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COVID-19 – KCE CONTRIBUTIONS

**COVID-19 TRANSMISSION AND
CHILDREN**

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This document is a rapid review of scientific literature retrieved from several publicly funded COVID-19 resource collections. The literature included in these repositories is not always peer-reviewed or externally validated. KCE synthesised the evidence in short time frames to respond to urgent questions and could therefore not follow its regular methodological procedures. This work is used to inform guidance of other governmental agencies (like Sciensano, CSS/HGR, AFMPS/FAGG and SPF/FOD).

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1 SUMMARY

The data on susceptibility and transmission of COVID-19 by children is unclear. This lack of clarity translates in an uncertainty for the national and regional planning to reopen schools. Both keeping schools closed and reopening them carries degrees of risk in terms of population harms. Further data on susceptibility and transmission from population-based studies is urgently needed.

1.1 Objectives

To summarise the recent evidence on transmission of COVID-19 to and by children.

1.2 Methods

Rapid review of the literature in a non-systematic way.

1.3 Key results

Paediatric cases of COVID-19 represent a small proportion (1-5%) of all reported COVID-19 cases worldwide; this is primarily related to the fact that infected children are predominantly asymptomatic or have mild illness and are hence less tested. It can, as yet, not be concluded that children are less susceptible to CoV-2-SARS infection compared to adults.

The importance of children in the transmission of the virus remains poorly understood. It is currently very difficult to assess the circulation of the virus in this population based on the knowledge generated during the first epidemic phase, and the possible contribution of children to the dynamics of the virus.

Within the measures of social distancing, modelling studies indicate that the effect of school closures on mitigating the epidemic peak is limited, but that maintaining a controlled level of transmission requires a prolonged period of closure. As yet, there are no available studies evaluating the specific effect of reopening schools.

1.4 Conclusion

In Belgium, in agreement with recommendations, school reopening is accompanied by preventive measures to limit community transmission: 1) avoidance of symptomatic children or contacts; 2) adaptation of "barrier" and social distancing measures to the age of the children accommodated; 3) implementation of specific environmental measures. Contact tracing is now underway throughout Belgium to identify cases and contacts as soon as possible. To define the contribution of children to the dynamics of transmission, outbreak teams have to be ready in case of high numbers of cases for example in schools.

Descriptive epidemiological studies are needed to describe and characterise the COVID-19 infection in children. Hence appropriate data of the infected person and its contact(s) (age, location, school, presumed place of infection,...) need to be collected during contact tracing to allow for such studies. Future surveillance activities ideally should include a larger number of children.

2 PROBLEM DESCRIPTION

The data on susceptibility and transmission of COVID-19 by children is unclear. This lack of clarity translates in an uncertainty for the national and regional planning to reopen schools. Both keeping schools closed and reopening them carries degrees of risk in terms of population harms. Further data on susceptibility and transmission from population-based studies is urgently needed.

Some countries, such as Sweden, never closed their schools, others reopened them in the meantime, such as Germany (some schools as early as April 20th - 4th May for 6th grade; later on also for younger children; different by state) and Denmark (from April 15th including primary schools and kindergartens). The Netherlands and France partially reopened their schools on May 11th. Schools in Belgium reopened partially on Friday May 15th, 2020. The inter-federal spokesman Steven Van Gucht explained on May 11th to the press that: "children and schools in general are not considered to be a major driving force behind the Covid-19 epidemic, unlike what we know about the classical flu virus" and that "children rarely get sick because of COVID-19; when they become ill, it

is usually with mild symptoms" (<https://www.knack.be/nieuws/belgie/crisiscentrum-heropening-scholen-kan-vrijdag-op-veilige-manier-gebeuren/article-news-1597853.html>).

It has been postulated that if children are driving the epidemic then increased infections will be seen in those countries where children have already returned to school. Previous research described social mixing patterns and contact characteristics to be similar across different European countries with contact patterns assortative with age.¹ Schoolchildren and young adults mixed with people of the same age; contacts lasting at least one hour or occurring on a daily basis mostly involved physical contact. Contacts at home, school, or leisure were more likely to be physical than contacts at the workplace or while travelling. Modeling the data for an emerging epidemic, transmitted by the respiratory route or close-contact, in a completely susceptible population, estimated that the age range 5-19 years were to suffer the highest incidence during the initial epidemic phase.¹

The knowledge on susceptibility and transmission of COVID-19 by children considers the underlying immunology in children e.g. expression of SARS-CoV-2 receptor ACE2, innate immunity and T cells, antibodies, and viral load.² Since SARS-CoV-2 is a new zoonotic pathogen, there is no pre-existing immunity. The symptoms of children infected by laboratory-confirmed SARS-CoV-2 are mild; severe COVID-19 disease in children is rare.³

3 OBJECTIVE

The aim of this rapid review is to search for evidence on susceptibility and transmission of COVID-19 by children and provide a short overview of this information.

4 METHODS

We evaluated the literature in a non-systematic way and searched the Belgian federal website, the Public Health Agency of Sweden, Denmark Statens Serum Institute, the Dutch RIVM, ECDC, WHO, the COVID-19 Health System Response Monitor, Lancet COVID-19 open source; medRxiv, NEJM, NIH, and Pubmed. The websites were searched from April 28st till May 14th 2020.

