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# Journal Pre-proof



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## The Impact of COVID-19 on Infant Maltreatment Emergency Department and Inpatient Medical Encounters

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**Abbreviations:** CM: child maltreatment; CPS: child protective systems; ICD-10: International Classification of Diseases, 10th Revision

**Keywords:** child maltreatment, child abuse, COVID-19, child injuries

### Contributions Statement

*Dr. Rebbe conceptualized and designed the study, carried out the analyses, interpreted the results, drafted the initial manuscript, and reviewed and revised the manuscript.*

*Ms. Reddy drafted the initial manuscript, interpreted the results, and reviewed and revised the manuscript.*

*Dr. Putnam-Hornstein, Dr. Kuelbs, and Dr. Huang conceptualized and designed the study, coordinated and supervised data collection, interpreted the results, and reviewed and revised the manuscript.*

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

**Abstract**

**Objective** To assess the counts of infant maltreatment-related medical encounters at a large medical system during a 21-month span of the COVID-19 pandemic.

**Methods** Retrospective data for this study came from all inpatient and emergency department medical encounters for infants from January 1, 2016, through November 30, 2021, at a single children's hospital system in California. Distributions of medical encounters were tabulated and plotted over time. Interrupted time series models were used to evaluate changes in child maltreatment medical encounters.

**Results** Medical encounters for infants with child maltreatment diagnoses increased following the onset of COVID-19. Monthly counts of encounters with indicated maltreatment trended upward following the start of the pandemic. Interrupted time series models showed the count of maltreatment encounters increased 64% with the onset of COVID-19.

**Conclusions** We found an increase in infant maltreatment medical encounters during a 21-month period following the onset of COVID-19. These findings suggest that the pandemic may have adversely affected the safety of infants and ongoing work is needed to understand better the pandemic impacts on child maltreatment.

Many stressors experienced by families since the onset of the COVID-19 pandemic are associated with child maltreatment, including familial isolation,<sup>1</sup> job loss,<sup>2</sup> economic hardship,<sup>3</sup> psychological strain,<sup>4</sup> decreased social support,<sup>5</sup> and increased intimate partner violence.<sup>6,7</sup> At the same time, common child maltreatment prevention, identification, and reporting mechanisms were interrupted during the early months of the pandemic, with home visitation programs, schools, and in-person primary care visits cancelled or moved to virtual settings.<sup>8,9</sup> Reports to child protection systems (CPS) decreased during the acute COVID-19 period,<sup>10,11</sup> which may have reflected decreased maltreatment identification, despite the potential of increased prevalence. Pediatric medical encounter data can offer insights into whether child maltreatment resulting in injuries increased with the onset of the pandemic, despite declines in CPS reports.

To date, quantitative examinations of child maltreatment-related medical encounters before and after the onset of the COVID-19 pandemic have produced mixed results.<sup>12-15</sup> That said, analyses have found that young children were at particular risk of increased maltreatment injury after the onset of the COVID-19 pandemic, including increased odds of intensive care unit admission and traumatic brain injury,<sup>16</sup> younger emergency department maltreatment patients,<sup>17</sup> increased proportions of child maltreatment visits for younger children,<sup>18,19</sup> and increased cases of abusive head trauma.<sup>20</sup> Infants, already at greatest risk of experiencing maltreatment-related injuries and fatalities,<sup>21-23</sup> may have been uniquely vulnerable to risk in the context of increased family stress and lower social surveillance resulting from pandemic-related service interruptions.<sup>8,24</sup> Furthermore, infants in need of home visiting, pediatric care, or developmental services may also have been at particular risk of maltreatment without access to those services.<sup>25-27</sup> Qualitative research has identified unique challenges experienced by parents of infants during the pandemic, including lack of social support, COVID-19 exposure risk, and varied experiences

with telehealth.<sup>28,29</sup> One study of sentinel injuries in infants younger than 6 months found increased maltreatment-related injuries in May and June 2020, compared with those same months in prior years.<sup>30</sup> It is unknown whether those trends persisted over time.

In the current analysis, we compared the counts of infant maltreatment-related medical encounters before and after the COVID-19 pandemic onset at a large primary level 1 pediatric trauma center. We used both emergency department and inpatient encounter records. Our objective was to assess any observable changes in the number of diagnosed infant maltreatment injuries during the first 21 months of the pandemic.

