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COVID-19, children, and schools: overlooked and at risk

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Abstract

It is widely thought that children are much less susceptible to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection than adults and do not play a substantial role in transmission. However, emerging research suggests this perception is unfounded. Seroprevalence and contact tracing studies show children are similarly vulnerable and transmit the virus to a meaningful degree. Research suggesting otherwise is hampered by substantial bias. Additionally, large clusters in school settings have been reported, with implications for the control of community transmission. Risk-reduction strategies must be implemented in schools as a matter of urgency.

Introline

Children are more susceptible than originally thought and play a role in community transmission

Text

An early cause for hope in the coronavirus disease 2019 (COVID-19) pandemic was the observation that children are much less likely to experience severe illness than adults.[1] This remains true, but has created a perception that children are less susceptible to infection and do not play a substantial role in transmission. Unfortunately, emerging research suggests this optimism is unfounded.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in children is generally characterised by mild illness.[1] Only a minority of children require hospitalisation and the case fatality rate is very low, although a small fraction of children can experience a severe postinfectious inflammatory syndrome.[2] Serious outcomes in children were seldom reported at the beginning of the pandemic, likely because strong infection control measures in China halted the epidemic there before it could spread widely among children. The expansion phase coincided with the Lunar New Year holiday period during which schools were closed, and schools remained closed thereafter. Additionally, cases in children were likely missed, as those with mild – or absent – symptoms were unlikely to receive testing.

More recent data paint a different picture. In a seroprevalence study of over 61,000 people from Spain, 3.4% of children and teenagers had antibodies against SARS-CoV-2 as measured by a point-of-care test, compared with 4.4% to 6.0% of adults. In a subset of almost 52,000 people who underwent immunoassay testing, the gap narrowed to 3.8% vs. 4.5% to 5.0%.[3] These findings could suggest that children are less susceptible to infection than adults, but more likely reflect shielding. Spain's schools closed in March and have yet to reopen. Household contact studies provide an alternative way to estimate the susceptibility of children. In a study of 391 cases and 1,286 close contacts in Shenzhen, China, children were as likely to be infected as adults.[4] These, and other data,[5] strongly suggest that children and adults are similarly vulnerable to infection.

The role that children play in transmission is less certain, but there is no reason to think that children are less likely to transmit the virus than adults. In a study of symptomatic people with mild to moderate COVID-19, the amount of viral RNA detected in the nasopharyngeal swabs of children aged 5-17 years was similar to that of adults. However, young children (<5 years) had levels 10 to 100 times higher.[6] Children may therefore have the potential to be substantial drivers of the pandemic, particularly given the large number of contacts children have in close-contact settings such as childcare centres and schools.

In a contact tracing study comprising 5,706 index cases and 59,073 contacts in South Korea, non-household contacts of child index cases were as likely to be infected as contacts of adult cases. Within the household, contacts of young paediatric index cases (<10 years) were less likely to become infected than those of adults, but the attack rate (AR) for the contacts of older children and teenagers was higher than any other group.[7] Preliminary data from Italy are similarly concerning. In the heavily affected province of Trento, contacts of children aged under 15 years were more likely to be infected than those of adults.[8] This suggests the potential for mass transmission within schools, which is borne out by reports of large clusters in these settings.[9-11]

The government of Israel mandated complete closure of the country's schools in mid-March. A cautious reopening was attempted less than two months later, and all schools reopened for face-to-face teaching on 17 May. Ten days later, the first major outbreak occurred in a high school.[9] Two cases without an epidemiological link were detected in students on 26 and 27

May, and mass testing of the school community occurred over the following days. A total of 153 students (AR: 13.2%) and 25 staff members (AR: 16.6%) tested positive. By mid-June, a further 87 cases among close contacts had been detected, including siblings attending other schools, parents, and the family members of staff. Interestingly, the outbreak coincided with an extreme heatwave during which students were exempted from wearing face masks and air conditioning was used continuously.[9]

A similarly rapid spread occurred in a private school catering for students from pre-primary to high school age in Chile.[10] The school year began on 4 March, after which parent-teacher meetings were held over the following days. The next week, two cases were detected in staff. By 6 April, 52 members of the school community had tested positive and one death had occurred. Serological testing was conducted 8-10 weeks after the start of the outbreak, in which 38% of students and 74% of staff participated. Overall, 9.9% of students and 16.6% of staff were seropositive. Students from pre-school to middle school age were most affected. The index case was a staff member who worked with all of the pre-school and primary school staff, likely explaining the higher seroprevalence among staff and younger children. Notably, 18% of staff and 40% of students were asymptomatic, indicating the potential for silent spread among children.[10]

