RESEARCH LETTER

Long-term Symptoms After SARS-CoV-2 Infection in Children and Adolescents

Children can experience SARS-CoV-2 postviral syndromes, but it is unclear to what extent these individuals are affected by long COVID. Evidence is predominantly limited to select populations without control groups,[1-4] which does not allow estimating the overall prevalence and burden in a general pediatric population. We compared symptoms compatible with long COVID in children and adolescents (hereafter "children") reported within 6 months after SARS-CoV-2 serologic testing.

Supplemental content

Methods | Ciao Corona is a longitudinal cohort study investigating SARS-CoV-2 seroprevalence in 55 randomly selected schools in the canton of Zurich in Switzerland,[5,6] which has a linguistically and ethnically diverse population of 1.5 million residents in urban and rural settings. Schools were selected randomly from the 12 cantonal districts, with number of schools proportional to population size. In Switzerland, children attended schools in person (with protective measures) in 2020-2021, except during a 6-week nationwide lockdown (March 16 to May 10, 2020).

Within participating schools, we invited all children of randomly selected classes to participate. Between June 2020 and April 2021, 3 testing phases included collection of venous blood for serologic analysis and online questionnaires for symptoms. For serologic analysis, we used the ABCORA 2.0 test (eMethods in the Supplement).[5]

We compared children who tested positive for SARS-CoV-2 antibodies in October or November 2020 with those who tested negative. We excluded children who were seronegative in October or November 2020 and seroconverted or were not retested by March or April 2021. In March to May 2021, parents reported symptoms of their children occurring since October 2020 and lasting for at least 4 weeks, as well as whether the symptoms persisted for more than 12 weeks. The questionnaire contained a list of predefined symptoms and a free-text field.

Descriptive analysis was performed with R version 4.0.3 (R Foundation). The Ethics Committee of the Canton of Zurich, Switzerland, approved the study and parents provided written informed consent.

Results | Overall, 1355 of 2503 children (54%) (median age, 11 years; interquartile range, 9-13; 54% girls) with a serology result in October or November 2020 were included. Two hundred thirty-eight children were not eligible because they seroconverted, 292 because they were not retested, and 618 because they did not provide information on symptoms. Compared with children not included, those included in the analysis were younger (median age, 11 vs 12 years) and more likely to be girls (54% vs 49%), and their parents had a higher proportion of university or college education (77% vs 64%). Age and sex distribution was comparable between seropositive children (n = 109) and seronegative ones (n = 1246) (**Table**).

Table. Participant Characteristics, Most Frequently Reported Symptoms After Serologic Testing (October 2020 Through March-April 2021), and Self-rated Health Among Seropositive and Seronegative Children

	No. (%)	
	Seropositive (n = 109)	Seronegative (n = 1246)
Female sex	58 (53)	669 (54)
Age, y		
6-11	66 (61)	703 (56)
12-16	43 (39)	543 (44)
≥1 Symptom lasting >12 wk	4 (4)	28 (2)
Tiredness	3 (3)	10 (1)
Difficulty concentrating	2 (2)	8 (1)
Increased need for sleep	2 (2)	0
Congested or runny nose	1 (1)	3 (<1)
Stomachache	1 (1)	3 (<1)
Chest tightness	1 (1)	0
≥1 Symptom lasting >4 wk	10 (9)	121 (10)
Tiredness	7 (6)	51 (4)
Headache	5 (5)	39 (3)
Congested or runny nose	3 (3)	40 (3)
Stomachache	3 (3)	18 (1)
Sleep disturbances	3 (3)	14 (1)
Cough	2 (2)	15 (1)
Self-rated health[a]		
Excellent	43 (41)	497 (41)
Good	56 (53)	680 (55)
Fair	5 (5)	48 (4)
Poor	2 (2)	2 (<1)

[a] The item self-rated health was assessed with the Health Behavior in School-Aged Children–Survey Instrument (eMethods in the Supplement). Self-rated health was not reported for 3 seropositive and 19 seronegative children.

Between October and November 2020 and March and April 2021, 4 of 109 seropositive children (4%) vs 28 of 1246 seronegative ones (2%) reported at least 1 symptom lasting beyond 12 weeks (see Table for all symptoms lasting beyond 4 and 12 weeks). The most frequently reported symptoms lasting more than 12 weeks among seropositive children were tiredness (3/109, 3%), difficulty concentrating (2/109, 2%), and increased need for sleep (2/109, 2%). None of the seropositive children reported hospitalization after October 2020. Similar proportions of seropositive and seronegative children reported excellent or good health.

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Discussion | This study found a low prevalence of symptoms compatible with long COVID in a randomly selected cohort of children assessed 6 months after serologic testing.

Although long COVID exists in children,[1,3,4] estimates of the prevalence of persisting symptoms based on scarce literature range from 0%[2] to 27%.[1] Initial SARS-CoV-2 infection severity, different methodological approaches (clinical assessment vs self-report), definition of cases (diagnosed vs suspected), variable follow-up times, and prevalence of preexisting clinical conditions likely contribute to the variability in prevalence estimates.

This study reports the distribution of symptoms compatible with long COVID on a population level; it did not capture severe SARS-CoV-2 infections because they are rare in children. A strength of this study is the population-based seronegative control group. Limitations include the relatively small number of seropositive children, lack of information on the exact time of SARS-CoV-2 infection, possible misclassification of some children with false seropositive results, potential recall bias, parental report of child's symptoms, lack of information on symptom severity, and noncompletion of the questionnaire. Also, systematic differences existed between children included vs not included in the analysis, possibly affecting the representativeness of the sample.

Thomas Radtke, PhD
Agne Ulyte, MD, PhD
Milo A. Puhan, MD, PhD
Susi Kriemler, MD

Author Affiliations: Epidemiology, Biostatistics and Prevention Institute (EBPI), University of Zurich, Zurich, Switzerland.

Corresponding Author: Susi Kriemler, MD, Epidemiology, Biostatistics and Prevention Institute (EBPI), University of Zurich, Hirschengraben 84, 8001 Zürich, Switzerland (susi.kriemlerwiget@uzh.ch).

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