEP-Gripe), referring to hospitalizations that occurred in 2021, available on the website: https://opendatasus.saude.gov.br and updated on February 7th, 2022.

The study population was composed of cases of children and adolescents hospitalized for SARS aged between zero and 18 years, and registered in the SIVEP-Gripe database between Epidemiological Weeks No. 1 to 52 of 2021, with a diagnosis of COVID-19 confirmed by laboratory criteria. Patients diagnosed only by clinical, clinical-epidemiological, or clinical-imaging criteria were excluded, as well as those with inconclusive results and those whose duration of hospitalization could not be calculated due to missing data.

A child was considered to be an individual aged between 0 (zero) and 11 years, and an adolescent was considered to be someone aged between 12 and 18 years. SARS was defined as the cases hospitalized for COVID-19 that presented at least one of the signs and symptoms, such as dyspnea, respiratory distress, low oxygen saturation (< 95%) on room air, and cyanosis. SARS-critical was characterized as the cases that required admission to the Intensive Care Unit (ICU) or needed invasive or non-invasive ventilatory support [14].

The variables of interest addressed in this study were the following: a) sociodemographic: age, sex, self-reported ethnicity, geographic area, and Brazilian region of residence; b) clinical: SARS-critical and presence of at least one comorbidity (chronic cardiovascular disease, chronic hematological disease; Down syndrome; chronic liver disease; asthma; diabetes mellitus; chronic neurological disease; chronic lung disease; immunodepression; chronic kidney disease, and obesity); c) outcomes: days of hospitalization, in-hospital lethality rates, and case evolution (survival or death).

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) statistical program, version 23.0. Descriptive and inferential analysis was performed. The Kolmogorov-Smirnov test was used to assess variable normality. For the descriptive analysis, the absolute and relative frequency distributions, measures of central tendency, and variability measures were used, according to the normality test results.

The prevalence and lethality rates of the study population were calculated, and the profiles of the patients who either survived or who did not survive were compared in order to identify the differences between them. The in-hospital lethality rate was calculated by considering the total number of hospital deaths divided by the total number of hospitalized cases, multiplied by 100. The Mann-Whitney or Kruskal-Wallis non-parametric tests were used to compare the median length of hospitalization.

Multivariate analysis was performed using binary logistic regression with the Backward Stepwise method considering the number of independent variables obtained by the bivariate analysis, with a 95% confidence interval and $p < 0.05$. The association measure adopted was the Adjusted Odds Ratio (AOR). The Hosmer and Lemeshow test was used to adjust the model. A value of $p < 0.05$ was considered significant.

Since this is a study that includes only public domain data and does not identify the participants, no approval by the Ethics Committee on Research with Human Beings was required.

Results

In Brazil, in 2021, 1,048,575 individuals were hospitalized for SARS, and 389,299 cases were due to

COVID-19, confirmed by a positive RT-PCR test result. When defining only the age range of interest for the study, it was found that 14,116 (3.6%) corresponded to children and adolescents hospitalized for SARS caused by COVID-19, and, of these, 568 died, totaling a case lethality rate of 4.0%.

As shown in Table 1, higher lethality rates were observed among adolescents aged between 15 and 18 (9.8%), followed by the 12 to 14 age group (9.0%). Lethality was also higher among natives (21.7%), rural residents (10.9%), and in the northern (9.5%) and northeastern (9.4%) Brazilian regions. Patients who evolved to SARS-critical and who had at least one comorbidity had case lethality rates of 5.4% and 9.3%, respectively.

Regarding the comorbidities present in the study population and their respective lethality rates (Table 2), in descending order, chronic liver disease (25.6%), chronic cardiovascular disease (19.0%), Down's Syndrome (18.1%), obesity (17.6%), immunodepression (17.5%), chronic hematological and neurological disease (13.3%), chronic kidney disease (12.6%), chronic lung disease (9.3%), and diabetes (7.8%) stand out. The lower lethality rate in the presence of asthma (1.1%) is noteworthy.

The median length of hospitalization in the overall population was 5.0 (interquartile range: 3.0-9.0) days. Patients who died were hospitalized for more days (10.5 days; interquartile range 4.0-21.0) compared to survivors (5.0 days; interquartile range: 3.0-8.0), with a statistical significance of $p < 0.001$.

From this point of view, among the deaths, longer hospitalization times were observed for the 12 to 14 and 15 to 18 age groups, and also for the presence of SARS-critical and presence of at least one comorbidity (Table 3). Among survivors, the longest hospitalization times occurred in the 12 to 14 and 15 to 18 age strata, in the Asian and Native populations, in rural areas, and in the North and Northeast regions, in the presence of SARS-critical and at least one comorbidity.

When the length of hospitalization was analyzed according to the comorbidities, among the patients who died, only liver disease was associated with longer lengths. Among the survivors, those with cardiovascular, hepatic, neurological, renal, and immunodepression diseases were hospitalized for longer; however, asthma was associated with a shorter duration of hospitalization (Table 4).

Aiming to verify the factors associated with a higher death rate among children and adolescents hospitalized with SARS caused by COVID-19, bivariate and multivariate logistic regression was performed (Table 5).

Table 1. Absolute and relative frequencies of the total population, cases of deaths, and lethality, in children and adolescents hospitalized with SARS caused by COVID-19, according to sociodemographic data and clinical conditions. SIVEP-Gripe, 2021, Brazil (n = 14,116).

Variables	Total		Deaths		Lethality
	n	%	n	%	%
Total	14,116	100	568	100	4.0
Age group (years)					
< 1	6,103	43.2	229	40.3	3.7
1-4	4,436	31.4	91	16.0	2.1
5-11	1,772	12.6	75	13.2	4.2
12-14	576	4.1	52	9.2	9.0
15-18	1,229	8.7	121	21.3	9.8
Sex					
Female	6,385	45.3	275	48.4	4.3
Male	7,722	54.7	293	51.6	3.8
Self-declared ethnicity					
Caucasian	5,492	49.7	203	41.1	3.7
African	398	3.6	15	3.0	3.8
Asian	57	0.5	3	0.6	5.3
Mixed	5,048	45.7	260	52.6	5.2
Native	60	0.5	13	2.6	21.7
Geographic area of residence					
Urban	12,149	96.2	444	89.5	3.7
Rural	476	3.8	52	10.5	10.9
Macro region of the country					
North	545	3.9	52	9.2	9.5
Northeast	2,004	14.2	189	33.3	9.4
Midwest	1,670	11.8	49	8.6	2.9
Southeast	6,693	47.4	190	33.5	2.8
South	3,200	22.7	88	15.5	2.8
SARS-critical					
Yes	8,709	67.7	473	93.8	5.4
No	4,154	32.3	31	6.2	0.7
Presence of at least one comorbidity					
Yes	3,616	25.6	338	59.5	9.3
No	10,500	74.4	230	40.5	2.2

SARS: severe acute respiratory syndrome; SIVEP-Gripe: Influenza Epidemiological Surveillance Information System; n: absolute frequency; %: relative frequency. Values refer to total valid responses, missing data not being considered. Source: SIVEP-Gripe data updated on February 7th, 2022.

Table 2. Absolute and relative frequencies of the total population, cases of deaths and lethality, in children and adolescents hospitalized with SARS caused by COVID-19, according to the presence of comorbidities. SIVEP-Gripe, 2021, Brazil (n = 14,116).

