

Synthesis Report

COVID-19 and Schools

January 27, 2020

COVID-19 Literature Report Team:

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Most countries world-wide implemented localized or national school closures in response to the COVID-19 pandemic, with estimates of >65% of enrolled children globally affected by school closures. Since the early pandemic, schools in many settings around the world have fully or partially re-opened for in-person instruction, while in other settings schools have re-opened exclusively using online learning.

This document is intended to serve an updated resource compiling information about what is known about COVID-19 and SARS-CoV-2 in the context of schools, with a primary focus on K-12 grades. Much of the information in this synthesis report is drawn from summaries included in the daily [COVID-19 Literature Situation Report](#). This is not intended to be a systematic or comprehensive summary, rather it is a **frequently updated compilation and synthesis of evidence related to topics relevant to those making decisions about schools during the COVID-19 pandemic**. This synthesis report is supplemented by [in-depth summaries](#) of evidence related to COVID-19 and schools, including models of school re-openings from around the world that were release in July and October 2020.

Susceptibility, Infectiousness, and Severity of SARS-CoV-2 in Children

There is clear evidence that school-age children are susceptible to SARS-CoV-2 infection ([Carsetti](#)), can transmit to other children and adults, and on rare occasions, can have severe cases of COVID-19 disease as well as multi-system inflammatory syndrome in children (MIS-C). While severe outcomes do occur among school-age children and young people, particularly those with co-morbidities, the incidence of severe outcomes is very low ([Carsetti](#), [Hua](#), [Stage](#), [Somekh](#), and [Heavey](#)). An analysis of COVID-19 cases among school-age children found that 1.2% school-aged children with COVID-19 were hospitalized, including 0.1% who required ICU admission ([Leeb](#)). While very rare, deaths associated with SARS-CoV-2 infection have occurred in children, accounting for 0.08% of deaths attributed to COVID-19 ([Bixler](#)).

Bixler et al. (Sept 15, 2020). SARS-CoV-2–Associated Deaths Among Persons Aged <21 Years — United States, February 12–July 31, 2020. MMWR. <https://doi.org/10.15585/mmwr.mm6937e4>

- A total of 121 SARS-CoV-2-associated deaths among people younger than 21 years of age had been reported to the CDC by July 31, 2020, accounting for 0.08% of all deaths due to COVID-19. Of these 121 deaths, 70% of were among those 10-20 years old and 10% were among infants. 78% of deaths

were among members of racial and ethnic minority groups, and 33% of deaths occurred outside of a hospital. The authors conclude that these results imply the need for ongoing surveillance for infants, children, and adolescents as schools reopen.

Hua et al. (June 2020). *Epidemiological Features and Viral Shedding in Children with SARS-CoV-2 Infection*. *Journal of Medical Virology*. <https://doi.org/10.1002/jmv.26180>

- An analysis of all children (n=314) from families with SARS-CoV-2 infected members in Zhejiang Province, China found incidence in children who were close contacts was significantly lower than in adults who were close contacts (13% vs 21%). Among 43 pediatric cases, the mean age was 8.2 years and mean incubation was 9.1 days, 77% had mild pneumonia and the remainder were asymptomatic. While SARS-CoV-2 RNA could be detected in stool samples in 91% of cases and for over 70 days in some children, no family contacts of these children were subsequently infected.

School-age children are capable of transmitting the virus to other children and adults (Szablewski, Stein-Zamir, Chu). While there is evidence that younger children (i.e., younger than 10 years old) may be less susceptible to infection and less likely to transmit to close contacts if they are infected (Park, Ladhani), a relatively small number of well documented outbreaks involving school-age children demonstrate the potential for widespread transmission among children, particularly when there are limited measures in place to stop transmission (Szablewski, Stein-Zamir, Chu) [See section of *Impact of Control Measures to Limit Transmission in Congregate Settings with Children and Outbreaks of SARS-CoV-2 Linked to K-12 Schools*].

Leeb et al. (2020). *COVID-19 Trends Among School-Aged Children — United States, March 1–September 19, 2020*. *MMWR*. <https://doi.org/10.15585/mmwr.mm6939e2>

- The incidence of SARS-CoV-2 infection in school-age children increased from March and peaked in July and August, followed by a decline in September. During March 1–September 19, 2020, the US reported a total of 277,285 laboratory-confirmed cases of COVID-19 in school-aged children. The average weekly COVID-19 incidence among adolescents aged 12–17 years was approximately 2-fold higher than among children aged 5–11 years (37.4 vs. 19.0 per 100,000). The weekly incidence increased to a peak of 34–38 per 100,000 in July and August and decreased with a slight rebound to 23–26 per 100,000 in early September. Trends in incidence were similar among both age groups.
- The authors note that these estimates provide a baseline to monitor transmission among school age children as schools reopen for in-person learning in some districts around the country.