5 RESULTS

5.1 Epidemiological features and contact tracing studies

5.1.1 Household transmission

An analysis from China has shown that children younger than 10 years accounted for only 1% of COVID-19 cases.⁴ In Zhejiang province, China, the children accounted for roughly 5% of total patients with COVID-19.⁵ It was shown that for 89% (n=32) of these children, the route of transmission happened through close contact with family members and that illness was mild or asymptomatic, accompanied with pneumonia in half of the cases.^{5, 6}

An early small study (391 cases in total) from Shenzhen, China described that children were as likely to be infected as adults (infection rate 7.4% in children <10 years vs population average of 6.6%).⁷ A larger study analysed contact surveys data for Wuhan and Shanghai before and during the outbreak.⁸ Of the 114 clusters studies, one index case was aged 0-14 years. The authors found that children 0-14 years were less susceptible to SARS-CoV-2 infection than adults 15-64 years of age (odds ratio 0.34, 95%CI 0.24-0.49), while in contrast, individuals over 65 years were more susceptible to infection (odds ratio 1.47, 95%CI: 1.12-1.92).

The WHO-China joint mission summarised in February the household transmission and data on children from China as follows⁹: In China, human-to-human transmission of the COVID-19 virus is largely occurring in families:

- Among 344 clusters involving 1308 cases (out of a total 1836 cases reported) in Guangdong Province and Sichuan Province, most clusters (78%-85%) have occurred in families. Preliminary studies ongoing in Guangdong estimate that the secondary attack rate in households ranges from 3-10%.
- Data on individuals aged 18 years old and under suggest that there is a relatively low attack rate in this age group: 2.4% of all reported cases.

- Within Wuhan, no children were positive in November and December of 2019 and in the first two weeks of January 2020.

The joint mission concluded that:

- From available data, and in the absence of results from serologic studies, it is not possible to determine the extent of infection among children, what role children play in transmission, whether children are less susceptible or if they present differently clinically (i.e. generally milder presentations).
- Infected children have largely been identified through contact tracing in households of adults.
- People interviewed by the Joint Mission Team could not recall episodes in which transmission occurred from a child to an adult.

The European Centre for Disease Control (ECDC) reported on the 23th April two studies on household transmission in China¹⁰: the household secondary attack rate^a (SAR) was 16.3% in the first¹¹ and 13.8% in the second¹² study. Age-stratified analysis showed that the SAR in children was 4.7% compared with 17.1% in adults (≥ 20 years of age)¹¹, and that the odds of infection in children was 0.26 times (95%CI 0.13-0.54) of that among the elderly (≥ 60 years of age).^{10, 12}

5.1.2 Child onward transmission

ECDC reviewed the child-to-other transmission and concluded that it appeared to be uncommon.¹⁰ The following evidence was reported:

- A study investigation of the first outbreak in France, where one infected child who attended three different schools while symptomatic and having 112 contacts (including children and teachers), showed no detection of symptomatic secondary cases.¹³
- ECDC also reported a few case reports, with poorly documented data, describing a paediatric case as potential source of infection for adults.^{14, 15}
- Data from population-based and cross-sectional studies indicate that children are unlikely to be primary source cases. In Vo' (Italy), two cross-sectional studies, including more than 2000 people each, showed that none of the 234 children (≤ 10 years of age) tested were infected (RNA detection).¹⁶ Among the 11-20 year old inhabitants, 1.2% and 1.0% tested positive in the two surveys compared to the population averages of 2.6% and 1.2%, respectively.¹⁶ In a population-based screening programme in Iceland, none of the 848 children under 10 years of age tested positive (RNA isolation), in comparison to 0.8% of the whole sample of 13 080 people.¹⁷ In a targeted testing of symptomatic people, or high-risk contacts, 38 (6.7%) children under the age of 10 tested positive, in comparison to 13.7% of those who were 10 years or older.¹⁷ In the Stockholm Region (Sweden), a cross-sectional study testing RNA in the upper respiratory tract including 707 participants reported an overall positivity rate of 2.5%. For the 147 children (< 15 years of age) the rate was 2.8%.¹⁸

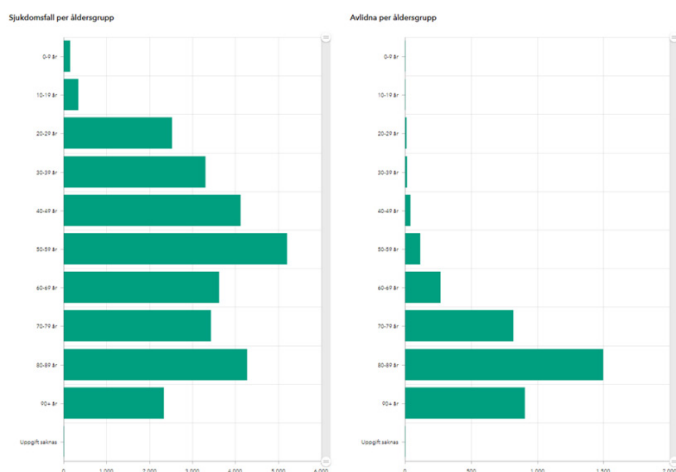
An Australian report on transmission from schools to the community (till April 21st 2020) showed, among 863 people (735 students and 128 staff) who had been in contact with 9 students and 9 staff members confirmed to have COVID-19 in primary and high schools ($n=15$) in the state of New South Wales, that only two cases of COVID-19 were recorded among those contacts. Both cases were children.¹⁹ One child was from a primary school and one child from a high school. No teacher or staff member contracted COVID-19 from any of the initial school cases.