Comorbidities	Total		Deaths		Lethality
	n	%	n	%	%
Chronic cardiovascular disease					
Yes	373	17.3	71	33.3	19.0
No	1,789	82.7	142	66.7	79.3
Chronic hematological disease					
Yes	113	5.5	15	8.2	13.3
No	1,925	94.5	169	91.8	8.8
Down Syndrome					
Yes	188	9.1	34	17.3	18.1
No	1,880	90.9	163	82.7	8.7
Chronic liver disease					
Yes	43	2.2	11	5.9	25.6
No	1,954	97.8	175	94.1	9.0
Asthma					
Yes	854	36.5	9	4.9	1.1
No	1,485	63.5	176	95.1	11.9
Diabetes Mellitus					
Yes	128	6.2	10	5.3	7.8
No	1,928	93.8	177	94.7	9.2
Chronic neurological disease					
Yes	525	23.8	70	32.9	13.3
No	1,680	76.2	143	67.1	8.5
Chronic lung disease					
Yes	214	10.3	20	10.4	9.3
No	1,872	89.7	172	89.6	9.2
Immunodepression					
Yes	252	11.9	44	22.0	17.5
No	1,860	88.1	156	78.0	8.4
Chronic kidney disease					
Yes	111	5.4	14	7.5	12.6
No	1,928	94.6	173	92.5	9.0
Obesity					
Yes	199	9.7	35	18.4	17.6
No	1,860	90.3	155	81.6	8.3

SARS: severe acute respiratory syndrome; SIVEP-Gripe: Influenza Epidemiological Surveillance Information System; n: absolute frequency; % relative frequency. Values refer to total valid responses, missing data not being considered. Source: SIVEP-Gripe data updated on February 7th, 2022.

Table 3. Hospitalization time of children and adolescents with SARS caused by COVID-19, according to sociodemographic and clinical variables, for the outcomes of survival and death. SIVEP-Gripe, 2021, Brazil (n = 14,116).

Variables	Survivors			Deaths		
	Hospitalization days		*p* value	Hospitalization days		*p* value
	Median	Q1-Q3		Median	Q1-Q3	
Age group (years)			< 0.001[a] *			< 0.025[a] *
< 1	5.0	10.0-3.0		9.0	4.0-22.0	
1-4	4.0	7.0-2.0		11.0	6.0-20.0	
5-11	5.0	9.0-3.0		7.0	3.0-18.5	
12-14	7.0	14.0-3.0		12.0	5.0-22.0	
15-18	6.0	13.0-3.0		14.0	5.0-22.0	
Sex			0.239[b]			0.203[b]
Male	5.0	9.0-3.0		10.0	4.0-21.0	
Female	5.0	9.0-3.0		11.0	4.0-22.0	
Self-declared ethnicity			< 0.001[a] *			0.874[a]
Caucasian	5.0	3.0-8.0		11.0	4.0-22.0	
African	5.0	3.0-8.0		9.0	4.5-14.0	
Asian	6.0	3.0-14.0		8.0	5.5-21.5	
Mixed	5.0	3.0-9.0		10.0	4.0-21.0	
Native	6.0	4.0-12.0		15.0	4.0-24.5	
Geographic area of residence			< 0.021[b] *			0.810[b]
Urban	5.0	3.0-8.0		10.0	4.0-21.0	
Rural	5.0	3.0-11.0		8.0	3.5-28.0	
Macro region of the country			< 0.001[a] *			0.780[a]
North	6.00	3.0-12.0		9.0	4.0-22.0	
Northeast	6.00	3.0-13.0		10.0	4.5-22.5	
Midwest	4.00	2.0-8.0		7.0	3.0-21.0	
Southeast	5.00	3.0-8.0		11.0	4.0-20.0	
South	4.00	2.0-8.0		11.0	4.0-22.0	
SARS-critical			< 0.001[b] *			0.026[b] *
Yes	5.0	3.0-10.0		11.0	4.0-22.0	
No	4.0	2.0-7.0		7.0	2.0-11.0	
Presence of at least one comorbidity			< 0.001[b] *			< 0.001[b] *
Yes	6.0	3.0-12.0		14.0	6.0-26.0	
No	4.0	3.0-8.0		7.0	3.0-15.0	

SARS: severe acute respiratory syndrome; SIVEP-Gripe: Influenza Epidemiological Surveillance Information System; Q1: 1st quartile (25%); Q3: 3rd quartile (75%). Values refer to total valid responses, missing data not being considered. *Significant: $p < 0.05$, by Kruskal-Wallis[a] and Mann-Whitney[b] tests. Source: SIVEP-Gripe data updated on February 7th, 2022.

Table 4. Hospitalization time of children and adolescents with SARS caused by COVID-19, according to comorbidities and the outcomes of survival and death. SIVEP-Gripe, 2021, Brazil (n = 14,116).

Variables	Survivors			Deaths		
	Hospitalization days		*p* value	Hospitalization days		*p* value
	Median	Q1-Q3		Median	Q1-Q3	
Chronic cardiovascular disease			< 0.001*			0.095
Yes	9.0	4.0-17.0		17.0	7.0-32.5	
No	6.0	3.0-12.0		12.0	5.0-23.0	
Chronic hematological disease			0.128			0.580
Yes	6.5	4.0-14.5		11.0	7.0-19.0	
No	6.0	3.0-12.0		15.0	5.5-24.5	
Down Syndrome			0.265			0.216
Yes	7.0	3.0-15.0		18.0	7.0-34.0	
No	6.0	3.0-12.0		13.0	5.0-24.0	
Chronic liver disease			0.026*			0.032*
Yes	10.0	6.0-20.0		26.0	16.0-33.0	
No	6.0	3.0-12.0		14.0	5.0-23.5	
Asthma			< 0.001*			0.387
Yes	4.0	2.0-6.0		12.0	17.0-34.0	
No	8.0	4.0-15.0		5.0	12.5-24.0	
Diabetes Mellitus			0.630			0.211
Yes	7.0	4.0-10.0		7.0	9.0-10.0	
No	6.0	3.0-13.0		5.0	14.5-24.0	
Chronic neurological disease			< 0.001*			0.746
Yes	10.5	5.5-20.0		10.0	6.0-26.0	
No	6.0	3.0-11.0		15.0	5.0-24.5	
Chronic lung disease			0.810			0.364
Yes	7.0	3.0-13.5		16.5	6.0-32.0	
No	6.0	3.0-12.0		15.0	6.0-24.0	
Immunodepression			< 0.001*			0.445
Yes	8.00	5.0-20.0		11.0	5.0-22.0	
No	6.00	3.0-12.0		16.0	5.0-26.0	
Chronic kidney disease			0.001*			0.624
Yes	9.0	5.0-17.0		20.0	4.0-26.0	
No	6.0	3.0-12.0		12.0	5.0-24.0	
Obesity			0.317			0.563
Yes	7.0	4.0-10.0		15.0	6.0-21.5	
No	6.0	3.0-12.0		13.5	5.5-24.0	

SARS: severe acute respiratory syndrome; SIVEP-Gripe: Influenza Epidemiological Surveillance Information System; Q1: 1st quartile (25%); Q3: 3rd quartile (75%). Values refer to total valid responses, missing data not being considered. *Significant: $p < 0.05$, by Kruskal-Wallis[a] and Mann-Whitney[b] tests. Source: SIVEP-Gripe data updated on February 7th, 2022.

Table 5. Bivariate and multivariate logistic regression analysis for factors associated with deaths from SARS caused by COVID-19 in children and adolescents. SIVEP-Gripe, 2021, Brazil (n = 14,116).

