National Collaborating Centre for Methods and Tools

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Rapid Review Update 4: What is the specific role of daycares and schools in COVID-19 transmission?

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Please Note: An update of this review may be available. Access the most current version of this review by visiting the National Collaborating Centre for Methods and Tools COVID-19 Rapid Evidence Service at the above link.

Executive Summary

Background

As jurisdictions continue to lift restrictions implemented to slow the spread of coronavirus disease 2019 (COVID-19), they face major decisions about when and how to re-open and operate schools and daycares. While children are known to be effective vectors for other viruses, such as influenza, their role in the transmission of COVID-19 is much less clear.

This rapid review was produced to support public health decision makers' response to the COVID-19 pandemic. This review seeks to identify, appraise and summarize emerging research evidence to support evidence-informed decision making.

This rapid review is based on the most recent research evidence available at the time of release. A previous version was completed on August 11, 2020. This updated version includes evidence available up to August 19, 2020.

In this rapid evidence review, we answer the question: **What is the specific role of daycares and schools in COVID-19 transmission?**

What Has Changed in This Version?

- New contact-tracing studies using national level registry data are included.
- As schools around the world continue to re-open, evidence from jurisdictions that have already opened may be more useful than reports from prior to lockdown; these studies have been separated in the included tables and are labeled accordingly.

Key Points

- Based on the published reports to date from both prior to COVID-19 lockdown and following re-opening, the risk of transmission from children to children and children to adults in primary school and daycare settings appears low. The certainty of the evidence is low (GRADE), and findings may change as new data become available.
- Analyses of infection clusters suggest that for children who were infected, transmission was traced back to community and home settings or adults, rather than amongst children. Within household clusters, adults were much more likely to be the index case than children. The certainty of the evidence is very low (GRADE), and findings are very likely to change as new data become available.

Overview of Evidence and Knowledge Gaps

- Most studies evaluating the transmission of COVID-19 in daycare and school settings are limited to case reports of contact tracing and prevalence studies, however there are more reports available using national or regional surveillance data and comprehensive contact tracing and testing strategies to minimize the likelihood of underestimation of cases.
- Surveillance data of outbreaks in school and daycare settings in the United States is inconsistent with data reported from other jurisdictions, suggesting levels of community transmission is important. Interpretation of this data is limited as key details such as index case and information about secondary transmission is not provided.
- The prevalence of COVID-19 infection in children in daycare and school settings was lower than the prevalence of COVID-19 in adults working in daycare and school settings across all jurisdictions.
- Contact tracing studies have identified very limited transmission by children to children, and children to adults in school and household settings. Limited evidence suggests the likelihood of infected adults transmitting to students is possible, but less likely than adult to adult transmission.
- Emerging evidence that has been published from jurisdictions that have reopened following lockdown is consistent with those prior to lockdown.
- As schools and daycares continue to open around the world and more evidence becomes available, this question should be reviewed again as findings may change. At least two comprehensive studies are underway in the UK and Germany as schools reopen.
- Across studies there appears to be a linear relationship between age and likelihood of contracting and transmitting COVID-19. More research is needed to understand why this may occur, and what the absolute and relative risk differences are across age ranges. The study quality is low, and findings are consistent.

Methods

Research Questions

What is the specific role of daycares and schools in COVID-19 transmission?

1. What is known about the likelihood of transmission of COVID-19 among children and adults in daycare and schools and among children to their household members?

2. What is known about the likelihood of transmission of COVID-19 by toddlers and school-aged children to others in other settings?

Search

On May 7, June 26 and 30, July 20, and again on August 6, 7, 13, and 19, 2020 the following databases were searched for evidence pertaining to the role of children in the transmission of COVID-19:

- Pubmed's curated COVID-19 literature hub: LitCovid
- Trip Medical Database
- World Health Organization's Global literature on coronavirus disease
- Joanna Briggs Institute COVID-19 Special Collection
- COVID-19 Evidence Alerts from McMaster PLUS™
- Public Health +
- COVID-19 Living Overview of the Evidence (L·OVE)
- Cochrane Coronavirus (COVID-19) Special Collections
- Oxford COVID-19 Evidence Service
- Guidelines International Network (GIN)
- Cochrane Rapid Reviews Question Bank
- Prospero Registry of Systematic Reviews
- NCCMT COVID-19 Rapid Evidence Reviews
- MedRxiv preprint server
- NCCDH Equity-informed Responses to COVID-19
- NCCEH Environmental Health Resources for the COVID-19 Pandemic
- NCCHPP Public Health Ethics and COVID-19
- NCCID Public Health Quick Links
- NCCID Disease Debrief
- NCCIH Updates on COVID-19
- Public Health Ontario
- Institute national d'excellence en santé et en services sociaux (INESSS)
- Uncover (USHER Network for COVID-19 Evidence Reviews)

A copy of the search strategy is available on request.

Study Selection Criteria

The search first included recent, high-quality syntheses. If no syntheses were found, single studies were included. English-language, peer-reviewed sources and sources published ahead of print before peer review were included. Grey literature and surveillance sources were excluded.

	Inclusion Criteria	Exclusion Criteria
Population	Children and adolescents aged 1–18	Infants
Intervention	Exposure to or diagnosis of COVID-19	
Comparisons	-	
Outcomes	Transmission of COVID-19	
Setting	Schools, daycares, playgrounds, parks, homes	

Data Extraction and Synthesis

Data on study design, setting, location, population characteristics, interventions or exposure and outcomes were extracted when reported. We synthesized the results narratively due to the variation in methodology and outcomes for the included studies.

The identified syntheses relevant to this report had considerable overlap in the primary literature but varied in the data reported across reviews for the same primary studies. We chose to conduct a new synthesis rather than reporting the overlapping results of the identified syntheses in order to present the data most succinctly and clearly. The primary studies were used to extract study characteristics and key findings, and to appraise study quality.