5.1.3 Epidemiological data from Sweden - example

Sweden has had a different strategy in regards to children and quarantine. On March 17th the upper secondary schools, Folk High Schools and universities are urged to teach at a distance (digital/online learning), but elementary schools are kept open.²⁰ In total, 135 children in the age group 0-9 years and 330 children aged 10-19 years have been laboratory confirmed with COVID-19 (Figure 1). Figure 2 shows a decrease of number of new cases per day from mid-April while schooling continued.

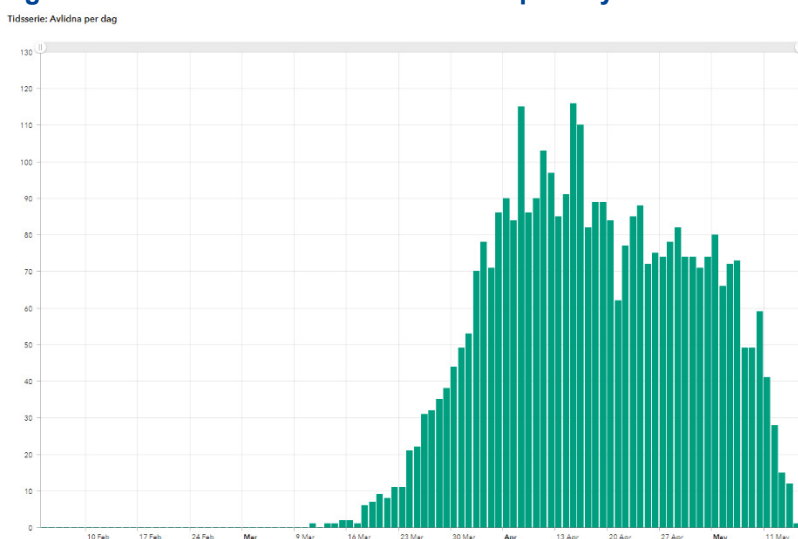
^a A household secondary attack rate is defined as the probability that an infection occurs among susceptible people within a specific house hold.

Figure 1 – COVID-19 cases and deaths by age for Sweden May 15th 2020



Left graph: number of new cases; right side: number of deaths

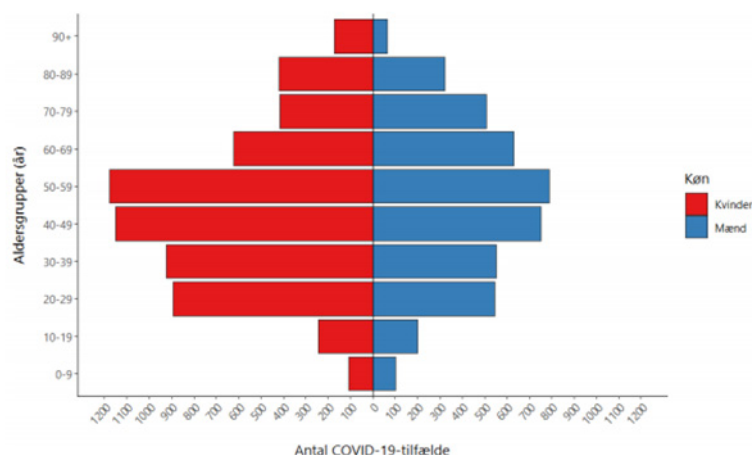
Figure 2 – Number of cases of COVID-19 per day in Sweden



5.1.4 Epidemiological data from Denmark - example

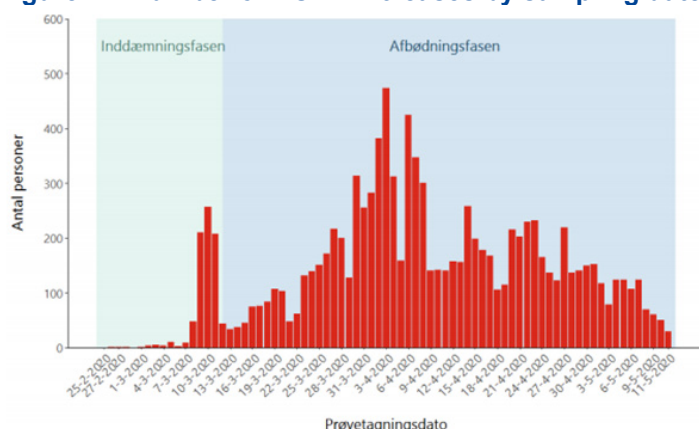
From the end of February to March 11, people with respiratory symptoms who traveled to Denmark from high-spreading countries were tested for COVID-19.²¹ This happened as part of the containment phase. As of March 12, as part of the mitigation strategy, more people with symptoms for COVID-19 have been tested. As of April 1, 2020, extended testing has been carried out. In total, 212 children aged 0-9 years and 444 children aged 10-19 tested positive for COVID-19 (Figure 3). Since the partial re-opening on April 15th of the schools, the number of cases has not increased (Figure 4).

