

CORRESPONDENCE



Open Schools, Covid-19, and Child and Teacher Morbidity in Sweden

TO THE EDITOR: In mid-March 2020, many countries decided to close schools in an attempt to limit the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus causing coronavirus disease 2019 (Covid-19).^{1,2} Sweden was one of the few countries that decided to keep preschools (generally caring for children 1 to 6 years of age) and schools (with children 7 to 16 years of age) open. Here, we present data from Sweden on Covid-19 among children 1 to 16 years of age and their teachers. In Sweden, Covid-19 was prevalent in the community during the spring of 2020.³ Social distancing was encouraged in Sweden, but wearing face masks was not.³

Data on severe Covid-19, as defined by intensive care unit (ICU) admission, were prospectively recorded in the nationwide Swedish intensive care registry. We followed all children who were admitted to an ICU between March 1 and June 30, 2020 (school ended around June 10) with laboratory-verified or clinically verified Covid-19, including patients who were admitted for multisystem inflammatory syndrome in children (MIS-C, which is likely to be related to Covid-19)⁴ according to the Swedish Pediatric Rheumatology Quality Register. (More information on the registry and a link to the World Health Organization scientific brief on MIS-C are provided in the Supplementary Appendix, available with the full text of this letter at NEJM.org.) The Stockholm Ethics Review Board approved the study. Informed consent was waived by the review board.

The number of deaths from any cause among the 1,951,905 children in Sweden (as of December 31, 2019) who were 1 to 16 years of age was

65 during the pre-Covid-19 period of November 2019 through February 2020 and 69 during 4 months of exposure to Covid-19 (March through June 2020) (see the Supplementary Appendix). From March through June 2020, a total of 15 children with Covid-19 (including those with MIS-C) were admitted to an ICU (0.77 per 100,000 children in this age group) (Table 1), 4 of whom were 1 to 6 years of age (0.54 per 100,000) and 11 of whom were 7 to 16 years of age (0.90 per 100,000). Four of the children had an underlying chronic coexisting condition (cancer in 2, chronic kidney disease in 1, and hematologic disease in 1). No child with Covid-19 died.

Data from the Public Health Agency of Sweden (published report⁵ and personal communication) showed that fewer than 10 preschool

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Table 1. Characteristics of the Children with Covid-19, Including Those with MIS-C, Admitted to Swedish ICUs in March–June 2020.*

Age	Sex	SARS-CoV-2 Test Result PCR	Antibodies	Days in ICU†	No. of Admissions	BP and Laboratory Measures at Admission‡	Organ Support	Complications
1 yr‡	F	Negative	Positive	5	1	Systolic BP, 70 mm Hg; SaO ₂ , 99%; BE, +0.6 mmol/liter; lactate, 1.6 mmol/liter	—	MIS-C, septic shock, renal failure
3 yr	F	Positive	ND	38	3	Systolic BP, 75 to 143 mm Hg; SaO ₂ , 96%; lactate, 1.2 mmol/liter	Invasive mechanical ventilation	<i>Clostridium difficile</i> infection
4 yr	F	Positive	Positive	6	1	Systolic BP, 87 mm Hg; SaO ₂ , 99%	—	MIS-C, renal failure, coagulation disorder
5 yr	F	Positive	Positive	3	1	Systolic BP, 83 mm Hg; SaO ₂ , 98%; BE, -0.7 mmol/liter	—	MIS-C
7 yr¶	M	Negative	ND	<1	1	Systolic BP, 85 mm Hg; SaO ₂ , 97%; BE, -0.7 mmol/liter	—	Iron deficiency, coma, fever
7 yr	F	Positive	Positive	35	2	Systolic BP, 115 mm Hg; SaO ₂ , 90%; lactate, 0.8; BE, +5 mmol/liter	Invasive mechanical ventilation, renal replacement therapy	—
10 yr‡	F	Negative	Positive	1	1	Systolic BP, 95 mm Hg; SaO ₂ , 99%; lactate, 1.1 mmol/liter; BE, -1.5 mmol/liter	—	MIS-C, cardiomyopathy
12 yr	M	Positive	ND	<1	1	Systolic BP, 100 mm Hg; SaO ₂ , 98%; BE, -6 mmol/liter	—	—
12 yr	M	Positive	ND	2	1	—	—	Viral pneumonia
13 yr	M	Positive	ND	11	2	Systolic BP, 123 to 137 mm Hg; SaO ₂ , 92%; lactate, 0.9 mmol/liter; BE, +3.2 mmol/liter	—	—
13 yr	F	Positive	Positive	7	2	Systolic BP, 80 mm Hg; SaO ₂ , 98%; lactate, 3.7 mmol/liter; BE, -9 mmol/liter	Invasive mechanical ventilation	MIS-C, heart failure
14 yr‡	M	Negative	Positive	4	1	Systolic BP, 57 mm Hg; SaO ₂ , 98%; lactate, 3.4 mmol/liter; BE, -1.5 mmol/liter	—	MIS-C, myocarditis, sepsis
14 yr	M	Positive	ND	4	2	Systolic BP, 90 to 100 mm Hg; SaO ₂ , 83%; lactate, 2.7 mmol/liter; BE, +4 mmol/liter	Invasive mechanical ventilation	—
16 yr	M	Positive	Positive	9	1	—	—	—
16 yr¶	M	Negative	Positive	5	1	—	—	MIS-C, myocarditis with heart failure

