Heavy Exposure of Children Aged 9–12 Years With Severe Acute Respiratory Syndrome Coronavirus 2 Did Not Lead to Infection

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The reason for the apparently lower infection rate of children with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) compared to adults is still unclear. Here, we report on 4 schoolchildren with heavy exposure to SARS-CoV-2 with no clinical signs of coronavirus disease 2019, repeated negative nasopharyngeal swabs for SARS-CoV-2 RNA, and no seroconversion.

Key words. children; COVID-19; infectiousness; SARS-CoV-2; transmission.

Since December 2019, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has infected >25 million people worldwide through the end of August 2020. Several studies from China reported a relatively low infection rate in children of 1%–5%; this age group represents about 20% of the Chinese population [1, 2]. Another interesting observation in children with coronavirus disease 2019 (COVID-19) is their relatively mild or even asymptomatic disease [3, 4]. Whether the lower infection rate in children is due to less exposure (schools were closed for most of the epidemic because of the Chinese New Year holidays), lower testing rates due to children’s milder symptoms compared to adults with COVID-19, or decreased virus transmission to children is still enigmatic. However, in judging upon preventive measures like social distancing for whole populations, more precise risk stratifications are needed.

Here, we report on 4 schoolchildren of 1 family with heavy exposure to SARS-CoV-2 over several days with no clinical signs of COVID-19, repeated negative nasopharyngeal swabs, and no seroconversion 3 weeks after exposure to SARS-CoV-2. More specifically, after infection of the father, an MD (50 years of age; M50), on February 20–21, 2020 [5], his wife, also an MD (46 years of age; F46), became infected after a short unprotected contact on February 27 before the local health authorities informed M50 to be a contact person of a presymptomatic COVID-19 patient (Figure 1). On March 13, nasopharyngeal swabs for detection of SARS-CoV-2 RNA by established methods [6] were positive in F46 but negative in the 4 children of M50 and F46, 3 girls and 1 boy aged 12, 10, 9, and 9 years (F12, F10, F9, M9). F46 developed dry cough, limb pain, and headache on March 10, and from March 13 to 21 additionally developed fever up to 39.0°C, fatigue, and dyspnea grade 4 (American Thoracic Society) (Figure 1). Since the local health authorities in Lübeck, Germany, announced quarantine for all household members in home isolation together with a COVID-19 patient for a minimum of 2 weeks beginning from the last day of quarantine of the COVID-19 patient, this would have meant home isolation for several months in case of sequential infection of the 4 siblings. Therefore, the family decided to expose the children to SARS-CoV-2. From March 13 to 16, F46 and all children spent the nights on a 3 × 2 m2 mattress in a small bedroom. Furthermore, no social distancing was performed thereafter.

In all children, nasopharyngeal swabs for detection of SARS-CoV-2 RNA were negative 1 and 2 weeks later (Figure 1). After 3 weeks, serum immunoglobulin A (IgA) and immunoglobulin G (IgG) against the recombinant S1 domain of structural protein of SARS-CoV-2 (Euroimmun, Lübeck, Germany [7]) were absent in all children. In line with this, none of the children had generated serum IgG or immunoglobulin M (IgM) antibodies against a SARS-CoV-2–specific fragment of the N protein (Euroimmun, unpublished). In contrast, F46 and M50 had developed anti–SARS-CoV-2 serum IgG and IgA against the S protein (Figure 1) and IgG (F46, M50) and IgM (F46) against the N protein. Of note, none of the children developed any clinical symptoms of COVID-19 throughout the observation period.

These data suggest that the relatively low number of children at school age with COVID-19 may be explained, at least in part, by a lower infectivity of SARS-CoV-2 in children compared to adults. This view is in accordance with a recent study in Hunan Province, China, where children aged 0–14 years were significantly less susceptible to SARS-CoV-2 infection than adults [8]. In line with these findings, a case of a 9-year-old child with mild COVID-19 who had 102 contacts, most of them being children...
in the same age, in 3 different schools and a ski-club resulted in no secondary infections, although all were contacted by the local health authorities and 55 tested negative for SARS-CoV-2 RNA [9]. A different transmission dynamic in children has also been suggested by a Chinese household cohort study where the secondary attack rate to children was significantly lower compared with the rate to adults [10].

Our observation of the absent transmission of SARS-CoV-2 to 4 children aged 9–12 years despite heavy viral exposure may have implications for preventive measures such as school closures and social distancing during the SARS-CoV-2 pandemic and encourages further studies on viral cell entry and transmission in children. In the above-mentioned study from Zhang et al [8], social distancing alone was shown to be sufficient to control COVID-19 while school closures may reduce peak incidences and contribute to a delayed spread of the virus during the pandemic.

Notes

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