Figure 3 – Number of COVID-19 cases by gender and age in Denmark



Kvinder: vrouwen; Maend: mannen

Figure 4 – Number of COVID-19 cases by sampling date in Denmark



5.2 Susceptibility

Data on susceptibility on children is lacking. It has been stated that children appear to be as susceptible to CoV-2-SARS infection as adults. However, paediatric cases of COVID-19 represent a small proportion (1-5%) of all reported COVID-19 cases worldwide; this is primarily related to the fact that infected children are predominantly asymptomatic or mildly severe and hence are not tested (as a consequence of which they don't appear in the figures). Severe forms and deaths in children are exceptional. Several authors responded on the low number of affected children by COVID-19 commenting that children may have specific mechanisms regulating the immune response.^{6, 2} Table 1 summarises the scientific explanations for this.

Table 1 – Immune mechanisms in children

Author	Susceptibility and transmission basic science explanations
Kelvin et al. ⁶ (comment on Carsetti et al. below)	<p>Suggestion that children have specific mechanisms regulating the interaction between the immune system and respiratory machinery, which could be contributing to milder disease. There is an urgent need for further investigation of the role of children in the chain of transmission.</p> <ul style="list-style-type: none"> • children are susceptible to SARS-CoV-2 infection, but frequently do not have notable disease; • possibility that children could be facilitators of viral transmission
Carsetti et al. ²	<p>In general:</p> <ul style="list-style-type: none"> • viral load peaks in the first week of infection

- primary immune response by days 10–14
- followed by virus clearance through the action of high-affinity antibodies and T cells
- response of naive B cells through the germinal centre
 - B cells somatic mutations in the antigen-binding site of the immunoglobulin variable heavy chain genes
 - modified B cells express high-affinity antibodies
 - they become memory B cells (MBCs) and plasma cells

For children the immune preparedness to any novel pathogens, including SARS-CoV-2, might be based on several factors:

- natural antibodies produced by innate or IgM MBCs, a population of MBCs that is generated independently of the germinal centres and is most abundant in children.
 - in the early phases of infection, mostly of IgM isotype
 - broad reactivity and a variable affinity
 - contain the infection during the 2 weeks necessary for production of high-affinity antibodies and MBCs
- natural antibodies with broad reactivity
 - not yet been selected and shaped by the reaction to common environmental pathogens
 - children have the ability to rapidly produce these
- Infants and children have MBCs CD27 that are highly adaptable to new antigens compared to adults CD27

5.3 Viral load

To define if children can transmit the virus to adults or other children, as is the case in other respiratory viruses, the viral RNA load has been studied in the upper respiratory tract of confirmed COVID-19 patients. A study from Berlin (pre-print) reported that the variance of viral loads in patients of different age categories was not significantly different between any pair of age categories including children.²² The authors concluded that: “children may be as infectious as adults”. Some online interesting comments on this pre-print paper were the following:

- The number of children in the higher load categories is limited.
- The sampling does not appear to be population-based: the authors report a sub-analysis which suggests that children with underlying conditions have lower viral loads than healthy children.
- It is not yet clear whether high levels of viral RNA are an indicator of how infectious a person is.

Table 2 – Viral load respiratory tract

Author	Results
Jones et al. ²² (pre-print version not peer-reviewed)	Data on viral load, as estimated by real-time RT-PCR threshold cycle values from 3,712 COVID-19 patients were analysed to examine the relationship between patient age and SARS-CoV-2 viral load. Analysis of variance of viral loads in patients of different age categories found no significant difference between any pair of age categories including children. In particular, these data indicate that viral loads in the very young do not differ significantly from those of adults. Based on these results, we have to caution against an unlimited re-opening of schools and kindergartens in the present situation. Children may be as infectious as adults.

5.4 Immunity

Seroprevalence studies in children are lacking. Data from serosurveys including a larger number of children are needed. Results from Geneva (Switzerland) showed that children 5-19 year old had similar seroprevalence (6.0%) compared to 20-49 year olds (8.5%) in a population-based study of 8 weekly serosurveys.²³ A significantly lower seroprevalence of 3.7% was observed among those 50 and older. Data for Belgium (unpublished data, submission for publication planned; personal communication Prof Van Damme) showed a weighted prevalence that was stable around 5.5% with an interval of 3 weeks (Table 3).