* Four children had underlying conditions: 2 had cancer, 1 had chronic kidney disease, and 1 had hematologic disease and had undergone stem-cell transplantation. Two children had additional conditions: 1 had alcohol intoxication, and 1 had sustained a traumatic injury; coronavirus disease 2019 (Covid-19) was diagnosed in these 2 children only when they underwent screening for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the intensive care unit (ICU) (they did not have Covid-19 symptoms). BE denotes base excess, BP blood pressure, MIS-C multisystem inflammatory syndrome in children, ND not done, PCR polymerase chain reaction, and SaO₂ oxygen saturation.

† For patients with multiple admissions, the total duration is reported.

‡ For patients with multiple admissions, the most aberrant value is reported.

§ The patient was identified through the presence of MIS-C according to the Swedish Pediatric Rheumatology Quality Register. Covid-19 was not diagnosed during ICU care, but the results of subsequent antibody testing were positive.

¶ Covid-19 was diagnosed clinically (i.e., SARS-CoV-2 was not detected during the ICU admission).

teachers and 20 schoolteachers in Sweden received intensive care for Covid-19 up until June 30, 2020 (20 per 103,596 schoolteachers, which is equal to 19 per 100,000). As compared with other occupations (excluding health care workers), this corresponded to sex- and age-adjusted relative risks of 1.10 (95% confidence interval [CI], 0.49 to 2.49) among preschool teachers and 0.43 (95% CI, 0.28 to 0.68) among schoolteachers (see the Supplementary Appendix).

The present study had some limitations. We lacked data on household transmission of Covid-19 from schoolchildren, and the 95% confidence intervals for our results are wide.

Despite Sweden's having kept schools and preschools open, we found a low incidence of severe Covid-19 among schoolchildren and children of preschool age during the SARS-CoV-2 pandemic. Among the 1.95 million children who were 1 to 16 years of age, 15 children had Covid-19, MIS-C, or both conditions and were admitted to an ICU, which is equal to 1 child in 130,000.

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Disclosure forms provided by the authors are available with the full text of this letter at NEJM.org.

This letter was published on January 6, 2021, at NEJM.org.

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 3. Ludvigsson JF. The first eight months of Sweden's COVID-19 strategy and the key actions and actors that were involved. *Acta Paediatr* 2020;109:2459-71.
 4. Whittaker E, Bamford A, Kenny J, et al. Clinical characteristics of 58 children with a pediatric inflammatory multisystem syndrome temporally associated with SARS-CoV-2. *JAMA* 2020;324:259-69.
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- DOI: 10.1056/NEJMc2026670

Duration of Culturable SARS-CoV-2 in Hospitalized Patients with Covid-19

TO THE EDITOR: The duration of transmissibility of coronavirus disease 2019 (Covid-19) and the associated level of contagion have been uncertain. We cultured severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in serial respiratory samples obtained from hospitalized patients with Covid-19 to assess the duration of shedding of viable virus.

The data reported here represent all the patients with Covid-19, as confirmed by positive real-time reverse transcriptase–polymerase chain reaction (RT-PCR) testing, who were hospitalized at Chung-Ang University Hospital in Seoul, South Korea, between February and June 2020. The Allplex 2019-nCoV Assay (Seegene) for nasopharyngeal and oropharyngeal samples was used for real-time RT-PCR testing.¹ Patients were isolated until two consecutive negative or inconclusive results on real-time RT-PCR were document-

ed, at least 24 hours apart.^{2,3} We endeavored to obtain samples at approximately 2-day intervals, but this was not always possible. Viral RNA was quantitated with the use of the cycle-threshold value for the N gene of SARS-CoV-2.⁴ Viral cultures were conducted by means of a plaque assay until at least two consecutive cultures showed no growth.

We compared the time from the onset of illness to viral clearance in culture with the time to clearance in real-time RT-PCR tests.⁵ Detailed methods and sensitivities of the culture and real-time RT-PCR assay and the definition and estimation of the time to viral clearance are described in the Supplementary Appendix, available with the full text of this letter at NEJM.org.

