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## ORIGINAL ARTICLE

# Decrease in paediatric emergency room visits during the COVID-19 pandemic restrictions: A population-based study

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## Abstract

**Aim:** To investigate paediatric emergency room (ER) visits to evaluate the immediate health effects of COVID-19 pandemic restrictions on children.

**Methods:** We retrospectively examined paediatric ER visits in the Helsinki University Hospital (HUH) district during the first wave of the pandemic (1 March to 31 May 2020), and a 2-month period immediately before and after. These periods were compared to the corresponding time periods in 2015–2019 ('reference period').

**Results:** The total number of ER visits decreased by 23.4% (mean 6474 during the reference period, 4960 during the pandemic period (incidence rate ratio [IRR] 0.75, 95% confidence interval 0.72–0.77;  $p < 0.001$ ). This was due to a decrease in visits related to infectious diseases; visits due to surgical reasons did not decrease. The amount or proportion of patients triaged to the most urgent class (Emergency Severity Index 1) did not increase. Paediatric ER visits returned to baseline after lifting of restrictions.

**Conclusions:** Although paediatric ER visits substantially decreased during the pandemic restrictions, children seen at the ER were not more severely ill. Our results do not indicate immediate detrimental health effects of pandemic control measures on children.

## KEYWORDS

COVID-19, emergency care, emergency department, health care, paediatric

## 1 | INTRODUCTION

The novel pandemic coronavirus SARS-CoV-2 is responsible for COVID-19 disease and generally causes a mild disease in children.<sup>1–4</sup> Nevertheless, paediatric health and healthcare has been affected by infection control measures. These effects may have been detrimental to child health,<sup>5–8</sup> even to the extent that children may be considered collateral damage of the pandemic.<sup>9–11</sup> As children rarely

become seriously ill with SARS-CoV-2, it is not acceptable for them to be excessively harmed by infection control measures.

A decrease of up to 70–80% in paediatric emergency visits during the SARS-CoV-2 pandemic has been reported,<sup>12–18</sup> and children seeking emergency care have been more severely ill.<sup>5,8–10</sup> On the other hand, paediatric emergency room (ER) visits have been steadily increasing prior to the coronavirus pandemic,<sup>19</sup> and there has been an international consensus that a significant

**Abbreviations:** ER, emergency room; ESI, emergency severity index; PICU, paediatric intensive care unit; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

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proportion of paediatric ER visits are medically unnecessary or at least not urgent.<sup>20</sup>

The decrease in ER visits during the coronavirus pandemic provides an opportunity to examine how large-scale information and restriction measures in society have affected the use of paediatric ERs. The situation can be examined particularly well in Finland, where healthcare capacity was not endangered, and the prevalence of SARS-CoV-2 was relatively low during the first wave of the pandemic.<sup>21</sup> Under these circumstances, changes in healthcare seeking were more likely due to the societal measures than to the virus itself. Thus, we studied how ER visit patterns changed, and how this was reflected in the outcomes of ER visits.

## 2 | METHODS

The Hospital District of Helsinki and Uusimaa (HUS) region in Southern Finland has 1,263,000 inhabitants, including 217,000 children (0–15-years; 2019). The region consists of both urban and sub-urban areas and cover 1216 km<sup>2</sup>.

Finland (total population 5.5 M, paediatric population 0.9 M) is a Nordic welfare state with universal public healthcare. Tertiary-level emergency care, paediatric in-hospital care and paediatric intensive care are provided exclusively in public hospitals. Helsinki University Hospital (HUH) has two paediatric emergency rooms (70,000 annual visits combined).

For this retrospective, single-centre study, we retrieved all secondary and tertiary emergency room visits in the HUH region during the pandemic period 1 March to 31 May 2020 and corresponding time periods in 2015–2019. To exclude any potential new confounders, we also analysed the most recent prepandemic period (1 Jan to 28 Feb 2020 and corresponding time periods 2015–2019) and the immediate time periods after lifting the state of emergency in Finland (1 June to 31 July 2020 and the same period in 2015–2019). The state of emergency was lifted 15 June 2020.