Table 3 – Information on seroprevalence

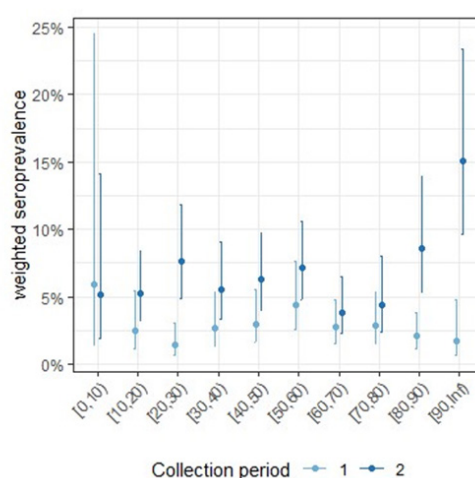
Author	Results
Stringhini et al. ²³ (pre-peer review)	<p>Geneva</p> <p>In the first three weeks, 1335 participants coming from 633 households were enrolled, with 16% <20 years of age and 53.6% female, a distribution similar to that of Geneva. In the first week, we estimated a seroprevalence of 3.1% (95% CI 0.2-5.99, n=343). This increased to 6.1% (95% CI 2.6-9.33, n=416) in the second, and to 9.7% (95% CI 6.1-13.11, n=576) in the third week. Five to 19 year-olds (6.0%, 95% CI 2.3-10.2%) had similar seroprevalence to 20-49 year olds (8.5%, 95%CI 4.99-11.7), while a significantly lower seroprevalence was observed among those 50 and older (3.7%, 95% CI 0.99-6.0, p=0.0008).</p> <p>Interpretation: No differences in seroprevalence between children and middle age adults are observed. On April 24th, we observe that there are roughly 10 infections for every COVID-19 confirmed case in Geneva, reflecting the variability in disease severity, testing practices and care-seeking behaviors.</p>
Belgium : report University of Antwerp	<p>The overall prevalence increased from 2.86% (n=3910) in the week of March 30th 2020 to 6.0% (n=3391) the week of April 20th 2020. The number of children contributing to the data is low with wide confidence intervals as a result. Nevertheless, the weighted seroprevalence increased significantly for the age groups 20-30 years and 90+ but not for the children up to 20 years. Data provided by the team of Prof Van Damme are presented below (unpublished data, submission for publication planned; personal communication Prof Van Damme).</p>

Weighted seroprevalence - whole Belgium

overall

collection period	seroprevalence (%) - weighted	2.5 %	97.5 %
1	2.86	2.26	3.62
2	6.00	5.08	7.10

by age category



5.5 Transmission modelling studies

Modelling studies indicate that the effect of school closures on mitigating the epidemic peak is limited, but that maintaining a controlled level of transmission requires a prolonged period of closure.²⁴ There are no available studies evaluating the specific effect of reopening schools.

Table 4 – Modelling studies

Author	Results
Ferguson et al. ²⁴	This review is not peer reviewed but recognised as from a well-known modelling centre: Imperial College COVID-19 Response Team:
WHO Collaborating Centre for Infectious Disease Modelling - MRC Centre for Global Infectious Disease Analysis Abdul Latif Jameel Institute for Disease and Emergency Analytics - Imperial College London	<p>The study by Ferguson et al. analyses the influence of school and university closures in controlling the COVID-19 epidemic in the context of Great Britain and the United States. They show that in the UK and US context, suppression will minimally require a combination of social distancing of the entire population, home isolation of cases and household quarantine of their family members. This may need to be supplemented by school and university closures, though it should be recognised that such closures may have negative impacts on health systems due to increased absenteeism.</p> <p>Closing schools in isolation has little effect on mitigating the impact (deaths and resuscitation admissions) of the first epidemic wave, and does not improve predictions when added to the combination of the most effective measures (i.e., isolation of cases, quarantines and distancing of those at risk). In this model, school closure is accompanied by a 50% increase in intra-family contacts and a 25% increase in community contacts. On the other hand, for a long-term epidemic suppression goal that relies on reducing the reproduction rate (R) below 1 so that human-to-human circulation stops (as was the case with SARS or Ebola), school closure is more effective, combined with widespread social distancing. The reduction of contact via children (with the as yet untested hypothesis of contagiousness in children equivalent to that of adults) has a stronger contribution here than in the objective of mitigating the impact, which mainly concerns those at risk and the elderly. Nevertheless, to ensure this suppressive effect ($R < 1$), these measures must be maintained for many months to avoid a rebound in the impact of the measures.</p>
Lin et al. ²⁵ pre-peer review	<p>This model briefly discusses the lack of data on children:</p> <p>Our results suggest that models of transmission assuming a relatively lower R0 value that do not consider a large number of asymptomatic cases can result in misunderstanding of the underlying dynamics, leading to poor policy decisions and outcomes.</p> <ul style="list-style-type: none"> • Data on the disease's effect on children have been almost entirely lacking in the numbers of cases and hospitalizations reported. • Evidence suggests children are likely getting infected at the same rate as adults, albeit with lesser severity, implying that, at a minimum, at least 15% of the population in many countries may be asymptomatic when infected; the numbers are likely much higher.
Liu et al. ²⁶	<p>This is a transmission modelling study that gives a visual explanation of the contacts across and within age-groups in the society of China:</p> <p>The researchers developed a computational model to reveal the interactions in terms of the social contact patterns among the population of different age-groups. "We divide a city's population into seven age-groups: 0-6 years old (children); 7-14 (primary and junior high school students); 15-17 (high school students); 18-22 (university students); 23-44 (young/middle-aged people); 45-64 years old (middle-aged/elderly people); and 65 or above (elderly people). We consider four representative settings of social contacts that may cause the disease spread: (1) individual households; (2) schools, including primary/high schools as well as colleges and universities; (3) various physical workplaces; and (4) public places and communities where people can gather, such as stadiums, markets, squares, and organized tours. A contact matrix (see below) was computed to describe the contact intensity between different age-groups in each of the four settings. The four contact matrices were used to model the underlying transmission patterns of COVID-19 among 6 cities in China."</p>

