



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

BRIEF COMMUNICATIONS

COVID-19 Pediatric Patients: Gastrointestinal Symptoms, Presentations, and Disparities by Race/Ethnicity in a Large, Multicenter US Study



Yusuf Ashktorab,¹ Anas Brim,¹ Antonio Pizuorno,² Vijay Gayam,³ Sahar Nikdel,¹ and Hassan Brim¹

¹Department of Medicine, Howard University College of Medicine, Washington DC; ²Faculty of Medicine, School of Medicine, La Universidad del Zulia, Maracaibo, Zulia state, Venezuela; and ³Department of Medicine, SUNY Downstate University Hospital, New York, New York

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), commonly referred to as coronavirus disease 2019 (COVID-19), is currently causing a severe outbreak in the United States and the world. SARS-CoV-2 mostly causes respiratory and gastrointestinal (GI) symptoms.¹ Clinical manifestations range from the common cold to severe disease such as bronchitis, pneumonia, SARS, multiorgan failure, and death.²

SARS-CoV-2 seems to less commonly and less severely affect children. Understanding whether children are affected differently is important for clinical and containment strategies. Also, finding the nature of immune responses in children is important given the rare but severe multisystem inflammatory syndrome in children that has been reported in about 1000 cases worldwide. This recently identified syndrome appears to be temporally associated with SARS-CoV-2 infection in children.³ In this study we describe the clinical presentations, age, sex, and GI symptoms of children with confirmed SARS-CoV-2 infection.

Methods

Search Strategy

We conducted a systematic literature search of published articles using electronic databases such as PubMed, OVID, Scopus, and Google Scholar from January 20 through November 5, 2020 using the following terms: COVID-19 Children, COVID-19 Infants, COVID-19 Adolescents, COVID-19 Teenagers, COVID-19 Newborns, and COVID-19 Pediatrics. We also searched reference databases from various public health systems such as the Centers for Disease Control and Prevention. Case characteristics were described, including demographics and symptoms (Figure 1). We also included our limited deidentified data from Interfaith Medical Center, a tertiary hospital in Brooklyn, that is affiliated with the State University of New York.

Statistical Analysis

Data from 6639 patients from 5 sources^{3–7} were collected. Symptoms and demographics were combined and analyzed by weighted analysis. The effect of symptoms was reported using weighted analysis where weights were related to the size of the reported study. SPSS version 23 (SPSS Inc, Chicago, IL) was used for this analysis.

Results

Demographics and Clinical Characteristics of Patients

Our study consisted of 6639 patients from 212 centers in the United States (Figure 1). Of our 5 sources the 1 that contributed the most to patient data is the Peds COVID-19 Registry⁷ (208 hospitals and 6581 patients). The median age of our cohort was 14.79 years, and boys were represented at 51%. Fever was reported in 48% of patients, whereas cough was reported in 35.6% (Figure 1B).

GI Symptoms and Distribution of Minorities

Vomiting was the predominant GI symptom in our study, reported in 13.2% of the total cohort. This was followed by abdominal pain at 10.1% and diarrhea at 11%.

Minorities were well represented in our cohort, with 1974 (29.7%) African Americans and 2040 (30.7%) Hispanics. Although no characterization of race with symptoms was available from aggregated data, the Interfaith Medical Center COVID-19 patients (all African Americans) displayed diarrhea, nausea, and vomiting in 2 of 3 African American patients (66.6%).

Discussion

In this study we describe clinical manifestations of hospitalized US children with COVID-19. The median age in our cohort was 15 years. Most children appeared to have mild disease and to recover with supportive treatment. There were slightly more boys in our cohort. However, it is not unlikely that gender has an impact on outcome.

