Does school closure help in the prevention of the spread of COVID-19?

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Date of Review: [31- MAY-2020 (version 3)]
Last Updated: [10-JUNE-2020 (version 3)]

This rapid review summarizes the available evidence on the efficacy and safety of school closure as a mitigating measure in the spread of coronavirus 2019. This may change as new evidence emerges.

KEY FINDINGS

At present, there is still inconsistent evidence over the impact of school closure as a mitigation strategy during the COVID-19 pandemic.

- Non-pharmaceutical interventions (NPIs) around the world including mandatory school closures were implemented in response to the COVID-19 pandemic. (1)
- Modeling studies and indirect evidence on school closure in the prevention spread of COVID-19 produced mixed results. Results of modeling studies varied as baseline characteristics of the simulated population, epidemiologic factors included, and data assumptions made also varied.
- The Center for Disease Control and Prevention supports the role of school closure in response to school-based cases of COVID-19 for decontamination and contact tracing. (2)
- Different organizations have released guidelines and planning considerations on school closure and implementation of safe back to school program. (3-5)

RESULTS

Non -pharmaceutical interventions (NPIs) (including school closures) in response to the COVID-19 pandemic were implemented in different degrees among countries. According to the data gathered from other countries, it is still uncertain whether school measures are effective in a coronavirus outbreak, most specifically COVID-19, since transmission dynamics seem to be different. [6]

Countries like Sweden and Nicaragua which adopted a relatively relaxed approach to COVID 19 (including non-closure of schools) faced higher case and death rates over the past months. The implementation of other NPIs, including schools in other countries (Japan, South Korea, Singapore, U.S., Italy) were closed, was believed to have contributed to mitigating the disease spread. The individual effects of these interventions were not quantified and documented.

The timing of implementation was observed to be critical in the overall effect of the intervention. This was exemplified by the situation in the United Kingdom wherein recommendations for standard containment approach were not adopted right away. Immediate modification of policies could have limited death rates. The experience of Taiwan, however, appeared that transmission rates may be minimized without widespread planned school closure.

Scientific modeling studies and the systematic review included in this review revealed an inconsistent impact of school closure as a contributory mitigating strategy in COVID-19 disease spread. Its independent attributable effect from all other interventions was not identified. The applicability of the study findings depend on the characteristics of the modeled or simulated population and if the assumptions made will hold true in a different setting.

CONCLUSION

- There is still inconsistent evidence to support school closure as a strategy in the prevention of the spread of COVID-19.
- The applicability of the study findings depend on the characteristics of the modeled population and if the assumptions made will hold true in a different setting.

Declaration of Conflict of Interest

No conflict of interest

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Table 1. Characteristics of included studies

No.	Title/Author	Study design	Country	Population	Intervention Group(s)	Comparison Group(s)	Outcomes	Key findings
1	**School Opening delay Effect on Transmission Dynamics of Coronavirus Disease 2019 in Korea: Based on Mathematical Modeling and Simulation Study** [7] / Soyoung Kim, et al	Observational Descriptive study – Modeling and Simulation Study	Korea	Schools in simulated population	School Opening Delay	No delay in School opening in the simulated population model	• Simulation study through the mathematical model showed that school closure is an essential non-pharmaceutical intervention during a pandemic.	• Results showed that the government could reduce at least 200 and 900 cases assuming a 10-fold and 30-fold increase in transmission, respectively. • Extended school closure for ~8 weeks in total could reduce the number of cases and speed up the end of the epidemic; If the transmission rate will be increased 10 fold and 30 fold after school opening, the number of expected cases for children is increased to approximately 33 or 255 cases for 14 days. • According to KCDC, 80.9% of the total confirmed cases are related to the clustered outbreak that occurred in religious facilities and venues with close contacts such as in schools.
2	**Interventions to mitigate early spread of SARS-CoV-2 in Singapore: a modelling study**[8]/ Koo, Joel, et al.	Observational Descriptive study – Modeling Study	Singapore	The Simulated scenario in Singapore	Quarantine, School Closure, Workplace distancing, Combination intervention	Baseline scenario	• Implementing the combined interventions of quarantining infected individuals and their family members, workplace distancing, and school closure once community transmission has been detected could substantially reduce the number of SARS-CoV-2 infections.	• Compared with the baseline scenario, the combined intervention was the most effective, reducing the estimated median number of infections by 99.3%, 93%, 78,2% when basic reproduction number is 1.5, 2.0 and 2.5% • The combined approach resulted in the largest reduction in cases from baseline (93% reduction) • In the study, it was assumed that no individual has existing immunity to SARS-CoV-2.