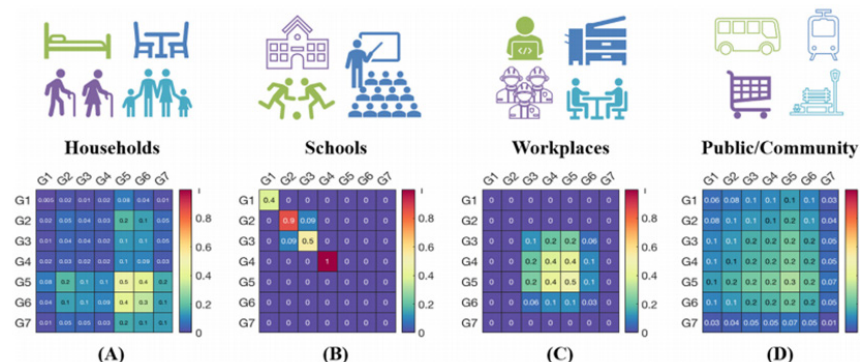


Fig. 2. Measurement of the intensity of social contacts among seven age-groups (G₁: 0–6; G₂: 7–14; G₃: 15–17; G₄: 18–22; G₅: 23–44; G₆: 45–64; and G₇: 65 or above) in four major settings: (A) households; (B) schools; (C) workplaces; and (D) public/community, in Wuhan. The contact patterns in these four settings are consistent with common social behaviors observed in a typical society. Specifically, as shown in (A), the majority of the social contacts within households occur across different generations. (B) demonstrates that the main social contact in schools centers around kids in the same age-group. As depicted in (C), workplaces are dominated by social contacts among young adults and the middle-aged adults. In (D), the social contacts are more diverse when people are in public places.

5.6 Retrieved reviews

Viner et al. reviewed the effectiveness of school closures and other school social distancing practices during coronavirus outbreaks.²⁷ Data from the SARS outbreak in mainland China, Hong Kong, and Singapore suggest that school closures did not contribute to the control of the epidemic. Public health France reviewed the literature and concludes that the importance of children in the transmission of the virus remains poorly understood.²⁸ The assessment of the role of children in "deconfinement" is at this stage very uncertain.

Table 5 – Overview reviews

Author	Abstract and other details from papers
Viner et al. ²⁷	<p>Sixteen out of 616 identified articles met the inclusion criteria for the review of the effectiveness of school closures and school social distancing practices. No data were found on the relative contribution of school closures to transmission control. Data from the SARS outbreak in mainland China, Hong Kong, and Singapore suggest that school closures did not contribute to the control of the epidemic. Modelling studies of SARS produced conflicting results. Recent modelling studies of COVID-19 predict that school closures alone would prevent only 2–4% of deaths, much less than other social distancing interventions.</p> <p>Other aspects mentioned in the review are:</p> <ul style="list-style-type: none"> the social distancing measures implemented during the COVID-19 outbreak reduced community transmission by 44% in Hong Kong, which was much greater than the estimated 10–15% reduction in influenza transmission conferred by school closures implemented alone during the 2009 pandemic in Hong Kong; twice daily temperature screening in Singapore schools did not identify children with SARS; although there were school children diagnosed with SARS in Singapore; The effect of a 5-day closure due to extreme weather of nearly all schools in the greater Seattle metropolitan area in February, 2019, on the transmission of endemic human coronaviruses (229E, NL63, OC43, and HKU1) was studied: the school closure resulted in an estimated 5.6% (95% CI 4.1–6.9) reduction in coronavirus infections, similar to influenza H1N1 (7.6%; 5.2–9.7) but higher than influenza H3N2 (3.1%; 2.5–3.2), all of which were prevalent at the time; only one study examined the effect of school closures separately to other social distancing measures.
Castagnoli et al. ²⁹	<p>Review searched up to the early date of March 3th 2020</p> <p>Eighteen studies with 1065 participants (444 patients < 10 years, and 553 between 10 and 19 years) with confirmed SARS-CoV-2 infection were included in the analysis. All but one study included reflected research performed in China. One clinical case from Singapore was also included.</p> <p>Children at any age were mostly reported to have mild respiratory symptoms, namely fever, dry cough, and fatigue, or were asymptomatic. Bronchial thickening and ground-glass opacities were the main radiologic features, and these findings were also reported in asymptomatic patients. Among the included articles, there was only 1 case of severe</p>