Appraisal of Evidence Quality

We evaluated the quality of included evidence using critical appraisal tools as indicated by the study design below. Quality assessment was completed by one reviewer and verified by a second reviewer. Conflicts were resolved through discussion.

Study Design	**Critical Appraisal Tool**
Synthesis	Assessing the Methodological Quality of Systematic Reviews (AMSTAR) AMSTAR 1 Tool
Cohort	Critical Appraisal Skills Programme (CASP) Cohort Study Checklist
Case Series	Joanna Briggs Institute (JBI) Checklist for Case Series
Case Report	Joanna Briggs Institute (JBI) Checklist for Case Reports
Prevalence	Joanna Briggs Institute (JBI) Checklist for Prevalence Studies
Cross sectional	Joanna Briggs Institute (JBI) Checklist for Analytical Cross Sectional Studies

Completed quality assessments for each included study are available on request.

The Grading of Recommendations, Assessment, Development and Evaluations (GRADE) approach was used to assess the certainty in the findings based on eight key domains.

In the GRADE approach to quality of evidence, **observational studies,** as included in this review, provide **low quality** evidence, and this assessment can be further reduced based on other domains:

- High risk of bias
- Inconsistency in effects
- Indirectness of interventions/outcomes
- Imprecision in effect estimate
- Publication bias

and can be upgraded based on:

- Large effect
- Dose-response relationship
- Accounting for confounding.

The overall certainty of the evidence for each outcome was determined taking in to account the characteristics of the available evidence (observational studies, some not peer-reviewed, unaccounted-for potential confounding factors, different tests and testing protocols, lack of valid comparison groups). A judgement of 'overall certainty is very low', means that the findings are very likely to change as more evidence accumulates.

Findings

Summary of Evidence Quality

In this update, four new single studies, and four updates to previously included studies were identified for a total of 45 publications addressing two distinct questions.

Question	Evidence included		Overall certainty in evidence
What is known about the likelihood of transmission of COVID-19 among children and adults in daycare and schools and among children to their household members?	Syntheses In progress syntheses Single studies In progress single studies	8 2 19 6	Low
What is known about the likelihood of transmission of COVID-19 by toddlers and school-aged children to others in other settings?	Syntheses In progress syntheses Single studies	12 3 8	Very low

Warning

Given the need to make emerging COVID-19 evidence quickly available, many emerging studies have not been peer reviewed. As such, we advise caution when using and interpreting the evidence included in this rapid review. We have provided a summary of overall certainty of the evidence to support the process of decision making. Where possible, make decisions using the highest quality evidence available.

Question 1: What is known about the likelihood of transmission of COVID-19 among children and adults in daycare and primary schools and children to their household members?

Table 1: Single Studies

Reference	Date Released	Study Design	Location	Setting	Summary of Findings	Quality Rating:
Data collected following school re-opening						
New evidence reported August 27, 2020						
Robert Koch Institute. (2020, August 19). *Coronavirus Disease 2019 (COVID-19) Daily Situation Report of the Robert Koch Institute*.	Aug 19, 2020	Prevalence	Germany	Daycare, schools, after school care, other educational facilities, children's homes, camps	Of 225 565 cases in Germany to Aug 19, 2020, 5342 (2.4%) were in those cared for or attending childcare settings and 3176 (1.4%) were in staff employed in these settings. No information available on source of exposure or the total number of staff and students who attended during the time period. Prevalence much lower than other settings such as hospitals and care settings (8.2% of total cases), congregate living settings (12.9% of total cases) and similar to prevalence of cases in the food sector (2.4% of total cases). No data is given on the number of people employed in these settings.	High
National Institute for Public Health and the Environment (RIVM). (2020, August 19). *Children and COVID-19.*	Aug 19, 2020	Prevalence	Netherlands	Primary schools, childcare facilities	Prior to school closures on March 16th, there were no reports of COVID-19 clusters linked to school or childcare facilities. Partial school re-opening began on May 11 and schools were fully reopened on June 8th. There are a few reports of school employees becoming infected with COVID-19 (0.5%); there are no reports of employees being infected by children.	Low

European Centre for Disease Prevention and Control (2020, August 6). *COVID-19 in children and the role of school settings in COVID-19 transmission*.	Aug 6, 2020	Cross-sectional	Europe and UK	Preschools, schools	15 of 31 European and UK countries responded to a telephone survey about cases or outbreaks in schools. • 4 countries reported no cases in schools • 5 reported individual cases in students or staff with no secondary transmission • 5 countries reported limited clusters of <10 cases in school settings involving few secondary cases • 1 country reported a cluster of ≥10 cases in a school setting (4 students, 9 staff) Countries which had reopened schools did not see an increase in cases.	Low
National Centre for Immunisation Research and Surveillance. (2020, July 31). *COVID-19 in schools and early childhood education and care services – the Term 2 experience in NSW*.	Jul 31, 2020	Cohort	Australia	Daycare, primary school, secondary school	Surveillance data from April 10 to July 3 while all daycares were open, and schools were undergoing gradual reopening. Schools were fully reopened with face to face learning by May 25. Daycare: • 1 child with confirmed COVID-19 had contact with 84 students and 18 staff in school • 82% of contacts were tested; none tested positive Primary school: • 1 child with confirmed COVID-19 had contact with 15 students and 4 adults in school • 57% of contacts were tested; none tested positive Secondary school: • 2 adolescents with confirmed COVID-19 had contact with a total of 165 students and 23 adults in school • 55% of contacts were tested; none tested positive	Moderate