The Emergency Severity Index (ESI) is a tool used in ER triage. The ESI stratifies patients into five groups, from level 1 (most urgent) to level 5 (least urgent). Higher acuity patients (ESI 1 and 2) are more likely to be admitted to the hospital. We used ESI triage classification and ICU admissions to estimate the illness severity at the time of presentation to the ER.

### 2.1 | Statistical analysis

Data are described using counts and percentages and medians and inter-quartile ranges (IQR) for categorical and continuous variables, respectively. The overall differences between years 2015–2019 and 2020 were tested by comparing incidences rates between the years. The person-years for the incidences were obtained by scaling the yearly paediatric population sizes to the time periods. We further investigated the differences by comparing the weekly occurrences

### Key Notes

- Emergency visits related to infectious diseases declined remarkably during COVID-19 pandemic restrictions.
- Children visiting the emergency room during pandemic restrictions were not more acutely or severely ill.
- Stay at home recommendations from public health authorities in our setting did not appear to result in immediate harm to children attending the emergency room.

of all visits (Mann–Whitney *U* test) and proportions of the visit types ( $\chi^2$  tests) during the time periods between the pre-pandemic and pandemic years.

*p*-Values < 0.05 were considered significant. Analyses were performed using R version 4.0.5. Plots were created using ggplot2-package.<sup>22,23</sup>

## 3 | RESULTS

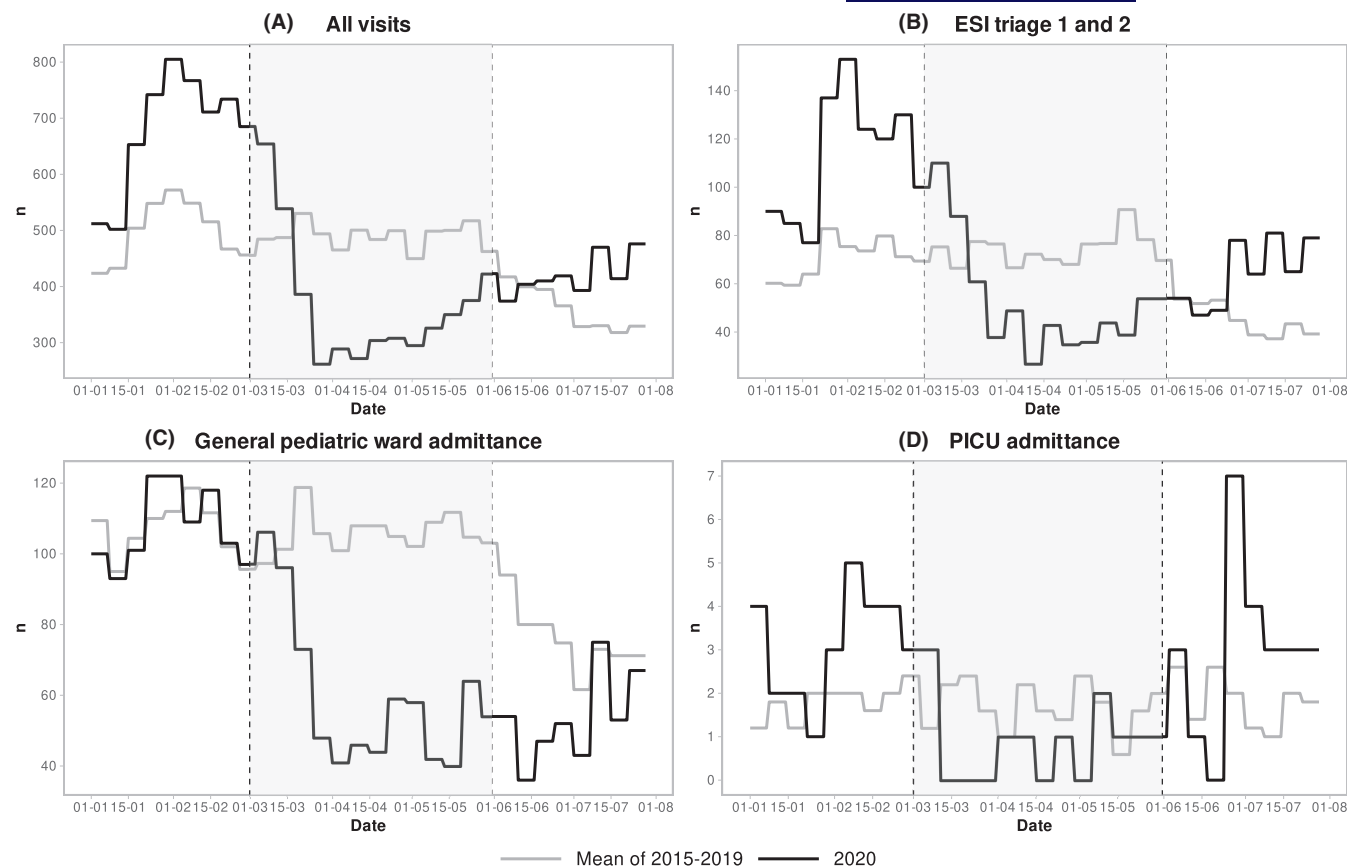
The total number of ER visits decreased by 23.4% during the pandemic period when compared with the reference period mean in 2015–2019 (Figure 1, Table 1). The incidence of visits during the pandemic period decreased from 157.25 visits per 10,000 person years (PY) in 2015–2019 to 117.20 visits per 10,000 PY in 2020 (Table 1). The decrease in visits was sudden and remained at a lower-than-normal level until the end of May 2020 and at the end of May 2020. When the restrictions were significantly relaxed, the total number of visits quickly returned to or slightly exceeded pre-pandemic levels (Figure 1). The decrease in visits was not explained by a pre-existing trend (Figure 1).

