COVID-19 and School

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The COVID-19 pandemic has led to an unprecedented closure of schools in terms of duration. The option of school closure, SARS-CoV-2 initially being poorly known, was influenced by the epidemiological aspects of the influenza virus. However, school closure is still under debate and seems unsupported by sure evidence of efficacy in the COVID-19 era.

Keywords: SARS-CoV-2 ; COVID-19 ; children ; adolescents ; secondary transmission ; molecular swab ; non-therapeutic intervention ; influenza virus ; variants ; recommendations ; psychological aspects

1. Introduction

In March 2020, due to the SARS-CoV-2 spread, most countries decided to close schools, including Italy. The option of school closure was strongly influenced by the analogies existing between COVID-19 and the influenza virus. In the past, school closure effectively contributed to mitigate the diffusion of influenza epidemics [1]. However, the debate is still open and school closure seems not supported by sure evidence of efficacy against SARS-CoV-2.

Although the evident and unquestionable beneficial impact of in-person attendance of teaching programs, for students, the current pandemic forced a thorough risk assessment to avoid the possible outbreak of infections in the school setting. To date, in Italy, 73% of youth and children attend school lessons by accessing the remote teaching system (distance learning). The new Prime Minister's decree, effective on 6 March 2021, established the school closure in those regions considered at high risk of viral spread, leaving the decision to the regional governors in case of mild or low risk regions [2]. The schools were closed due to the unfounded conviction that children could represent the major vectors of the SARS-CoV-2 domestic transmission, as observed for the influenza virus [3].

Currently, some early Chinese data seemed to confirm the role of children in the transmission of the infection, although they usually present a mild or completely asymptomatic form of the disease [4]. Public opinion and political communication have contributed to keeping schools closed by claiming that schools could act as infection amplifiers. The closure concerned up to 90% of students worldwide, with the exception of Sweden, where such restrictive lockdown measures were not adopted [5].

Observational studies suggest that school closure might achieve a reduction in the incidence of viral transmission. Conversely, studies sustaining school reopening highlight that the disease is generally mild in children, emphasizing that children play a less important role in the infection's transmission, if compared to adults. Even transmission from children to teacher or other members of the school staff would not seem statistically significant [6].

Following the first wave of SARS-CoV-2 diffusion, the choice to reopen schools differed from country to country, as did the choice to apply dedicated medical procedures. The schools were closed once again after the identification the UK viral variant, despite lack of information concerning the exact impact of the B.1.1.7 variant on children [7].

In this narrative review, we aimed to discuss the available literature on SARS-CoV-2 spread among children and adolescents, and especially in the school setting. We investigated why children seem less susceptible to severe disease and less involved in secondary transmission; we also tried to define the efficacy of school closure, through an overview of the effects deriving from the different choices adopted by the various European and extra-European countries, trying to identify which, among the preventive measures recommended, could be effective for a safe school reopening, also taking into account the effects of the vaccinations programs and the new emerging viral variants. Finally, we also focused on the psychological consequences of such a prolonged school closure in children, adolescents and their families.

Moreover, it appears clear that online learning favours urban and more developed areas, due to a lack of network's resources, the unavailability of electricity and electronic devices in rural areas, widening the disparity between the poor and the rich, instead of uniting the nation in the fight against COVID-19 [8]. For example, the Ethiopian government failed to make interventions to support the marginalized rural students of any level of education [9]. Ethiopia also recommended

private schools to explore methods to either cancel fees or defer payments until parents can afford to pay. Indeed, reduction of incomes due to the COVID-19 economic crisis may also lead to shifts in enrolment from private schools to public schools, adding further pressure on public education finances [10].

In Table 1, we summarized the available studies investigating SARS-CoV-2 transmission in the school setting. SARS-CoV-2, children, COVID-19, influenza, and school were used as key words in our literature research, updated to 29 March 2021.

2. SARS-CoV-2 Management at School

The school management of SARS-CoV-2, to avoid its spread, is composed of two steps. The first involves handling a “suspicious” case (a child showing typical symptoms of COVID-19). In this case, an isolation room is necessary to isolate the subjects until the swab results are ready [11]. Moreover, in all countries, experts agree that children should refrain from attending classes if they show symptoms.

The second step involves handling a “confirmed” positive case; in this case, the time required before readmission to school varies among the various countries. More specifically, such a period ranges from 7 days in France [12], to at least 10 days in Spain [13], and 14 days in countries like India [14].

All countries require quarantine for close contacts of the index-case, except for Luxembourg. In this country, none of the contacts are isolated; however, the whole class (staff and students) is tested with a molecular swab; if the latter proves negative, classes may resume [15]. This approach opens the debate about whether the decision to have preventive quarantine, as happens in the other countries, may indeed be based on economic considerations.