Variables	Raw OR			Adjusted OR		
	OR	CI 95%	*p* value	AOR	CI 95%	*p* value
Age group (years)						
<1	1.871	1.462-2.394	< 0.001*	1.721	1.264-2.342	0.001*
1-4	1.000	-	-	1.000	-	-
5-11	2.124	1.556-2.901	< 0.001*	1.393	0.942-2.061	0.097
12-14	5.076	3.560-7.238	< 0.001*	3.448	2.218-5.359	< 0.001*
15-18	5.286	3.992-7.000	< 0.001*	3.447	2.419-4.913	< 0.001*
Sex						
Male	1.000	-	-	-	-	-
Female	1.138	0.961-1.346	0.133	-	-	-
Self-declared ethnicity						
Caucasian	1.000	-	-	1.000	-	-
African	1.082	0.633-1.849	0.774	0.714	0.374-1.360	0.305
Asian	1.496	0.462-4.844	0.501	1.487	0.404-5.477	0.551
Mixed	1.472	1.219-1.776	< 0.001*	0.779	0.593-1.024	0.073
Native	7.073	3.751-13.340	< 0.001*	3.235	1.358-7.705	0.008*
Geographic area of residence						
Urban	1.000	-	-	1.000	-	-
Rural	3.643	2.680-4.952	< 0.001*	1.488	0.968-2.287	0.070
Macro region of the country						
North	3.961	2.772-5.662	< 0.001*	3.921	2.430-6.327	< 0.001*
Northeast	4.614	3.554-5.989	< 0.001*	5.963	4.005-8.878	< 0.001*
Midwest	1.121	0.786-1.598	0.529	1.356	0.846-2.172	0.206
Southeast	1.084	0.839-1.401	0.537	1.428	1.040-1.960	0.028*
South	1.000	-	-	1.000	-	-
SARS-critical						
Yes	7.575	5.256-10.917	< 0.001*	7.494	4.939-11.372	< 0.001*
No	1.000	-	-	1.000	-	-
Presence of at least one comorbidity						
Yes	4.635	3.900-5.508	< 0.001*	3.572	2.836-4.500	< 0.001*
No	1.000	-	-	1.000	-	-

SARS: severe acute respiratory syndrome; SIVEP-Gripe: Influenza Epidemiological Surveillance Information System; OR: Odds Ratio; AOR: adjusted odds ratio. Quality of adjustment by Hosmer and Lemeshow test: $X^2 = 9.111$; $p = 0.333$. *Significance: $p < 0.05$. Source: SIVEP-Gripe data updated on February 7th, 2022.

In the final model, the following were associated with a higher death rate: Age groups under one year old (1.7 times) and 12 to 18 years old (3.4 times); Native ethnicity (3.2 times); Brazilian regions: North (3.9 times), Northeast (5.9 times), and Southeast (1.4 times); and clinical conditions: SARS-critical (7.5 times) and the presence of at least one comorbidity (3.6 times).

Discussion

Lethality rates

In this study, it was possible to observe that the pediatric age group comprised 3.6% of hospitalizations caused by COVID-19 in Brazil in 2021. The case lethality rate was 4.0% among hospitalized children and adolescents, and the highest rates were found in adolescents aged between 15 and 18 years (9.8%), followed by adolescents aged between 12 and 14 years (9.0%). These data are consistent with a study conducted in Iranian cities, where the case lethality rate was 4.3% among children and adolescents, with half of the deaths occurring in children over 5 [15].

Furthermore, in 2020, a study was conducted aiming to assess the impact of admission of pediatric patients with COVID-19 and eventual deaths in individuals aged between zero and 19 worldwide. This study showed that Brazil has one of the highest mortality rates from COVID-19 in pediatric patients, recording 23 deaths/million children, while in the United States, which has also been severely impacted by the disease, this figure was less than 2 deaths/million [16]. Furthermore, a higher lethality rate was observed among Native children and adolescents, pointing to the ethnic and social inequalities across the Brazilian regions. According to a Brazilian study, Native children and adolescents were approximately 3.3 times more likely to die than the Caucasian pediatric population [17].

The increased lethality rate in Native populations may be a result of historical barriers to health services, difficulty in accessing adequate sanitation, and the prevalence of infectious and chronic diseases among Native Brazilians. In addition, the high risk of contagion may be a reflection of limitations in access to safe drinking water, communication failures, and high numbers of trips to large cities and tourist attractions for Native communities [18,19].

The determinants of the Native population's health vulnerability in the context of the COVID-19 pandemic can be described in three interdependent dimensions: (1) Individual, which includes incorrect and/or insufficient knowledge regarding prevention and transmission of the novel coronavirus; (2) Social, which includes factors such as nutritional aggravations, high prevalence of chronic infectious-contagious diseases, and extended family nucleus; and (3) Programmatic, which includes, for instance, unavailability/insufficiency of healthcare and inputs, lack of basic sanitation, food insecurity, and difficulty in accessing health services [18]. Such factors ultimately contribute to the higher lethality rates for COVID-19 among the Native population, as observed in this study.

The present study also indicated that socioeconomic vulnerabilities may be related to the course of the disease and death, as a higher pediatric lethality rate was observed in residents of rural areas and the northern and northeastern regions of the country. Despite the high rates of social isolation in some states in the north and northeast regions, children living in these two regions are 3.4 times more likely to evolve to death than children living in other regions of Brazil [20]. Moreover, in less developed cities, the odds of death are 25% higher when compared to those with higher development indexes. Thus, in addition to sanitary conditions, the response to the pandemic should also consider social vulnerabilities regarding infrastructure, quality, and organization of the local health system [21]. Furthermore, the regionalized organization of health services may involve additional challenges in the pandemic context, especially if the distance to be traveled by patients to access the service is too great [22]. Added to this is the distribution of pediatric ICU beds per 10,000 pediatric inhabitants for each Brazilian region according to the 2016 Brazilian ICU Census, the lowest rates are in the northern and northeastern regions, corroborating a greater inequality of assistance and access to healthcare [23].

Another factor that contributed to the increased lethality in the pediatric population was the presence of at least one comorbidity and the development of SARS-critical during hospitalization. Although children are less susceptible to COVID-19, those with pre-existing comorbidities are more predisposed to the development of severe conditions [24]. Children and adolescents with comorbidities such as liver disease, obesity, diabetes, cardiovascular and renal disease, and immunosuppression have an increased prevalence of severe cases of COVID-19 and approximately a 10-fold greater risk of mortality compared to those without pre-existing health conditions [25–27]. A North American study with children and adolescents hospitalized for the disease associates a higher risk of severity with the presence of certain comorbidities, according to age group: among children aged under five, cardiac and

congenital anomalies, with an emphasis on prematurity among those aged under one year; among adolescents aged between 12 and 18, type 1 diabetes, epilepsy and/or seizures, obesity, hypertension, and asthma [24].

The pathological mechanisms that link liver disease as a risk factor for increased lethality related to COVID-19 are not clear. Although most children have abnormal liver enzymes without signs of severity, those who already have some type of liver injury may progress to worsening of the condition due to some factors, such as the immunological damage caused by the inflammatory response to COVID-19; the toxicity of the virus due to its replication in hepatocytes; anoxia leading to ischemic hepatitis; drug-induced liver damage; and reactivation of pre-existing liver disease leading to worsening of cholestasis [28,29].