## **Methods**

### *Data*

Data were obtained from Rady Children's Hospital-San Diego, a single children's hospital in California and sole pediatric trauma provider for the region, serving more than 230,000 children annually. Rady Children's is a level 1 trauma center. With limited exceptions, most children in the region (more than 1 million in the catchment area, including 42,700 births in 2016) who require inpatient care are hospitalized at Rady Children's. Children initially treated elsewhere in the region but who require evaluation for suspected abuse and neglect are also evaluated at Rady Children's. For the current study, we used deidentified discharge records for inpatient and emergency department medical encounters for infants (younger than 1 year old) from January 1, 2016, through November 30, 2021. These encounters (henceforth referred to as medical encounters) served as the unit of analysis. The current analysis fell under existing data-sharing agreements and state and university human subjects approvals.

### *Measures*

Key variables. Child maltreatment was retrospectively identified in medical encounter data based on the presence of at least one diagnosis from the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM): (a) specifically indicating child maltreatment (T74 [confirmed] or T76 [suspected]); or (b) a high-risk injury for physical abuse identified by Chaiyachati et al.<sup>15</sup> (without a co-occurring code excluding maltreatment, such as transport accidents). Cases with suspected maltreatment codes (T76) were included because previous research suggested they are often confirmed as maltreatment through chart review.<sup>31</sup> Full codes are available in Table I (online). For the onset of the COVID-19 pandemic, we used March 16, 2020, the date when schools in San Diego were closed to in-person instruction.<sup>32</sup>

Covariates. Binary indicators were coded for sex (male, female), medical encounter payment method (public health insurance, private insurance or other payment), and medical encounter type (emergency department, inpatient). Inpatient medical encounters that originated in the emergency department were only counted as inpatient encounters in this analysis. A five-category mutually exclusive race and ethnicity variable was constructed (any Hispanic, non-Hispanic Asian or Pacific Islander, non-Hispanic Black, non-Hispanic White, and other or unknown). We also constructed a maltreatment subtype variable based on the diagnostic code. Finally, for interrupted time series models, we created a binary variable indicating any physical abuse diagnosis (including abusive head trauma) versus all nonphysical abuse maltreatment (sexual, neglect, uncategorized, psychological).

#### *\Statistical analysis*

Medical encounter distributions by month and encounter type were tabulated and stratified by the onset of the COVID-19 pandemic. Chi-square tests were used to determine if the observed distribution of medical encounters with child maltreatment diagnoses differed from the



expected distribution. The count of child maltreatment medical encounters by month and encounter type was tabulated and plotted over time.

To address possible seasonality of child maltreatment medical encounters and compare the counts of specific months after the onset of the pandemic with the same month in years preceding the pandemic, we plotted the counts of maltreatment medical encounters by month and year. We calculated the percentage difference between the observed count for a month in either 2020 or 2021 and the mean for 2016–2019 for that same month. The following formula was used for these calculations:

$$\text{Percent Difference} = \left[ \frac{|C - M|}{\frac{C + M}{2}} \right] \times 100$$

where the absolute value of the difference between the count of a month during COVID-19 ( $C$ ) and the mean of that month for 2016–2019 ( $M$ ) was divided by the average of those two values and then multiplied by 100 to obtain a percentage.

Interrupted time series models were used to assess possible changes in the count of child maltreatment medical encounters associated with the COVID-19 pandemic. This approach has been identified as the strongest quasi-experimental design for measuring the effects of a given event using data from before and after an event.<sup>33</sup> Given the use of count data, we specified a Poisson model. We tested for overdispersion but did not identify it using the “dispersiontest” function in the R package “AER.”<sup>34</sup> We also tested for autocorrelation and partial autocorrelation using the “acf” and “pacf” functions in the R “stats” package, neither of which was identified.<sup>35</sup> We assumed a level change following March 16, 2020, our defined pandemic onset date. The following model was used<sup>36</sup>:

$$Y_t = \beta_0 + \beta_1 T + \beta_2 X_t + \beta_3 (T - T_i) X_t$$

where  $Y_t$  is the monthly counts of medical encounters with a child maltreatment diagnosis,  $\beta_0$  is the baseline level at  $T = 0$ ,  $\beta_1$  is the underlying pre-COVID-19 change associated with time,  $\beta_2$  is the level change associated with COVID-19, and  $\beta_3$  is the product of the slope change following COVID-19 and the time since the onset of COVID-19. We additionally specified models by our coded indicator of abuse subtype and encounter type. Results are presented as relative risks (RR) with 95% confidence intervals (95% CI). All analyses were completed using R version 4.1.1.<sup>35</sup>

## Results

Overall, infants experienced 130,026 emergency department and inpatient hospitalization encounters at Rady Children's Hospital-San Diego between January 1, 2016, and November 30, 2021. Of those encounters, 554 had a documented child maltreatment diagnosis: 159 with a specific maltreatment, confirmed code; 284 with a specific maltreatment, suspected code; and 101 with a high-risk injury for physical abuse code, without a co-occurring code excluding maltreatment. Table II (online) presents the characteristics of encounters with a child maltreatment diagnosis. Many included a physical abuse diagnosis (81.4%), involved male children (54.2%), were paid for using public health insurance (60.8%), and were inpatient hospital admissions (57.7%). The most frequent age group was less than 9 months to 12 months (36.0%). Table III presents the characteristics of these medical encounters stratified by the onset of COVID-19. Statistically significant differences were observed in the distributions of each examined category based on the onset of COVID-19. Particularly, medical encounters with a child maltreatment diagnosis represented 0.3% of medical encounters before the onset of COVID-19 and 0.8% of encounters after the onset ( $\chi^2 = 107.9$ ,  $p < .001$ ).