ER visits during the pandemic period were less often urgent, as 0.5% (25 patients) were triaged to the most urgent class (ESI triage I) (Table 1). Compared with a mean of 70 (range 40–115) or 1.1% of all visits in the reference period, this translates to 1.68 ESI I triage class patients per 10,000 PY in 2015–2019 to 0.59 ESI I triage patients per 10,000 PY in 2020 (Tables 1 and 2). After the first wave of the pandemic, the number of ESI-triage I and II patients increased marginally (Figure 2, Table 2).

The number of children transported by ambulance did not change during the pandemic period (Tables 1 and 2).

The hospitalisation rate decreased from 21.6% during the reference period to 16% during the pandemic period (Table 1). This translated to 33.92 patient admissions per 10,000 PY in 2015–2019 to 18.78 patient admissions per 10,000 PY in 2020 (Table 2). Paediatric intensive care unit (PICU) admission rates were similar during the pandemic and the reference periods (Tables 1 and 2).

Visits related to psychiatric conditions decreased slightly during the pandemic period (Table 2). However, the incidence of psychiatric visits increased significantly after lifting of restrictions (Table 2).



**FIGURE 1** Number of (A) All visits (B) ESI triage classes 1 and 2 (C) General paediatric ward admittance and (D) Paediatric intensive care unit admittance per 2 week periods. Grey line years 2015 - 2019 mean, black line year 2020. Pandemic period indicated with dashed lines.