The US closed schools in all 50 states in March. A study found this was temporally associated with a marked decrease in COVID-19 incidence and mortality, and the effect was greatest in states which acted earlier when cases were low.[12] While adjustments were made for other non-pharmaceutical interventions, some residual confounding is likely. However, data from France strongly support the role of schools in community transmission. In a retrospective analysis of a high school cluster, incident cases dropped dramatically and abruptly after the start of the school holidays, and again after wider lockdown measures were introduced in the region.[11] These findings have historical precedent. School closures coupled with bans of mass gatherings were associated with reduced mortality in the 1918-19 influenza pandemic in the US, but only when enacted early. Excess mortality was particularly high in Pittsburgh, which banned public gatherings early but delayed closing schools.[13]

A recent study of COVID-19 in educational settings in New South Wales appears to suggest a small role for schools at first glance, with limited transmission reported between January to April, although a large outbreak occurred in a childcare centre.[14] However, schools switched to distance learning for the majority of students in March, after which school attendance fell to 5%. Additionally, only 44% of close contacts were tested (the majority after developing symptoms), so cases in children may have been missed. Furthermore, the majority of cases in the state were acquired overseas at the time of the study, and there was minimal community transmission. Two conclusions can therefore be drawn. First, the risk associated with schools and childcare centres is likely modest only in the setting of low community transmission. Second, investigation of children has frequently been poor, with insufficient testing performed.

These limitations are unfortunately common to many studies of COVID-19 and children. Most have been conducted during lockdown periods – which are not normal conditions – or at a time of low community transmission. Adult travellers seeded epidemics and the virus initially circulated among their contacts, delaying children's exposure. In some countries, cases were rapidly isolated and quarantined away from home, further limiting spread to children. Testing was initially limited, excluding those not fitting clinical criteria. This is of particular relevance given the high prevalence of asymptomatic infection among children, and also increases the likelihood that index cases in children will be missed. Paediatric cases may only be detected after transmission from the child to a second person (often an adult) has occurred. The child may then be tested as a contact, and either mistakenly thought to be a secondary case, or missed entirely if the child's viral load has declined by this point. Finally, limited transmission by children in some studies[14] is not cause for reassurance. Approximately 80% of secondary COVID-19 cases are generated by about 10% of individuals.[15] It is therefore unsurprising to find examples where children have not transmitted the virus. Many adults do not, either.

This complacency cannot continue. The situation in Victoria provides stark warning to the rest of Australia. As community transmission has grown, clusters have arisen in educational settings catering for children of all ages.[16,17] Notably, an epidemiological link was found between a school cluster and a major outbreak in Melbourne's public housing towers,[18] prompting dramatic measures to curtail transmission. A school cluster currently comprising 11 students, 4 teachers, and 2 social contacts of school community members has since emerged in Sydney.[19]

Schools are clearly neither inherently safe nor unsafe. The risk associated with these settings depends on the level of community transmission, and it must be continuously evaluated. Schools must not remain open for face-to-face teaching in the setting of ongoing community transmission. In regions where community transmission is minimal, risk-reduction strategies must be implemented in schools as a matter of urgency. Comprehensive guidelines have been developed (summarised in Box 1),[20] but at a minimum, interventions should include the wearing of face masks by staff and students, increasing ventilation and indoor air quality, and the regular disinfection of shared surfaces.

The evidence clearly shows that children and schools are at risk, with wider implications for the community. Additionally, serious outcomes in children will become increasingly common – at least in absolute terms – if the virus is allowed to spread. We can no longer afford to overlook the role children play in transmission if we hope to contain the virus.

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Tables

Box 1. Summary of Healthy Buildings Program[20] risk-reduction strategies for schools

Area	**Recommendations**
Classrooms	Students and staff should wear face masks Wash hands frequently Move class outdoors if possible and repurpose large unused spaces as temporary classrooms Keep class groups as distinct and separate as possible Regularly disinfect shared surfaces
Buildings	Increase ventilation by bringing in more fresh outdoor air Filter indoor air Supplement with portable air cleaners Use plexiglass as a physical barrier around desks Improve toilet hygiene and keep toilet lids closed, especially when flushing
Activities	Hold physical education classes outdoors Replace high-risk activities (e.g., choir practice) with safer alternatives
Schedules	Stagger school arrival and departure times and class transitions Modify school start times to allow students who use public transport to avoid rush hour
Policies	Form a COVID-19 response team and plan Prioritize staying home when sick Encourage viral testing any time someone has symptoms, even if mild

	Support remote learning options Protect high-risk students and staff