Clinical presentations in children in our cohorts were largely nonspecific with predominance of fever and cough among both genders. With respect to GI symptoms, vomiting was the most prevalent symptom. This finding corresponds to other reports, such as from Bolia et al⁸ in which they

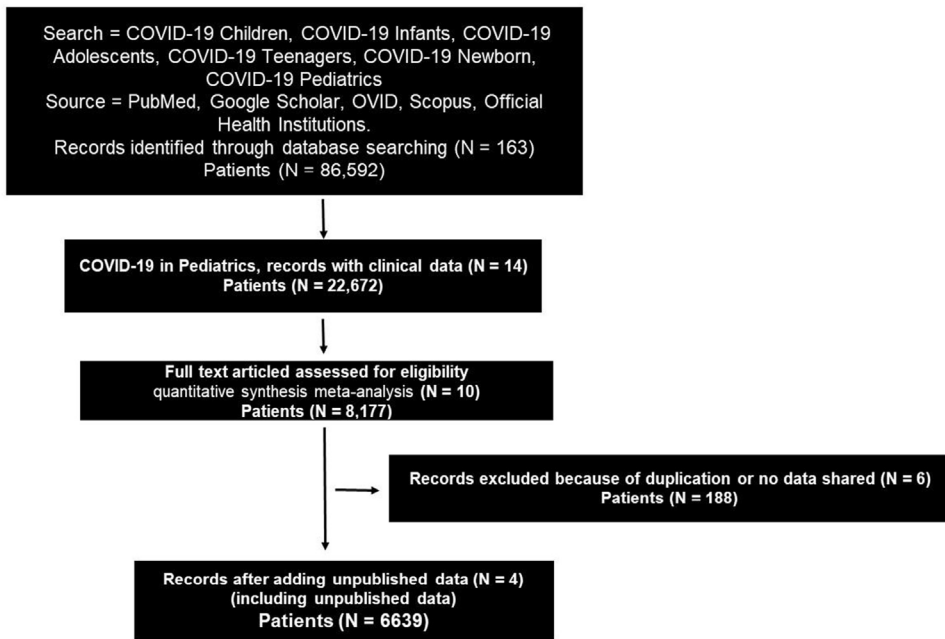
Abbreviations used in this paper: COVID-19, coronavirus disease 2019; GI, gastrointestinal; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

Most current article

© 2021 by the AGA Institute
0016-5085/\$36.00

<https://doi.org/10.1053/j.gastro.2020.12.078>

A)



B)

Region (Total patients N=6,639)	New York Manhasset	New York City	New York Bronx	New York SUNY	Peds COVID-19 US Reg.	Total Weighted % (n)
Patients % (n)	0.53 (35)	0.23 (15)	0.08 (5)	0.05 (3)	99.13 (6,581)	-
Sex % (n)						
Male	62.8 (22)	73 (11)	40 (2)	66.6 (2)	51 (3,356)	
Female	37.2 (13)	27 (4)	60 (3)	33.3 (1)	49 (3,224)	-
Age Range (years)	2.2-19	3-20	<1	<18	<21	-
Median Age	8.6	12	0.3	10.3	M	-
N of Hospitals	1	1	1	1	208	-
Race % (n)						
Caucasian		13.3 (2)			39 (2,566)	
African Americans		13.3 (2)			30 (1,974)	
Hispanic		66 (10)			31 (2,040)	
Asian	M		M	100 (3)	3 (197)	
Others		6.6 (1)			12 (789)	-
Fever % (n)	100 (35)	100 (15)	80 (4)	100 (3)	47.6 (3132)	48 (3189)
Cough % (n)	55 (19)	20 (3)	20 (1)	100 (3)	35.6 (2342)	35.6 (2368)
Abdominal Pain % (n)	97 (34)	13 (2)	M	0	9.7 (638)	10.1 (674)
Nausea % (n)	M	M	M	66.6 (2)	8.8 (579)	8.8 (581)
Vomiting % (n)	97 (34)	13 (2)	0	66.6 (2)	12.8 (842)	13.2 (880)
Diarrhea % (n)	97 (34)	13 (2)	0	66.6 (2)	10.6 (697)	11 (735)
Conjunctivitis % (n)	M	27 (4)	M	M	2.7 (177)	2.7 (181)
Mechanical Ventilation % (n)	3 (1)	20 (3)	0	0	0	0.06 (4)
Collection Date	APR. 17 th - MAY 17 th	APR. 24 th - JUN. 19 th	Before APR. 26 th	APR. 30 th - MAY 30 th	JAN. 20 th - NOV 5 th	
References	[4]	[5]	[6]	Our data	[7]	This study

M= Missing

Figure 1. Study design and data. (A) Flowchart for study selection. (B) Demographics and clinical manifestations of COVID-19 pediatric patient data.

report that the most prevalent GI symptom for children is vomiting.