	COVID-19 infection, which occurred in a 13-month-old infant. No deaths were reported in children aged 0 to 9 years. Available data about therapies were limited.
Santé Publique France ²⁸	<p>This recent review on children was published May 4th. It provides a good overview of the topic and the school closures across Europe. The following key recommendations were made:</p> <ul style="list-style-type: none"> • Les enfants semblent autant sujets à l'infection par le SARS-CoV-2 que les adultes. Toutefois, les cas pédiatriques de COVID-19 représentent une faible partie (1 à 5 %) de l'ensemble des cas de COVID-19 rapportés dans le monde ; ceci est essentiellement lié au fait que les enfants infectés présentent majoritairement des formes asymptomatiques ou peu graves. Les formes graves et les décès chez les enfants sont exceptionnels. • L'importance des enfants dans la transmission du virus reste mal connue. Il est actuellement très difficile d'évaluer la circulation du virus dans cette population à partir des connaissances produites lors de la première phase épidémique, et la contribution envisageable des enfants à sa dynamique. L'appréciation du rôle des enfants lors du « déconfinement » est à ce stade des connaissances très incertaine. • Au sein des mesures de distanciation sociale, les études de modélisation indiquent que l'effet de la fermeture des écoles sur l'atténuation du pic épidémique est limité mais que le maintien à un niveau contrôlé de la transmission passe par le maintien prolongé de cette fermeture. Il n'existe pas d'études disponibles évaluant l'effet spécifique de la réouverture des écoles. • Les recommandations disponibles indiquent que la réouverture des écoles doit être accompagnée de mesures de prévention pour limiter la transmission communautaire : 1) l'éviction des enfants symptomatiques ou contacts ; 2) l'adaptation des mesures « barrières » et de distanciation sociale à l'âge des enfants accueillis ; 3) la mise en place de mesures environnementales spécifiques. • La déclinaison opérationnelle doit mobiliser l'ensemble des acteurs locaux afin d'adapter les mesures aux besoins spécifiques du terrain, les agents devraient être formés et disposer de ressources éducatives adaptées à l'âge des enfants, des stratégies de marketing social ou de « nudge » pourraient être utilisées. • La mise en place d'un environnement favorable à la prévention de la propagation du virus au sein des écoles doit être cohérent avec les mesures de prévention mises en œuvre au domicile des enfants. • L'apprentissage des gestes « barrières » par les enfants apparaît être une stratégie positive pour impliquer les enfants en tant que promoteurs/défenseurs de la prévention. • Des mesures spécifiques pour prévenir la stigmatisation et soutenir la santé mentale devraient être déployées. • Les parents et les enseignants sont inquiets de la réouverture des crèches et des établissements scolaires. • La fermeture des écoles et le confinement, mesures nécessaires à la gestion de l'épidémie, par l'impact qu'ils entraînent sur les déterminants psycho-sociaux, sociaux et environnementaux de la santé, peuvent avoir des conséquences sur la santé physique, mentale et le bien-être des enfants aujourd'hui et à long terme. • Ces conséquences ne seront pas uniformément réparties dans la population et un creusement des inégalités sociales de santé, déjà fortes chez les enfants, est à prévoir.

5.7 Guidance from ECDC

ECDC defined the following considerations when planning and deciding to adjust community level physical distancing measures (23th April):¹⁰

- Start monitoring epidemiological indicators before the planned change to create a baseline (at least two weeks is recommended) and when measures are adjusted differentially at a sub-national level, establish monitoring information at subnational level.
- Start adjusting measures (if conditions allow, one at a time), in smaller or localised geographical areas, in order to minimise the impact, should the lifting/easing of that measure result in a significant surge of cases.

- Allow sufficient time after lifting/easing one measure to evaluate its impact on virus circulation and on consequent COVID-19 related morbidity and mortality (evidence to-date indicates that the impact of adjusting measures may take at least two to four weeks to become apparent in epidemiological monitoring systems).
- When deciding which measures can be lifted first, choose those measures targeted to **specific age groups where evidence shows continued limited disease transmission is less likely to result in major public health impact**. So far, **this may apply only to children younger than 10 years of age** (who are not also members of high-risk groups), although there are **still limited data** on the role of children in transmitting the disease.^{16, 17}
- When adjusting physical distancing measures, identify measures that could be maintained for longer periods of time with some adjustments; consider for example allowing people to leave home but keeping a two meter distance from one another, opening activities where physical distance can be guaranteed, allowing access to open spaces where people can easily keep distance from outdoor activities and access to open or indoor spaces where people can easily keep distance from one another, or those measures with little societal impact (e.g. teleworking).

Further they noted regarding children: “All indirect consequences of lifting measures should be assessed prior to their modification, such as effects on public transportation usage and other crowding of public spaces where high rates of viral transmission may occur, or **specific mixing patterns such as between children and elderly individuals**.”

