

Paediatric COVID-19 admissions in a region with open schools during the two first months of the pandemic

According to the United Nations Educational, Science and Cultural Organization, 194 countries had implemented country-wide school closures by April 1, 2020, in an effort to combat the COVID-19 pandemic. It is estimated that those closures affected 91.3% of students across the globe. However, Sweden adopted a different approach to the strict lockdowns imposed elsewhere and day-care centres and schools for children up to 15 years of age remained open. The strategic decision to shift schools to distance learning only for children aged 16 years and older was influenced by multiple factors, including the potential impact on school closures on the availability of the healthcare workforce, the increasing evidence of mainly mild infections among children and the potential negative consequences of school closures for younger children.

While it appears that most children get mild symptoms if they become infected with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2),¹ there have been concerns that they may present with high viral loads and contribute to asymptomatic transmission.² In addition, the number of admissions could exceed the available paediatric hospital care resources.³ Because many Swedish schools have remained open during the pandemic, there is a unique opportunity to assess the impact of this strategy on the incidence and severity of paediatric admissions.

We carried out a two-month review of paediatric admissions aged 0-17 years who tested positive for SARS-CoV-2 in the Stockholm region, where approximately 514 000 (24%) of all Swedish children live. This covered March 13, when local transmission was announced, until May 14. We included children of all age groups to allow for comparison of admissions between children who remained in school and teenagers who were affected by school closures. During the study period, a nasopharyngeal sample was collected from close to all paediatric hospital admissions, regardless of why they had been hospitalised, and these were analysed using real-time reverse transcriptase-polymerase chain reaction assays for the SARS-CoV-2. The patient files were reviewed to identify children who were positive for the virus and to collect data on their background characteristic, the symptoms they presented with, any concurrent illnesses and their outcomes. Ethical approval to conduct the study was obtained from the Central Ethical Research Board in Sweden (EPM #2020-02487), and a waiver of informed consent was provided because of the minimal risk of the study.

A total of 63 admitted children aged 0-17 years tested positive for SARS-CoV-2 during the study period. Thirty had a primary COVID-19 diagnosis, corresponding to 0.7% of all admissions due to COVID-19 in the region. Fourteen children were admitted with another concurrent illness, and 19 children were incidentally found to be SARS-CoV-2-positive, that is the reason for their admission was a non-infectious cause. The cumulative incidence for hospitalisation with a non-incident diagnosis of COVID-19 among children was nine per 100 000 children. This compares to 230/100 000 hospitalised and 99/100 000 deaths due to COVID-19 among the adult population in Stockholm ($n \approx 1.84$ million) during the same time period.

Table 1 provides an overview of the characteristics of the 63 children. This shows that 39/63 (62%) presented with fever and 32/63 (51%) had respiratory symptoms. We found that four children (6%) required oxygen treatment and one patient with immunosuppression was admitted for intensive care but was never intubated. Infants represented more than half of all symptomatic admissions (16/30, 53%), whereas the proportion of all SARS-CoV-2-positive admitted children aged 16-18 (10/63, 16%), for whom schools have been operating on distance, were similar to proportions of children aged 1-5 years (11/63, 17%).

Hyperinflammation occurred in one child who has recovered well on follow-up assessments. One infant with a severe underlying condition arrived at the hospital with cardiac arrest and died after a short history of gastrointestinal illness. The child subsequently tested positive for SARS-CoV-2. As three other pathogens were also identified in post-mortem samples—*Streptococcus salivarius* and *Staphylococcus aureus* in blood culture and *Klebsiella pneumoniae* in nasopharyngeal swab—it is unclear to what extent the SARS-CoV-2 infection affected the outcome of this child.

Paediatric admissions accounted for a minor part of the total admissions due to COVID-19 as a primary diagnosis during the first two months of the pandemic in Stockholm (30/4347, 0.7%). In line with previous research, most children with a primary diagnosis of COVID-19 were less than one year of age and fever and respiratory symptoms were common, but not universal, symptoms.⁴

Overall, our results point towards a low incidence of severe illness due to COVID-19 among Swedish children, even though day-care centres and primary schools remained open. This suggests that the Swedish strategy did not aggravate the course

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TABLE 1 Characteristics of paediatric admissions in Stockholm region, Sweden, from March 13, to May 14, 2020, based on COVID-19 diagnosis categories

	Number (%)			Total COVID-19 cases (N = 63)
	Primary diagnosis (n = 30)	Secondary diagnosis (n = 14)	Incidental diagnosis (n = 19)	
Age				
<1 y	16 (53)	4 (29)	1 (5)	21 (33)
1-5 y	4 (13)	2 (14)	5 (26)	11 (17)
6-15 y	6 (20)	6 (43)	9 (47)	21 (33)
16-18 y	4 (13)	2 (14)	4 (21)	10 (16)
Median age, years	0.5	7.6	9.4	4.7
Gender				
Female	9 (30)	8 (57)	9 (47)	26 (41)
Chronic illness				
Asthma	3 (10)	0	0	3 (5)
Haematological/oncological	3 (10)	1 (7)	7 (37)	11 (17)
Neurological and multiple	3 (10)	2 (14)	2 (11)	7 (11)
Other	0	2 (14)	2 (11)	4 (6)
Symptom presentation				
Asymptomatic	0	1 (7)	10 (53)	11 (17)
Symptomatic	30 (100)	13 (93)	9 (47)	52 (83)
Fever	27 (90)	7 (50)	5 (26)	39 (62)
Respiratory	22 (73)	4 (29)	6 (32)	32 (51)
Gastrointestinal	9 (30)	6 (43)	1 (5)	16 (25)
Hyperinflammation ^a	1 (3)	0	0	1 (2)
Seizures	3 (10)	2 (14)	0	5 (8)
Treatment				
Oxygen	4 (13)	0	0	4 (6)
Non-invasive respiratory support	3 (10)	0	0	3 (5)
Intensive care	1 (3)	0	0	1 (2)
Outcome				
Recovered	30 (100)	13 (93)	19 (100)	62 (98)
Deaths	0	1 (7)	0	1 (2)

^aTwo children with hyperinflammation were admitted during this period: one was only positive for SARS-CoV-2 antibodies and is not included in this Table.

of the pandemic for children in Sweden, when it is compared to countries with stricter lockdown measures.⁴ However, the impact on the open school strategy on the overall transmission of SARS-CoV-2 within the Swedish society is unknown. The potential degree of SARS-CoV-2 transmission from children to the adults and its consequences for adult hospitalisations and deaths is beyond the scope of this report.


Continued assessment of hyperinflammation and other late-onset complications in children is warranted, given that symptoms may present weeks after the acute infection. Results should be considered in relation to the limited evidence regarding the overall benefit of school closures and the potential risks that school closures pose for children who are already vulnerable.⁵

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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