

# Demographic predictors of hospitalization and mortality in U.S. children with COVID-19

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## Short Report

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# Abstract

Understanding which children are at increased risk for poor outcome with COVID-19 is critical. In this study, we link pediatric population-based data from the United States' Center for Disease Control and Prevention to COVID-19 hospitalization and in-hospital death. In 27,045 U.S. children with confirmed COVID-19, we demonstrate that African American [OR 2.28 (95% CI: 1.93, 2.70)] or mixed race [OR 2.95 (95% CI: 2.28, 3.82)] and an underlying medical condition [OR 3.55 (95% CI: 3.14, 4.01)] are strong predictors for hospitalization. Death occurred in 39 (0.19%) of 20,096 hospitalized children; children with a prior medical condition had an increased odd for death [OR 8.8 (95% CI: 3.7, 21.1)].

*Conclusion:* Hospitalization and in-hospital death are rare in children diagnosed with COVID-19. However, children at higher risk for these outcomes include those with an un underlying medical condition, as well as those of African American descent.

## What Is Known

- Demographic factors are independent prognosticators of poor outcome in children with COVID-19

## What is New

- Children with an underlying medical condition and those from an African American or mixed race/ethnicity are at high for COVID-19 hospitalization
- History of a comorbidity supersedes age, gender, and race/ethnicity as a risk factor for in-hospital pediatric COVID-19 death

## Introduction

As of October 15th, 2020, more than 7.9M cases of COVID-19 have been confirmed in the United States.<sup>1</sup> A recent report from the American Academy of Pediatrics and the Children's Hospital Association estimates nearly 700,000 total COVID-19 cases in U.S. children.<sup>2</sup> Previous studies have shown that age, gender, race/ethnicity, and underlying medical conditions are independent risk factors for poor outcome in COVID-19.<sup>3-6</sup> Understanding the role these factors play in severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) may inform clinicians, researchers, and governing agencies which children are at highest risk for severe COVID-19. Thus, our goal was to quantify the relationship between demographic factors and U.S. pediatric COVID-19 hospitalization and death.

## Methods

The Centers for Disease Control and Prevention COVID-19-associated hospitalization surveillance network (CDC COVID-NET) is a population-based system that captures laboratory-confirmed COVID-19 cases in over 250 U.S. acute-care hospitals.<sup>7</sup> The CDC COVID-NET is comprised of demographic variables

(e.g., gender, age group, race and ethnicity, medical conditions), date of positive SARS-CoV-2 test, as well as outcomes, including hospitalization and mortality. The publicly available database stratifies the variables as follows:

- Age group: stratified to 0-9 years or 10-19 years
- Gender: male or female
- Race and ethnicity:
- Medical condition: yes or no
- Hospitalization: yes or no
- Death: yes or no

Our primary outcomes were hospitalization and in-hospital mortality. We only included children that had complete information (e.g., no missing data). We examined the association of age, gender, race and ethnicity, and medical condition on hospitalization, followed by in-hospital mortality. All demographic variables were included in the multivariable logistic regression model. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. A p value <5% was considered statistically significant. Analyses were performed in STATA (version 13, College Station, TX) on CDC COVID-NET data downloaded on August 17<sup>th</sup>, 2020.

## Results

A total of 27,045 U.S. children with COVID-19 were included in this report. The majority (n=18,924; 70%) of children were between the ages of 10 to 19 years with a similar gender distribution (Please refer to Table1). Hispanic/Latino, White, non-Hispanic, and Black, non-Hispanic totaled 90.3% of the population. Thirty-nine percent (n=10,438) of children had an underlying medical condition.

Of 27,045 children, 1,274 (4.7%) required hospitalization. Multivariate analysis demonstrated that age, race/ethnicity, and medical conditions were significant features for hospitalization. Specifically, COVID-19 positive children <10 years of age [OR 1.5 (95% CI 1.3, 1.7)] who were black or of mixed race/ethnicity, and with a medical condition [OR 3.5 (95% CI 3.1, 4.0)] associated with a higher odds for hospitalization.