COVID-Explained. (2020, August 23). *Data Overview: Child Care Centers, Camps, and Outbreaks*.	Ongoing	Surveillance (crowd-sourced)	United States	Daycares, camps Infection control measures and community transmission vary within and across state.	State-level data is reported as of Aug 20 • Arizona: 6 childcare facilities with positive cases • California: Of 8973 childcare centers open, 1110 cases have been reported (47% staff, 21% children, 28% parents, 3% other) • Colorado: 14 daycares or camps have reported outbreaks with a total of 82 cases (73% staff) • Kansas: 78 cases in 16 outbreaks, no hospitalizations or deaths • Minnesota: Of 1761 childcare centers, 125 have had one case, 38 have had two or more cases • Nevada: 13 child, 21 staff cases in 20 facilities out of 443 total facilities • North Carolina: 1 school (19 cases) and 20 daycare (total 221 cases) clusters with a total of 206 cases • Ohio: 442 reported cases, 75% determined to be acquired through community spread • Oregon: 1 current outbreaks with 26 reported cases • Pennsylvania: 92 child or parent and 137 staff cases reported in licensed childcare facilities • Rhode Island: 12 cases amongst 8000 children enrolled (0.15%), 14 cases amongst 1000 adults providing care (0.14%) • Texas: as of July 9, 592 children and 1207 staff cases across an estimated 12 222 open centers • Tennessee: 47 facilities with positive cases as of July 14 • Utah: 12 outbreaks with 60 total cases in schools, 29 outbreaks with 139 cases in childcare settings • Virginia: 170 cases from 42 outbreaks	Not rated

Previously reported evidence						
Macartney, K., Quinn, H. E., Pillsbury, A. J., Koirala, A., Deng, L., Winkler, N., … Chant, K. (2020). Transmission of SARS-CoV-2 in Australian educational settings: a prospective cohort study. *The Lancet Child & Adolescent Health*. Epub ahead of print.	Aug 3, 2020	Cohort	New South Wales, Australia	Daycare, primary and secondary school Physical distancing and hand hygiene measures in place; masks not required.	From Jan 25 to April 10, all lab-confirmed COVID-19 cases in children or staff who attended school or daycare within 24h of symptom onset. 15 adults, 12 children (8 secondary school, 1 primary school, 3 daycare) attended while infectious. Of 1448 close contacts identified, 43.7% had RT-PCR testing. Secondary transmission occurred in 4 of 25 settings. In schools, 5 secondary cases (3 children, 2 adults) were identified in 3 schools. No secondary transmission occurred in 9 of 10 daycares, however one outbreak was identified where 6 adults and 7 children were infected. Secondary attack rate of staff to staff was 4.4%, staff to child 1.5%, child to staff 1.0% and child to child 0.3%.	Moderate

Szablewski, C.M., Chang, K.T., Brown, M.M., Chu, V.T., Yousaf, A.R., Anyalechi, N., … Stewart, R.J. (2020). SARS-CoV-2 transmission and infection among attendees of an overnight camp. *Morbidity and Mortality Weekly Report 69*(31): 1023-1025.	Jul 31, 2020	Prevalence	Georgia, USA	Overnight summer camp All attendees tested negative within 12 days of attending. Masks for staff but not campers, doors and windows were not opened for ventilation.	158 staff and counsellors took part in training June 17-20. 363 campers and 3 staff joined on June 21. On June 22 a staff member developed symptoms, on June 23 left the camp and on June 24 tested positive. The camp was closed that day. Test results were available for 344 of 597 attendees. Attack rate was highest amongst staff (56%) compared to youth (49%), and those in larger cabins (53%). The authors note they cannot rule out multiple index cases due to high incidence of COVID-19 in Georgia.	Low
Stein-Zamir, C., Abramson, N., Shoob, H., Libal, E., Bitan, M., Cardash, T., … Miskin, I. (2020). A large COVID-19 outbreak in a high school 10 days after schools' reopening, Israel, May 2020. *Eurosurveillance 25*(29): pii=2001352.	Jul 23, 2020	Prevalence	Israel	Regional public school with 1,190 students age 12-18 years and 162 staff. No physical distancing or masks. Children took school buses together and participated in extracurricular activities (e.g., sports and dance classes).	Within 10 days of schools reopening an outbreak among high school students was observed linked back to 2 independent index cases. The prevalence of confirmed cases was 13.1% among students and 16.4% among teachers. Cases were highest in grade 7 and grade 9. There was no report of the grade of index cases, or prevalence among close contacts. Prior to school reopening regional prevalence rate among those age 10-19 years was 19.8%. Following opening of schools, the prevalence increased to 40.9%.	Low

Public Health Agency of Sweden. (2020, July 7). *Covid-19 in schoolchildren A comparison between Finland and Sweden*.	Jul 7, 2020	Prevalence	Sweden Finland	Preschool, primary school, secondary school In Finland, all schools were closed in March 2020. In Sweden only secondary and post-secondary schools were closed. No ↓ class sizes, physical distancing, temperature checks or masks; handwashing unclear	As of June 14, 2020: In Finland, 584 out of 7,110 (8.2%) reported cases of COVID-19 were among children ages 1-19 years. Age-specific rates were: • 1-5 years: 36 per 100 000 • 6-15 years: 42 per 100 000 • 16-19 years: 98 per 100 000 Primary school closures and reopening in Finland did not impact weekly number of reported COVID-19 cases. In Sweden, 1,124 out of 52,424 (2.1%) reported cases of COVID-19 were among children ages 1-19 years. Age-specific rates were: • 1-5 years: 16 per 100 000 • 6-15 years: 30 per 100 000 • 16-19 years: 150 per 100 000 No increased risk of infection was found amongst Swedish school or daycare staff. • Daycare, Relative Risk (RR) = 0.9 (95% Confidence Interval (CI), 0.7-1.1) • Primary school, RR = 1.1 (95% CI: 0.9-1.3) • Secondary school, RR = 0.7 (95% CI: 0.5-1.0)	Low

