Promoting Factfulness in the Covid-19 pandemic-related policymaking: a map to understanding school closures

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Abstract

Introduction: In the era of data-driven decision-making, an unacceptable haziness and inconsistency surrounds the yearlong scientific and public debate on the school closure policy in the COVID-19 pandemic mitigation efforts. Aim: The present literature review stems out of the need for a clear scaffold collecting in one place all current evidence, as well as helping organizing incoming future evidence, concerning both the role of schools in driving the Sars-CoV-2 community spread and the cost-effectiveness of school closure in containing such spread. Methods: References for this review were initially identified through searches of PubMed, Scopus and Cochrane Library for articles published from March, 2020, to March, 2021 by use of the terms “Schools” “COVID-19” “pandemic” “clusters” “outbreak” “seroprevalence”. Further search was undertaken through Google Scholar and ResearchGate, and finally through Google. Results: School closure at times of high background prevalence of COVID-19 should not be considered a measure implemented to protect the health of children. Children had lower secondary attack rates than adults and that they infrequently represented the index case. One year of pandemic has been sufficient for the emergence of one indication of concern: a potentially increased burden of paediatric mental health disorders. Conclusions: A fact-based understanding of what is currently known on such a consequential policy is required to provide a basis of evidence for an advocacy of either school closure or school opening at times of high intensity community transmission of Sars-CoV-2.

Promoting *Factfulness* in the Covid-19 pandemic-related policymaking:

a map to understanding school closures

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Abbreviations:

Coronavirus disease-2019 (COVID-19)

World Health Organization (WHO)

European Union (EU)

United Nations Education, Scientific and Cultural Organization (UNESCO)

reproduction number (Rt)

severe acute respiratory syndrome coronavirus 2 (Sars-Cov-2)

other non-pharmaceutical interventions (NPI)

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Introduction

These days are marking the exact anniversary of the earliest direct effects of the Coronavirus disease-2019 (COVID-19) pandemic on the educational sector in the European Union, with Italy as the pioneer member state. In fact, on March 4th, 2020, the Italian government issued a ministerial decree that in its first article declared a nationwide shutdown of pre-schools, schools, and universities, adapting all didactic activities to distance education. By March 20th, when the overall prevalence of COVID-19 in the World Health Organization (WHO) European region was of 151,754 total reported cases (of which 35% were in Italy, 16% in Spain, 14% in Germany and 10% in France), 24 (89%) out of the 27 countries making up the European Union (EU) had fully closed their educational facilities (with Sweden's schools being partially open and Slovenia's and Bulgaria's fully open). Worldwide, on the same date, the United Nations Education, Scientific and Cultural Organization (UNESCO) *Global monitoring of school closures caused by COVID-19* reports a total of 146 country-wide closures, affecting 52.4% of total globally enrolled learners. By the end of April 2020, the world had witnessed an unprecedented international disruption of education, with the peak reached on April 26th, 2020, with 82.9% of total enrolled learners affected (equal to a total of 1,451,874,449 learners globally).

As local upsurges of COVID-19 multiplied, so did nationwide lockdowns and concurrent closure of educational facilities. The decision to close schools early in the epidemic outbreak relied partly on data collected from mitigation policies to curb previous pandemics [1] with novel influenza viruses. In the 1918-1919 influenza pandemic, illness rates were highest among children of school age, and mortality rates were highest among infants and young adults other than the elderly [2]. In the 2009 H1N1 virus pandemic children and young adults were once again disproportionately affected [3]. The indications coming from already existing disease modelling studies, rapidly supplemented by new studies published in March-April 2020, evidenced school-closure as a cost-effective non-pharmaceutical intervention for controlling community transmission of seasonal and pandemic influenza viruses [4]. This would be especially noteworthy at a time when documented effective pharmaceutical interventions were unavailable. Although the evidence on the effectiveness of such measures during coronavirus outbreaks were limited, governments acted uniformly in line with the *WHO framework for national and local planning and response to the 2009 pandemic* , in which proactive rather than reactive school closures/class suspension early in a pandemic outbreak were recommended to achieve the maximal reduction in attack rates. This reduction was expected to be all the greater if framed within the setting of a general lockdown. The likelihood of extra-scholastic student aggregation, which hampers the efficiency of school closures against viral spread, would then be minimized [5].