Ladhani et al. (Aug 12, 2020). *COVID-19 in Children: Analysis of the First Pandemic Peak in England*. *Archives of Disease in Childhood*. <https://doi.org/10.1136/archdischild-2020-320042>

- Ladhani et al. analyzed public health surveillance data including 540,305 people tested for SARS-CoV-2 in England through May 3, 2020 and found that 1408/35,200 (4%) tests were positive among children younger than 16, compared to 19%–35% positive among adult age groups. Children accounted for 1.1% of SARS-CoV-2 positive cases. These included 8 deaths among children, three of whom had multiple co-morbidities and an additional four in whom SARS-CoV-2 was determined to be an indirect contributor to death from another cause. There was no evidence of excess mortality in children during this period.

Park et al. (Oct 2020). *Contact Tracing during Coronavirus Disease Outbreak, South Korea, 2020. Emerging Infectious Diseases.* <https://doi.org/10.3201/eid2610.201315>

- Among 59,073 contacts of 5,706 COVID-19 index cases in South Korea monitored for an average of 9.9 days after index case diagnosis, 12% of household contacts acquired COVID-19, versus 2% for non-household contacts. Probability of a contact being positive was highest for household contacts when the index case was 10-19 years old (19%); however, only 2% of index cases were in this age group. Among non-household contacts, the highest proportion of positive contacts was among index case who were 70 years of age or older.

Widespread transmission can occur among school-age children (Szablewski, Stein-Zamir). A well-documented case of widespread SARS-CoV-2 transmission among school-age children came from an overnight camp in Georgia in July 2020 (Szablewski). Additional outbreak investigations have demonstrated the involvement of school-age children in large clusters of transmission, particularly when transmission control measures have not been rigorously implemented (Pray, Schwartz). By contrast, when adherence to control measures are adhered to, the risk of transmission from a symptomatic child to a caregiver is low (Lee).

Szablewski et al. (2020). *SARS-CoV-2 Transmission and Infection Among Attendees of an Overnight Camp — Georgia, June 2020. MMWR.* <https://doi.org/10.15585/mmwr.mm6931e1>

- An outbreak investigation found evidence of widespread transmission of SARS-CoV-2 among children of all ages at the camp. SARS-CoV-2 tests were available for 344 of 597 camp attendees, of whom 260 (76%) were positive. The overall attack proportion was 44%. The attack proportion was 51% among those aged 6–10 years, 44% among those aged 11–17 years, and 33% among those aged 18–21 years. While the camp was adhering to current Executive Orders in place in Georgia allowing camps to operate and put in place most of the components of CDC’s [Suggestions for Youth and Summer Camps](#) to minimize the risk for SARS-CoV-2 introduction and transmission, these measures were insufficient to prevent transmission. The camp involved large groups sleeping in the same cabin and engaging in singing, cheering, and both indoor and outdoor activities. Use of cloth masks was not required among campers. All trainees, staff members, and campers provided documentation of a negative viral SARS-CoV-2 test ≤12 days before arriving.

Pray et al. (Oct 30, 2020). *COVID-19 Outbreak at an Overnight Summer School Retreat — Wisconsin, July–August 2020. MMWR.* <https://doi.org/10.15585/mmwr.mm6943a4>

- Investigation of a SARS-CoV-2 outbreak associated with an overnight high-school retreat suggests a single introduction from a student subsequently infected 76% (116) of attendees. The suspected index case received a negative PCR result 1 week prior to the retreat but experienced symptoms shortly after arrival. The attack rate among susceptible attendees was 91% (116 of 128), excluding 24 attendees with positive serologic results prior to the retreat (none of whom received positive PCR results at the retreat). All illnesses were mild to moderate, with no hospitalizations or deaths.