Stage, H.B., Shingleton, J., Ghosh, S., Scarabel, F., Pellis, L., & Finnie, T. (2020). Shut and re-open: the role of schools in the spread of COVID-19 in Europe. *Preprint*.	Jun 26, 2020	Cohort	Germany Denmark Norway Sweden	Community Preschool, primary school, secondary school infection control measures vary by country. Germany: ↓ class sizes, physical distancing, rapid testing; no masks Denmark: ↓ class size, physical distancing, handwashing; no temperature checks or masks Norway: ↓ class sizes, physical distancing, handwashing; no temperature checks or masks Sweden: No reduced class sizes, physical distancing, temperature checks or masks; handwashing unclear	Timing of school closures coincided with a reduction in the growth rate of COVID-19 cases and hospitalizations compared to data models with no intervention. However, implementation of concurrent community interventions (e.g., travel restrictions, social distancing, banned gatherings) mean is it difficult to determine which interventions were most effective. Reopening of schools among younger student groups and those participating in exams did not result in a significant increase in rates of COVID-19. In countries with low community transmission of COVID-19, return of all students did not appear to increase transmission. The return of older students in a country of high community transmission levels appeared to increase transmission among students but not staff.	High

Yung, C.H., Kam, K., Nadua, K.D., Chong, C.Y., Tan, N.W.H., Li, J., … Ng, K.C. (2020). Novel coronavirus 2019 transmission risk in educational settings. *Clinical Infectious Diseases.* Epub ahead of print.	Jun 25, 2020	Case report	Singapore	Preschool, secondary school Daily school disinfection. Children were cohorted with staggered recess and lunches.	1 child with COVID-19 attended a preschool for ages 3–6 (number of contacts not reported): • 34 contacts developed symptoms and were tested; none tested positive 1 adolescent with COVID-19 attended a secondary school for ages 12–15 (total number of contacts not reported): • 8 contacts developed symptoms and were tested; none tested positive	High
Folkhälsomyndigheten. (2020, May 27). *Förekomst av covid-19 i olika yrkesgrupper*.	May 27, 2020	Prevalence	Sweden	Preschool, primary school, secondary school No ↓ class sizes, physical distancing, temperature checks or masks; handwashing unclear	National public health data and census data were used to determine the relative risk of COVID-19 infection for various occupations. For occupations working with children, such as primary and secondary school teachers, preschool teachers and nannies, the relative risk of COVID-19 infection was no different than other occupations. Notably, Sweden has not implemented nationwide lockdown measures.	Moderate

Data collected prior to school lockdown measures						
Previously reported evidence						
Dub, T., Erra, E., Hagberg, L., Sarvikivi, E., Virta, C., Jarvinen, A., … Nohynek, H. (2020). Transmission of SARS-CoV-2 following exposure in school settings: experience from two Helsinki area exposure incidents. *Preprint*.	July 30	Case report	Finland	Primary school, other school not noted. Infection control procedures not reported.	Case A was a 12-year old student who tested positive for COVID-19 in early March, who had attended school and team sports with minor symptoms since late February. 89 of 121 close school and sport contacts were tested; no secondary cases were identified. Case B was a school staff member who attended work for two days while symptomatic. 51 of 63 close contacts were tested for antibodies >28 days after exposure. 6 of 42 students and 1 of 9 teachers were positive for IgG antibodies. Two students had confirmed COVID-19 7- and 6-days post-exposure, one student had confirmed COVID-19 more than 26 days after exposure, thus source of contact was not confirmed. Secondary attack rate amongst household and extended contacts for students was 17%. Secondary attack rate for the single staff was 100% (spouse and two children were the only contacts).	High

Torres, J.P., Piñera, C., De La Maza, V., Lagomarcino, A.J., Simian, D., Torres, B., … O'Ryan, M. (2020). SARS-CoV-2 antibody prevalence in blood in a large school community subject to a Covid-19 outbreak: a cross-sectional study. *Clinical Infectious Diseases*. Epub ahead of print.	Jul 10, 2020	Prevalence	Chile	Private school with 14 grade levels experiencing an outbreak following a week of parent-teacher nights. Index case was a staff member. No infection control measures were reported.	There were 52 confirmed cases in students (15%), staff (35%) and parents (52%). Positive antibody tests were higher amongst teachers (20.6%) compared to support staff (7.1%) and students (9.9%) two months later. 1,009 of 2,616 students (aged 4 – 18) participated: • 100 students (9.9%; CI: 8.6 – 11.5) tested positive for antibodies • The highest positive rate was among preschool students (12.3%; CI: 7.8-18.6) and lowest was among high school students (5.7%; CI: 3.6-8.9) Students were more likely to have contracted COVID-19 from home caregivers and household relatives than classmates or teachers.	Moderate
Fontanet, A., Grant, R., Tondeur, L., Madec, Y., Grzelak, L., Cailleau, I., … Hoen, B. (2020a). SARS-CoV-2 infection in primary schools in northern France: A retrospective cohort study in an area of high transmission. *Preprint.*	Jun 29, 2020	Retrospective cohort	France	Primary school No infection control measures were reported. Schools had been shut down for 4 weeks prior to antibody testing.	510 of 1047 students (aged 6–11 years) at a primary school consented to testing for antibodies to the virus that causes COVID-19: • 45 of 510 (8.8%) tested positive for antibodies • 11.9% parents tested positive for antibodies No information was reported on index cases.	Moderate
Heavey, L., Casey, G., Kelly, C., Kelly, D., & McDarby, G. (2020). No evidence of secondary transmission of COVID-19 from children attending school in Ireland, 2020. *Eurosurveillance 25*(21):pii=2000903.	May 28, 2020	Case report	Ireland	Primary school, secondary school No infection control measures in place. Sports, music and choir practice continued.	3 children aged 10–15 with COVID-19 attended one primary and two secondary schools: • The children had contact with 822 students and 83 adults in schools. • Contacts who developed symptoms were tested; the number was not reported. No contacts tested positive.	Moderate