3	**Impact Assessment of non-pharmaceutical interventions against coronavirus disease 2019 and influenza in Hong Kong: an observational study** [9]Cowling B Ali S, et al.	Observational Study – Modeling Study in a hypothetical pandemic scenario Observational Descriptive Study – Modeling study	Atlanta, Georgia Hong Kong	Simulated population in Atlanta, Georgia Simulated population of pediatric COVID-19 cases	School Closure Non-pharmaceutical interventions: border restriction, quarantine, isolation, distancing and changes in population behavior	Baseline population data Actual laboratory-confirmed COVID 19 pediatric cases	• Non-pharmaceutical interventions (including border restrictions, quarantine and isolation, distancing, and changes in population behavior) were associated with the transmission of COVID-19 in Hong Kong.	• Results show that although extended school closure may not reduce the magnitude of the peak of the epidemic, it can delay the peak by 100 days. • For the 30% attack rate scenario, we found that for every week the school closed (up to 12 weeks), the peak would be delayed by approximately 5 days. School closure for 84 days could delay the peak for approximately 60 days. • COVID-19 transmissibility measured by R1 has remained at approximately 1 for 8 weeks in Hong Kong • Limited predicted the effect of school closure in this study may be related to the more conservative assumptions • Although noted major effects of control measures and behavioral changes on influenza transmission, the magnitude of effects might differ due to the different transmission dynamics of COVID-19.
4	**The effect of control strategies to reduce social mixing on outcomes of the COVID 19 epidemic in Wuhan, China: a modeling study** [10]/ Prem K	Descriptive, Observational Study- Modeling study	Wuhan, China	Synthetic location-specific contact patterns in Wuhan	School closure, extended workplace closures and reduction in mixing in the general community	Baseline no interventions, no winter school break, no lunar New year holidays	• Non-pharmaceutical interventions based on sustained physical distancing have a strong potential to reduce the magnitude of the epidemic peak of COVID-19 and lead to a smaller number of overall cases. • The study projections suggest that premature and sudden lifting of interventions could lead to an earlier secondary peak, which could be flattened by relaxing the interventions gradually.	• Physical distancing measures were most effective if a staggered return to work is implemented: reduced the median number of infections by more than 92% in mid-2020 and 24% at the end of 2020. • Intense control measures (prolonged school closure and work holidays) reduced the cumulative infections by end 2020 and peak incidence while delaying the peak of the outbreak. • The effects of these strategies vary across age categories: reduction in incidence is highest among school children and older individuals and lowest among working-age adults.

								• Modeled effects of physical distancing measures vary by the duration of infectiousness: If the disease has a short infectious period (3 days), relaxing physical distancing in March could avoid 30% of cases in children and older individuals and fewer cases can be avoided if with a lower duration of infectiousness. Relaxing the measures a month later (April) may be needed to observe a larger effect. • Contributions of asymptomatic and subclinical cases were incorporated. Evidence suggests that they are also likely to transmit infection. [11]
5	**Impact of climate and public health interventions on the COVID – 19 pandemic: a prospective cohort study** [12]/ Juni P. Rothenbuhler M	Prospective Cohort study	Australia, US, provinces, and territories for Canada, countries and overseas territories around the world	144 Geopolitical areas worldwide	School closure, measures of social distancing, restrictions in mass gathering		• Strong associations were found for restrictions of mass gatherings, school closure, and measures of social distancing. • The composite of public health intervention (social distancing, school closure, and mass gathering) showed strong negative associations with epidemic growth during the follow-up period.	• Epidemiologic growth varied by continent, health expenditure, infectious disease vulnerability index, and distance to the closest established epidemic. • Negative associations with public health interventions all remained robust, except for measures of social distancing. • A multivariate model based on stepwise backward selection showed a strong negative association. • Post hoc analyses based on a different metric to estimate epidemic growth showed more pronounced reductions with public health interventions.
6	**School Closure and management practices during coronavirus outbreaks including COVID-19: a rapid**	Systematic review	China, Hong Kong, Singapore Taiwan	Schools in all Chinese cities, Schools in Hong Kong, Singapore, and Taiwan	School Closure	none	• The evidence to support national closure of schools against COVID-19 is very weak and data from the influenza outbreak suggest that school closure might have relatively small effects on COVID 19 infections	• In China, The combination of quarantine and social distancing was effective in decreasing the epidemic curve of COVID -19 in mainland China. The individual contribution of school closure was not assessed. [14, 15]