Schwartz et al. (Oct 5, 2020). *Adolescent with COVID-19 as the Source of an Outbreak at a 3-Week Family Gathering — Four States, June–July 2020. MMWR.* <https://doi.org/10.15585/mmwr.mm6940e2>

- An adolescent (13 years old) was the index case of an outbreak that occurred during a 3-week family gathering where 11 of 14 attendees developed COVID-19, despite the index case testing negative

with a rapid antigen test prior to the gathering.¹⁵ Six other family members who maintained physical distancing by remaining outdoors did not develop COVID-19. This outbreak investigation highlighted the possibility of spread from children and adolescents, evidence of benefit from physical distancing, the lower sensitivity of rapid antigen tests, and the efficiency with which SARS-CoV-2 can spread during gatherings with prolonged close contact.

Lee et al. (Nov 30, 2021). Absence of SARS-CoV-2 Transmission from Children in Isolation to Guardians, South Korea. Emerging Infectious Diseases. <https://doi.org/10.3201/eid2701.203450>

- In an observational study of 12 SARS-CoV-2 positive children isolating with their uninfected guardians in hospital rooms in Korea, none of the guardians became SARS-CoV-2 positive despite frequent close contact. All guardians complied with wearing PPE, including gloves and a variety of masks, while only 4 children complied well with mask use. Two guardian-child pairs kept a distance of >1m during isolation.

Impact of Control Measures to Limit Transmission in Congregate Settings with Children

While there is clear evidence for the potential for widespread transmission of SARS-CoV-2 in a school environment, there is also direct and indirect evidence that the development of and adherence to protocols to identify cases, isolation of infected individuals and quarantining of close contacts, and maintaining cohorts or capsules with limited mixing between groups can substantially limit the spread of SARS-CoV-2 in the context of group settings with school-age children.

Krishnaratne et al. (Dec 17, 2020). Measures Implemented in the School Setting to Contain the COVID-19 Pandemic: A Scoping Review. Cochrane Database of Systematic Reviews.

<https://doi.org/10.1002/14651858.CD013812>

- A review of 42 studies that assessed measures to reopen or keep schools open during the COVID-19 pandemic found a heterogeneous set of interventions implemented in school settings, including organizational (n=36) and structural or environmental measures (n=11) to reduce transmission, as well as surveillance and response measures to detect SARS-CoV-2 infections (n=19). Most studies assessed transmission-related outcomes (n=29), while others assessed healthcare utilization (n=8), other health outcomes (n=3), and societal, economic, and ecological outcomes (n=5).

Atherstone et al. (Jan 26, 2021). SARS-CoV-2 Transmission Associated with High School Wrestling Tournaments — Florida, December 2020–January 2021. MMWR.

<https://doi.org/10.15585/mmwr.mm7004e4>

- An outbreak arising from a Florida high school wrestling tournament in December 2020 had an attack rate of at least 30% (38 of 126 tournament attendees who were tested) and a secondary attack rate of at least 9% (41 of 441 close contacts of the 38 COVID-19 patients). Among contacts, household members had the highest attack rate (at least 30%), test positivity rate (60%), and odds of receiving a positive test result (OR=2.7). The outbreak resulted in an estimated loss of 1,700 in-person school days due to isolation and quarantine of patients and contacts, and the death of one adult contact aged >50 years. At the time of the tournament, the county in which 7 out of 10 participating high school teams were located had a 14-day cumulative COVID-19 incidence in the highest category of transmission risk for SARS-CoV-2 (363 per 100,000), according to CDC classification.

Blaisdell et al. (Aug 26, 2020). Preventing and Mitigating SARS-CoV-2 Transmission — Four Overnight Camps, Maine, June–August 2020. MMWR. <https://doi.org/10.15585/mmwr.mm6935e1>

- During the 2020 summer camp season, **four overnight camps in Maine with 1,022 attendees from 41 states and international locations implemented a multi-layered prevention and mitigation strategy that was successful in identifying and isolating three asymptomatic persons with SARS-CoV-2 infection and preventing secondary transmission.** The four summer camps, which had similar sizes, session duration, and camper and staff member characteristics, opened with uniform non-pharmaceutical interventions, including pre-camp quarantine, pre- and post-arrival testing and symptom screening, cohorting, and physical distancing between cohorts. In addition, camps

required use of face coverings, enhanced hygiene measures, enhanced cleaning and disinfecting, maximal outdoor programming, and early and rapid identification of infection and isolation.

