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Clinical Communications

Racial differences in emergency encounters related to pediatric allergic diseases during the COVID-19 pandemic

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Clinical Implications

Emergency encounters for pediatric allergic diseases decreased during the intra—coronavirus disease 2019 period. This was particularly true for asthma, allergic rhinitis, and atopic dermatitis. The racial disparity observed for coronavirus disease 2019 extended to allergic diseases during the course of the pandemic.

The coronavirus disease 2019 (COVID-19) pandemic has had a significant impact on health care utilization, with substantially fewer medical encounters among children, particularly in the early pandemic phases. DeLaroche et al¹ reported a marked decrease (45.7%) in the number of pediatric asthma emergency department (ED) encounters across the United States. Similarly, a reduction in the number of hospital admissions due to asthma during the COVID-19 lockdown was reported in the Netherlands.² Although recent studies have reported consistent downward trends for asthma, data on trends in ED encounters for other allergic diseases (allergic rhinitis, atopic dermatitis, food allergy, and eosinophilic esophagitis) are limited. Therefore, we sought to determine changes in ED encounters for these pediatric allergic diseases before and during the COVID-19 pandemic at our large referral center. We also sought to evaluate how racial disparities in ED encounter rates changed from before to during the pandemic. Identifying racial disparities in ED encounters in allergic diseases during the COVID-19 pandemic could help to develop approaches to reduce ED encounters in equitable ways.

We conducted a retrospective review of electronic health record data from Cincinnati Children's Hospital Medical Center in Ohio. The data collected were from January 1, 2018, to December 31, 2020, and included demographic characteristics and the *International Classification of Diseases, Tenth Revision* codes for asthma (J45), allergic rhinitis (J30), atopic dermatitis (L20), eosinophilic esophagitis (K20), and food allergy (Z91).

The outcome of interest was the weekly number of allergic disease encounters (asthma, allergic rhinitis, atopic dermatitis, eosinophilic esophagitis, and food allergy). ED encounters that occurred from January 1, 2018, to March 13, 2020 (the date of national emergency declaration) were considered as pre—COVID-19, whereas encounters between March 14, 2020, and December 31, 2020, were considered intra—COVID-19.¹ We limited the analysis to December 31, 2020, to avoid any potential impact of the vaccination rollout that happened as of January 2021 and make our results comparable with recent literature.^{1,2} The primary independent variable on which we collected data was race, defined according to parent report. For purposes of these analyses, and in alignment with prevailing

demographic characteristics of individuals living in Cincinnati, we limited our evaluation to those children identified as Black or non-Hispanic White.

We compared average weekly ED encounters during the pre— and intra—COVID-19 periods for both races and across included allergic diseases using the *t* test. We used interrupted time-series models to evaluate weekly ED rates (per 10,000 population) by race and diagnosis. These models allow for the estimation of changes in rates over time (trends) and seasonality before and during an event is introduced (eg, the national emergency declaration of COVID-19)³ (for additional details about population characteristics, see Table E1 in this article's Online Repository at www.jaci-inpractice.org).

Overall, there were 139,403 ED encounters for allergic diseases across the study time course (108,581 in the pre—COVID-19 period and 30,822 in the intra—COVID-19 period). Comparing average weekly ED encounters during pre— and intra—COVID-19 periods, we found that asthma had 35% fewer average weekly ED encounters during the intra—COVID-19 period. For those identifying as Black, there were 34% fewer average weekly ED encounters, and 36% fewer for those identifying as White. Similarly, significant differences were observed for allergic rhinitis (23% overall, 19% lower in Black children, and 26% lower in non-Hispanic White youth) (see Table E1). There was a significant decrease in ED encounters for atopic dermatitis and eosinophilic esophagitis for Black youth but not for non-Hispanic White youth. There were no significant differences in average weekly ED encounters for food allergy.