Figure 1 presents the counts of medical encounters with child maltreatment diagnoses by month and encounter type with a locally estimated scatterplot smoothing line. Upward trends

following the onset of COVID-19 (as indicated by the dotted vertical line) were observed for both the emergency department and combined plots, whereas a level change was observed for the inpatient plot. The month with the highest counts of encounters with child maltreatment diagnoses was August 2021 for inpatient, emergency department, and combined types.

Figure 2 presents the monthly counts for 2020 and 2021 (in the upper panel, labeled “a”) and the percentage differences of counts from the monthly means of 2016–2019 (in the lower panel, labeled “b”) of medical encounters with maltreatment diagnoses. The monthly counts of medical encounters with a maltreatment diagnosis after the pandemic onset in 2020 and 2021 were consistently higher than the means for 2016–2019 with the exception of August and October 2020 and January 2021 (which were lower). The month with the highest count of maltreatment medical encounters, August 2021, was 85.7% higher than the mean in August from 2016–2019. Indeed, seven of the 11 months observed in 2021 had counts that averaged 40% higher than their respective average in 2016–2019.

Table IV presents the results of the interrupted time series models reported as RRs. The count of medical encounters with child maltreatment diagnoses increased 64% with the onset of COVID-19 (RR: 1.64, 95% CI: 1.33–2.02,  $p < .001$ ). We also observed statistically significant increases for the physical abuse subtype and in maltreatment counts for both emergency department and inpatient medical encounters. No statistically significant change in the count of nonphysical abuse medical encounters was identified.

## **Discussion**

We observed a 64% increase in infant medical encounters with child maltreatment diagnoses following the onset of the COVID-19 pandemic. The identified increase in the counts of child maltreatment medical encounters is at odds with several other recent studies suggesting

decreases in child maltreatment medical encounters during the pandemic.<sup>13,17,19,37</sup> Importantly, we focused on infants, the group of children with the highest incidence rate of child maltreatment-related medical encounters.<sup>22,23</sup> Further, our results are congruent with previous pandemic studies that found increases in intensive care unit admission or inpatient treatment for cases with diagnosed child maltreatment across all ages.<sup>14,16,38</sup>

Additionally, our study included a longer period than previous studies examining the relationship between child maltreatment medical encounters and the pandemic. Indeed, we documented higher monthly maltreatment counts in both 2020 and 2021 than the average counts for the four years prior to the pandemic onset. The month with the highest count of medical encounters with child maltreatment diagnoses was August 2021, 17 months after the pandemic's onset. Some studies that did not find changes in child maltreatment medical encounters had attempted to capture the "safer-at-home" mandates during COVID-19 including 1 month,<sup>12</sup> 3 months,<sup>13</sup> 4 months,<sup>16</sup> and 6 months.<sup>14,17,19,37-40</sup> Our results, however, highlight that the impact of the pandemic was not limited to the initial period when schools were closed to in-person learning, but continued through the end of 2021, about 21 months after the onset of the pandemic in March 2020. Thus, the impact of the pandemic may not have been acute or limited to the initial period of the pandemic or when schools were closed to in-person learning. It is also possible that COVID-19 Economic Impact Payments could have mitigated the stresses related to the pandemic. This could be one explanation for the observed highest counts in August, because the last payment was in March 2021 and these funds may have been exhausted after 3 or 4 months.<sup>41</sup> Importantly, research regarding the impact of the pandemic on child maltreatment is still emerging, and this study contributes to this fairly nascent literature. Specifically, these findings suggest that enduring concerns and uncertainty regarding issues such as health,

economics, childcare, housing, and employment related to the pandemic may have been more impactful on the stress experienced by families.

Similarly, disruptions to services designed to prevent child maltreatment, such as home visiting, were common during the pandemic.<sup>42</sup> Many home visitation programs utilized virtual options that required technology that not all families had access to and may have resulted in fewer high-risk families enrolling in these services after the COVID-19 onset.<sup>9</sup> Likewise, well-child visits for infants decreased during the pandemic,<sup>8</sup> which may have resulted in parents having less support during the critical first year with their new child.