Link-Gelles et al. (Aug 21, 2020). Limited Secondary Transmission of SARS-CoV-2 in Child Care Programs — Rhode Island, June 1–July 31, 2020. MMWR. <https://doi.org/10.15585/mmwr.mm6934e2>

- An analysis of SARS-CoV-2 infections linked to **childcare facilities in Rhode Island** identified 52 confirmed and probable childcare-associated cases of COVID-19 in 29 childcare programs in the state (June 1 to July 31) among 666 facilities with a capacity of 18,945 children. Of the cases, 30 (58%) were among children (median age = 5 years), and 22 (42%) were among adults (20 teachers and 2 parents, median age = 30 years). **The majority of affected centers (69%) reported only a single case without apparent secondary transmission.** Secondary transmission was suspected in four childcare centers, including one in which an investigation revealed a lack of adherence to the guideline prohibiting switching between groups of children. This provides additional evidence that under adequate control measures, the risk of transmission can be limited among groups of children and adult care providers.

Krishnaratne et al. (Dec 17, 2020). Measures Implemented in the School Setting to Contain the COVID-19 Pandemic: A Scoping Review. Cochrane Database of Systematic Reviews. <https://doi.org/10.1002/14651858.CD013812>

- A review of 42 studies that assessed measures to reopen or keep schools open during the COVID-19 pandemic found a heterogeneous set of interventions implemented in school settings, including organizational (n=36) and structural or environmental measures (n=11) to reduce transmission, as well as surveillance and response measures to detect SARS-CoV-2 infections (n=19). Most studies assessed transmission-related outcomes (n=29), while others assessed healthcare utilization (n=8), other health outcomes (n=3), and societal, economic, and ecological outcomes (n=5).

Rice et al. (Dec 11, 2020). Estimated Resource Costs for Implementation of CDC's Recommended COVID-19 Mitigation Strategies in Pre-Kindergarten through Grade 12 Public Schools — United States, 2020–21 School Year. MMWR. <https://doi.org/10.15585/mmwr.mm6950e1>

- Mitigation strategies recommended by CDC to prevent SARS-CoV-2 transmission in schools are estimated to cost between a mean value of \$55 per student for materials and consumables (e.g. desk shields, hand sanitizer, and face masks) to \$442 per student for additional custodial staff and transportation. These values represent an additional 0.3% to 7.1% above school expenditures reported by state in fiscal year 2018. Only seven states had a maximum estimate >4.2% for additional resources needed.

Yoon et al. (Nov 30, 2020). Stepwise School Opening and an Impact on the Epidemiology of COVID-19 in the Children. Journal of Korean Medical Science. <https://doi.org/10.3346/jkms.2020.35.e414>

- School opening with good adherence to mitigation measures among students in Korea did not cause significant school-related COVID-19 outbreaks. Following the implementation of social distancing strategies on February 29, 2020, in-person classes convened between May 20 and June 8 at four steps with high school senior students (grade 12) back to school first. As of July 31, more than 13,000 students and staff were tested from 38 institutions, and 44 COVID-19 cases among students were identified (from 14 high schools, 6 middle schools, 13 elementary schools, and 6

kindergartens). Only one elementary student was infected from the same classroom. There was no sudden increase in the number of pediatric patients or the proportion of pediatric patients among all confirmed cases in the nation after school reopened (7% by May 20 and 7.2% by July 31).

Outbreaks of SARS-CoV-2 Linked to K-12 Schools

When schools open for in-person instruction while there is transmission of SARS-CoV-2 in the community, the identification of infected students and staff should be expected, particularly asymptomatic cases in children. There have been a relatively small number of large outbreaks linked to schools ([Larosa, Stein-Zamir](#)); however, most cases linked to schools have resulted in either no secondary cases, or only a small number of secondary cases (1 to 2 secondary cases) ([Ismail, Larosa](#)). One of the first well documented school outbreaks of SARS-CoV-2 occurred in Jerusalem, Israel in a secondary school (grades 7-12) in mid-May 2020 ([Stein-Zamir](#)). In the US, there has been very limited evidence of within-school transmission ([Zimmerman, Falk, Fricchione](#)). In response to this evidence, the CDC has concluded that schools can be safe if precautions are taken on campus and in the community ([Honein](#)).

Falk et al. (Jan 26, 2021). COVID-19 Cases and Transmission in 17 K–12 Schools — Wood County, Wisconsin, August 31–November 29, 2020. MMWR. <https://doi.org/10.15585/mmwr.mm7004e3>

- Despite widespread community transmission, limited COVID-19 spread was observed from August to November 2020 in 17 rural K-12 schools in Wood County, Wisconsin that reopened with in-person instruction and several infection mitigation measures. Schools implemented physical distancing among students and staff, established groups of 11-20 students, and had a 92% reported mask adherence among students. Among 191 cases identified in 5,530 students and staff, there were 7 student cases and 0 staff cases linked to in-school transmission. The case rate among students and staff was lower than the county case rate (3,453 vs 5,466 per 100,000). An estimated 12% of Wood County's children were attending school virtually.