Nevertheless, due to multiple associated factors, the correlation between school closure and reproduction number (Rt) drop might not be so direct, and such a socially drastic intervention might not always produce an effect of equally drastic magnitude on incidence, hospitalizations and deaths. Already at the time when the global decision to close school was taken, evidence existed to challenge the effectiveness of school closure in the fight against coronaviruses. A scientific evidence-based review published in 2014 concluded that the impact of school closure on the size of the pandemic peak was greatest for viruses whose transmissibility in the community was low (i.e. with a basic Rt <2) and whose attack rates were higher in children than in adults [6]. Neither of these two conditions appeared to be applicable to Sars-Cov-2 at the start of the outbreak. However, evidence also existed in a second systematic review from 2018 that school closure could prove to be a measure on its own to control infectious spread, not merely a bridge until other measures are found [1].

In the short and medium term, immediate COVID-19 containment was prioritized over optimal educational continuity and the combined deployment of all readily amenable interventions did manage to curtail the first outbreak within the WHO European Region. By May 31st, 2020, incidence and case-fatality ratio decreased, with 717 deaths out of the 19,995 daily cases as reported to the WHO compared to the 5,312 daily deaths out of 41,265 daily cases, which corresponded to the peak of the first wave (registered for the WHO European region on April 4th, 2020). However, the steadiness of epidemiological parameters between spring and autumn term, when schools re-opened in most of Europe, represented only a temporary hiatus, and a second outbreak started. Although currently the outlook on the pandemic is still narrow, as new empirical evidence on the severe acute respiratory syndrome coronavirus 2 (Sars-Cov-2) and its variants grow on a daily basis, cumulative ongoing research has completely changed the context in which outbreaks are occurring, gradually diminishing key unknowns about the virus transmissibility, target populations, case-fatality, clinical features and available pharmacological interventions. Mass vaccinations that are occurring worldwide, and the chronicization of the COVID-19 pandemic, causes a paradigm shift for paediatricians and whoever else operates in the field of health promotion for children and adolescents. When considering only the younger demographic groups, the major problem related to the pandemic increasingly appears not to be the emergent infectious disease itself but its long-lasting pervasive indirect consequences. It is our responsibility to remain updated on both direct and indirect health effects of COVID-19 on our patient population.

The present literature review will focus on only one such indirect health effect of the pandemic: the prolonged early school closures and their precarious re-opening. Early decision-making surrounding educational facilities across the globe relied on multiple assumptions and could claim as its main objectives the protection of children, of educational staff and of the community as a whole from uncontrolled spread of COVID-19, employing a cost-effective policy. Our aim is to understand which, if any, of the original assumptions is now

fact-based, and whether the multifaceted latest knowledge on COVID-19 and its epidemiology in children is accounted for by policymakers, in a world that has currently lost on average 22 weeks of normal education (UNESCO data updated to January 25th), and up to more than 50 weeks in some countries (India, USA, Brazil, to cite a few). The large existing differences in the re-opening policies among different countries and in the published study types represent an informative starting point, lessening the risk of both collinearity bias and population bias compared to literature reviews compiled during the first wave of the pandemic. School closures were initially used in combination with multiple other mitigation strategies and testing, as well as medical care, prioritized symptomatic populations, i.e. including older adults more frequently than children.

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Safety concerns associated to the clinical picture of Covid-19 in paediatric age: do they oppose or support school closure?

Ever since the early months of the COVID-19 pandemic and up until now, the aggregated data collected from thousands of confirmed paediatric cases of COVID-19 initially in China and then increasingly worldwide points towards reassuring clinical characteristics in <18-year olds. All the published systematic reviews and meta-analyses assessing the disease course in children and adolescents repeatedly reached the conclusion that the clinical picture of COVID-19 appears to be overall significantly milder in paediatric than in adult age, with better prognosis and lower hospitalization rates, as well as low case-fatality ratios (<1% of hospitalized cases)[7,8]. Although symptom prevalence varies among different studies, the majority of confirmed cases the Sars-Cov-2 infection presented with either no or few symptoms, the most commonly reported ones being pyrexia and cough. This appears to be true both for countries that minimized the exposure of children early in the pandemic through school closure, and for those that prioritized keeping children in school throughout the outbreak [9].