Our findings indicate an increase in medical encounters with diagnosed physical abuse for infants, but no observable change in other forms of maltreatment (neglect, sexual abuse, uncategorized). There may be two reasons for this. First, although neglect has been identified as the most common maltreatment subtype resulting in hospitalizations,<sup>23,43</sup> these previous studies have relied on ICD-9 codes identified as suggestive of neglect,<sup>44</sup> because no specific code related to neglect existed in the ICD-9. The ICD-10 coding system added a code for neglect (T74.02), but providers may be slow to adopt this new code and uncertain about what neglect entails, given broader definitional uncertainty about neglect.<sup>45</sup> A list of codes suggestive of neglect has not yet been defined or tested for ICD-10 and therefore, was not included in our analysis. Second, neglect hospitalizations as categorized in the ICD-9, such as burns and drug poisonings, have been attributed to supervisory neglect as children become more ambulatory,<sup>23</sup> which would not be as relevant for infants.

Although the current study adds new knowledge to our understanding of the impact of the COVID-19 pandemic on medical encounters for infant maltreatment, several important limitations should be considered. First, the data for this study came from a single integrated

medical delivery network. This network was the primary medical provider for pediatric medicine, especially trauma, in the region. Still, it is unclear how generalizable the findings are to other communities. We also had limited ability to examine changes for specific types of maltreatment, such as abusive head trauma, due to low frequency. Second, we cannot rule out the possibility that the diagnostic practices of medical providers or other unmeasured dynamics changed with the onset of the pandemic. If that occurred, our results may reflect those provider changes rather than changes in the incidence of infant maltreatment. However, suspected child maltreatment cases are evaluated by a child abuse pediatrician that provides consistent oversight of potential abuse cases with a strong peer review system in place who provide feedback to inpatient and emergency department colleagues on child abuse cases; a practice implemented prior to the study time frame. This likely mitigates an impact based on provider changes. We also accessed data from the Chadwick Center for Children & Families, an accredited children's advocacy center that evaluates child maltreatment, including for infants, and is based at this hospital. We examined the monthly counts for the same period, which remained flat and did not indicate a change in procedure. So, although we did not observe changes at the advocacy center and our observed trends were over a longer term, it is still possible other dynamics related to child maltreatment responses, including transfers from other hospitals, may have played a role in the increases in emergency department and inpatient medical encounters we observed. Third, we relied heavily on diagnostic codes that specifically indicate child maltreatment. Given research that has documented that child maltreatment is frequently undercoded,<sup>31,46</sup> our findings may be an undercount of the actual number of medical encounters related to child maltreatment. Finally, it is possible that in the context of pandemic closures and other changes during COVID-19,

medical providers were more attuned and responsive to possible maltreatment and therefore, more inclined to screen and diagnose child abuse.

Our results suggest that infant medical encounters with maltreatment diagnoses increased after the onset of the COVID-19 pandemic and continued through the end of 2021. This was observed for both emergency department and inpatient medical encounters. The primary driver of this increase was an increase in the number of physical abuse encounters. These results raise the question of whether there is yet a full understanding of the short- and longer-term impact of the COVID-19 pandemic for infants and children, especially regarding child maltreatment.

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**Figure 1.** Count of Infant Medical Encounters with Child Maltreatment Diagnoses by Month and Setting

**Figure 2.** Monthly Count and Percentage Differences of Infant Maltreatment Encounters by Year

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**Table 1 (online).** ICD-10-CM Codes for Child Maltreatment