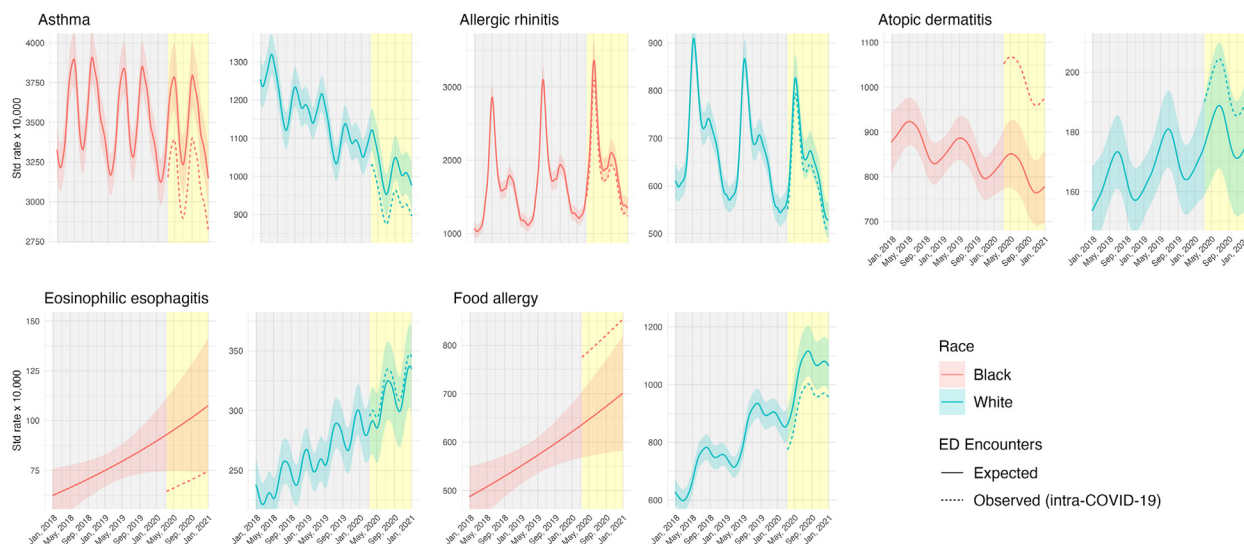
Table I and Figure 1 summarize the results from the time-series analysis. During the intra—COVID-19 period, asthma exhibited 10.4% (0.896; 95% CI, 0.852-0.942) and 8.2% (0.918; 95% CI, 0.871-0.968) lower than expected ED rates for Black and non-Hispanic White children, respectively, when compared with prepandemic rates. Similarly, allergic rhinitis and eosinophilic esophagitis showed 8% (0.92; 95% CI, 0.863-0.98) and 30.6% (0.694; 95% CI, 0.494-0.975) lower than expected ED rates, respectively, in Black children. However, atopic dermatitis showed 25.5% higher than expected ED rates (1.255; 95% CI, 1.133-1.389) in Black children during the intra—COVID-19 period. Finally, food allergy showed 21.8% higher than expected ED rates in Black children (1.218; 95% CI, 1.033-1.437) and 10.2% lower than expected ED rates in non-Hispanic White children (0.898; 95% CI, 0.83-0.971) during the intra—COVID-19 period.

In terms of overall trends and seasonality, asthma and allergic rhinitis showed a steady decline for non-Hispanic White children but remained stable for Black children. Likewise, eosinophilic esophagitis and food allergy both showed upward trends in ED visits for both Black and non-Hispanic White children (all $P_{\text{trend}} < .05$). Seasonal peaks in ED rates were observed for asthma, allergic rhinitis, and atopic dermatitis during May and September.

In this study, using descriptive statistics and time-series analysis, we found significant racial differences in pediatric allergic disease—related ED encounters during pre— and intra—COVID-19 periods. Changes in ED rates and trajectories were not

TABLE 1. Interrupted time-series analysis for ED encounters in allergic diseases during pre- and intra-COVID-19 periods