Mortality data was available for 20,096 (74.3%) individuals. Death occurred in 39 (0.19%) hospitalized children. Logistic regression showed that race/ethnicity and a history of a medical condition associated with in-hospital death. Children who were black, non-Hispanic [OR 3.0 (95% CI 1.3, 6.7)] and those with an underlying medical condition [OR 8.8 (95% CI 3.7, 21.1)] had an increased odd for death.

## Discussion

In a US cohort of 27,045 confirmed COVID-19 children, we found that hospitalization occurred 4.7% of the time with an in-hospital mortality rate of 0.19%. Cases of COVID-19 were more frequently observed in children older than 10 years of age and those of Hispanic/Latino and White, non-Hispanic race/ethnicity.

However, children more likely to be hospitalized or die were Black, non-Hispanic and children with an underlying health condition. Interestingly, medical condition was the strongest risk factor for a poor outcome.

There are limitations to our study. First, although the data is derived from 14 states, it only represents 10% of the US population. Second, missing data was common in the database which decreased our overall sample size. In particular, medical conditions had more than 50% of the data unknown or missing. Despite finding that a history of medical conditions impacts the trajectory of childhood COVID-19, we did not have details regarding the specific conditions.

To our knowledge, this is the largest pediatric evaluation investigating demographic information as risk factors of COVID-19 hospitalization and death. Implications from our study are threefold: (i) gender may not play a significant role in childhood COVID-19 severity, (ii) race and ethnicity, and underlying medical conditions are vital risk factors for COVID-19 hospitalization or death, and (iii) younger age increases hospitalization risk, but not death. Future studies should focus on unravelling the mechanisms underpinning poor COVID-19 outcomes in Black, non-Hispanic children, as well as those with medical conditions.

## Abbreviations

CDC-Centers for Disease Control and Prevention; CI-confidence interval; COVID-19-coronavirus disease 2019; COVID-NET-COVID-19-Associated Hospitalization Surveillance Network; NH-non-Hispanic; OR-odds ratio.

## Declarations

**Funding:** Parker B. Francis Fellowship Grant; The Francis Foundation had no role in the design or conduct of this study.

**Conflict of interest/competing interests/declarations:** None to report

**Ethics approval:** not applicable

**Consent to participate** not applicable

**Consent for publication:** not applicable

**Availability of data and material:** publicly available data

**Code availability:** not applicable

**Authors' contributions:**

Drs. Alvaro and Axel Moreira conceptualized and designed the study, drafted sections of the initial manuscript, carried out the analyses, and supervised the project.

Dr. Ahmed assisted with conceptualization, wrote sections of the initial manuscript, and critically reviewed and revised the manuscript.

Drs. Chorath, Rajasekaran, and Ms. Burmeister assisted with conceptualization and critically reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

## References

1. COVID Data Tracker. Centers for Disease Control and Prevention. [Covid.cdc.gov/covid-data-tracker/#cases\\_totalcases](https://covid.cdc.gov/covid-data-tracker/#cases_totalcases). Last accessed on 9.17.2020.
2. Children and COVID-19: State-Level Data Report. American Academy of Pediatrics. [Services.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/children-and-covid-19-state-level-data-report/](https://services.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/children-and-covid-19-state-level-data-report/). Last accessed on 10.15.2020.
3. Götzinger F, Santiago-García B, Noguera-Julián A, et al. COVID-19 in children and adolescents in Europe: a multinational, multicentre cohort study. *Lancet Child Adolesc Health*. 2020;4(9):653-661.
4. Shekerdemian LS, Mahmood NR, Wolfe KK, et al. Characteristics and outcomes of children with coronavirus disease 2019 (COVID-19) infection admitted to us and canadian pediatric intensive care units [published online ahead of print, 2020 May 11]. *JAMA Pediatr*. 2020;10.1001/jamapediatrics.2020.1948.
5. Kim L, Whitaker M, O'Halloran A, et al. hospitalization rates and characteristics of children aged <18 years hospitalized with laboratory-confirmed COVID-19 – COVID-NET, 14 States, March 1–July 25, 2020. *MMWR Morb Mortal Wkly Rep* 2020;69:1081–1088.
6. Hoang A, Chorath K, Moreira A, et al. COVID-19 in 7780 pediatric patients: A systematic review. *EClinicalMedicine*. 2020;24:100433. Published 2020 Jun 26.
7. Coronavirus disease 2019-associated hospitalization surveillance network (COVID-NET). Centers for Disease Control and Prevention. [Cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html](https://cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html). Last accessed on 9.17.2020.