	systematic review [13]/ Viner, Russell, et al.						• More research on the effectiveness of school closure alone in reducing transmission has to be done. • Data from the SARS outbreak in mainland China, Hong Kong, and Singapore suggested that transmission in schools has no significant role in the outbreak. Additionally, school closure and activities like temperature monitoring did not mitigate the spread • Equivocal findings on the Modelling studies from the SARS outbreak produced different results regarding the effect of school closure in disease transmission	• Social distancing measures in Hong Kong reduced community transmission of COVID-19 by 44%, much greater than the 10-15% reduction in influenza transmission conferred by school closure along during the 2009 pandemic. [16] • A preprint modeling study for COVID-19 concluded that the package of social distancing measures in Wuhan, China was effective in the final size and peak incidence of the outbreak while delaying its peak at the same time. The effect of school closure alone was not accounted for. • In a non-peer reviewed study using the UK population and transmission dynamics in Wuhan, school closure as an isolated measure was predicted to decrease the total death rates by ~2-4%. The authors concluded school closure is insufficient to mitigate the COVID-19 pandemic spread in contrast to the seasonal influenza pandemic. [17]
7	**Changes in contact patterns shape the dynamics of the COVID-19 outbreak in China** [18]/ Zhang J, et al	Descriptive, Observational Study- Modeling study	China	Cities of Wuhan and Shanghai, China	Non-pharmaceutical interventions (social distancing policies, school closures, travel restrictions)	baseline	• Social distancing alone is sufficient to control COVID-19. • While proactive school closures cannot interrupt transmission on their own, it can reduce peak incidence by 40-60% and delay the epidemic peak.	• The modeling approach indicated that when all school contacts are removed during a COVID-19 epidemic, a noticeable decrease in infection rate, peak incidence and a delay in the epidemic will be noted. Transmission, however, is not interrupted. • During the social distancing period, daily contacts were reduced by 7-8fold, with most interactions limited in the household. • Children 0-14 years are less susceptible to SARS COV 2 infection than adults 15-64 years old and individuals older than 65

								years old are more susceptible to infection. • The largest number of contacts was recorded among school-aged children. • Contact patterns gathered may not be fully representative of other locations in China and abroad where social distancing measures may be different. • The study did not explicitly model differences between asymptomatic and asymptomatic individuals. • Modeling results focused more on the number of contacts and ignored the type of social contact
8	**Early transmission dynamics of COVID-19 in a southern hemisphere setting: Lima-Peru: February 29- March 30, 2020** [19]/ Munayco, C et al	Descriptive, Observational Study- Modelling study	Lima, Peru	Communities in Lima, Peru	School closure and social distancing interventions	baseline	• School closure and social distancing interventions have helped slow down the spread of COVID-19, with the nearly exponential trend shifting to an approximately linear growth trend soon after broad-scale social distancing interventions were implemented. • Noted in this study that the number of new COVID-19 cases continues to accumulate but transmission rates slowed down.	• A real-time short term (20-day) forecast was generated using a generalized growth model. • There could have an underestimated reproductive number derived from the incidence's growth of symptomatic cases because of the substantial fraction of asymptomatic cases.
9	**Strong Social Distancing Measures In The United States Reduced The COVID-19 Growth Rate**[20]/ Courtemanche, C et al.	Event-study design/ Cohort study	United States of America	US Counties	Social Distancing Measures (large event bans, school closures, closures of entertainment venues, gyms, bars, and restaurant dining areas and shelter-in-place orders)	-	• The study demonstrates the exponential spread in the absence of interventions. • No evidence to support that school closures influenced the growth rate.	• Adoption of government-imposed social distancing measures reduced the daily growth rate by 5.4 percentage points after 1-5days, 6.8 after 6-10 days, 8.2 after 11-15 days, and 9.1 after 16-20 days. • The point estimates were never close to statistically significant, but 95% confidence intervals could not rule out reductions caused by school closure up to 4-5 percentage points.

10	**The Impact of School Closure for COVID-19 on the US Healthcare Workforce and the Net Mortality Effects**[21]/ Bayham J et al.	Descriptive Study: a population survey	United States of America	US healthcare workforce and Mortality effects	School closure	-	• It is unclear if the potential benefit of disease transmission from school closures justifies the potential loss of healthcare workers from the state of reducing cumulative mortality.	• Twenty-nine percent of healthcare provider households must provide care for children 3-12 years old. • Per infection mortality rate cannot increase from 2% to 2.35% when the healthcare workforce declines by 15%; otherwise, school closures will lead to a great number of deaths than it can prevent.
11	**Effects of non-pharmaceutical interventions on COVID-19 cases, deaths, and demand for hospital services in the UK: a modeling study**[22]**/**Davies, N et al	Descriptive, Observational Study- Modelling study	United Kingdom	186 county-level administrative units in England, Wales, Scotland, and Northern Island	four base interventions modeled were school closures, physical distancing, shielding of people aged 70 years or older, and self-isolation of symptomatic cases	Baseline scenario	• Extreme measures are required to bring the epidemic curve under control and to prevent very large numbers of deaths and an excess of demand on hospital beds.	• When school closures, physical distancing, shielding of older people, self-isolation of symptomatic individuals, and the combination intervention were timed to center on the peak of the unmitigated epidemic, they each decrease the total number of cases by 20–30% and delayed the peak of the epidemic by 3–8 weeks on average • When implemented alone, none of the short duration interventions were estimated to reduce R0 enough to bring about a sustained decline in the incidence of new infections. • Deploying all four interventions at the same time is projected to have a greater impact on Ro • Intensive interventions with a lockdown period would need to be in place for a large proportion of the coming year to prevent health-care demand exceeding availability.