On the other hand, asthma carriers represented a lower lethality rate among people with comorbidities. Researchers have demonstrated that the excessive mucus production present in some asthma patients may be a protective factor, as mucus is the first barrier against infection, making it difficult for SARS-CoV-2 to reach the distal airways and enter alveolar type 2 cells, which are rich in ACE 2 receptors [30,31]. SARS-CoV-2 needs two proteins to enter host cells: First, the virus binds to the ACE 2 receptor, and then the transmembrane protein TMPRSS2 splits the Spike protein present in the viral envelope into two segments, enabling the virus to penetrate the host cell. In asthmatic patients, the cytokine storm caused by COVID-19 appears to be contained by the Th2 immune response, related to lower quantities of ACE 2 receptors in airway epithelial cells. Asthmatics also have a higher concentration of eosinophils, which is associated with a better COVID-19 prognosis [32]. In addition, inhaled corticosteroids, which are the first line in asthma treatment, evidently decrease the expression of ACE 2 receptors and TMPRSS2 proteins, reducing SARS-CoV-2 ability to bind to airway epithelial cells [32]. It is believed that collectively, all the described factors may be involved in the pathophysiology of COVID-19 in asthmatic patients and may explain why asthma acts as a protective factor.

Hospitalization time

Hospitalization time was longer in adolescents, in individuals who evolved to SARS-critical, and among those who had comorbidities. In addition, among survivors, the longest hospitalization time was among Asian and Native patients, those living in rural areas, and in the northern and northeastern regions of the country. In a multicenter study conducted in the United States, including 43,465 children and adolescents hospitalized with COVID-19, it was observed that 52% of the population was aged between 12 and 18 years, and in 28.7% of cases, comorbidities were present [24].

It is worth noting that during the predominance of the Omicron variant in the last two weeks of December 2021, the pediatric patient profile with the highest record of hospitalizations in the United States was that of children aged between zero and four years [33]. Still in the US, a cohort study concluded that approximately 5% of the more than 12,000 children observed were hospitalized, and of this total, 18% required intensive care [34].

In Brazil, where a large territorial extension and important social inequality exist, social vulnerabilities, concomitant infection rates, and the frailty of health services are factors that result in differences in infection, hospitalization, and mortality rates for COVID-19 throughout the territory [20,35,36]. The presence of comorbidities is more prevalent among the low-income population, which acts as a risk factor for more severe SARS-CoV-2 infections [35,36]. The factors described above suggest some explanations for the longer length of hospitalization in pediatric patients who resided in rural areas and in the northern and northeastern regions of Brazil.

Data in the literature demonstrate relationships between ethnic disparity and length of hospitalization for pediatric patients with COVID-19. A study conducted in the United States concluded that a higher rate of hospitalization was found among African American or Hispanic children under the age of five, and between 12 and 17. This population was four to five times more likely to be hospitalized compared to non-Hispanic Caucasian children [37]. Another study, which involved data from pediatric hospitalizations from hospitals in several countries, such as Italy, the United States, the United Kingdom, India, and Middle Eastern countries, evidenced that children of African descent were at a 15-fold increased risk of developing COVID-19-related Multisystemic Inflammatory Syndrome compared to children of Caucasian descent, thus requiring longer hospitalization times for care [38]. These findings suggest that ethnicity may therefore be a factor influencing the length of hospitalization and the course of SARS-CoV-2 infection in pediatric patients, also observed in this study's results. A Brazilian study shows that Blacks and mixed have a higher mortality rate compared to Whites, which is associated with social inequality and medical care. Thus, the fatality rate from COVID-19 tends to increase with the worsening of the socioeconomic condition [39].

It was evidenced in the present study that, among the pediatric patients who evolved to death, those with longer hospitalization times were those who developed SARS-critical and had at least one comorbidity, especially liver disease, cardiovascular, neurological, and renal diseases, as well as immunosuppression. Children with comorbidities such as obesity, diabetes, heart disease, chronic lung disease other than asthma, epileptic disorders, and immunosuppression have an increased prevalence of severe COVID-19 and may, therefore, require longer hospitalization for the management of more complex symptomatology [25].

On the other hand, patients with asthma have shorter hospitalization times among those with comorbidities, in addition to a lower chance of evolving to death. The cohort study with pediatric patients aged between zero and 21 years in the United States evidences asthma as a risk factor for hospitalization in children with COVID-19, but not for worse disease outcomes [40]. Asthma, then, does not seem to be associated with COVID-19 aggravation and seems to act as a protective factor against longer hospitalization times, severe cases, and subsequent deaths [26,31,41].

Factors associated with deaths

In the present study, the following were associated with a greater chance of death among children and adolescents: The age groups under one year and 12 to 18 years; the Native ethnicity; the North, Northeast, and Southeast Brazilian regions, in descending order; and the SARS-critical clinical conditions and having at least one comorbidity.

The higher mortality between 12 and 18 years old in the study can be explained by the fact that 45% of adolescents had at least one comorbidity, while its frequency was lower among children and children under one year (30% and 15%, respectively). The age groups observed are corroborated by other studies as factors associated with higher COVID-19 severity. A study carried out in the United States also found higher mortality among adolescents and its association with underlying clinical conditions [42]. In China, children under one year of age corresponded to 10.6% of severe and critical cases, the highest percentage among pediatric age groups. In the United States, a cohort study evidenced that age extremes, such as under three months and over 20 years old, are more prone to developing severe COVID-19 infection [43].

Furthermore, a study conducted in Rio Grande do Sul concluded that although children aged zero to nine years rarely evolve into severe forms of COVID-19, SARS-CoV-2 infection combined with any comorbidity worsens the prognosis regarding SARS and death outcomes [44]. A meta-analysis also demonstrates greater vulnerability for severe illness or death from COVID-19 among infants and adolescents, those with cardiac or neurological conditions, or obesity [45].

Moreover, ethnic disparities are shown to be important risk factors for the greater severity of the disease. A study conducted in six hospitals in the United States between July and August 2021 showed that the majority of pediatric patients hospitalized for COVID-19 were African American or Hispanic [37]. Researchers highlight that Native children and adolescents are up to 3.36 times more likely to die from the disease compared to the Caucasian pediatric population [17].

Also noteworthy is the presence of comorbidities contributing to a worse prognosis and mortality in the pediatric population. Approximately two-thirds of children and adolescents hospitalized for COVID-19 present with one or more underlying comorbidities, with about one-third of patients aged between 12 and 17 being obese. Compared to those who are not obese, obese patients required more complex and prolonged care [37,41]. Obesity is described as one of the most significant risk factors associated with mechanical ventilation in children aged two years and older. When associated with type 2 diabetes, obesity is increasingly related to the prediction of pediatric severe disease and mortality [43]. On the other hand, asthma seems to develop a protective role in COVID-19. Although this role is not yet well established, most studies point to a reduction in the death rate of up to 60% [31].

Another important factor is the socioeconomic vulnerability of the population. A Brazilian study conducted in Sergipe concludes that individuals living in poverty are more likely to live in crowded households, have less access to clean water for hand washing, as well as fewer opportunities for home office work and less access to health services; therefore, people in poverty are at a higher rate of infection and mortality from COVID-19 compared to populations living in better socioeconomic conditions [33,34,46].

Strengths and weaknesses of this study

Using a rich dataset covering children and adolescents nationwide, comprising 14,116 RT-PCR-confirmed COVID-19 hospitalizations over 12 months, or 52 epidemiological weeks, a profile of sociodemographic and clinical characteristics and the factors associated with mortality from the disease was evidenced.