A total of 21 patients with Covid-19 were enrolled. Their clinical characteristics are shown in Table S1 in the Supplementary Appendix. The

Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Ludvigsson JF, Engerström L, Nordenhäll C, Larsson E. Open schools, Covid-19, and child and teacher morbidity in Sweden. *N Engl J Med* 2021;384:669-71. DOI: 10.1056/NEJMc2026670

(PDF updated March 1, 2021.)

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Denominator used for children aged 1 – 16 years.

Data on the Swedish child population were retrieved from the web site of the Government Agency Statistics Sweden:

http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START_BE_BE0101_BE0101A/BefolkningNy/

School attendance has been compulsory in Sweden throughout spring 2020.

Denominator used for schoolteachers (and pre-school teachers).

The denominator included preschool teachers and schoolteachers who were registered as being teachers by occupation according to the Swedish government agency *Statistics Sweden*. These individuals were then compared with individuals who had other occupations. There are however no data on whether teachers have worked as teachers (or whether policemen have worked as policemen and taxi drivers as taxi drivers etc.)(*Personal communication, the Swedish Public Health Agency Aug 26, 2020*).

Due to the small number of pre-school teachers (<10) with COVID-19-related intensive care, the Swedish Public Health Agency requested that we not present the exact number of cases or the denominator for pre-school teachers.

Exposure time.

Between March 1 and June 30, Swedish school children had about 66 days in class.

Duration of follow-up of children in the intensive care units.

Children (aged 1-16 years) were followed up until August 25, 2020 (*Personal communication, the Swedish Public Health Agency*). The last child included in our Table 1 was discharged on June 27. This means that we had a follow-up of more than 8 weeks of all included children to rule out that anyone of them had died after discharge (none had).

Total number of deaths for children 1-16 years in Sweden, regardless of whether admitted to ICU or not.

Below are data from the National Board of Health and Welfare on any deaths (including death from non-medical reasons) during four month before the pandemic and the first four months during the pandemic (Table A), and during March-June 2015-2020 (Table B). The numbers are small which means that variation can occur over time, and over the year. For instance drowning occurs in summer months, and traffic accidents throughout the year.

Table A

	Month,	1-6 years	Sum	7-16 years	Sum
2019	Nov	5		8	
	Dec	6		8	
2020	Jan	10		17	
	Feb	8	29	3	36
	March	6		14	
	April	5		8	
	May	2		15	
	June	5	18	14	51

Overall the number of deaths in our study population 1-16 years was 65 (29+36) in the four preceding months and 69 (18+51) in the four months exposed to COVID-19. The highest death rates for any of the age groups was seen in January 2020.

Table B

Year	Month	1-6 years	7-16 years
2015	March	5	11
2015	April	7	10
2015	May	6	3
2015	June	6	7

Year	Month	1-6 years	7-16 years
2016	March	12	5
2016	April	6	8
2016	May	6	8
2016	June	13	9

Year	Month	1-6 years	7-16 years
2017	March	6	6
2017	April	8	10
2017	May	6	6
2017	June	6	4

Year	Month	1-6 years	7-16 years
2018	March	10	10
2018	April	6	8
2018	May	9	9
2018	June	7	7

Year	Month	1-6 years	7-16 years
2019	March	7	8
2019	April	7	9
2019	May	5	10
2019	June	5	4

Year	Month	1-6 years	7-16 years
2020	March	6	14
2020	April	5	8
2020	May	2	15
2020	June	5	14

Red font denotes years (March-June) with highest number of deaths.

Study population for the teacher morbidity analysis:

Data were based on individuals aged 25-65 years in Sweden, between March 13 until June 30, 2020. Healthcare personnel were not included in this analysis, since their inclusion would have driven down the risk estimates for any other occupational group

Data on covid-19 for the teacher analysis were obtained from the SmiNet system administered by the Swedish Public Health Agency. More information can be found here:

<https://en.wikipedia.org/wiki/SmiNet>

Additional information

The Swedish intensive care register has not been validated for children with COVID-19. Webpage:

<https://www.icuregswe.org>

The Swedish pediatric rheumatology quality register has not been validated for children with Multisystem inflammatory Syndrome in children. Webpage: <http://barnreumaregistret.se>

Definition of Multisystem inflammatory Syndrome in children (MIS-C)

World Health Organization. Multisystem inflammatory syndrome in children and adolescents with COVID-19: Scientific Brief. 2020. Available at: <https://www.who.int/news-room/commentaries/detail/multisystem-inflammatory-syndrome-in-children-and-adolescents-with-covid-19> (Accessed on Nov 26, 2020).

Acknowledgement

Henrik Källberg, Statistician at the Swedish Public Health Agency