Zimmerman et al. (Jan 8, 2021). Incidence and Secondary Transmission of SARS-CoV-2 Infections in Schools. Pediatrics. <https://doi.org/10.1542/peds.2020-048090>

- Very limited within-school transmission of SARS-CoV-2 was found in the first 9 weeks of in-person instruction in North Carolina secondary schools between August and October 2020. There were 773 community-acquired infections documented by molecular testing in the 11 school districts with over 90,000 students and staff. Through contact tracing, health department staff identified an additional 32 infections acquired within schools. No instances of child-to-adult transmission of SARS-CoV-2 were reported.

Fricchione et al. (Dec 30, 2020). Data-Driven Reopening of Urban Public Education Through Chicago's Tracking of COVID-19 School Transmission. Journal of Public Health Management and Practice. <https://doi.org/10.1097/PHH.0000000000001334>

- Data from COVID-19 contact tracing conducted in a large urban private school system in Chicago show that the attack rate for those participating in in-person learning was lower than working-age adults (0.2% for students and 0.5% for staff, compared to 0.7% for working age adults). Data were collected during August to October 2020, during a plateau in case incidence between Chicago's first and second wave.

Xu et al. (Dec 10, 2020). What Is the Evidence for Transmission of COVID-19 by Children in Schools? A Living Systematic Review. Journal of Global Health. <https://doi.org/10.7189/jogh.10.021104>

- A systematic review and meta-analysis of 11 studies from Europe, Asia, Australia, and South America indicate that the overall SARS-CoV-2 attack rate and positivity rate in school environments are low. Data from 5 cohort studies (n=3,345 contacts and 8 transmissions) found a pooled attack rate of 0.15% for students and 0.7% for staff. Across 6 cross-sectional studies (n=639 positive cases among 6,682 participants tested), the proportion of positivity was 8% among students and 14% among staff. Authors note that overall study quality was judged to be poor and at risk of performance and attrition bias.

Stein-Zamir et al. (July 23, 2020). A Large COVID-19 Outbreak in a High School 10 Days after Schools' Reopening, Israel, May 2020. *Eurosurveillance*. <https://doi.org/10.2807/1560-7917.ES.2020.25.29.2001352>

- After re-opening on May 17 after a two-month closure, a cluster of SARS-CoV-2 infections was identified at the school 10 days later. Overall, 13% of students and 17% of staff had SARS-CoV-2 infection, of whom 43% of students and 76% of staff were symptomatic. The highest prevalence of SARS-CoV-2 was in grades 7-9 (17% to 33%), which corresponded to the grades with the initial index cases, and prevalence was considerably lower in grades 10-12 (1.6%-4.5%), which had classrooms in a separate wing of the school. Even within the younger grades, cases appeared to be clustered within specific classrooms that were linked to the index cases.
- Contact tracing of close contacts of cases from the school identified 87 additional cases. An environmental school inspection reported crowded classes (35-38 students per class). While facemasks were initially required, this mandate was removed during a heatwave that occurred within days of the school re-opening. **Important takeaways from this outbreak are that transmission can occur rapidly in crowded classrooms and cohorting of groups of students such that there is limited mixing between cohorts can limit the scope of transmission.** This is potentially relevant to use of so called “protective capsules” to limit transmission in schools.

Ismail et al. (Dec 9, 2020). SARS-CoV-2 Infection and Transmission in Educational Settings: A Prospective, Cross-Sectional Analysis of Infection Clusters and Outbreaks in England. *The Lancet Infectious Diseases*. [https://doi.org/10.1016/S1473-3099\(20\)30882-3](https://doi.org/10.1016/S1473-3099(20)30882-3)