**TABLE 1** Characteristics of paediatric emergency room visits during the pandemic period (1 March to 31 May 2020) and reference period (1 March to 31 May, years 2015 - 2019)

	Pandemic period 1 March to 31 May 2020	Reference period 1 March to 31 May 2015-2019	IRR	p-Value
All ER visits (n, total)	4960	32,366		
Incidence, per 10,000 person-years (95% CI)	117.20 (114.00–120.49)	157.25 (155.56–158.96)	0.75 (0.72–0.77)	<0.001
Age, median (IQR), years	4.79 (1.2–10.93)	4.2 (1.14–10.45)		0.001
<b>Proportions of visits (n, %)</b>				
ESI triage I	25, 0.5%	346, 1.1%		<0.001
ESI triage II	679, 14.1%	4557, 14.1%		0.997
ESI triage III–IV	4120, 85.4%	27441, 84.8%		0.317
Infectious diseases	1122, 22.9%	11439, 35.7%		<0.001
Ambulance transport	552, 11.1%	3399, 10.5%		0.189
PICU admission	13, 0.3%	109, 0.3%		0.469
General ward admission	795, 16.0%	6981, 21.6%		<0.001

Abbreviations: ER, emergency room; ESI, emergency severity index; PICU, paediatric intensive care unit.

Visits due to infections decreased from a mean of 2288 (35.7% of all visits) during the reference period to 1122 (22.9%) during the pandemic period ( $p < 0.001$ ) (Table 1). This was true for both respiratory and gastrointestinal infections (Table 2). The number of visits due to infections quickly returned to baseline after the pandemic period (Figure 2, Table 2).