Allergic disease	Black			Non-Hispanic White		
	Expected encounters (95% CI)	<i>P</i> _{value} *	<i>P</i> _{trend} *	Expected encounters (95% CI)	<i>P</i> _{value} *	<i>P</i> _{trend} *
Asthma			.236			<.001
Period		<.001			.002	
Pre-COVID-19	Reference group			Reference group		
Intra-COVID-19	0.896 (0.852-0.942)			0.918 (0.871-0.968)		
Allergic rhinitis			<.001			<.001
Period		.011			.135	
Pre-COVID-19	Reference group			Reference group		
Intra-COVID-19	0.92 (0.863-0.98)			0.96 (0.91-1.012)		
Atopic dermatitis			.112			.166
Period		<.001			.195	
Pre-COVID-19	Reference group			Reference group		
Intra-COVID-19	1.255 (1.133-1.389)			1.083 (0.96-1.221)		
Eosinophilic esophagitis			.029			<.001
Period		.037			.551	
Pre-COVID-19	Reference group			Reference group		
Intra-COVID-19	0.694 (0.494-0.975)			1.03 (0.935-1.134)		
Food allergy			.008			<.001
Period		.020			.008	
Pre-COVID-19	Reference group			Reference group		
Intra-COVID-19	1.218 (1.033-1.437)			0.898 (0.83-0.971)		

P* < .05.FIGURE 1.** Weekly ED rates (per 10,000 population) by race and disease during pre-COVID-19 (*light gray*) and intra-COVID-19 (*light yellow*) periods.

experienced equitably. Possible reasons for the substantial decrease in asthma-related ED encounters have been reported in other studies, including lower exposure to environmental triggers, fear of coming to hospitals, extra prevention measures with asthmatic children at the beginning of the pandemic, and the decrease in automobile traffic.^{2,4} However, it is anticipated that the return to normalcy and the lifting of COVID-related restrictions will once

again increase infectious and environmental triggers and, potentially, rates of asthma-related ED encounters.⁵ That said, long-term downward trends in asthma and allergic rhinitis have been reported previously.^{6,7}

Racial differences in ED encounters for atopic dermatitis, eosinophilic esophagitis, and food allergy during the intra-COVID-19 period were observed. The increase in atopic

dermatitis encounters among Black children might be due to the high frequency of handwashing measures during the COVID-19 pandemic. This was supported by a report in Denmark that showed an increase in the incidence of contact dermatitis because of the high frequency of handwashing during the COVID-19 period and low access to moisturizers.⁸ However, factors that are independent of the pandemic (eg, environmental allergens and loss of immune tolerance) might be implicated in the upward trends in eosinophilic esophagitis and food allergy.⁹ Modifiable clinical factors could emerge from this knowledge. For example, at the system level, communication to certain communities about elevated environmental or infectious risks could be warranted to proactively prevent disease transmission and exacerbation. At the patient level, clinicians could tailor their anticipatory guidance to ensure quality of care in patients and their families. They may alter prescribing habits to more efficiently identify patients who could benefit from controller or preventive medications. Both system- and patient-level change could be useful in reducing disparities at ED encounters for minoritized groups.

To our knowledge, this is the first study to evaluate racial differences in ED encounters for pediatric allergic diseases during the pre- and intra-COVID-19 periods. Our results showed that ED encounters for allergic diseases varied during the COVID-19 period in ways that differed significantly by race, generally illustrative of widening of racial disparities. Our approach is distinct from previous efforts in that we implemented the time-series analysis to disentangle ED encounters by race and allergic disease type. Our findings might indicate the need for disease-specific interventions. Finally, our data set is limited to a single geographic area and more recent time frames. Hence, our results should be interpreted with caution. Future research might include current ED visits and explore ED trends during other phases of the pandemic.