Desmet, S., Skinci, E., Wouters, I., Decru, B., Beuselinck, K., Malhotra-Kumar, S., & Theeten, H. (2020). No SARS-CoV-2 carriage observed in children attending daycare centers during the first weeks of the epidemic in Belgium. *Preprint.*	May 18, 2020	Prevalence	Belgium	Daycare centers No infection prevention and control were reported.	84 children aged 0–2.5 years attending 8 different daycare centers were randomly sampled and tested for COVID-19. No children tested positive.	High
Fontanet, A., Tondeur, L., Madec, Y., Grant, R., Besombes, C., Jolly, N., … Hoen, B. (2020b). Cluster of COVID-19 in northern France: A retrospective closed cohort study. *Preprint*.	Apr 23, 2020	Prevalence	France	Secondary school No infection control measures reported. Schools had been shut down for 4 weeks prior to antibody testing.	326 of 1262 students (aged 14–17), teachers and staff at a secondary school consented to testing for antibodies to the virus that causes COVID-19: • 92 of 240 (38.3%) of students tested positive for antibodies • 11.4% of parents tested positive for antibodies • 10.2% of siblings tested positive for antibodies	Moderate
Danis, K., Epaulard, O., Bénet, T., Gaymard, A., Campoy, S., Bothelo-Nevers, E., … Saura, C. (2020). Cluster of Coronavirus Disease 2019 (COVID-19) in the French Alps, February 2020. *Clinical Infectious Diseases 71*(15): 825-832.	Apr 11, 2020	Case report	France	Primary schools No infection control measures at the schools were reported. Schools were closed upon identification of the case.	1 child aged 9 years with COVID-19 attended 3 primary schools: • The child had 86 contacts • 55 contacts developed symptoms and were tested; none tested positive	High

Please note that this information is not available in both official languages because the source of the information is not subject to the Official Languages Act.

Table 2: In-progress Single Studies

Title	Anticipated Release Date	Setting	Description of Document
Previously reported evidence			
Ladhani, S., Ramsay, M., Zambon, M., Flood, J., Beckmann, J., Baawuah, F., … Garstang, J. (2020). *COVID-19 Surveillance in Children attending preschool, primary and secondary schools*.	Not reported	Preschool, primary and secondary school	Primary objective is to monitor SARS-CoV-2 infection and antibodies in children and school staff.
Charité. (2020). *Berlin's testing strategy – Charité starts screening program for staff from childcare centers and school-based study*.	N/A	School	Through this study, primary and secondary school children and staff will undergo testing at regular intervals over 12 months.

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Table 3: Syntheses

Reference	Date Released	Included Studies Relevant to Transmission by Children in Daycares and Schools	Review Conclusions	Quality Rating
Previously reported evidence				
Li, X., Xu, W., Dozier, M., He, Y., Kirolos, A., & Theodoratou, E. (2020). The role of children in transmission of SARS-CoV-2: A rapid review. *Journal of Global Health*, *10*(1), 011101.	Jul 3, 2020 (Search completed Apr 30, 2020)	Danis, 2020 Fontanet, 2020a NCIRS, 2020 RIVM, 2020	Children are infected less frequently and infect others less frequently than adults. Prolonged fecal shedding may increase the risk of fecal-oral transmission in children.	Low
Usher Institute. (2020, July 2). *Summary: What is the evidence for transmission of SARS-COV-2 by children [or in schools]?*	Jul 2, 2020 (Search completed Jun 21, 2020)	Fontanet, 2020a Heavey, 2020 National Institute for Public Health and the Environment, 2020 NCIRS, 2020 Desmet, 2020	Children, especially young children, are less likely to be infected and to infect others than adults. Children appear to have lower viral loads than adults. Fecal shedding of the virus that causes COVID-19 has been shown and fecal-oral transmission is possible.	Low
Rajmil, L. (2020). Role of children in the transmission of the COVID-19 pandemic: a rapid scoping review. *BMJ Paediatrics Open*, *4*(1), e000722.	Jun 30, 2020 (Search completed May 28, 2020)	Heavey, 2020 NCIRS, 2020 RIVM, 2020	Children do not transmit the virus that causes COVID-19 more than adults. Many reported cases of transmission in children were traced to transmission within families.	Low
Health Information and Quality Authority. (2020, June 23). *Evidence summary for potential for children to contribute to transmission of SARS-CoV-2*.	Jun 23, 2020 (Search completed May 31, 2020)	Desmet, 2020 Fontanet, 2020a Heavey, 2020 NCIRS, 2020	The role that children play in the transmission of the virus that causes COVID-19 is unclear. Larger-scale studies are needed.	Low
Institut national de sante publiqué Québec. (2020, May 21). *Revue rapide de la littérature scientifique - COVID-19 chez les enfants: facteurs de risque d'infections sévères et potentiel de transmission*.	May 21, 2020 (Search completed May 15, 2020)	Danis, 2020 Fontanet, 2020a NCIRS, 2020	Children are susceptible to COVID-19 infection, but upon exposure to the COVID-19, they are less likely to be infected than adults. Transmission of COVID-19 by children is limited.	Low
Ludvigsson, J.F. (2020). Children are unlikely to be the main drivers of the COVID-19 pandemic – A systematic review. *Acta Paediatrica 109*(8), 1525-1530.	May 19, 2020 (Search completed May 11, 2020)	Danis, 2020 NCIRS, 2020	Children are unlikely to be key drivers of transmission. Opening daycares and schools is unlikely to affect mortality in adults.	Low

Brurberg, K.G. (2020). The role of children in the transmission of SARS-CoV-2-19 – 1st update - a rapid review Oslo: Folkehelseinstituttet/ Norwegian Institute of Public Health.	Apr 30, 2020 (Search completed Apr 22, 2020)	Fontanet, 2020a NCIRS, 2020 Viner, 2020a	Children can transmit the virus that causes COVID-19 but are unlikely to be the main drivers of transmission. It is too early to make firm conclusions about the role of children in transmission.	Low
Viner, R.M., Russell, S.J., Croker, H., Packer, J., Ward, J., Stansfield, C., … Booy, R. (2020a). School closure and management practices during coronavirus outbreaks including COVID-19: a rapid systematic review. *The Lancet Child & Adolescent Health, 4*(5), 397–404.	Apr 6, 2020 (Search completed Mar 19, 2020)	None included in Table 1. This review included studies from pandemics prior to COVID-19.	It is not possible to specifically evaluate the impact of school closures on infection prevention and control, as they were part of a broad range of quarantine and social distancing measures.	Low