One of the essential recommendations by all European countries is to focus on the optimal ventilation of school premises. One interesting approach could be based on the filtration systems on aeroplanes, where the risk of COVID-19 infection is markedly lower than in buildings such as offices or schools [16]. The International Air Transport Association (IATA) decided to introduce, in addition to conventional prevention measures such as a negative test before boarding, use of face covers during the flight and careful hand hygiene, the most important novelty in terms of appropriate airing, namely fresh air recirculation and recycling in the form of High Efficiency Particulate Air [17]. Handheld HEPA filtering units appear to be an ideal solution for air filtering, placed depending on the size of the room, number and age of the people inside it [18].

In Italy, the first consensus document on the prevention and protection of SARS-CoV-2 spread after school reopening was drafted by technical-scientific committee (CTS) on 28 May 2020, in which the importance of physical distancing by at least one 1 m between students and between staff members was highlighted. The importance of face covers, especially when moving around the school (when physical distancing is impossible), was underlined and, in this regard, “students were always expected to wear a face mask in school, except during physical education classes and while on a lunch break” [19]. Nevertheless, in a review by the World Health Organization (WHO) dating back to 21 August 2020 , the following guidelines were provided regarding the use of masks, depending on age: children up to 5 years of age are not required to use a mask; among children between 6 and 11 years of age, face mask use depends on the local epidemiology situation, paying specific attention to its impact on a child’s learning ability; finally, children of 12 years old and more have to follow the same measures for adults.

These recommendations by the WHO, together with the United Nations Children’s Fund (UNICEF), are becoming widespread in several countries in Europe and other continents, which recently updated their instructions regarding the use of face masks [20]. Another important measure for prevention is hand hygiene at regular intervals, which is something children should be advised and encouraged to do, especially in younger age groups where contacts with the surrounding environment are multi-faceted and heterogeneous [14].

3. A Changing Picture: COVID-19 Variants among Children

The impact of COVID-19 variants in a school environment is uncertain. Although the media have reported an increase in hospital admissions and a rise in serious forms of respiratory disease, it is not yet clear if there might be a correlation between the viral spread and the school attendance [21].

According to a survey by Davies et al., the new variant (“traditional UK variant”, VOC 202012/01 also called B.1.1.7), firstly recorded in the south of England, appears to be 56% more transmissible than the pre-existing variants. Its involvement in a more or less serious form of the disease is not yet clarified; nevertheless, the authors have concluded that its higher transmission rate may lead to the failure of national control measures, unless vaccines start to be inoculated and closure of primary, secondary schools and universities is implemented [7]. According to a report by the

Public Health England, the transmissibility of this viral variant, in subjects older than 20 years, is 39% higher compared to the wild-type SARS-CoV-2; on the other hand, among children of school age younger than 10 years, it appears to be 46% lower than among adults [22].

More recently, data from the United Kingdom seem to indicate that children are also less susceptible to the infection caused by two of the variants currently causing the greatest concern in Britain, represented by the VOC 202012/01, with 109,093 confirmed and probable cases between 1 October 2020 and 1 March 2021 , (case fatality 2.6% among the general population), and a South-African variant, VOC 202012/02 (also called B.1.351), accounting for 226 confirmed and 76 probable cases between 1 October 2020 and March 2021 (case fatality 2.3% among the general population) [23].

A study by Brookman et al. has focused on two groups of patients aged 18 or younger, admitted to King's College Hospital during the two pandemic waves: twenty of them were admitted between 1 March 2020 and 31 May 2020, sixty between 1 November 2020 and 19 January 2021. The frequency of severe forms requiring ventilation support or oxygen therapy appears rare during both of these periods. The study has proved that, even though a smaller number of children and young adults was admitted to hospitals during the second wave of the pandemic, they do not have to suffer from a more severe infection form. This suggests that the infection caused by the B.1.1.7 variant seems no different from the one caused by the original strain [24].

On the other hand, paediatricians from Israel have reported that, contrarily to what happened during the first pandemic wave, "more than 50,000 children" were tested positive only in January. This might be related to the emerging of the more contagious UK variant: the Director of the Immunotherapy Laboratory in Israel has concluded that, since the daily number of cases among children younger than 10 has risen by 23% after the new variant appearance in Israel, even though it has not yet been shown that the latter is more dangerous for children than the original strain, it might be advisable to reopen schools gradually in order to follow the infection pattern more carefully [17].

Similar concerns have been raised in Corzano, a village in the province of Brescia (with a population of about 1500 individuals), where, on 3rd February 2021, 10% of the inhabitants were tested positive, with children from primary or nursery school accounting for 60% of the total [25]. Discussion about the new variant called B.1.617 (often called—Indian variant) is not the aim of this review, but currently new updates and new scenarios about its transmission are emerging. According the 'Our World In Data', COVID-19 vaccination coverage in India, up to the 10 May 2021, is 9.7% of the total population with at least one dose. In European countries, instead, the median one dose vaccination uptake is 31.6% of the total population [26].

Such a low vaccination coverage is probably the main reason for the increased mutation rate that occurred in SARS-CoV-2. In India, evolution and adaptation related SARS-CoV-2 diversification has been recently observed. There are three distinct Indian lineages within B.1.617, with distinct mutation profiles: B.1.617.1, B.1.617.2 and B.1.617.3 [27][28].