- The risk of SARS-CoV-2 infections and outbreaks were low in educational settings since reopening in the summer half-term in England, with the likelihood of a school outbreak strongly associated with the regional level of COVID-19 incidence. A prospective cohort study among 57,600 educational settings in England reported that there were 113 educational settings in which a single infected individual was identified, nine settings in which two or more cases were detected within 48 hours (no evidence of a chain of transmission), and 55 outbreaks (at least two epidemiologically linked cases, with sequential cases diagnosed within 14 days in the same educational setting). The outbreaks involved 210 epidemiologically linked cases. This analysis corresponds to a reopening period from June 1-July 17, 2020, with enhanced surveillance after the first national lockdown.
- The risk of outbreaks increased by 72% for every five cases per 100,000 population increase in community incidence (p<0.0001). Most cases linked to outbreaks (73% of 210) were in staff members and the median number of secondary cases in outbreaks was 1 (IQR 1–2) for student index cases and 1 (IQR 1–5) for staff index cases. Staff-to-staff transmission was most common, while student-to-student transmission was rare.

Larosa et al. (Nov 18, 2020). *Secondary Transmission of COVID-19 in Preschool and School Settings after Their Reopening in Northern Italy a Population-Based Study*. Pre-print downloaded Nov 19 from <https://doi.org/10.1101/2020.11.17.20229583>

- [Pre-print, not peer reviewed] An outbreak investigation in a group of schools in Italy from September to October 2020 detected an overall attack rate of 3.9%; 10 student and 2 teacher primary cases infected 39 secondary cases among 994 students included in the investigation. The attack rate in secondary schools was 6.6%, with the largest cluster of 22 secondary cases occurring in a middle school. Meanwhile, the attack rate in primary schools was 0.4%, with no secondary transmission occurring in early childhood educational settings.

Role of K-12 Schools in Driving Community Transmission

There is very little evidence, at least in the context of relatively low community transmission, that schools have been a driver of transmission ([Leidman](#)). Debates are ongoing about how to best balance the potential benefit of reducing SARS-CoV-2 transmission, by closing schools or significantly modifying the schedule of in-person learning, against the very real consequences of such measures on student learning, indirect harms to students (e.g., lack of access to school-based feeding programs), and the considerable burden this places on parents and caregivers, particularly those who need to simultaneously work. The burden of these indirect effects is likely to fall disproportionately on lower income families and people of color.

A small number of countries in regions with some level of community transmission of SARS-CoV-2 never imposed school closures. Sweden is notable among countries that did not close all schools, although Sweden did close schools for secondary grade students between March 18 and June 4, 2020 ([Vogel](#)). The incidence of severe COVID-19 was low among school-age children in Sweden and the risk among schoolteachers was similar to other occupations ([Ludvigsson](#)). Starting in late April and May, many countries around the world started re-opening schools, many of which also sustained limits on other mobility and closures of many businesses after schools were re-opened. Since the initial re-opening, which often occurred for subsets of students or with modified schedules, schools have fully reopened for all students in many settings. While there have been examples of large-scale school closures in response to cases arising in schools soon after re-opening, particularly when school re-opening coincided with widespread relaxation of mobility restrictions and business closures (*Israel, parts of the United States*), many countries have been able to keep the large majority of schools open, even as cases of COVID-19 have increased in the community (*Germany, France, Norway, Belgium, Scotland, South Korea*).

Leidman et al. (Jan 13, 2021). COVID-19 Trends Among Persons Aged 0 – 24 Years — United States. MMWR. <http://dx.doi.org/10.15585/mmwr.mm7003e1>

- COVID-19 cases in children, adolescents, and young adults increased since summer 2020, with weekly incidence higher in each successively increasing age group. During March 1–December 12, 2020, a total of 2,871,828 laboratory-confirmed cases of COVID-19 in young people aged 0–24 years were reported in the United States, with the majority (57%) occurring among those aged 18–24 years. 52% of all cases occurred in females. Among the 1,504,165 (52%) young people with COVID-19 with complete information on race/ethnicity, 50% were non-Hispanic white, 27% were Hispanic/Latino, and 12% were non-Hispanic Black.
- The authors note that the data do not indicate that increases in incidence in adults were preceded by increases among preschool- or school-aged children and adolescents. In contrast, incidence among young adults (aged 18–24 years) was higher than that in other age groups throughout the summer and fall, with peaks that preceded increases among other age groups, suggesting that young adults might contribute more to community transmission than do younger children.