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Table 4: In-progress Syntheses

Title	Anticipated Release Date	Setting	Description of Document
Previously reported evidence			
Harling, M., Pearce-Smith, N., Clark, R., Kijauskaite, G., & Nicholson, W. (2020). *What is the risk of transmission of COVID-19 within school and preschool settings, and how effective are interventions to reduce transmission? A rapid review*. *PROSPERO, CRD42020191867*.	Jul 24, 2020	School	This rapid review will summarize evidence for the risk of transmission within schools and onsite daycare centres, as well as evaluate the effectiveness of infection prevention and control measures in school settings.
Minozzi, S., Amato, L., Mitrova, Z., & Davoli, M. (2020). *COVID-19 among children and adolescents and impact of school closure on outbreaks control: an overview of systematic reviews*. *PROSPERO, CRD42020186291*.	Jul 31, 2020	Home, school	This review will summarize available evidence for the prevalence of infection and disease as well as the risk of transmission by children and adolescents. The review also seeks to assess the effect of school closures on controlling the spread of COVID-19.

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Question 2: What is known about the likelihood of transmission of COVID-19 by toddlers and school-aged children to others?

Table 5: Syntheses

Reference	Date Released	Description of Included Studies	Summary of Findings	Quality Rating: Synthesis	Quality Rating: Included Studies
Previously reported evidence					
Madewell, Z.J., Yang, Y., Longini, I. M., Halloran, M. E., & Dean, N. E. (2020). Household transmission of SARS-CoV-2: A systematic review and meta-analysis of secondary attack rate. *Preprint*.	Aug 1, 2020 (Search completed Jul 29, 2020)	40 published studies reporting household secondary transmission, including 10 that compared children to adults.	A meta-analysis found that secondary attack rates were higher from adults to adult contacts (31%, 95% Confidence Interval (CI): 19.4, 42.7%) than from adults to child (<18 years old) contacts (15.7, 95% CI: 9.9, 21.5%). An analysis of attack rates from child index cases was not conducted due to the limited available data.	Low	Not reported
Merckx, J., Labrecque, J.A. & Kaufman, J.S. (2020). Transmission of SARS-CoV-2 by children. *Deutsches Ärzteblatt International 2020*(117), 553-60.	Jul 5, 2020 (Search completed Jun 25, 2020)	Total number of studies not reported, but studies of: • Household clusters (n = 4) • School outbreaks (n = 3) • Sero-prevalence (n = 4) • Viral load (n = 2) • Time-series (n = 1) • Modelling (n = 3)	The authors conclude that whether or not children transmit the virus causing COVID-19 effectively is inconclusive. Viral load estimates are only reported from select samples, which introduces selection bias. Secondary attack rate appears lower for younger children, but the age effect is not well understood. The authors call for studies in representative populations using rigorous epidemiological methods across different settings.	Low	Not reported

Li, X., Xu, W., Dozier, M., He, Y., Kirolos, A., & Theodoratou, E. (2020). The role of children in transmission of SARS-CoV-2: A rapid review. *Journal of Global Health*, *10*(1), 011101.	Jul 3, 2020 (Search completed Apr 30, 2020)	16 primary studies: • 1 household contact tracing • 4 school contact tracing • 5 studies providing indirect evidence for potential transmission by children • 6 studies reporting the prevalence of COVID-19 in children	One case report describes presumed transmission from an infant to its parents. One case report describes environmental contamination by an infant with COVID-19 in a hospital setting. Three studies found that fecal shedding in children lasts longer than in adults. Another study of 3712 COVID-19 patients found similar viral loads between age groups.	Low	Not reported
Usher Institute. (2020, Jul 2). *Summary: What is the evidence for transmission of SARS-COV-2 by children [or in schools]?*	Jul 2, 2020, (Search completed Jun 21, 2020)	83 primary studies: • 2 case reports of transmission by children • 14 studies on the potential for infection by children, such as through fecal shedding • 8 studies related to schools or daycares	Overall, there is limited evidence of transmission of COVID-19 from children to others. Children can become infected through exposure to confirmed cases, most often through household contacts or those with recent travel history. There appears to be a linear relationship between age and likelihood of transmitting COVID-19 in those age 1-19.	Low	Not reported
Health Information and Quality Authority. (2020, Jun 23). *Evidence summary for potential for children to contribute to transmission of SARS-CoV-2*.	Jun 23, 2020 (Search completed May 31, 2020)	10 case series and case reports of household or close-contact transmission involving children.	Overall, included case series show that children very rarely transmit COVID-19 to household members or close contacts. A case report from a single family confirmed transmission from children to caregivers. Analysis of a larger case series reported no confirmed transmission from cases aged 15 years or younger.	Low	Low-moderate
Rajmil, L. (2020). Role of children in the transmission of the COVID-19 pandemic: a rapid scoping review. *BMJ Paediatrics Open*, *4*(1), e000722.	Jun 21, 2020 (Search completed May 28, 2020)	14 primary studies: • 11 contact tracing in households • 2 contact tracing studies in schools • 1 study reported prevalence of COVID-19 in children	Studies of family clusters demonstrate transmission of COVID-19 to children by family members. Studies did not confirm transmission to family members by children. One study noted that 8% (3 of 40 cases) of children developed symptoms prior to the adults in their households.	Low	Not reported