## Table

Table 1.

**Demographic characteristics associated with COVID-19 hospitalization**

<b>Variable</b>	<b>Total</b>	<b>Non-hospitalized</b>	<b>Hospitalized</b>	<b>p value</b>
<i>Age</i>				
0-9 years	8,121	7,639 (94.1%)	482 (5.9%)	<0.01
10-19 years	18,924	18,132 (95.8%)	792 (4.2%)	
<i>Sex</i>				
Female	13,959	13,299 (95.3%)	660 (4.7%)	0.99
Male	13,086	12,472 (95.3%)	614 (4.7%)	
<i>Race/Ethnicity</i>				
White, NH	7,974	7,717 (96.8%)	257 (3.2%)	<0.01
Black, NH	4,224	3,876 (91.8%)	348 (8.2%)	
Hispanic/Latino	12,236	11,697 (95.6%)	539 (4.4%)	
Asian, NH	972	936 (96.3%)	86 (3.7%)	
Multiple/Other, NH	980	894 (91.2%)	55 (8.8%)	
Hawaiian/Pacific Islander, NH	478	471 (98.5%)	7 (1.5%)	
Alaskan/American Indian, NH	181	180 (99.4%)	1 (0.6%)	
<i>Comorbidity</i>				
No	16,607	16,195 (97.5%)	412 (2.5%)	<0.01
Yes	10,438	9,576 (91.7%)	862 (8.3%)	

**Risk factors associated with hospitalization and in-hospital death**

<b>Variable</b>	<b>Odds Ratio (95% CI)</b>	<b>p value</b>
<b>HOSPITALIZATION</b>		
<i>Age</i>		
0-9 years	1.48 (1.31 - 1.67)	<0.01
10-19 years	1 (reference)	...
<i>Sex</i>		
Female	1.03 (0.92 - 1.16)	0.56
Male	1 (reference)	...
<i>Race/Ethnicity</i>		

White, NH	1 (reference)	...
Black, NH	2.28 (1.93 - 2.70)	<0.01
Hispanic/Latino	1.38 (1.19 - 1.61)	<0.01
Asian, NH	1.11 (0.78 - 1.61)	0.56
Multiple/Other, NH	2.95 (2.28 - 3.82)	<0.01
Hawaiian/Pacific Islander, NH	0.25 (0.12 - 0.54)	<0.01
Alaskan/American Indian, NH	0.20 (0.03 - 1.42)	0.11
<i>Comorbidity</i>		
No	1 (reference)	...
Yes	3.55 (3.14 - 4.01)	<0.01

## **DEATH**

<i>Age</i>		
0-9 years	1.23 (0.63 - 2.42)	0.53
10-19 years	1 (reference)	...
<i>Sex</i>		
Female	0.98 (0.52 - 1.85)	0.96
Male	1 (reference)	...
<i>Race/Ethnicity</i>		
White, NH	1 (reference)	...
Black, NH	2.96 (1.30 - 6.73)	0.01
Hispanic/Latino	0.88 (0.36 - 2.13)	0.78
Asian, NH	...	...
Multiple/Other, NH	3.33 (0.90 - 12.4)	0.07
Hawaiian/Pacific Islander, NH	...	...
Alaskan/American Indian, NH	...	...
<i>Comorbidity</i>		
No	1 (reference)	...

Yes	8.82 (3.68 - 21.1)	<0.01
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CI-confidence interval, NH-non-Hispanic.