Somekh et al. (Jan 18, 2021). Reopening Schools and the Dynamics of SARS-CoV-2 Infections in Israel: A Nationwide Study. Clinical Infectious Diseases. <https://doi.org/10.1093/cid/ciab035>

- Nationwide weekly incidence of SARS-CoV-2 infections in Israel gradually increased after school reopening in May 2020, and positivity rates 21-27 days following school reopening increased at least 3-fold among adults ≥ 20 years, but did not increase for children < 20 years old. No increase was

observed in COVID-19 associated hospitalizations and deaths following school reopening. However, following the easing of social gathering restrictions from May to June 2020 (which coincided with the end of the academic school year), a significant increase in hospitalizations and mortality was observed. The authors suggest that easing social gathering restrictions, rather than school reopening, was the major contributor to transmission.

Ludvigsson et al. (Jan 6, 2021). *Open Schools, Covid-19, and Child and Teacher Morbidity in Sweden*. *New England Journal of Medicine*. <https://doi.org/10.1056/NEJMc2026670>

- Incidence of severe COVID-19 was low among school-aged children in Sweden from March to June 2020, despite keeping schools open and the absence of face mask policies. A total of 15 children (0.77 per 100,000) were admitted to the ICU, four of whom had an underlying condition. All children survived. Risk of severe COVID-19 among schoolteachers and preschool teachers was similar to other occupations (excluding healthcare workers), after adjusting for sex and age.

Stage et al. (June 26, 2020). *Shut and Re-Open the Role of Schools in the Spread of COVID-19 in Europe*. *Medrxiv*. <https://doi.org/10.1101/2020.06.24.20139634>

- Stage et al. compared daily hospitalization trends in northern European countries (Denmark, Norway, Sweden, and Germany), and found that the growth rate of COVID-19 cases declined approximately 9 days after implementation of school closures.
- Limited school attendance did not appear to significantly affect transmission.
- Reopening of schools for all students in countries with low community transmission (Denmark and Norway) has not resulted in a significant increase in the growth rate of COVID-19 cases. Return of most students to school in countries with higher levels of community transmission (Germany) has been accompanied by increased transmission among students, but not school staff.

Hobbs et al. (Dec 15, 2020). *Factors Associated with Positive SARS-CoV-2 Test Results in Outpatient Health Facilities and Emergency Departments Among Children and Adolescents Aged <18 Years — Mississippi, September–November 2020*. *MMWR*. <https://doi.org/10.15585/mmwr.mm6950e3>

- In a case-control study of 397 children and adolescents in Mississippi, in-person school or child care attendance two weeks prior to a SARS-CoV-2 test was not associated with a positive test result (aOR=0.8). Close contact with persons with COVID-19 (aOR=3.2), gatherings with persons outside the household such as social functions (aOR=2.4) and playdates (aOR=3.3), and having had visitors in the home (aOR=1.9) two weeks prior to a SARS-CoV-2 test were associated with a positive test result. A majority of parents of both case- and control-patients reported mask-use by their children and staff in school or child care facilities, while parents whose children attended social gatherings and had visitors at home reported lower rates of mask use and physical distancing adherence.

Impacts of School Closures and Modified Educational Models of Student Achievement

Tomasik et al. (Nov 24, 2020). Educational Gains of in-person vs. Distance Learning in Primary and Secondary Schools: A Natural Experiment during the COVID-19 Pandemic School Closures in Switzerland. International Journal of Psychology. <https://doi.org/10.1002/ijop.12728>

- Educational gains among primary school students in Switzerland were cut in half with distance learning during school closures due to the COVID-19 pandemic. An analysis of educational gains during the 8 weeks of school closures related to the COVID-19 pandemic in Switzerland, compared to the prior 8 weeks, found high heterogeneity in learning processes between individual primary school students during the lockdown, and that overall learning slowed down. Primary school students learned more than twice as fast in person as they did in the distance learning setting. No significant differences in the learning pace of secondary school students were observed.

Modeling

Klein et al. (Nov 5, 2020). *Testing the waters: is it time to go back to school? Diagnostic screening as a COVID-19 risk-mitigation strategy for reopening schools in King County, WA.* Institute for Disease Modeling. Downloaded Nov. 5 from

https://covid.idmod.org/data/Testing_the_waters_time_to_go_back_to_school.pdf

- [Pre-print, not peer-reviewed] Modeling of K-12 school reopening in King County, Washington found that if in-school countermeasures are observed, diagnostic screening either with PCR tests or rapid antigen tests may be of little benefit due to a higher rate of false positive tests in this low prevalence setting. Modeled in-school countermeasures included daily symptom screening, contact tracing, face masks, hand hygiene, improved ventilation, and physical distancing. Countermeasures could reduce the 3-month cumulative incidence to 2% or less for students, teachers, and staff. In this setting, school-based transmission was also found to be a limited driver of community spread, holding the effective reproduction number $Re = 1$ over 3 months.