Some limitations of the study should also be acknowledged. Firstly, the epidemiological information on pre-existing comorbidities presents low data filling completion, as this information is not mandatory. On this basis, the estimates from these variables should be interpreted with caution due to potential underreporting bias. Secondly, this study's data prevent analyzing the effects of the quality of in-hospital care from the perspective of physical infrastructure or human resources. And finally, the data only assess the hospitalized population, not allowing inferences about the COVID-19 cases that had no record of hospital admission.

Implications for clinical practice and health policies

Since the outbreak of the pandemic, concerns have been raised by health authorities about the collapse of healthcare systems and shortages of clinical hospital beds and intensive care units for patients with moderate and severe COVID-19. This study's findings suggest that regional differences exist in the survival of hospitalized pediatric patients nationwide, which may be due to geographic access to hospital beds and intensive care units.

From this research, it is noted that the pediatric population, despite corresponding to 3.6% of the hospitalized population for COVID-19 in Brazil in 2021, presented a lethality rate of 4.0%, which is relevant. In the present study, the following were associated with higher death rates among children and adolescents: The age groups under one year and 12 to 18 years; the Native ethnicity; the North, Northeast, and Southeast Brazilian regions, in descending order; and the SARS-critical clinical conditions and having at least one comorbidity.

It is worth noting that the data could not evaluate the effects of the new SARS-CoV2 variant, which caused a resurgence of cases and deaths in Brazil, nor the impact of vaccination against COVID-19, which started in January 2021.

Conclusions

By using a dataset that covers children and adolescents nationwide, comprising 14,116 hospitalizations for COVID-19 confirmed by RT-PCR over a period of 12 months, or 52 epidemiological weeks, a profile of sociodemographic and clinical characteristics and factors associated with mortality from the disease is obtained. The pediatric population, despite corresponding to 3.6% of the population hospitalized for COVID-19 in Brazil in 2021, presented a lethality rate of 4.0%, which is relevant. In the present study, the following were associated with a higher death rate among children and adolescents: The age groups under one year and 12 to 18 years; the Native ethnicity; the North, Northeast, and Southeast Brazilian regions, in descending order; and the SARS-critical clinical conditions and having at least one comorbidity.

Despite presenting lower rates of hospitalization and deaths than adults, the prevalence, complications, and mortality from COVID-19 in the pediatric population are relevant. Moreover, this study's findings expose the severity of the epidemic in the context of social inequality and the frailty of health services, especially in impoverished areas, where the impact of the pandemic on mortality is heightened. The study highlighted the impact of social inequalities on morbidity and mortality rates from COVID-19. Thus, knowledge of the impact of the disease on this population requires the adoption of public health strategies aimed at reducing social inequalities and access to health services. Thus, children and adolescents should not be neglected in the context of COVID-19 infection, and it is vital to develop studies that clarify the mechanisms that influence COVID-19 mortality. Finally, the knowledge of the profile of children and adolescents hospitalized for COVID-19 and the factors associated with the deaths allows the guidance of response efforts directed to assist this vulnerable population.

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Authors' Contributions

Maria Cristina B. Soares: Research conception and design; Data collection; Data analysis and interpretation; Methodology; Literature review; Article writing; Final approval of the version to be published. Igor R. Mendes: Research conception and design; Data collection; Interpretation of results; Final approval of the version to be published. Ana Peres C. Quintão: Research conception and design; Data collection; Interpretation of results; Final approval of the version to be published. Luana V. Toledo: Critical revision of the intellectual content of the manuscript and final approval of the version to be published. Ana Laura A. C. de Freitas: Literature review; final approval of the version to be published. Bruno D. Henriques: Critical revision of the intellectual content of the manuscript and final approval of the version to be published. Brunnella A. C. de

Freitas: Research conception and design; Data analysis and interpretation; Methodology; Writing - original draft; Final approval of the version to be published; Responsibility for all aspects of the work in ensuring the accuracy and integrity of any part of the work.

References

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P, Zhan F, Ma X, Wang D, Xu W, Wu G, Gao GF, Tan W, China Novel Coronavirus Investigating and Research Team (2020) A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 382:7 27–733.
2. World Health Organization (2020) WHO Director-General's opening remarks at the media briefing on COVID- 19 - 11 March 2020. Available: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020. Accessed: 19 Dec 2022.
3. Ministry of Health, Government of Brazil (2019) Covid-19 Epidemiological surveillance guide: public health emergency of national importance due to coronavirus disease. Available: https://www.gov.br/saude/pt-br/coronavirus/publicacoes-tecnicas/guias-e-planos/guia-de-vigilancia-epidemiologica-covid-19/view. Accessed: 19 Dec 2022. [Article in Portuguese]
4. Zeng L, Xia S, Yuan W, Yan K, Xiao F, Shao J, Zhou W (2020) Neonatal early-onset infection with SARS-CoV-2 in 33 neonates born to mothers with COVID-19 in Wuhan, China. JAMA Pediatr 174: 722–725.
5. Milani GP, Bottino I, Rocchi A, Marchisio P, Elli S, Agostoni C, Costantino G (2021) Frequency of children vs adults carrying severe acute respiratory syndrome coronavirus 2 asymptomatically. JAMA Pediatr 175: 193–194.
6. Castagnoli R, Votto M, Licari A, Brambilla I, Bruno R, Perlini S, Rovida F, Baldanti F, Marseglia GL (2020) Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in children and adolescents: A systematic review. JAMA Pediatr 174: 882–889.
7. CDC COVID-19 Response Team (2020) Coronavirus disease 2019 in children - United States, February 12-April 2, 2020. MMWR Morb Mortal Wkly Rep 69: 422–426.
8. Sanna G, Serrau G, Bassareo PP, Neroni P, Fanos V, Marcialis MA (2020) Children's heart and COVID-19: Up-to-date evidence in the form of a systematic review. Eur J Pediatr 179: 1079–1087.
9. Maciel ELN, Gomes GC, Almada GL, Fernandes de Medeiros N, Cardoso OA, Jabor PM, Reuter T, Gomes de Andrade VL, Bastos WM, Zandonade E (2021) COVID-19 in children, adolescents and young adults: A cross-sectional study in Espírito Santo, Brazil, 2020. Epidemiologia e Serviços de Saúde 30: e20201029.
10. Salian VS, Wright JA, Vedell PT, Nair S, Li C, Kandimalla M, Tang X, Carmona Porquera EM, Kalari KR, Kandimalla KK (2021) COVID-19 transmission, current treatment, and future therapeutic strategies. Mol Pharm 18: 754–771.
11. Ministry of Health, Brazil (2022) Epidemiological surveillance guide: public health emergency of national concern due to coronavirus disease 2019 – Covid-19. Available: https://portaldeboaspraticas.iff.fiocruz.br/biblioteca/guia-de-vigilancia-epidemiologica-emergencia-de-saude-publica-de-importancia-nacional/. Accessed: 19 Dec 2022. [Article in Portuguese]
12. CDC (2020) Health departments. in: centers for disease control and prevention. Available: https://www.cdc.gov/coronavirus/2019-ncov/php/contact-tracing/contact-tracing-plan/overview.html. Accessed: 19 Dec 2022
13. CDC (2020) Interim clinical guidance for management of patients with confirmed coronavirus disease (COVID-19). Available: https://stacks.cdc.gov/view/cdc/89980. Accessed: 19 Dec 2022
14. Gomes NTN, Haslett MIC, Alves AJS e, Percio J, Duarte MMS, Malta JMAS, Carvalho FC de, Almeida WAF de, Gava C, Souza LR de O, Fantinato FFST, Santos ED dos (2021) Retrospective cohort of children and adolescents hospitalized for COVID-19 in Brazil from the beginning of the pandemic to August 1, 2020. Rev bras epidemiol 24: e210026. [Article in Portuguese]
15. Armin S, Mirkarimi M, Pourmoghaddas Z, Tariverdi M, Jafrasteh A, Marhamati N, Shirvani A, Karimi A, Rafiei Tabatabaei S, Mansour Ghanaei R, Fahimzad S, Shirvani F, Hoseini-Alfatemi SM (2021) Iranian pediatric COVID-19 epidemiology and clinical characteristics. Can J Infect Dis Med Microbiol 2021: 4914371.
16. Kitano T, Kitano M, Krueger C, Jamal H, Al Rawahi H, Lee-Krueger R, Sun RD, Isabel S, García-Ascaso MT, Hibino H, Camara B, Isabel M, Cho L, Groves HE, Piché-Renaud P-P, Kossov M, Kou I, Jon I, Blanchard AC, Matsuda N, Mahood Q, Wadhwa A, Bitnun A, Morris SK (2021) The differential impact of pediatric COVID-19 between high-income countries and low- and middle-income countries: A systematic review of fatality and ICU admission in children worldwide. PLoS One 16: e0246326.
17. Oliveira EA, Colosimo EA, Simões E Silva AC, Mak RH, Martelli DB, Silva LR, Martelli-Júnior H, Oliveira MCL (2021) Clinical characteristics and risk factors for death among hospitalised children and adolescents with COVID-19 in Brazil: an analysis of a nationwide database. Lancet Child Adolesc Health 5: 559–568.
18. Campos ARP de F, Alfama GF, Barbosa CCH (2022) Determinants of health vulnerability of indigenous peoples in the context of the COVID-19 pandemic: an integrative literature review. Braz J Health Rev 5: 6642–6653.
19. Meneses-Navarro S, Freyermuth-Enciso MG, Pelcastre-Villafuerte BE, Campos-Navarro R, Meléndez-Navarro DM, Gómez-Flores-Ramos L (2020) The challenges facing indigenous communities in Latin America as they confront the COVID-19 pandemic. Int J Equity Health 19: 63.
20. Sousa BLA, Brentani A, Costa Ribeiro CC, Dollnikoff M, Grisi SJFE, Ferrer APS, Ferraro AA (2021) Non-communicable diseases, sociodemographic vulnerability and the risk of mortality in hospitalised children and adolescents with COVID-19 in Brazil: a cross-sectional observational study. BMJ Open 11: e050724.
21. Natividade M dos S, Bernardes K, Pereira M, Miranda SS, Bertoldo J, Teixeira M da G, Livramento HL, Aragão E (2020) Social distancing and living conditions in the COVID-19 pandemic in Salvador-Bahia, Brazil. Ciênc saúde coletiva 25: 3385–3392. [Article in Portuguese]
22. Noronha KVM de S, Guedes GR, Turra CM, Andrade MV, Botega L, Nogueira D, Calazans JA, Carvalho L, Servo L, Ferreira MF (2020) COVID-19 pandemic in Brazil: analysis of demand and supply of hospital beds and assisted ventilation