Description	ICD-10-CM Code
<i>ICD-10-CM Codes for Suspected and Confirmed Child Maltreatment</i>	
Child neglect or abandonment, confirmed	T74.02XA
Child neglect or abandonment, suspected	T76.02XA
Child physical abuse, confirmed	T74.12XA
Child physical abuse, suspected	T76.12XA
Child sexual abuse, confirmed	T74.22XA
Child sexual abuse, suspected	T76.22XA
Child psychological abuse, confirmed	T74.32XA
Child psychological abuse, suspected	T76.32XA
Shaken infant syndrome	T74.4XXA
Forced sexual exploitation, confirmed	T74.52XA
Forced sexual exploitation, suspected	T76.52XA
Forced labor exploitation, confirmed	T74.62XA
Forced labor exploitation, suspected	T76.62XA
Unspecified child maltreatment, confirmed	T74.92XA
Unspecified child maltreatment, suspected	T76.92XA
<i>High-Risk Injury for Child Physical Abuse ICD-10-CM Codes<sup>a</sup></i>	
Bruising/contusion <sup>b</sup>	S0003, S001, S0020, S0033, S0040, S0043, S0050, S0053, S0080, S0083, S0093, S2030, S051, S100, S200, S202, S300-303, S309, S400, S500-502, S600-S602, S700-S701, S800-S801, S900-S903, S1080, S1083, S2010, S2030, S2040, S309, S4091-S4092, S5090-5091, S6039, S609, S709, S809, S909
Oropharyngeal injury <sup>b</sup>	S015, S025, S0050, S0051, S0053, S0057
Femur/humerus fracture/dislocation	S422-S424, S72
Radius/ulna/tibia/fibula fracture/dislocation	S52, S821-S829
Intracranial hemorrhage	S061-S068
Rib fracture(s)	S223-S225
Abdominal trauma	S35-S37, S381, S383, S3981, S3991
Genital injury	S302, S303, S312-S315, S380, S382, S30812-S30817, S30872-S30877, S3093-S3098
Subconjunctival hemorrhage	H113
<i>Exclusion Codes</i>	
Repeat Visit	7th Character D, S
Transport Accident	V00-V99
Birth Injuries	P10-P15, P52, P545, Z38
Metabolic bone diseases	E550, E643, M839, N250, Q780, E8330-E8339
Bleeding disorders	D66, D67, D68, D69, P53, P60, P610, P616

<sup>a</sup> Chaiyachati BH, Wood JN, Carter C, et al. Emergency Department Child Abuse Evaluations During COVID-19: A Multicenter Study. *Pediatrics*. 2022:e2022056284.

<sup>b</sup>Less than 6 months old

**Table 2 (online). Distribution of Characteristics of Cases with Diagnosed Child Maltreatment**

	All CM Encounters (N = 544)	
	n	%
<b>Child Maltreatment Subtype</b>		
Physical Abuse	443	81.4%
Neglect	67	12.3%
Abusive Head Trauma	47	8.6%
Unspecified	36	6.6%
Sexual Abuse	12	2.2%
<b>Maltreatment Code Type</b>		
High Risk Physical Abuse only	101	18.6%
Specific Maltreatment code – Confirmed (T74)	159	29.2%
Specific Maltreatment code – Suspected (T76)	284	52.2%
<b>Age at Admission</b>		
Less than 3 months	172	31.6%
3-9 months	176	32.4%
>9-12 months	196	36.0%
<b>Child Sex</b>		
Female	249	45.8%
Male	295	54.2%
<b>Public Health Insurance?</b>		
Yes	333	61.2%
No	211	38.8%
<b>Medical Encounter Type</b>		
Emergency Department	230	42.3%
Inpatient Hospitalization	314	57.7%
<b>Race/Ethnicity</b>		
Hispanic	253	46.5%
Non-Hispanic White	163	30.0%
Other/Unknown	47	8.6%
Non-Hispanic Black	51	9.4%
Non-Hispanic Asian/Pacific Islander	30	5.5%

*Notes:* Maltreatment subtypes are not mutually exclusive, but all other categories are