It is worth noting, however, that in our small African American patient group from Interfaith Medical Center, diarrhea, nausea, and abdominal pain were represented at 66.6% (2/3 patients), pointing probably to higher GI manifestations in this minority group. Overall, Hispanic and African American children had higher cumulative rates of COVID-19-associated hospitalizations (16.4 and 10.5 per 100,000, respectively) than white children (2.1 per 100,000) and account for two-thirds of the registered deaths so far. As such, better prevention and management efforts are needed for minorities to counter risk factors and the effects of comorbidities on infection rates and disease outcome.

Given the wide variety of clinical symptoms, we recommend clinicians should have a high index of suspicion for SARS-CoV-2 infection in young infants presenting with systemic symptoms, even in the absence of fever. However, as the pandemic continues and children are unlikely to receive vaccines soon, it is critical for emergency department providers to recognize the various clinical presentations of COVID-19. A more comprehensive evaluation may be warranted in any child presenting with fever in combination with rash, conjunctivitis, and/or GI symptoms, regardless of SARS-CoV-2 exposure.

This study has the limitation of being a retrospective investigation of a relatively small patient population. Another limitation is that young children may show signs and symptoms that are not detected and reported by their guardians and physicians. As such, the appearance and frequency of new symptoms is expected to change as we get more familiar with COVID-19 in children. Also, a large portion of our data is aggregated and did not allow detailed subgroup and race-based analyses.

In conclusion, we here report that cough and fever are the primary symptoms in hospitalized pediatric COVID-19

patients in the United States. Vomiting, abdominal pain, and diarrhea were common among these patients, with vomiting as the most prevalent GI symptom.

References

1. Ashktorab H, et al. *Gastroenterology* 2021;160:938–940.
2. Ali I, et al. <https://doi.org/10.1016/j.scitotenv.2020.138861>.
3. Sinaei R, et al. <https://doi.org/10.1007/s12519-020-00392-y>.
4. Sahn B, et al. *J Pediatr Gastroenterol Nutr* 2021;72:384–387.
5. Riollano-Cruz M, et al. *J Med Virol* 2021;93:424–433.
6. Suwanwongse K, et al. *Arch Pediatr* 2020;27:400–401.
7. Pediatric COVID-19 US Case Registry. <https://www.pedscovid19registry.com/current-data.html>.
8. Bolia R, et al. *Indian J Pediatr* 2021;88:101–102.

Received December 7, 2020. Accepted December 31, 2020.

Correspondence

Address correspondence to: Hassan Brim, PhD, Howard University College of Medicine, Washington DC 20060; e-mail: hbrim@howard.edu.

CRedit Authorship Contributions

Yusuf Ashktorab, (Conceptualization: Supporting; Data curation: Supporting; Formal analysis: Supporting; Validation: Supporting; Writing - original draft: Supporting). Anas Brim, (Data curation: Supporting; Formal analysis: Supporting; Validation: Antonio Pizuorno, MD (Data curation: Lead; Formal analysis: Equal; Methodology: Lead; Supervision: Supporting; Validation: Supporting; Writing - original draft: Supporting). Vijay Gayam, MD (Data curation: Equal). Sahar Nikdel, MD (Data curation: Supporting; Formal analysis: Supporting; Methodology: Supporting; Supervision: Supporting; Validation: Supporting). Hassan Brim, Ph.D. (Conceptualization: Lead; Data curation: Lead; Formal analysis: Lead; Investigation: Lead; Methodology: Lead; Supervision: Lead; Validation: Lead; Writing - original draft: Lead; Writing - review & editing: Lead).

Conflicts of interest

The authors disclose no conflicts.

Funding

This project was supported (in part) by the National Institute on Minority Health and Health Disparities of the National Institutes of Health under Award Number G12MD007597.