Lineages B.1.617.1 and B.1.617.2 were reported in India since December 2020; over the past eight weeks, there was an increase in the number of reported cases and deaths. According to the literature, there is very little information about the severity of B.1.617 lineage in the other countries [29]. Lineage B.1.617.3 has been firstly detected in India in February 2021; later, it was found in the United Kingdom, Russia and USA [30]. Even though all three lineages contain the mutation L452 R and D614G, both associated with increased transmissibility, lineage B.1.617.2 seems to be as transmissible as B.1.1.7 (the dominant UK variant) [31].

Further studies are still underway, and available data are not sufficient to assume that there may be an increased risk of viral susceptibility and spread among children and young people in general. Again, the disease caused by variants of the virus, in children, seems to have the same characteristics as the original strain.

4. "What Doesn't Kill Me Makes Me Stronger": Are We Sure? Psychological Aspects of the Pandemic

On 16 June 2020, the Italian Ministry of Health informed that the lockdown phase 'which had just been completed' led to a situation of stress among children and teenagers in our country, with negative consequences not just in terms of their physical health, but also on their emotional–psychological condition [31]. The Undersecretary of State for Health underlined that these were the conclusions from an Italian survey, conducted at the Gaslini Hospital (Genoa), on the psychological impact of the COVID-19 pandemic in Italian families [32]. The study analysed data from online questionnaire involving 6800 respondents.

Relevant behavioural changes were reported in two groups of children, aged < 6 and 6–18 years, with a rate of 64.3% and 72.5%, respectively. The first group also showed increased irritability (34.7%), restlessness (18.6%) and separation anxiety (16.4%), while in the second group, the behavioural changes more frequently entailed somatic components, for example shortness of breath (71.3%) and difficulty in getting asleep then awake again. It also appeared (using the SleepScore, SubUse and COVIDstress methods) that the severity of dysfunctional behaviours in both groups was closely related to the distress experienced by the parents themselves in dealing with quarantine (with a significant p-value of <0.0001). Since June 2020, the Italian freephone helpline for psychological assistance received over 50,000 calls, and 9.5% out of the total came from students [31].

[33] has shown a more severe psychological impact of COVID-19 among females (the male gender seems to be a protective factor against negative feelings) and among students living in regions where the incidence of COVID-19 is higher. More specifically, a feeling of sadness appeared to be remarkably more frequent among females (84%) than in males (68.2%), and especially significant in the 14–19 years age range; it has been assumed that the primary cause of this feeling might be loneliness, associated with the lack of social contacts generally established in a school setting. Finally, 48.7% of girls reported that they felt like crying every day (compared to 13.4% in males, p-value < 0.001). A study conducted in the region where “everything began”, Hubei, collected data from 1784 students after an average of 33.7 days in lockdown, reporting symptoms of depression and generalized anxiety in 22.6% and 18.9% of cases, respectively [34].

Saurabh et al. [35] interviewed 121 subjects, children and teenagers, average age 15.4 years, who said that their prevailing thoughts were associated with feelings of anxiety (68.6%), hopelessness (66.1%) and concern about the future (61.9%).

A recent study by Qin et al. [36] covered a large section of the population (almost two million subjects) in the province of Guangdong, whose average age was 12 years; through a questionnaire, the study aimed at assessing the mental health outcome between 8 March 2020 and 30 March 2020. A total of 10.5% subjects reported a significant psychological distress and, among them, 51.5% were girls. Moreover, as previously mentioned with regard to Italian students, the negative impact in terms of mental health appears to have been higher in regions with a higher positivity rate, compared to those with a lower incidence of the virus.

Before the COVID-19 pandemic, the prevalence of mental health disorders among children and adolescents was 13.4% [37]; now, one year after the global epidemic began, there are still few longitudinal studies, nevertheless the conclusion is that an increase in disorders related to generalized anxiety and episodes of depression has been reported and will continue to be recorded in the near future [38].

With regard to parents’ “thoughts” regarding this new “distance learning” approach and its impact on their children, a study [39] involving 6.720 parents from 7 different countries showed that 19.2% considered the quality of online teaching to be extremely poor, and 45% perceived the support provided by schools to students learning from home as lacking.

Furthermore, parental welfare was part of the assessment by Cusinato et al. [40], who concluded that many mothers perceived low levels of well-being and self-control and exhibited higher levels of anxiety compared to the general population. This family distress situation was also highlighted in a paper by Marchetti et al. [41], associating parent’s psychological distress as a risk factor for the development of externalizing problems and hyperactivity in children.

Finally, in a currently under review study [42] 69 patients were interviewed (43 adults and 26 children) who had participated in an earlier transversal neuro-imaging study regarding the development of social emotions. The scores for depression reached clinically significant levels in 32.56% of respondents (4.65% of them meeting at least one of the criteria for diagnosing a major depression episode).

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