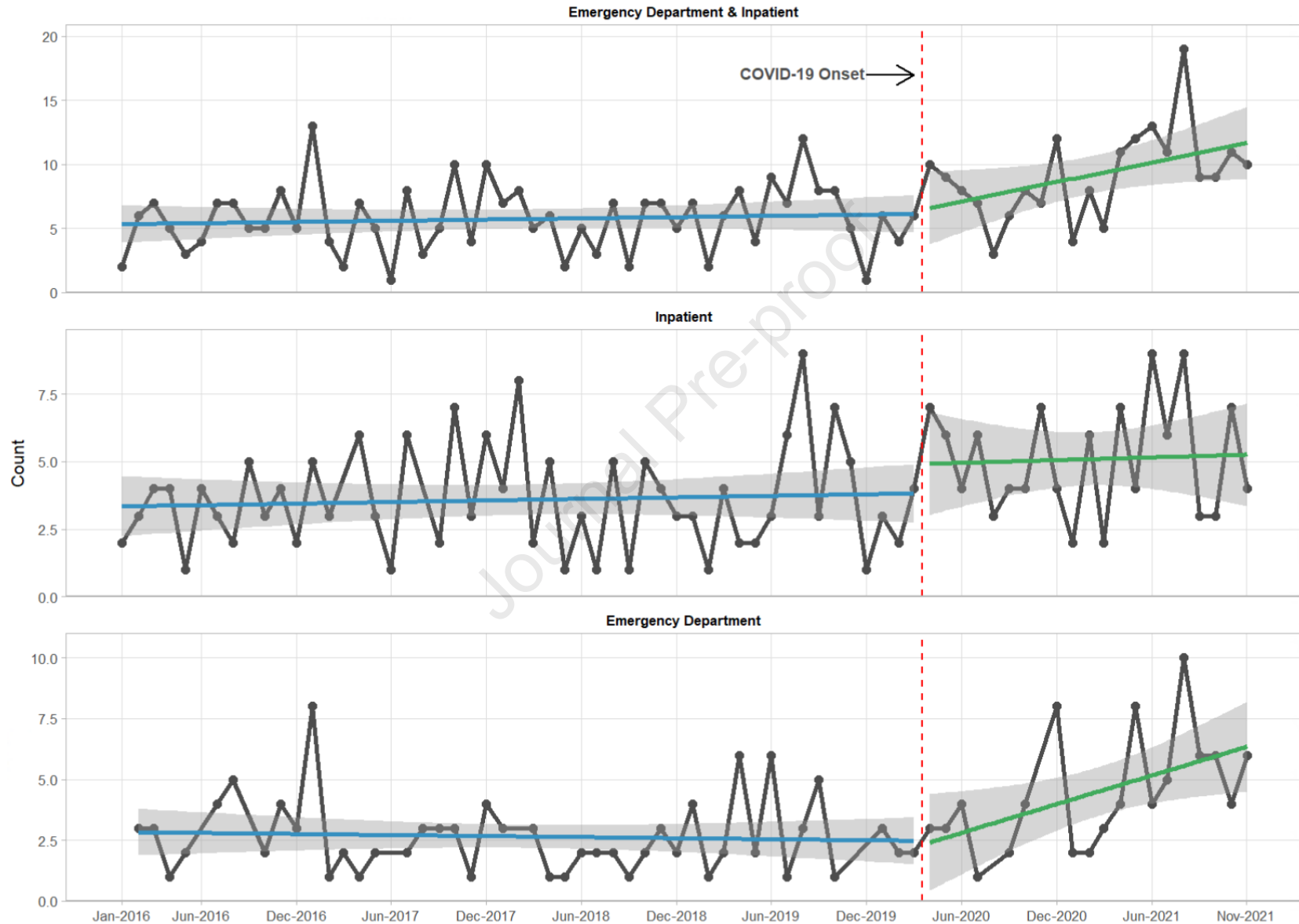
**Table 3.** Characteristics of Study Population by COVID-19 Status