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REFERENCES

1. DeLaroché AM, Rodean J, Aronson PL, Fleegler EW, Florin TA, Goyal M, et al. Pediatric emergency department visits at US children's hospitals during the COVID-19 pandemic. *Pediatrics* 2021;147:E2020039628.
2. Kruizinga MD, Peeters D, van Veen M, van Houten M, Wieringa J, Noordzij JG, et al. The impact of lockdown on pediatric ED visits and hospital admissions during the COVID19 pandemic: a multicenter analysis and review of the literature. *Eur J Pediatr* 2021;180:2271-9.
3. Bernal JL, Cummins S, Gasparrini A. Interrupted time series regression for the evaluation of public health interventions: a tutorial. *Int J Epidemiol* 2017;46:348-55.
4. Arsenault S, Hoofman J, Poowuttikul P, Secord E. Sustained decrease in pediatric asthma emergency visits during the first year of the COVID-19 pandemic. *Allergy Asthma Proc* 2021;42:400-2.
5. Correa-Agudelo E, Ding L, Beck AF, Brokamp C, Altaye M, Kahn RS, et al. Understanding racial disparities in childhood asthma using individual- and neighborhood-level risk factors. *J Allergy Clin Immunol* 2022;150:1427-1436.e5.
6. Ginde AA, Espinola JA, Camargo CA Jr. Improved overall trends but persistent racial disparities in emergency department visits for acute asthma, 1993-2005. *J Allergy Clin Immunol* 2008;122:313-8.
7. Akinbami LJ, Moorman JE, Simon AE, Schoendorf KC. Trends in racial disparities for asthma outcomes among children 0 to 17 years, 2001-2010. *J Allergy Clin Immunol* 2014;134:547-553.e5.
8. Borch L, Thorsteinsson K, Warner TC, Mikkelsen CS, Bjerring P, Lundbye-Christensen S, et al. COVID-19 reopening causes high risk of irritant contact dermatitis in children. *Dan Med J* 2020;67:A05200357.
9. Dellon ES, Hirano I. Epidemiology and natural history of eosinophilic esophagitis. *Gastroenterology* 2018;154:319-332.e3.

ONLINE REPOSITORY

TABLE E1. Population characteristics for weekly ED encounters in allergic diseases during pre– and intra–COVID-19 periods*

Characteristic	Overall	Pre–COVID-19 period	Intra–COVID-19 period	<i>P</i> value *	Percentage change
Total encounters, N	139,403	108,581	30,822		
Total no. of weeks	157	115	42		
Weekly ED visits, mean $\pm$ SD					
Asthma					
Overall	381.52 $\pm$ 91.54	421.23 $\pm$ 63.55	272.81 $\pm$ 64.24	<.001	
Black	197.52 $\pm$ 49.83	217.40 $\pm$ 37.32	143.10 $\pm$ 37.87	<.001	34% decrease
White	184.00 $\pm$ 45.80	203.83 $\pm$ 32.74	129.71 $\pm$ 29.63	<.001	36% decrease
Allergic rhinitis					
Overall	206.13 $\pm$ 59.55	219.49 $\pm$ 59.08	169.55 $\pm$ 43.78	<.001	23% decrease
Black	96.37 $\pm$ 37.09	101.57 $\pm$ 39.76	82.14 $\pm$ 23.54	.003	19% decrease
White	109.76 $\pm$ 27.12	117.92 $\pm$ 23.59	87.40 $\pm$ 23.49	<.001	26% decrease
Atopic dermatitis					
Overall	79.94 $\pm$ 16.76	82.46 $\pm$ 15.03	73.05 $\pm$ 19.35	.002	11% decrease
Black	51.23 $\pm$ 11.43	53.16 $\pm$ 10.68	45.95 $\pm$ 11.87	<.001	14% decrease
White	28.71 $\pm$ 7.80	29.30 $\pm$ 7.00	27.10 $\pm$ 9.57	.117	8% decrease
Eosinophilic esophagitis					
Overall	49.44 $\pm$ 12.01	49.97 $\pm$ 10.49	47.98 $\pm$ 15.49	.358	
Black	4.32 $\pm$ 1.94	4.70 $\pm$ 1.90	3.25 $\pm$ 1.63	<.001	31% decrease
White	45.20 $\pm$ 11.32	45.31 $\pm$ 9.79	44.88 $\pm$ 14.86	.833	1% decrease
Food allergy					
Overall	170.89 $\pm$ 41.24	171.03 $\pm$ 25.39	170.48 $\pm$ 68.40	.94	
Black	35.20 $\pm$ 10.44	34.54 $\pm$ 6.67	37.00 $\pm$ 16.93	.192	7% increase
White	135.69 $\pm$ 33.20	136.50 $\pm$ 21.99	133.48 $\pm$ 53.31	.616	2% decrease

*ED encounters that occurred from January 1, 2018, to March 13, 2020 (national emergency declaration) were considered as pre–COVID-19, whereas encounters between March 14, 2020, and December 31, 2020, were considered as intra–COVID-19.