equipment according to different scenarios. Cad Saúde Pública 36. [Article in Portuguese]
23. Associação de Medicina Intensiva Brasileira (2016) Censo AMIB 2016. Available: https://www.amib.org.br/censo-amib/censo-amib-2016. Accessed: 20 Jun 2022. [Article in Portuguese]
24. Kompaniyets L, Agathis NT, Nelson JM, Preston LE, Ko JY, Belay B, Pennington AF, Danielson ML, DeSisto CL, Chevinsky JR, Schieber LZ, Yusuf H, Baggs J, Mac Kenzie WR, Wong KK, Boehmer TK, Gundlapalli AV, Goodman AB (2021) Underlying medical conditions associated with severe covid-19 illness among children. JAMA Netw Open 4: e2111182.
25. Choi JH, Choi S-H, Yun KW (2022) Risk factors for severe COVID-19 in children: A systematic review and meta-analysis. J Korean Med Sci 37: e35.
26. Graff K, Smith C, Silveira L, Jung S, Curran-Hays S, Jarjour J, Carpenter L, Pickard K, Mattiucci M, Fresia J, McFarland EJ, Dominguez SR, Abuogi L (2021) Risk factors for severe covid-19 in children. Pediatr Infect Dis J 40: e137–e145.
27. Sousa GJB, Garces TS, Cestari VRF, Florêncio RS, Moreira TMM, Pereira MLD (2020) Mortality and survival of COVID-19. Epidemiol Infect 148: e123.
28. Chai X, Hu L, Zhang Y, Han W, Lu Z, Ke A, Zhou J, Shi G, Fang N, Fan J, Cai J, Fan J, Lan F (2020) Specific ACE2 expression in cholangiocytes may cause liver damage after 2019-ncov infection. BioRxiv.
29. Sun D, Li H, Lu X-X, Xiao H, Ren J, Zhang F-R, Liu Z-S (2020) Clinical features of severe pediatric patients with coronavirus disease 2019 in Wuhan: a single center's observational study. World J Pediatr 16: 251–259.
30. Liuzzo Scorpo M, Ferrante G, La Grutta S (2021) An overview of asthma and COVID-19: Protective factors against SARS-COV-2 in pediatric patients. Front Pediatr 9: 661206.
31. Muñoz X, Pilia F, Ojanguren I, Romero-Mesones C, Cruz M-J (2021) Is asthma a risk factor for COVID-19? Are phenotypes important? ERJ Open Res 7: 00216–02020.
32. Moreno-Sánchez E, Castillo-Viera E, Vélez-Moreno E, Gago-Valiente F-J (2021) Facts and challenges about asthma and covid-19 among the paediatric population: A systematic literature review. Medicina (Kaunas) 57: 1306.
33. Marks KJ, Whitaker M, Anglin O, Milucky J, Patel K, Pham H, Chai SJ, Kirley PD, Armistead I, McLafferty S, Meek J, Yousey-Hindes K, Anderson EJ, Openo KP, Weigel A, Henderson J, Nunez VT, Como-Sabetti K, Lynfield R, Ropp SL, Smelser C, Barney GR, Muse A, Bennett NM, Bushey S, Billing LM, Shiltz E, Abdullah N, Sutton M, Schaffner W, Talbot HK, Chatelain R, George A, Taylor CA, McMorrow ML, Perrine CG, Havers FP, COVID-NET Surveillance Team (2022) Hospitalizations of children and adolescents with laboratory-confirmed COVID-19 - COVID-NET, 14 States, July 2021-January 2022. MMWR Morb Mortal Wkly Rep 71: 271–278.
34. Parcha V, Booker KS, Kalra R, Kuranz S, Berra L, Arora G, Arora P (2021) A retrospective cohort study of 12,306 pediatric COVID-19 patients in the United States. Sci Rep 11: 10231.
35. Martins-Filho PR, Quintans-Júnior LJ, de Souza Araújo AA, Sposato KB, Souza Tavares CS, Gurgel RQ, Fontes Leite DC, de Paiva SM, Santos HP, Santos VS (2021) Socio-economic inequalities and COVID-19 incidence and mortality in Brazilian children: a nationwide register-based study. Public Health 190: 4–6.
36. Orellana JDY, Cunha GM da, Marrero L, Horta BL, Leite I da C (2020) Mortality explosion in the Amazonian epicenter of the COVID-19 epidemic. Cad Saúde Pública 36. [Article in Portuguese]
37. Wanga V, Gerdes ME, Shi DS, Choudhary R, Dulski TM, Hsu S, Idubor OI, Webber BJ, Wendel AM, Agathis NT, Anderson K, Boyles T, Chiu SK, Click ES, Da Silva J, Dupont H, Evans M, Gold JAW, Haston J, Logan P, Maloney SA, Martinez M, Natarajan P, BMBS1, Spicer KB, Swancutt M, Stevens VA, Brown J, Chandra G, Light M, Barr FE, Snowden J, Kociolek LK, McHugh M, Wessel D, Simpson JN, Gorman KC, Breslin KA, DeBiasi RL, Thompson A, Kline MW, Boom JA, Singh IR, Dowlin M, Wietecha M, Schweitzer B, Morris SB, Koumans EH, Ko JY, Kimball AA, Siegel DA (2021) characteristics and clinical outcomes of children and adolescents aged < 18 years hospitalized with COVID-19 - Six Hospitals, United States, July-August 2021. MMWR Morb Mortal Wkly Rep 70: 1766–1772.
38. Middelburg JG, Crijnen TEM, D'Antiga L, Verdoni L, Chikermane A, Garg P, Acharyya BC, Pruccoli G, Schnapp A, Rauf A, Middelburg RA (2021) Association of ethnicity with multisystem inflammatory syndrome in children related to SARS-CoV-2 infection: An international case-referent study. Front Pediatr 9: 707650.
39. Ribeiro KB, Ribeiro AF, Veras MA de SM, de Castro MC (2021) Social inequalities and COVID-19 mortality in the city of São Paulo, Brazil. Int J Epidemiol 50: 732–742.
40. Gaietto K, Freeman MC, DiCicco LA, Rauenswinter S, Squire JR, Aldewereld Z, Iagnemma J, Campfield BT, Wolfson D, Kazmerski TM, Forno E (2022) Asthma as a risk factor for hospitalization in children with COVID-19: A nested case-control study. Pediatr Allergy Immunol 33: e13696.
41. Sanchez-Piedra C, Gamiño-Arroyo A-E, Cruz-Cruz C, Prado-Galbarro F-J (2022) Impact of environmental and individual factors on COVID-19 mortality in children and adolescents in Mexico: An observational study. Lancet Reg Health Am 8: 100184.
42. McCormick DW, Richardson LC, Young PR, Viens LJ, Gould CV, Kimball A, Pindyck T, Rosenblum HG, Siegel DA, Vu QM, Komatsu K, Venkat H, Openshaw JJ, Kawasaki B, Siniscalchi AJ, Gumke M, Leapley A, Tobin-D'Angelo M, Kauerauf J, Reid H, White K, Ahmed FS, Richardson G, Hand J, Kirkey K, Larson L, Byers P, Garcia A, Ojo M, Zamcheck A, Lash MK, Lee EH, Reilly KH, Wilson E, de Fijter S, Naqvi OH, Harduar-Morano L, Burch A-K, Lewis A, Kolsin J, Pont SJ, Barbeau B, Bixler D, Reagan-Steiner S, Koumans EH, Pediatric Mortality Investigation Team (2021) Deaths in children and adolescents associated with covid-19 and mis-c in the United States. Pediatrics 148: e2021052273.
43. Zhang J-J, Dong X, Liu G-H, Gao Y-D (2022) Risk and protective factors for covid-19 morbidity, severity, and mortality. Clin Rev Allergy Immunol 1–18.
44. Martins MM, Prata-Barbosa A, Magalhães-Barbosa MC de, Cunha Ajla da (2020) Clinical and laboratory characteristics of sars-cov-2 infection in children and adolescents. Rev paul pediatr 39.
45. Harwood R, Yan H, Talawila Da Camara N, Smith C, Ward J, Tudur-Smith C, Linney M, Clark M, Whittaker E, Saatci D, Davis PJ, Luyt K, Draper ES, Kenny SE, Fraser LK, Viner RM (2022) Which children and young people are at higher risk of severe disease and death after hospitalisation with SARS-CoV-2 infection in children and young people: A systematic review