More severe clinical pictures requiring hospitalization did occur, reaching a proportion of up to 10 out every 100 cases in the youngest age group (0 to 4-year olds), but most had favourable outcomes [10]. In multivariable analyses of intensive care unit admissions for COVID-19 in paediatric age, the most significant and frequently reported risk factors were age (<1 month), pre-existing medical conditions, and signs or symptoms of lower respiratory tract infection at presentation [11]. In addition, one rare COVID-19 related clinical picture has been defined by the WHO: multisystem inflammatory syndrome in children (MIS-C), characterized by elevated inflammatory markers, constitutional signs of organ dysfunction and evidence of SARS-Cov-2 infection. Furthermore, beyond the acute effects of Sars-Cov-2 infection, there are growing concerns about the so-called "Long-Covid" in children, or rather the presence of long-lasting symptoms ascribed to the infection [12]. From a clinical perspective diagnosing and successfully treating these severe and long-term clinical pictures of COVID-19 in the paediatric age is of utmost importance. However, they neither occur nor lead to unfavourable outcomes frequently enough to be considered a threat to the health of the paediatric population.

One year into the pandemic, through the public health perspective needed for pandemic-related policymaking, the claim that COVID-19 in school-aged children is mostly a mild disease remains undoubtedly evidence-based. Consequently, school closure at times of high background prevalence of COVID-19 should not be considered a measure implemented to protect the health of children.

Children in schools as "super-spreaders" of Sars-Cov-2: myth or truth?

Having established during the first COVID-19 outbreak that protecting school-aged children from Sars-Cov-2 infection was largely unnecessary, the rationale for restricting in-presence school attendance lay entirely in its potential epidemiological benefits in protecting the adults in their households and the educational

staff in their schools. Keeping students at home directly reduces in-school and public transportation social contacts for all of pupils, teachers and school staff, thus limiting the mixing of households and horizontal viral transmission, as well as limiting the interactions between children, who have been repeatedly labelled as potential "super-spreaders" of infectious diseases on account of their increased crowding compared to adults. It also holds secondary pandemic mitigation potential signalling the severity of the public health emergency and keeping caregivers at home, albeit harder to quantify.

The questions now arise: in the case of the COVID-19 pandemic and based on what is currently known, is the idea of children in the school-setting acting as "super-spreaders" plausible? Is it reasonable to suspect that the second wave of the Sars-Cov-2 virus spread in the WHO European region has been driven also by school re-opening to in-presence learning for the 2020-2021 academic year? Two key unknowns should be investigated to understand Sars-CoV-2 infectiousness in paediatric age. First, what is the susceptibility of children and adolescents to the infection, and are there differences in attack rates, length of the infection and viral shedding between the two age groups? Second, depending on their susceptibility to the infection and their opportunity for onward transmission, how likely are children and adolescents to become the index case of COVID-19 clusters, respectively?

With regards to the first key unknown, preliminary evidence collected during the first COVID-19 outbreak elucidated that adults appeared to be at a higher chance of becoming infected with Sars-CoV-2 on exposure compared to younger age groups. This starting point for interpreting the infectiousness of Sars-CoV-2 in children comes from a large metanalysis published at the end of September 2020 [13] that included 32 studies. Evolving evidence strengthens these preliminary ones: children and adolescents are not spared from the infection, but they are a repeatedly underrepresented population of COVID-19 cases. This is logically true for the very few seroprevalence studies conducted on symptomatic cohorts [14-15], susceptible to an inclusion bias due to the high prevalence of subclinical infection in the younger populations. More significantly, this is also true for the few large seroprevalence studies on random cohorts selected independently of symptoms, in countries where children were continuously exposed to the infection because of continued in-presence learning or in which the exposure probabilities were comparable across generations [16-19]. Unfortunately, this epidemiological fact is not established biologically: when it comes to viral load during the infection and duration of viral shedding, especially in symptomatic cases, there seem to be fewer differences between adults and children of all ages [20]. Less has been confirmed for asymptomatic cases: the full demonstration of a significantly shortened or lessened infectiousness of asymptomatic cases would indisputably strengthen all positions favouring school opening, giving a reproducible explanation for the observed lower susceptibility to Sars-CoV-2 of the younger demographic groups.

The consistency of the epidemiological evidence alone encourages the claim that children should not be a primary target population of COVID-19 pandemic mitigation strategies [21] and has been used as sufficient evidence to disclaim the role of children as super-spreaders [22], but it does not disregard the risk that children are susceptible to the infection and may hence transmit it both in their classroom and within their household. As a very recently published modelling study [23] discloses, when it comes to the dangers of seeding COVID-19 cases across a large community through extensively undetected school clusters, even an extremely low number of child index cases might eventually amplify and result in a sizeable community spread with increased overall incidence and mortality. Confirming this concern are two large early studies coming from Asia [24,25]. A number of other studies strongly contradict this evidence, 57 of which were included in an international metanalysis on household Sars-CoV-2 transmission clusters during the first pandemic wave [26], finding that children had lower secondary attack rates than adults and that they infrequently represented the index case. This data was partly re-confirmed for the second wave in a large UK study [27].