Bracis et al. (Nov 13, 2020). *Widespread Testing, Case Isolation and Contact Tracing May Allow Safe School Reopening with Continued Moderate Physical Distancing: A Modeling Analysis of King County, WA Data.* Infectious Disease Modelling. <https://doi.org/10.1016/j.idm.2020.11.003>

- Modeling based on King County, Washington State indicates that returning to a level of 75% of pre-COVID-19 physical interactions between May 15-July 15 was projected to result in 350 daily deaths by early September 2020. Maintaining less than 45% of pre-COVID-19 physical interactions was required to ensure low levels of daily infections and deaths. A combination of increased testing, isolation of symptomatic infections, and contact tracing permitted 60% of pre-COVID-19 physical interactions and allowed opening of schools with <15 daily deaths.

Kaiser et al. (Dec 2, 2020). *Social Network-Based Strategies for Classroom Size Reduction Can Help Limit Outbreaks of SARS-CoV-2 in High Schools. A Simulation Study in Classrooms of Four European Countries.* Pre-print downloaded Dec 3 from <https://doi.org/10.1101/2020.11.30.20241166>

- [Pre-print, not peer reviewed] A simulation study of classroom based on longitudinal survey data collected from four European countries (n=507 classrooms, 12,291 students) found that while establishing student cohorts that minimize out-of-school contact between different cohorts would be most effective in preventing spread of SARS-CoV-2, cohorting by approximation of social networks also performed well. Network-based cohorting outperformed dividing classrooms by gender. For all cohorting strategies, schedules with alternating weeks of instruction were most effective.

Naimark et al. (Nov 21, 2020). *The Potential Impact of School Closure Relative to Community-Based Non-Pharmaceutical Interventions on COVID-19 Cases in Ontario Canada.* Pre-print downloaded Nov 23 from <https://doi.org/10.1101/2020.11.18.20234351>

- [Preprint, not peer-reviewed] A modeling study based on a scenario of one million individuals in Ontario, Canada predicted that school reopening would result in a small change in COVID-19 case numbers among students and teachers in a setting with community-based prevention measures. The model showed that the increase was driven mostly by acquisition in the community, and fewer

than 5% of infections among students and teachers were acquired within schools. It also indicated that implementation of community-based prevention measures would reduce 39,355 COVID-19 incident cases by October 31, 2020, while school closure vs. reopening on September 15 would reduce 2,040 cases.

Saad et al. (Nov 3, 2020). COVID-19 Active Surveillance Simulation Case Study - Health and Economic Impacts of Active Surveillance in a School Environment. Pre-print downloaded Nov 4 from <https://doi.org/10.1101/2020.10.28.20221416>

- A simulation study of a school environment concluded that daily testing can assist with maintenance of a low infection rate. The authors concluded that a reasonable daily test percentage (6%-10% with social distancing and mask wearing, or 8-10% without mitigation procedures) among the student population can achieve a low infection rate ($\leq 10\%$).

Opinion Surveys

Gilbert et al. (Dec 11, 2020). Racial and Ethnic Differences in Parental Attitudes and Concerns About School Reopening During the COVID-19 Pandemic — United States, July 2020. MMWR.

<https://doi.org/10.15585/mmwr.mm6949a2>

- An internet panel survey (n=858) conducted in July 2020 found parents of school-aged children who identified as members of racial and ethnic minority groups expressed more concerns about some aspects of school re-opening than their peers who identified as non-Hispanic white. Though the majority (56.5%) strongly or somewhat agreed that schools should reopen in fall 2020, non-Hispanic white parents were significantly more likely than Black or Hispanic parents to support school reopening. Minority racial/ethnic groups were also more likely to report concerns about schools opening at full capacity, student mitigation compliance, and their child contracting COVID-19 from school and bringing it home.

Other Resources

- [Checklist to support schools re-opening and preparation for COVID-19 resurgences or similar public health crises](#) – WHO (Dec 10)
- [Physical Distancing in Schools for SARS-CoV-2 and the Resurgence of Rhinovirus](#) – The Lancet Respiratory Medicine (Oct 22)
- [The Role of Schools and School-Aged Children in SARS-CoV-2 Transmission](#) – The Lancet Infectious Diseases (Dec 8)