and individual patient meta-analysis. EClinicalMedicine 44: 101287.
46. Martins-Filho PR, de Souza Araújo AA, Quintans-Júnior LJ, Santos VS (2020) COVID-19 fatality rates related to social inequality in Northeast Brazil: a neighbourhood-level analysis. J Travel Med 27: 128.

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5.3. Cartilha

O QUE É COVID-19?

A COVID-19 é uma doença causada pelo coronavírus, um vírus também chamado de SARS-Cov-2.

Ele surgiu na China, no final de 2019, e se espalhou pelo mundo. Chegou no nosso país em fevereiro de 2020.

É uma doença viral, que pode acometer todas as faixas etárias, de bebês a idosos.

COMO A COVID-19 É TRANSMITIDA?

O vírus da COVID-19 pode ser transmitido de pessoa para pessoa, através de pequenas partículas que sai da pessoa infectada quando ela fala, tosse ou espirra.

É muito comum ele se espalhar entre pessoas que vivem juntas ou possuem contato diários, como no trabalho e nas escolas.

QUAIS SÃO OS SINTOMAS QUE AS CRIANÇAS APRESENTAM?

Os sintomas podem variar entre as crianças, podendo ser mais exuberantes em umas e mais brandos em outras.

Os principais sintomas

apresentados são: febre, tosse, nariz entupido, nariz escorrendo, dores de cabeça e no corpo. Podem ainda apresentar cansaço, dor de garganta, diarreia, vômitos e calafrios.

É muito comum as crianças infectadas não quererem comer como o habitual.

Crianças que apresentam algumas doenças crônicas como doenças genéticas, doenças neurológicas graves, doenças cardíacas, anemia falciforme, doenças pulmonares crônicas, podem evoluir de forma mais grave.

MEU FILHO ESTÁ COM SINTOMAS, COMO SABER SE ELE ESTÁ COM COVID-19?

Os exames que detectam que o paciente está com COVID-19, são aqueles realizados pelo nariz, podendo ser o de antígeno ou o RT-PCR específico para o vírus. Os exames de sangue para medir a sorologia, que é a presença de anticorpos contra o vírus, não são indicados para avaliar uma infecção ativa.

COMO A COVID-19 PODE SER TRATADA?

A infecção pelo coronavírus não tem nenhum tratamento específico. O recomendado para as crianças é medicar para dor e febre com analgésicos já prescrito pelo pediatra e hidratar bastante. A infecção, na sua grande maioria, melhora dentro de 10 a 14 dias, apenas com essas medidas.

Alguns pacientes, no entanto, apresentam sintomas mais graves e devem procurar o atendimento médico o mais rápido possível. Os sintomas de alarme, que os pais devem ficar atentos são:

- Tiver dificuldade para respirar;
- Sentir dor ou pressão no peito;
- Estiver com os lábios roxinhos;
- Tiver dor de barriga muito forte;
- Ficar muito sonolento ou muito irritado;
- Vomitando várias vezes ao dia;
- Não estiver fazendo xixi.

COMO EVITAR QUE MEU FILHO PEGUE O CORONAVÍRUS?

As principais maneiras para evitar com o que a criança ou o adulto peguem COVID-19 são?

- Uso de máscaras;
- Distanciamento social;
- Lavar as mãos com água e sabão e usar o álcool em gel;

•Vacinar contra a COVID-19. Crianças acima de 6 meses, já podem se vacinar!!