Viner, R.M., Mytton, O.T., Bonell, C., Melendez-Torres, G.J., Ward, J.L., … Eggo, R. (2020b). Susceptibility to SARS-CoV-2 infection amongst children and adolescents compared with adults: a systematic review and meta-analysis. *Preprint*.	May 24, 2020 (Search completed May 16, 2020)	9 contact-tracing studies, including 2 preprint articles and one unpublished report.	Data from 8 contact tracing studies conducted within households or close contacts were meta-analyzed. Secondary infection rates in those <20 years were compared to those >20 years; children were less than half as likely to be infected as adults (Odds Ratio (OR) = 0.41, 95% Confidence Interval (CI) = 0.23, 0.73). It was not possible to compare the likelihood of infection transmission by children vs. adults due to limited available data. One included synthesis found that in 3 of 31 (9.7%) household clusters analyzed; the index case was a child. It is not possible to determine whether children are less likely to be an index case because they are less infectious than adults or because they are less likely to be infected.	Moderate	Low-Moderate
Institut national de sante publiqué Québec. (2020, May 21). *Revue rapide de la littérature scientifique - COVID-19 chez les enfants: facteurs de risque d'infections sévères et potentiel de transmission*.	May 21, 2020 (Search completed May 15, 2020)	9 studies relevant to transmission by children: • 1 rapid review of • 1 contact tracing study in a household • 2 contact tracing studies in schools 5 studies providing indirect evidence for potential transmission by children.	Analysis of likelihood of transmission within family clusters was described as challenging since many children remain asymptomatic. Another study of COVID-19 patients found similar viral loads between age groups.	Low	Not reported

Ludvigsson, J.F. (2020). Children are unlikely to be the main drivers of the COVID-19 pandemic – A systematic review. *Acta Paediatrica 109*(8), 1525-1530.	May 19, 2020 (Search completed May 11, 2020)	47 articles were reviewed; a full list of included studies was not provided.	This review described a systematic search and screen for included studies, however the author did not provide a list of studies reviewed and it is unclear how evidence was synthesized across studies. Cross-sectional studies found that viral loads or viral shedding are similar in different age groups. Most of these studies assessed symptomatic cases. Two case reports and 2 syntheses analyzed transmission of COVID-19 within households. Most reported no evidence of child-to-child or child-to-adult transmission. One included synthesis found that in 3 of 31 (9.7%) household clusters analyzed, the index case was a child (Viner, 2020a).	Low	Not reported
Mehta, N.S., Mytton, O.T., Mullins, E.W.S., Fowler, T.A., Falconer, C.L., Murphy, O.B., … Nguyen-Van-Tam, J.S. (2020). SARS-CoV-2 (COVID-19): What do we know about children? A systematic review. *Clinical Infectious Diseases*. Epub ahead of print.	May 11, 2020 (Search completed Mar 9, 2020)	24 primary studies: • 20 studies assessing prevalence, symptoms and outcomes in children • 4 case reports of transmission involving children	Evidence related to transmission by children was limited. Cases in children tended to be identified through contact tracing of adult cases. One case report described probable transmission from an infant to her parents.	Moderate	Not reported
Brurberg, K.G. (2020). The role of children in the transmission of SARS-CoV-2-19 – 1st update - a rapid review. Oslo: Folkehelseinstituttet/ Norwegian Institute of Public Health.	Apr 30, 2020 (Search completed Apr 22, 2020)	9 case series or case reports and one narrative review related to the likelihood of children transmitting COVID-19 to others.	Case reports indicate that children are susceptible to COVID-19 infection, although less so than adults. The overall prevalence of COVID-19 among children is unknown due to lack of comprehensive testing. According to tracing of infection routes in case studies, infected children are less likely to transmit the disease than adults, but this data is very limited.	Low	Not reported

Zhen-Dong, Y., Gao-Jun, Z., Run-Ming, J., Zhi-Sheng, L., Zong-Qi, D., Xiong, X., & Guo-Wei, S. (2020). Clinical and transmission dynamics characteristics of 406 children with coronavirus disease 2019 in China: A review. *Journal of Infection 81*(2), e11–e15.	Apr 28, 2020 (Search completed Apr 3, 2020)	406 case reports of children up to 16 years of age diagnosed with COVID-19.	Among the included case reports, nearly half of cases were asymptomatic or had only mild symptoms. Evidence from stool samples indicated that children had higher rates of fecal virus RNA (81.8%) than adults (53.4%), suggesting that further investigation of fecal-oral transmission by children may be warranted.	Low	Low

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Table 6: In-progress Syntheses

Title	Anticipated Release Date	Setting	Description of Document
Previously reported evidence			
Chan, M., Bhuiyan, M., Islam, S., Hassan, Z., Satter, S., Haider, N., & Homaira, N. (2020). *Epidemiology of COVID-19 in children aged <5 years: a systematic review and metanalysis*. *PROSPERO*, CRD42020181936.	Jul 31, 2020	Home	This review will summarize COVID-19 epidemiology in children younger than 5 years of age, including answering the question, "Is there any secondary/household transmission from pediatric COVID-19 cases?"
Du, P., & Luo, X. (2020). *Are children more unsusceptible to COVID-19? A rapid review and meta-analysis*. *PROSPERO*, CRD42020190740.	Sep 7, 2020	Home, community	This review will compare the likelihood of infection in children and adults who have been exposed to COVID-19.
Medeiros, G., Azevedo, K., Hugo, V., Segundo, O., Santos, G., Mata, A.N., ... Piuvezam, G. *The control and prevention of COVID-19 transmission in children: a protocol for systematic review and meta-analysis*. *PROSPERO, CRD42020179263*.	Nov 1, 2020	Home	This review will summarize the role of children in COVID-19 Community transmission.