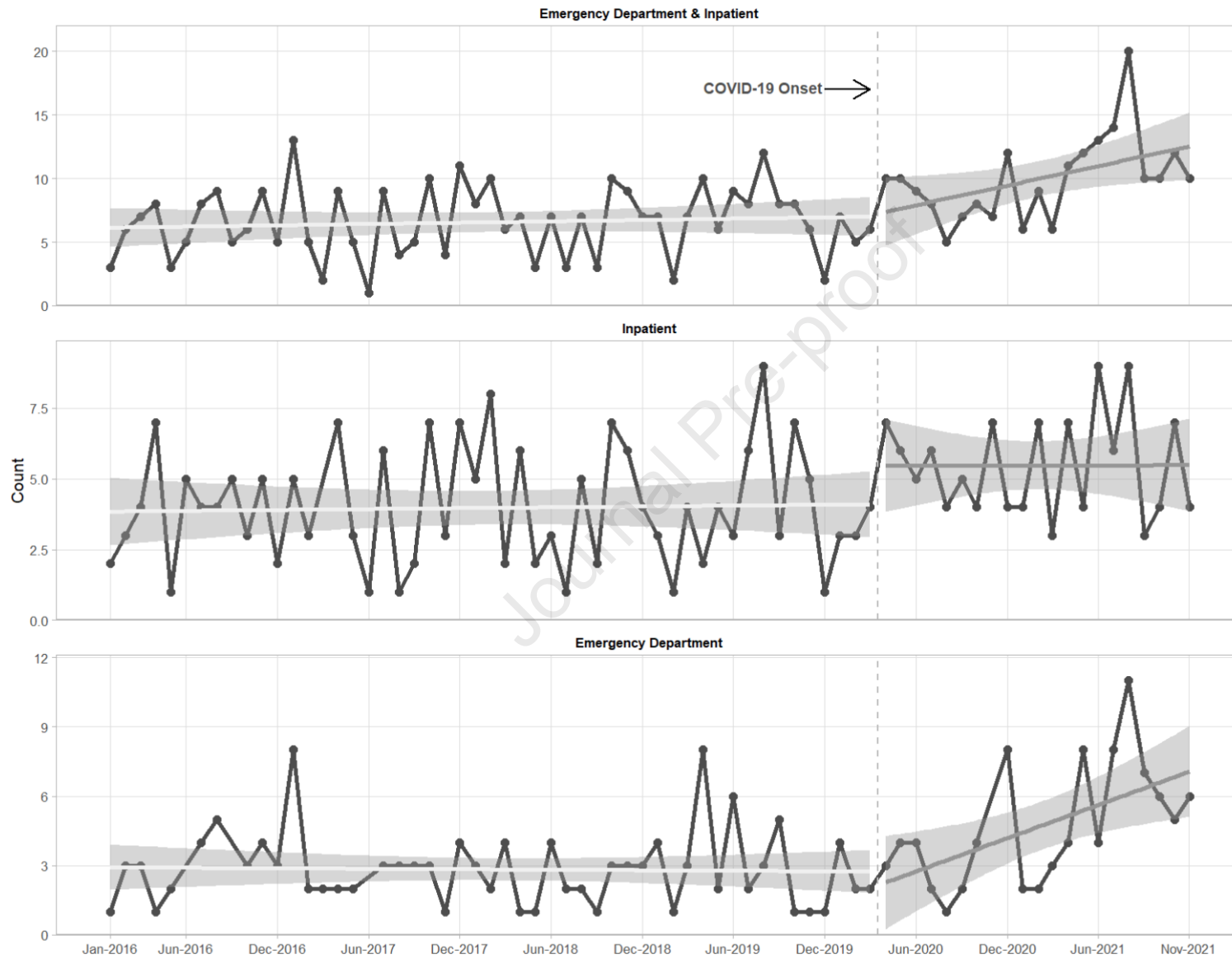
	All ED/Inpatient Medical Encounters		Before Onset of COVID-19		After Onset of COVID-19		<i>p</i> -value
	N = 130,026		n = 102,946		n = 27,080		
	n	%	n	%	n	%	
Child Maltreatment (CM)							<0.001
CM Diagnosis Present	544	0.4	332	0.3	212	0.8	
No CM Diagnosis Present	129482	99.6	102614	99.7	26868	99.3	
Child Sex							<0.001
Male	72431	55.7	57694	56.0	14737	54.4	
Female	57595	44.3	45252	44.0	12343	45.6	
Encounter Health Insurance							<0.001
Public Health Insurance	81277	62.5	66073	64.2	15204	56.1	
Private/Non-Public Insurance	48749	37.5	36873	35.8	11876	43.9	
Race/Ethnicity							<0.001
Hispanic	71114	54.7	56399	54.8	14715	54.3	
White	33188	25.5	25749	25.0	7439	27.5	
Other/Unknown	10999	8.5	9342	9.1	1657	6.1	
Black	7447	5.7	5710	5.5	1737	6.4	
Asian/Pacific Islander	7278	5.6	5746	5.6	1532	5.7	