6 ONGOING AND PLANNED TRANSMISSION STUDIES

Table 6 – Examples of planned and ongoing studies in neighbouring countries

<p>RIVM: National Institute for Public Health and the Environment Ministry of Health, Welfare and Sport</p> <p>https://www.rivm.nl/en/novel-coronavirus-covid-19/children-and-covid-19</p>	<p><u>Research on families and young people</u></p> <p>RIVM is carrying out research among families in the Netherlands where someone has contracted the coronavirus. The aim is to gather more information about the course of the disease: how long symptoms last, how long it takes to recover, and how people build up immunity to the virus. In addition, they want to know if children also pass the virus on to others. Research is taking place in various provinces across the Netherlands, among a hundred families with coronavirus patients. Once there is confirmation that someone is infected, a nurse visits the family. Nose, throat and blood samples are collected. The family then keeps track of their symptoms for a month. If a family member becomes ill, samples are taken again to see if this person also has COVID-19. In any case, samples are taken from the whole family two more times: 2-3 weeks and 4-6 weeks after the first home visit. The results will be processed six weeks after all the families have had their first home visit.</p> <p><u>Research on antibodies against COVID-19</u></p> <p>Working with Sanquin, the organisation that runs the Dutch blood banks, RIVM is looking into the extent to which people in the Netherlands have antibodies against COVID-19 in their blood. If there are antibodies in people's blood, it means they have already had the virus. Sanquin is conducting an initial test to see whether these antibodies are present in the blood supply. RIVM is assessing the test in order to confirm the results.</p> <p><u>Large-scale study on immunity (and herd immunity)</u></p> <p>RIVM will invite 6 000 people from all over the country to take part.</p> <ul style="list-style-type: none"> • ages from 2 to 92 years old. • already participating in a long-term study on protection against infectious diseases (known as the PIENTER study). • fingerprick self-sample set; send it back to RIVM by post. All participation in the study takes place at home.
<p>Denmark: Statens Serum Institute</p> <p>https://en.ssi.dk/news/epi-news/2020/no-12---2020</p>	<p>The SSI will use two different systems to monitor community transmission.</p> <ul style="list-style-type: none"> • The GPs who participate in the sentinel surveillance of seasonal influenza will receive test kits that patients with mild respiratory symptoms can then have picked up in their practices and use for home-testing. The GPs will be asked to collect a similar number of throat swabs from healthy patients who see their GP for other reasons.

	<ul style="list-style-type: none"> Furthermore, there are plans to use the influmeter.dk website for weekly self-reporting of relevant symptoms consistent with COVID-19. Combined data from these two monitoring systems may subsequently be used to estimate the number of infected people in the community.
France (no direct link at present)	<p>Étude menée par Arnaud Fontanet</p> <ul style="list-style-type: none"> six écoles primaires de Crépy-en-Valois, commune française très touchée au début de l'épidémie.
France	<p>ACTIV</p> <p>Epidemiological study in children on symptoms, viral load, and serology for COVID-19.</p> <p>https://clinicaltrials.gov/ct2/show/NCT04318431?cond=COVID&map_cntry=FR&age=0&draw=1</p> <p>Prevalence of SARS -Cov2 carriage in asymptomatic and mildly-symptomatic children (COVILLE); Centre Hospitalier Intercommunal Creteil</p>
France	<p>Une étude de plus long terme, est en cours via une coopération entre l'hôpital Necker à Paris et le Commissariat à l'énergie atomique (CEA). 1000 enfants venus consulter pour tous types de motifs seront testés ainsi qu'un de leurs parents. "En analysant les anticorps, on saura qui a contaminé qui. On pourrait avoir des retours assez rapides", indique-t-on à Necker, en précisant que les cas positifs seront suivis pendant un an.</p>

7 CONCLUSION

Paediatric cases of COVID-19 represent a small proportion (1-5%) of all reported COVID-19 cases worldwide; this is primarily related to the fact that infected children are predominantly asymptomatic or have mild illness and are hence less tested. It can, as yet, not be concluded that children are less susceptible to CoV-2-SARS infection compared to adults.

The importance of children in the transmission of the virus remains poorly understood. It is currently very difficult to assess the circulation of the virus in this population based on the knowledge generated during the first epidemic phase, and the possible contribution of children to the dynamics of the virus.

Within the measures of social distancing, modelling studies indicate that the effect of school closures on mitigating the epidemic peak is limited, but that maintaining a controlled level of transmission requires a prolonged period of closure. As yet, there are no available studies evaluating the specific effect of reopening schools.

In Belgium, in agreement with recommendations, school reopening is accompanied by preventive measures to limit community transmission: 1) avoidance of symptomatic children or contacts; 2) adaptation of "barrier" and social distancing measures to the age of the children accommodated; 3) implementation of specific environmental measures. Contract tracing is now underway throughout Belgium to identify cases and contacts as soon as possible. To define the contribution of children to the dynamics of transmission, outbreak teams have to be ready in case of high numbers of cases in for example schools.

Descriptive epidemiological studies are needed to describe and characterise the COVID-19 infection in children. Hence appropriate data of the infected person and its contact(s) (age, location, school, presumed place of infection,...) need to be collected during contact tracing to allow for such studies. Future surveillance activities ideally should include a larger number of children.

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Colophon

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