Open schools or school re-opening: under which conditions has it jeopardized epidemic control in 2020-2021

The disparity of evidence brings us to the second key unknown we had previously identified: what have we learnt about the role that transmission among children and adolescents has played at the population level? Epidemiological data coming from countries that have prioritized continuous in-presence schooling

especially for the younger age groups, such as Iceland, France, Norway, Sweden, Estonia, Denmark, and studies monitoring the effect of re-opening of schools in countries that had previously kept them closed, such as Italy, Germany, USA, UK, can be greatly informative to understand the real-life epidemiological consequences of leaving complete school closure to be a last resort in controlling the COVID-19 pandemic. Although multiple contextual variables could be factored out to account for any incompatibilities in this large pool of evidence, three appear to be of key importance: the age of the school-children involved, the background prevalence, and the infection control measures initiated concurrently with opened educational facilities.

The lower the age of schoolchildren, the lower the risk of school-related uncontrollable infection clusters.

Evidence coming from retrospective and cross-sectional studies early in the pandemic [28-29] and from larger surveillance studies relating to the second peak of the pandemic, strongly supports minimal transmission rates in European day-care centres and primary schools, both for pupils and educational staff [30-32,42-44]. Significantly, this finding remains consistent also in areas of high COVID-19 background incidence and after systematic contact testing of each paediatric index case. Conversely, the only large outbreak of infection among younger children that has been reported in the literature is most likely explained by particular epidemiological features and does not provide conclusive counterevidence [33]. For older children and adolescents, larger or more numerous clusters of COVID-19 traced back to school environments have been evidenced, albeit very rarely, pointing to a potentially non-negligible transmissibility of Sars-CoV-2 in older age groups that could be explained by social as well as biological factors [13,34-35].

We should target community transmission first to protect educational settings, and not vice versa.

Recent empirical work from multiple countries that correlates school re-opening to local Rt direction changes and secondary infection clusters increasingly confirms earlier findings of minimal contribution of educational settings to the community COVID-19 growth rates [36-38,52-54]: open schools of all grades may be considered safe and will not act as amplifiers of Sars-CoV-2 spread at times of low COVID-19 background prevalence. In fact, it appears that adults, and not children, play a key role in bringing the virus into their households [39,55], and that in-school COVID-19 incidence is directly consequential to local background prevalence [40,41,56,57]. An Italian study demonstrated that the COVID-19 incidence in young adults (20-49 year-olds) was the earliest to peak only to be later followed by younger age groups, making young adults the likeliest main drivers of the second pandemic wave in Italy. With data coming from 97% of Italian public schools, this multidimensional study provides no evidence of a driving role for schools [36,52]. This observation is further corroborated by a studies revealing young adults as consistently the group with the highest incidence of COVID-19 during the second wave [43,44]. Evidence seems to suggest that policies targeting young adults could be significantly more effective than those targeting children and adolescents, which could then consequently be themselves partly protected from the infection.

Potentially successful alternative strategies and proactive measures avoiding school closure are available both at general population level and within schools.

Although high-quality evidence is still lacking to confirm no benefit in pandemic control in countries that relied the most on school closure and reciprocally no negative impact from minimizing school closures, reports found in the grey literature, in particular by the ECDC, do imply such a trend. The modelled protective potential of school closures [45] appears to be comparable to that of other non-pharmaceutical interventions (NPI), such as bans on mass gatherings or closure of non-essential businesses, implying that widespread school closures could be circumvented through ready employment of alternative strategies, while still achieving minimized Sars-CoV-2 spread. This was exemplified in real-life by the minimal and only temporary closures of Taiwanese schools throughout 2020 [46]. Furthermore, as synthesized in a large systematic review [47], multiple organizational, environmental and surveillance measures have been implemented heterogeneously worldwide to minimize the risk of in-class infection, including highly effective test-and-trace strategies, decreased class size, opening for specific cohorts in a staggered timetable, lessons held outdoors, physical distancing as well as hygiene measures in the classroom, the creation of social bubbles limiting

contacts between those who rarely meet, and the instruction to stay at home when sick [48-50]. Although successfully curtailed school-related outbreaks are less likely to be reported in the literature than outbreaks that have occurred, we have sufficient real-world evidence indicating that different types of infection control measures may effectively either avert or minimalize COVID-19 clusters among students [51-54]. While the efficacy of each measure has been extensively modelled, very few experimental and quasi-experimental studies have been published assessing the effectiveness of specific measures, including one finding that lower physical distancing policies may safely be adopted in school settings [55]. A larger pool for evidence extrapolation is now needed to better tailor guidelines for safe school re-opening. Acquiring this data would provide critical knowledge for all future cost-effective policymaking minimizing educational losses even at times of high-intensity coronavirus spread in the community.