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Table 7: Single Studies

Reference	Date Released	Study Design	Location	Setting	Summary of Findings	Quality Rating:
New evidence reported August 26, 2020						
National Institute for Public Health and the Environment (RIVM). (2020, August 19). *Children and COVID-19.*	Aug 19, 2020	Prevalence	Netherlands	Community Preschool, primary school	Children aged 0-18 years have not been identified as primary sources of COVID-19 transmission. Amongst 10 children ages 0-18 years with COVID-19, in-depth contact tracing and testing identified no further positive cases. Low rates of COVID-19 cases have been reported among children ages 0-18 years (0.3%-1.4%).	Low

Kim, J., Choe, Y.J., Lee, J., Park, Y.J., Park, O., Han, M.S., … Choi, E.H. (2020). Role of children in household transmission of COVID-19. *Archives of Disease in Childhood*. Epub ahead of print.	Aug 7, 2020	Case Series	South Korea	Household	All confirmed pediatric cases of COVID-19 from January 20 to April 6, 2020 were included.
					• 107 index cases and 248 household members identified; median age 15 years, interquartile range 10-17 years
					• 41 of 248 contacts (16.5%) developed COVID-19
					  ○ one episode of secondary transmission identified as a younger sibling
					  ○ exposure time was 2 days during the presymptomatic period and 1 day during the symptomatic period of the index case
					• Overall, household secondary attack rate was 0.5% (95% CI 0.0% to 2.6%)
					
					The authors note potential underestimation of results due to testing inaccuracies and exclusion of household cases with the same initial exposure.
						Moderate

Maltezou, H.C., Vorou, R., Papadima, K., Kossyvakis, A., Spanakis, N., Gioula, G., … Papa, A. (2020). Transmission dynamics of SARS-CoV-2 within families with children in Greece: A study of 23 clusters. *Journal of Medical Virology*. Epub ahead of print.	Aug 7, 2020	Case series	Greece	Household	From February 26 to May 3, 2020 (period of lockdown) all family clusters with at least one child were identified from a national registry: • 23 clusters with 109 household members (66 adults, 43 children) were identified • Median attack rate was 60% (range 33.4 to 100%) • Despite close contact between infected children and non-infected adults in 14 clusters, no child to adult or child to child transmission was confirmed. • An adult was the first identified case in 21 clusters, and a child in 2	Low
van der Hoek, W., Backer, J.A., Bodewes, R., Friesema, I., Meijer, A., Pijnacker, R., … van den Hof, S. (2020). The role of children in the transmission of SARS-CoV-2. *Nederlands Tijdschrift Voor Geneeskunde,* 164: D5140.	Jun 3, 2020	Cohort	Netherlands	Household	All laboratory confirmed cases of COVID-19 from March 23 to April 16, 2020 in families were identified: • Within 54 clusters (227 participants, 185 were immediate family) no children under 12 were the source of transmission • Children 1-11 were less often positive compared to older children or adults • 368 children (0-18 years) have been positive for COVID-19 accounting for 0.9% of the total number of cases	Low
Previously reported evidence						
Laxminarayan, R., Wahl, B., Dudala, S.R., Gopal, K., Mohan, C., Neelima, S., … Lewnard, J.A. (2020). Epidemiology and transmission dynamics of COVID-19 in two Indian states. *Preprint*.	Jul 17, 2020	Prevalence	Tamil Nadu and Andhra Pradesh, India	Community	Of 33,584 positive cases from March 5 to June 4, 2020, 4206 had contact tracing data available. Secondary attack rate was highest in household settings (9%) compared to community (2.6%) or healthcare (1%) settings. Secondary attack rates were higher for children than adults, but this was only seen in household settings. The authors note that in many cases, classification of the index case in order to determine secondary attack rate may be imprecise.	Low

Park, Y.J., Choe, Y.J., Park, O., Park, S.Y., Kim, Y.M., Kim, J., … Jeong, E.K. (2020). Contact tracing during Coronavirus disease outbreak, South Korea, 2020. *Emerging Infectious Diseases*. Epub ahead of print.	Jul 16, 2020	Case series	South Korea	Community	Of 5,705 COVID-19 positive cases analyzed between January 20 and March 27, 2020: • 29 (0.5%) were children ages 0-9 • 124 (2.2%) were children ages 10-19 Young children are less likely to transmit COVID-19 than adults: • Amongst children ages 0-9, 5.3% (95% CI: 1.3-13.7) of household contacts, 1.1% (95% CI: 0.2-3.6) of non-household contacts tested positive. Among children ages 10-19, 18.6% (95% CI: 14.0-24.0) of household contacts, 0.9% (95% CI: 0.1-2.9) of non-household contacts tested positive.	Low
Wongsawat, J., Moolasart, V., Srikirin, P., Srijareonvijit, C., Vaivong, N., Uttayamakul, S., & Disthakumpa, A. (2020). Risk of novel coronavirus 2019 transmission from children to caregivers: A case series. *Journal of Paediatrics and Child Health*, *56*(6), 984–985.	Jun 22, 2020	Case series	Thailand	Home	3 cases of confirmed COVID-19 in children are reported. In each case, source of infection was determined to be a close family contact. Following national policies, children were isolated in a health facility. During isolation, caregivers were encouraged to follow strict hand hygiene protocols and not share personal items. Surgical masks were provided but compliance was poor. Caregivers of 2 of 3 children tested negative for COVID-19; the third caregiver did not undergo testing.	Moderate

Somekh, E., Gleyzer, A., Heller, E., Popian, M., Kashani-Ligumski, L., Czeiger, S… Stein, M. (2020). The role of children in the dynamics of intra family coronavirus 2019 spread in densely populated area. *The Pediatric Infectious Diseases Journal 39*(8), e202-e204.	Jun 1, 2020	Case series	Israel	Households	Members of 13 households of COVID-19 cases were tested for COVID-19. Test results were presented by age group: • 21 of 36 (58.3%) adults tested positive • 13 of 40 (32.5%) children aged 5–17 tested positive • 2 of 18 (11.1%) children younger than 5 years tested positive In 1 household, the index case was an adolescent aged 14.5 years who was exposed in the community. The index case for the other 12 households were adults.	Low

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