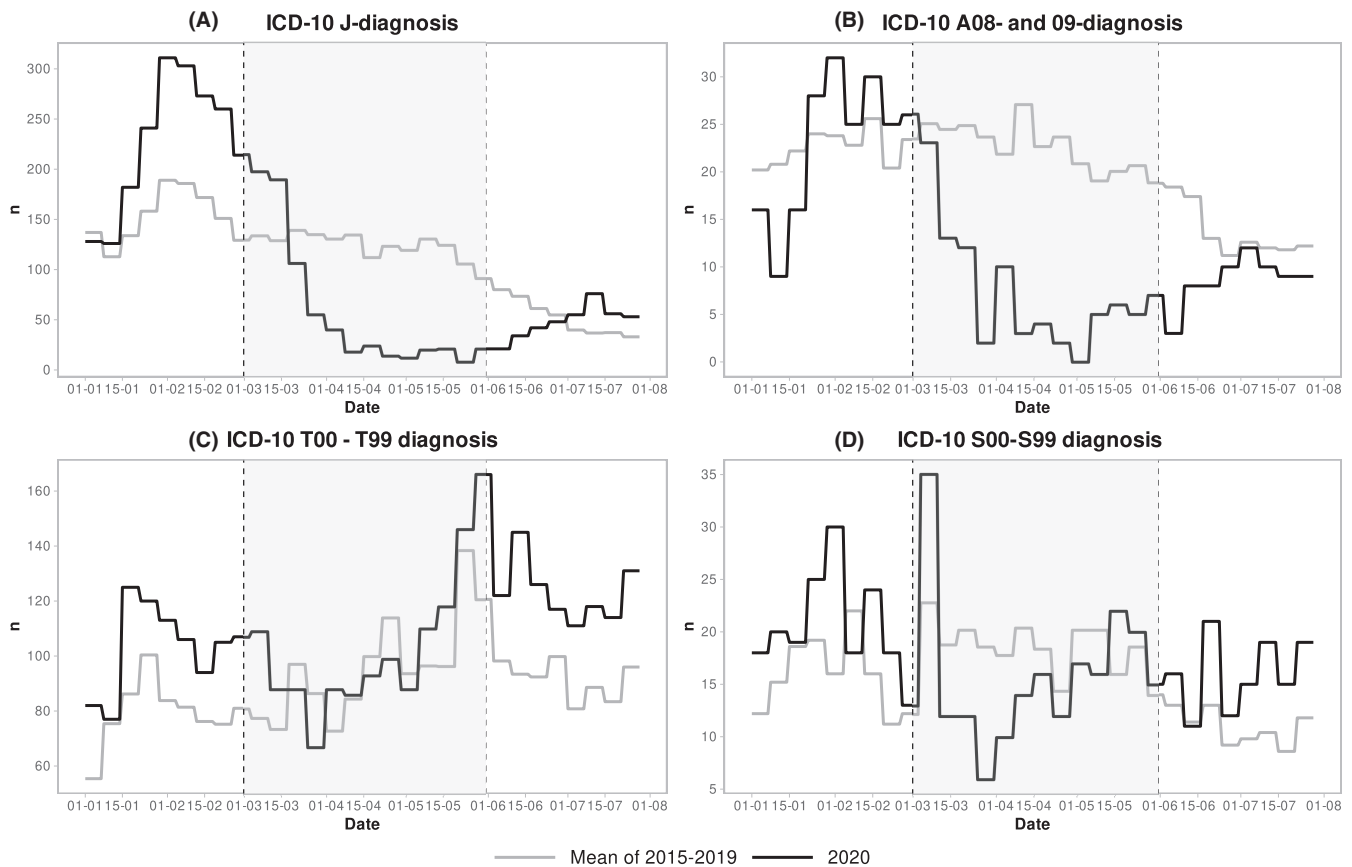
## 4 | DISCUSSION

This retrospective, single-centre, population-based study compared a 12-week period (1 March to 31 May 2020) during the first wave of the SARS-CoV-2 pandemic in Finland to the corresponding period in 2015–2019. Consistent with other studies,<sup>1,12–18</sup> we observed that

**TABLE 2** Characteristics of paediatric emergency room visits, incidences per 10 000 person years with 95% confidence intervals, shown for pre-pandemic (1 January to 28 February), pandemic (1 March to 31 May) and post-pandemic (1 June to 31 July) periods in 2020 and 2015–2019