Prolonged school closure may be detrimental not only to education, but also to health:

Across the globe, educational facilities hold a pivotal role in the promotion and maintenance of long-term health, which is complementary to their didactic role. While online schooling partly ensured the continuity of their didactic role, school-based screening and prevention programs were severely disrupted throughout 2020-2021. More time will need to elapse before the consequences of such loss become evident, but a vast heterogeneity of the potential harmful consequences that prolonged school closure and home confinement introduces for the school-aged population and their families, were recognized early in the pandemic by the scientific community operating in the field of developmental paediatrics [56,57] and child psychiatry [58]. Multiple streamlines should be included in such a lifelong investigation of today's youth, examining changes in the epidemiology of obesity and malnutrition [59], immunization rates, unattended domestic violence and child abuse [60], delays or precocity in cognitive, physical or social growth [57], later diagnoses of developmental conditions, and overall rates of health inequity [61]. However, one year of pandemic has been sufficient for the emergence of one indication of concern: a potentially increased burden of paediatric mental health disorders.

Even on its own, a public health emergency creates multiple stressors for children and adolescents irrespective of their previous mental health status, due to fear of infection, elevated levels of stress and anxiety of caregivers [62,63] and recommended or mandated social isolation [64]. These are further exacerbated with school shutdowns, especially if protracted to an indefinite time, and are supplemented by other stressors, including a disrupted routine, reduced socialization and physical activity, increased screen time and social media consumption, increased boredom, unhealthy or insufficient nutrition, exposure to parental burnout [63], stressors related to school dropout, and others. The cumulative effect of these stressors was partly registered in low-to-high quality studies published early in the pandemic and during lockdowns, consistently finding scores above thresholds for psychological distress, anxiety, depression in substantial a percentage of participants [64-69] and, when comparison was possible, higher than in pre-pandemic cohorts [70]. Adolescents were found to represent a particularly vulnerable cohort [71]. Concomitantly, the clinical frontlines reported both a significant decline in the incidence of admissions for psychiatric emergencies during lockdowns [72-74] and increased suicide ideation and self-harm rates [75]. Such a rise in psychiatric emergencies overall, and specifically in suicide behaviours, is already documented in manifold reports and news article easily found through a Google search: we now await high-quality published studies empirically confirming this alarming trend beyond the grey literature, framing it developmentally as well as clinically. In the difficult trade-off of school closures as pandemic mitigation strategies, policymakers will need a larger body of strong evidences regarding the so-called "hidden epidemic" hitting the younger populations.

Conclusions

Overall, opening schools and keeping them open in the context of the Sars-CoV-2 pandemic is theoretically possible, although behaviourally challenging and unfeasible if educational facilities or testing services are inadequate. Based on the data synthesized here, we can establish that, contrary to other respiratory viruses, children are not the primary targets of Sars-CoV-2 infection, transmission and disease, and schools may avoid becoming infection hubs for them, their teachers, the educational staffs and their households. It also appears that the second wave of the Sars-CoV-2 virus spread in the WHO European region has been unrelated to

school re-opening. The pandemic exit strategy should necessarily prioritize an increased vigilance towards signs of negative health outcomes of the public health emergency on the younger population. A redeployment of public resources in such a direction might soon become necessary: the urgency may shift away from COVID-19 and towards increased prevalence of non-communicable and mental health disorders in the general population. We urge public health institutions across the globe to continue planning rescue programs and school restructuring in the near future to overcompensate for all that has been lost now, to avoid the future blame of the increasingly labelled *Covid generation* for not having used today all the available evidences to protect their long-term global health.

In conclusion, the clear benefits justifying the indiscriminate use of school closures as first-resorts at times of intensified viral spread in the community may increasingly no longer be current. Larger and longer prospective studies with widespread screening and mechanistic genomic tracing are now needed for risk stratification for all virus variants of concern, in different socio-economic contexts, background demographics and school designs. It is our duty to encourage investments in this type of research and best-informed policymaking, and to discourage all generalizations and unverified assumptions in politicized debates for school closure or opening by the lay public.

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