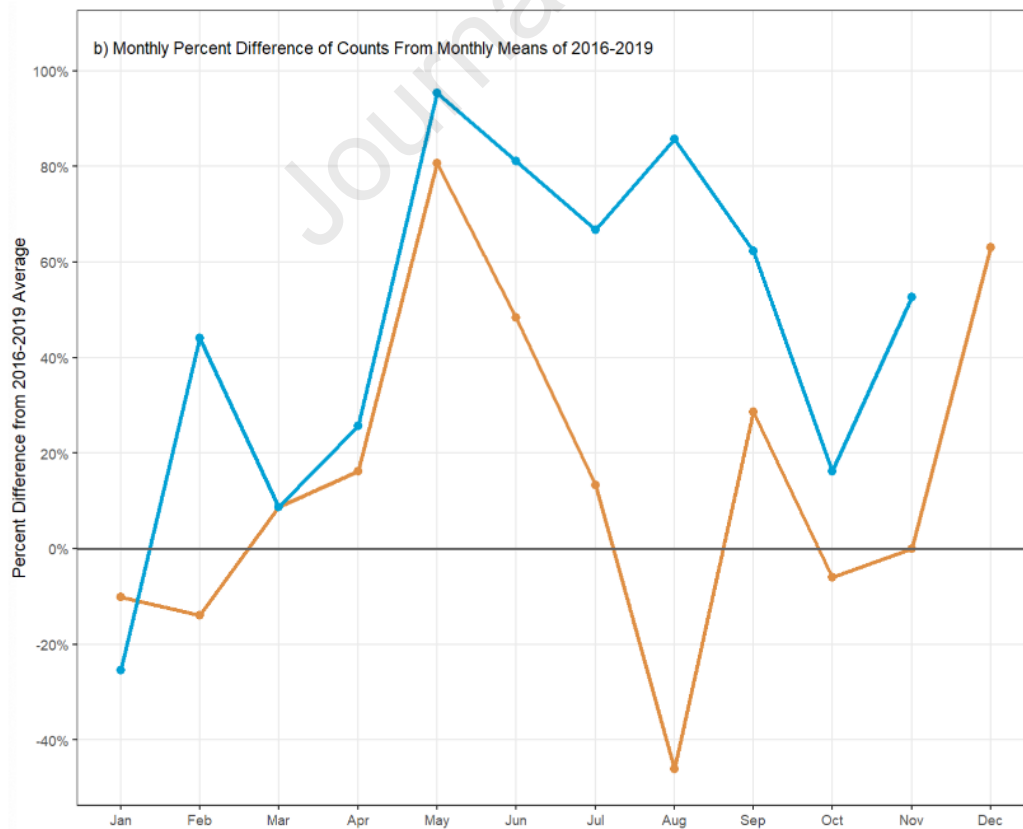
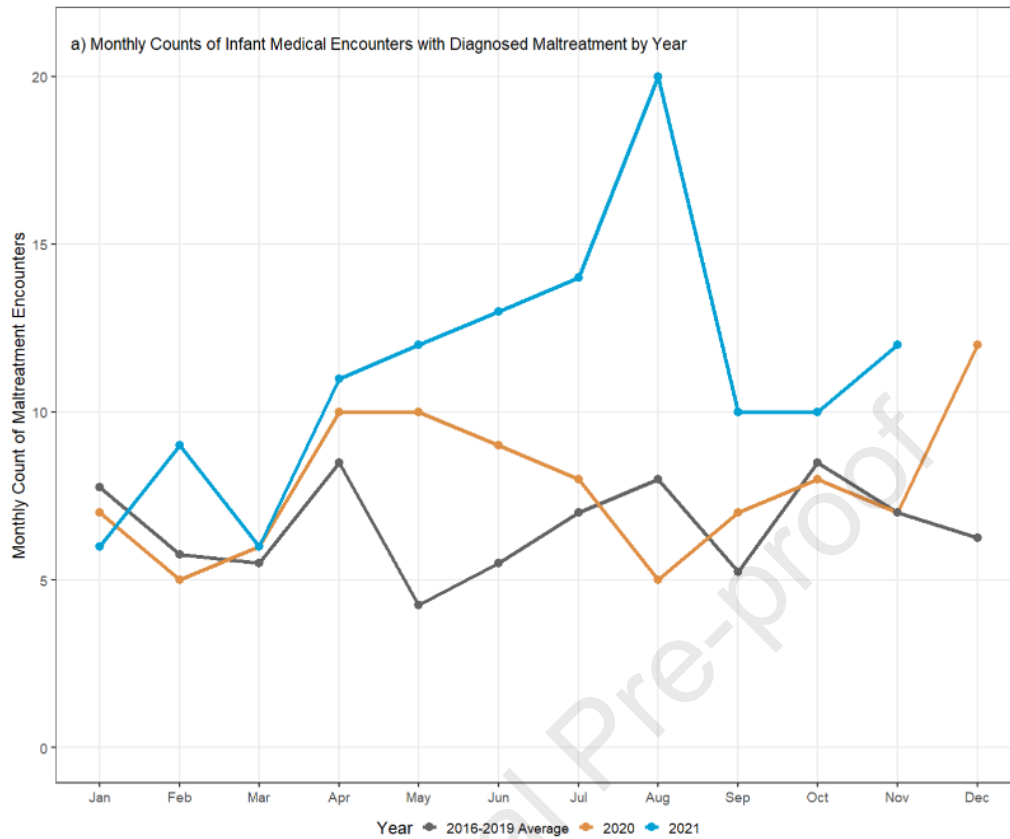
*Note: CM = child maltreatment; differences tested using chi-square; race/ethnicity categories are mutually exclusive*

**Table 4.** Relative Risk of Medically Diagnosed Infant Maltreatment

	Count of Infant Medical Encounters with Maltreatment Diagnoses		
	Relative Risk	95% Confidence Interval	<i>p</i> -value
All	1.64	1.33-2.02	<0.001
<i>Sub Type</i>			
Physical Abuse	1.65	1.30-2.09	<0.001
Nonphysical Abuse	1.50	0.91-2.47	0.110
Emergency Department	1.94	1.40-2.69	<0.001
Inpatient	1.45	1.11-1.91	0.01

**Figure 1.** Count of Infant Medical Encounters with Child Maltreatment Diagnoses by Month and Setting

**Figure 1.** Count of Infant Medical Encounters with Child Maltreatment Diagnoses by Month and Setting -- (black& white version)

**Figure 2.** Monthly Count and Percent Differences of Infant Maltreatment Encounters by Year

**Figure 2.** Monthly Count and Percent Differences of Infant Maltreatment Encounters by Year (black & white version)