	Incidences per 10,000 person-years, 95% CI			
	Year 2020	Years 2015–2019	IRR (95% CI)	p-Value
<b>Infectious disease diagnosis<sup>a</sup></b>				
1 Jan to 28 Feb	51.76 (50.70–52.84)	69.78 (67.07–72.59)	1.35 (1.29–1.41)	<0.001
1 March to 31 July	42.47 (41.70–43.25)	20.48 (19.31–21.71)	0.48 (0.45–0.51)	<0.001
1 June to 31 July	22.85 (22.16–23.56)	18.07 (16.74–19.51)	0.79 (0.73–0.86)	<0.001
<b>Psychiatric diagnosis (ICD-10 F00–F99)</b>				
1 Jan to 28 Feb	3.97 (3.69–4.28)	5.13 (4.43–5.93)	1.29 (1.09–1.52)	0.002
1 March to 31 July	4.52 (4.27–4.78)	3.83 (3.35–4.39)	0.85 (0.73–0.98)	0.027
1 June to 31 July	2.69 (2.46–2.94)	3.90 (3.31–4.60)	1.45 (1.20–1.75)	<0.001
<b>Respiratory infections (ICD-10 J00–J99 diagnosis)</b>				
1 Jan to 28 Feb	38.12 (37.21–39.05)	55.97 (53.55–58.50)	1.47 (1.40–1.54)	<0.001
1 March to 31 July	30.47 (29.82–31.13)	14.62 (13.64–15.66)	0.48 (0.45–0.52)	<0.001
1 June to 31 July	12.84 (12.33–13.38)	11.57 (10.51–12.73)	0.90 (0.81–1.00)	0.049
<b>Gastroenteritis (ICD-10 A08 and A09 diagnosis)</b>				
1 Jan to 28 Feb	5.55 (5.20–5.91)	5.58 (4.85–6.42)	1.01 (0.86–1.17)	0.931
1 March to 31 July	5.54 (5.27–5.83)	1.86 (1.53–2.26)	0.34 (0.27–0.41)	<0.001
1 June to 31 July	3.39 (3.13–3.67)	1.99 (1.58–2.51)	0.59 (0.46–0.75)	<0.001
<b>ESI I triage</b>				
1 Jan to 28 Feb	1.05 (0.91–1.21)	2.12 (1.69–2.66)	2.02 (1.54–2.65)	<0.001
1 March to 31 July	1.28 (1.16–1.43)	0.46 (0.31–0.68)	0.36 (0.24–0.53)	<0.001
1 June to 31 July	1.19 (1.04–1.36)	1.66 (1.29–2.14)	1.40 (1.05–1.86)	0.021
<b>ESI II triage</b>				
1 Jan to 28 Feb	16.54 (15.94–17.16)	25.68 (24.06–27.42)	1.55 (1.44–1.67)	<0.001
1 March to 31 July	16.92 (16.43–17.42)	12.39 (11.49–13.36)	0.73 (0.68–0.79)	<0.001
1 June to 31 July	10.00 (9.55–10.48)	14.00 (12.84–15.28)	1.40 (1.27–1.55)	<0.001
<b>ESI III triage</b>				
1 Jan to 28 Feb	106.20 (104.67–107.74)	137.12 (133.31–141.03)	1.29 (1.25–1.33)	<0.001
1 March to 31 July	101.87 (100.68–103.08)	75.18 (72.93–77.51)	0.74 (0.71–0.76)	<0.001
1 June to 31 July	78.01 (76.72–79.31)	83.70 (80.78–86.72)	1.07 (1.03–1.12)	<0.001
<b>Ambulance transport</b>				
1 Jan to 28 Feb	12.06 (11.55–12.59)	14.14 (12.95–15.45)	1.17 (1.06–1.29)	0.001
1 March to 31 July	12.62 (12.20–13.05)	10.07 (9.27–10.95)	0.80 (0.73–0.87)	<0.001
1 June to 31 July	10.41 (9.94–10.89)	12.09 (11.01–13.28)	1.16 (1.05–1.29)	0.005
<b>General ward admissions</b>				
1 Jan to 28 Feb	26.55 (25.79–27.33)	26.51 (24.86–28.27)	1.00 (0.93–1.07)	0.969
1 March to 31 July	25.92 (25.32–26.53)	14.51 (13.53–15.55)	0.56 (0.52–0.60)	<0.001
1 June to 31 July	18.69 (18.07–19.34)	12.98 (11.86–14.21)	0.69 (0.63–0.76)	<0.001
<b>PICU admissions</b>				
1 Jan to 28 Feb	0.44 (0.35–0.55)	0.74 (0.51–1.09)	1.68 (1.08–2.62)	0.021
1 March to 31 July	0.40 (0.34–0.49)	0.24 (0.14–0.41)	0.59 (0.33–1.04)	0.066
1 June to 31 July	0.46 (0.37–0.57)	0.72 (0.49–1.06)	1.56 (1.00–2.42)	0.047

<sup>a</sup>Infectious diseases: ICD-10 J-, A-, B- and R50 -diagnoses.



**FIGURE 2** Number of (A) ICD-10 J-diagnosis (respiratory infections), (B) ICD-10 A08- and A09-diagnosis (gastroenteritis) (C) ICD-10 T00-T99 diagnosis (injury, poisoning and certain other consequences of external causes) (D) ICD-10 S00-S99 diagnosis (injuries, bone fractures) per 2 week periods. Grey line years 2015–2019 mean, black line year 2020. Pandemic period indicated with dashed lines.

the number of paediatric emergency visits decreased by 23.4%. In contrast to other studies,<sup>9,12</sup> we did not observe an increase in illness acuity or admission rate suggesting that despite the marked decrease in ER visits, the children seen in the ER were not more severely ill than in previous years. In fact, the proportion and the number of children triaged in the most urgent classes was even lower during the pandemic. However, another study in our area suggested a higher paediatric out-of-hospital mortality rate,<sup>11</sup> which suggests that not all aspects of adequate emergency care can be evaluated from an ER perspective.