O melhor tratamento e prevenção para o novo coronavírus é a conscientização da população. Se o seu filho está doente, não o mande para a creche e nem leve para a festinha de aniversário. Ele pode estar com COVID-19 e transmitir para outras pessoas.

Caso alguém da famîlia ou o seu filho apresentem sintomas, entre em contato com o seu médico de confiança para ser mais bem orientado.

E se alguém apresentar qualquer dos sinais de alarme que falamos acima, procurem o mais rápido o atendimento médico de urgência. Na nossa região, o Hospital São Sebastião é referência para o atendimento pediátrico.


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6. CONCLUSÃO

A população pediátrica, apesar de corresponder a uma pequena taxa da população brasileiraque carece de internação hospitalar, apresentou uma taxa de letalidade relevante. Associaram- se à maior chance de óbito entre crianças e adolescentes: as faixas etárias dos menores de um ano e de 12 a 18 anos; a raça indígena; as regiões brasileiras norte, nordeste e sudeste, em ordemdecrescente; e as condições clínicas SRAG-crítico e a presença de pelo menos uma comorbidade.

Os achados dos estudos expõem a gravidade da epidemia no contexto da desigualdade sociale fragilidade dos serviços de saúde, sobretudo em áreas mais precárias, nas quais se acentua o impacto da pandemia sobre a mortalidade.

Crianças e adolescentes não devem ser negligenciados na infecção por COVID-19. É de fundamental importância o desenvolvimento de mais estudos que elucidem os mecanismos pelos quais as algumas comorbidades influenciam na maior mortalidade pela COVID-19.

O conhecimento do perfil de crianças e adolescentes hospitalizados por COVID-19 permite o direcionamento de ações preventivas e de enfrentamento voltadas a essa população vulnerável.

Espera-se que a cartilha elaborada ajude os pais e responsáveis pelas crianças e adolescentes a terem um conhecimento maior sobre a COVID-19 nesta população, além de saberem como evitar a propagação e adotarem medidas de prevenção do novo coronavírus.

REFERÊNCIAS BIBLIOGRÁFICAS

BASTOS, Leonardo Soares; NIQUINI, Roberta Pereira; LANA, Raquel Martins; et al. **COVID-19 and hospitalizations for SARI in Brazil: A comparison up to the 12th epidemiological week of 2020**. Cadernos de Saúde Pública, v. 36, n. 4, p. 1–8, 2020.

BERNARDINO, Fabiane Blanco; ALENCASTRO, Lidiane Cristina da Silva; SILVA, Ronaldo Antonio da; RIBEIRO, Antonia Dinágila do Nascimento; CASTILHO Geovane Roberto de Campos; GAÍVA, Maria Aparecida Munhoz. **Epidemiological profile of children and adolescents with COVID-19: a scoping review.** Rev Bras Enferm. 2021 Jan 29;74Suppl 1(Suppl 1):e20200624. English, Portuguese. doi: 10.1590/0034-7167-2020-0624. PMID: 33533805.

BRASIL, Ministério da Saúde. **Protocolo de manejo clínico da COVID-19 na Atenção Primária à saúde: versão 9**. p. 1–41, 2020.

BRASIL. Secretaria de Vigilância em Saúde. **Guia de Vigilância Epidemiológica Emergência de Saúde Pública de Importância Nacional pela Doença pelo Coronavírus** 2019. p. 1–59, 2020.

BRASIL. Ministério da Saúde - SVS - **Recomendações de proteção aos trabalhadores dos serviços de saúde no atendimento de COVID-19 e outras síndromes gripais COVID-19**.COE/SVS/MS Abr. 2020.

CDC. Center for Disease Controland Prevention. **Guidance on Integration of COVID-19 in Existing Acute Febrile Illness (AFI) Surveillance Systems**. Disponível em: https://www.cdc.gov/coronavirus/2019-ncov/global-covid-19/surveillance-guidance-integration.html. Acesso em 20 de julho de 2020.

CDC. Centers for Disease Control and Prevention. **Updated guidelines for evaluating public health surveillance systems: Recommendations from the guidelines working group**. MMWR 2001; 50(RR-13):1-36.

CRODA, Júlio Henrique Rosa; GARCIA, Leila Posenato. Resposta imediata da Vigilância em Saúde à epidemia da COVID-19. **Epidemiologia e serviços de saúde: revista do Sistema Único de Saúde do Brasil**, v. 29, n. 1, p. e 2020002, 2020. 17

GAO, Qijun; HU, Yingfu; DAI, Zhiguo; et al. **The epidemiological characteristics of 2019 novel coronavirus diseases (COVID-19) in Jingmen, Hubei**, China. Medicine, v. 99, n. 23, p. e 20605, 2020.

HILLESHEIM, Danúbia et al. **Síndrome respiratória aguda grave por COVID-19 em crianças e adolescentes no Brasil: perfil dos óbitos e letalidade hospitalar até a 38ª Semana Epidemiológica de 2020.** Epidemiologia e Serviços de Saúde, v. 29, n. 5, 2020.

KILLERBY, Marie E; LINK-GELLES, Ruth; HAIGHT, Sarah C; et al. **Characteristics Associated with Hospitalization Among Patients. Morbidity and Mortality Weekly Report Characteristics**, v. 69, n. 25, p. 790–794, 2020.

LAI, ChihCheng; LIU, YenHung; WANG, Cheng Yi; et al. **Asymptomatic Carrier state, acute respiratory disease, and pneumonia due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2): Facts and myths**. Journal of Microbiology, Immunology and Infection, v. 53, n. 3, p. 404–412, 2020.

LANA, Raquel Martins; COELHO, Flávio Codeço; DA COSTA GOMES, Marcelo Ferreira; *et al*. The novel coronavirus (SARS-CoV-2) emergency and the role of timely and effective national health surveillance. **Cadernos de Saúde Pública**, v. 36, n. 3, 2020.

MARTINS-FILHO, P.R.; QUINTANS-JÚNIOR, L.J.; de SOUZA ARAÚJO, A.A.; SPOSATO, K.B.; SOUZA TAVARES, C.S.; GURGEL, R.Q.; FONTES LEITE, D.C.; de

PAIVA, S.M.; SANTOS, H.P. Jr.; SANTOS, V.S. **Socio-economic inequalities and COVID-19 incidence and mortality in Brazilian children: a nationwide register-based study.** Public Health. 2021 Jan;190:4-6. doi: 10.1016/j.puhe.2020.11.005. Epub 2020 Dec 11. PMID: 33316478; PMCID: PMC7833565.

OMS-Organização Mundial de Saúde. Coronavirus disease (COVID-2019) situation reports. Disponível em: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports. 2020.

RIBAS, Rosineide Marques; CAMPOS, Paola Amaral de; BRITO, Cristiane Silveira de; et al. **Coronavirus Disease 2019 (COVID-19) and healthcare-associated infections: Emerging and future challenges for public health in Brazil**. Travel Medicine and Infectious Disease, v. 2019, n. March, p. 101675, 2020.

SAFADI, Marco Aurelio Palazzi; SILVA, Clovis Artur Almeida da. O espectro desafiador e imprevisível da COVID-19 em crianças e adolescentes. Revista Paulista de Pediatria. 2021, vol. 39, e2020192

WERNECK, Guilherme Loureiro; CARVALHO, Marilia Sá. **A pandemia de COVID-19 no Brasil: Crônica de uma crise sanitária anunciada**. Cadernos de Saúde Pública, v. 36, n. 5, p. 1–4, 2020.