In Finland, the state of emergency led to extensive infection control measures, including school closures and changes in healthcare. Families were instructed to stay at home and health authorities emphasised the risk of healthcare congestion. Interestingly, the number of emergency room visits decreased even though the incidence of SARS-CoV-2 was low during the first pandemic wave<sup>21</sup> and health care capacity was not endangered in Finland. This is consistent with other studies from other countries that were more severely affected by the virus.<sup>12-18,21</sup>

The fear of possible SARS-CoV-2 transmission and healthcare overload may have increased the threshold to seek urgent care in families with children, as this has been reported in adults.<sup>9,24</sup> Avoiding public transport, restrictions on the number of escorts in

emergency departments and reduced availability of childcare may also have created practical barriers to healthcare access.

Due to school closures, improved hand hygiene, and social distancing, children generally had fewer infectious diseases and invasive bacterial infections and thus did not need to visit the ER.<sup>25</sup> This decrease in visits due to infectious diseases also may have led to the reduced admission rate to the general ward, as infectious diseases are a common reason for paediatric hospital admissions. This may also have driven the decrease in the number of children presenting with the most urgent health problems, as these visits are also often due to infectious diseases (e.g., sepsis, febrile seizures, bronchiolitis and respiratory failure).<sup>26</sup>

In contrast to another study, visits due to surgical reasons did not decrease during the pandemic.<sup>27</sup> The increase in number of visits due to psychiatric reasons after lifting of restrictions suggests that the detrimental health effects of restrictions on children are more long term than immediate, a finding consistent with other studies.<sup>28,29</sup>

Children frequently present to the ER with complaints that are of low acuity and do not require emergency care.<sup>19,20</sup> Educational interventions among parents may substantially reduce low acuity ER visits.<sup>30,31</sup> According to our results, it is difficult to determine whether this phenomenon reduced ER visits during the pandemic period, as the distribution in the acuity or the causes of the visits



did not change. Nevertheless, our results suggest that there were no immediate, serious health effects despite a 25% decrease in ER visits.

The strengths of this study include systematic data retrieval from a single electronic patient record system by a single researcher. The data are easily reproducible. In addition, the low SARS-CoV-2 prevalence in Finland<sup>21</sup> accompanied with very strict restrictions allowed us to study the effects of the infection control measures separately from those of the virus itself. Accordingly, our results indicate that a substantial change in healthcare-seeking behaviour of a population can occur within a short time frame solely by following instructions from healthcare authorities, public measures affecting healthcare availability and high media coverage.

This study is limited by its single-centre setting. However, the two ERs included in this study are responsible for 23% of paediatric hospital emergency visits in Finland. Second, our outcomes, such as ER visit triage categories or hospitalisation rates, are not very sensitive markers of child health, even if they are robust. Thus, we cannot state that children and their health would not have been affected by the infection control measures; large-scale studies with more sensitive endpoints and longer follow-up are required to address these questions.

The long-term health effects of pandemic restrictions are unknown, and they may not have affected all children and all patient groups similarly. Nevertheless, our results suggest that in a setting with an established public healthcare system, a reduction in the number of ER visits due to public awareness and self-directed avoidance is possible without immediate detrimental health effects and likely also safe and feasible after the pandemic.

These results warrant further studies how to best inform families with children about indications for ER visits. These results also suggest that prevention of acute infections in small children is feasible with strict infection control measures; enhanced hand hygiene or staying at home when ill need not be limited to pandemic situations.

## 5 | CONCLUSIONS

Paediatric ER visits decreased significantly during the first wave of the pandemic in Finland, where SARS-CoV-2 prevalence was low. Children who attended the ER were not more severely ill or more often hospitalised. Thus, in this setting, advising families to stay at home resulted in a 23.4% decrease in ER visits without causing immediate, detectable harm by delayed provision of health care.

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### CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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