Research Article

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Covid-19 Incidence amongst Students at an International School with Strict Mitigation Measures at the Height of the Pandemic: a Retrospective Study

Banthisa Somboon[1], Krittin Kunjala[1], Dhave Setabutr[2,3]

[1] Faculty of Medicine, Thammasat University, Pathum Thani, Thailand.

[2] Chulabhorn International College of Medicine, Department of Otolaryngology Head & Neck Surgery, Thammasat University Hospital, Pathum Thani, Thailand.

[3] International School Bangkok, Thailand.

Correspondence: Banthisa Somboon, Faculty of Medicine, Thammasat University, Pathum Thani, Thailand, 12120. E-mail: icebsomboon@gmail.com

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Abstract

The purpose of this research is to evaluate COVID-19 infection among students in an educational setting that reinforces COVID-19 mitigation measures at the peak of the pandemic. Between November 2021 and April 2022, a descriptive study was conducted at an international school in Nonthaburi, Thailand. The school's COVID-19 mitigation measures were aligned with measures presented by the Thai Ministry of Public Health and the Ministry of Education. Students who attended school on-campus were tested with a rapid antigen test kit (ATK) for COVID-19 twice a week according to the school surveillance protocol. The parents or guardians of the students were responsible for performing the ATK tests and providing the results via the school's electronic database, with informed consent. The school's team of registered nurses and medical director recorded the database and performed contact tracing via phone calls with the parents or guardians of the infected students. Of the 52,757 ATK tests performed, only 237 (0.45%) tests were positive, and no cases of reinfection were reported. Among the 237 students who tested positive, 32 (13.5%) had a close-contact history to COVID-19 inside the school, while the majority (86.5%) had close-contacts from outside the school, such as household members and within the local community. Close-contact was defined per the Ministry of Health's guideline measures. Despite a surge in COVID-19 cases in the community, the implemented mitigation measures proved effective in reducing the spread of the virus in the school setting.

Keywords: Antigen test kit, COVID-19 mitigation, Mask-use, School infection, School health

What was Known

- COVID-19 infection had prompted school closure globally due to fear of disease outbreak amongst children and adolescents.
- Adverse mental health symptoms and health behaviors have been reported in students who endured school closures during the COVID-19 pandemic, with up to sixty percent of students scoring above risk thresholds for distress, anxiety, and depressive symptoms.

What's New and Next

- School transmission of a highly contagious communicable disease such as COVID-19 can be reduced even at peaks during a pandemic, when mitigation measures are implemented.
- The mitigation measures (e.g. decreasing the numbers of students per square footage in the enclosed spaces, ensuring adequate room ventilation, wearing facial masks, promoting personal hygiene) are effective to contain communicable disease within an educational setting, and therefore may be useful to help contain future disease outbreaks amongst students.

Introduction

Since the first wave of the COVID-19 pandemic in 2020, schools in Thailand have alternated between both online and onsite learning, more so dominated by online learning. Each decision to close or open schools was dictated on a national level by both the Ministry of Public Health and Ministry of Education. Therefore, school reopening was often accompanied by unexpected school closures either due to increased number of COVID-19 infections in the community or on school campuses. Nevertheless, Xu et al.[2] found that there is limited high quality evidence to evaluate the extent of COVID-19 transmission in schools, especially those that incorporated strict COVID-19 mitigation measures. Therefore, the purpose of our investigation is to evaluate COVID-19 infection rates amongst students inside an educational setting that reinforced strict COVID-19 mitigation measures.

Materials and Methods

Location and Study Period

A retrospective descriptive study was done at a selected international school located in Nonthaburi, Thailand from November 2021 to April 2022. The study was done at the height of the COVID-19 pandemic, according to the online database from Thailand Department of Disease Control, Ministry of Public Health, which displayed a heightened number of infection and death tolls in Thailand at the time (see Figure 1)[11]. This was in part due to the introduction of the Omicron variant of COVID-19 in November of 2021[3].

The Ethical Committee of the Faculty Medicine, Thammasat University, Thailand, approved this study in 2022 (MTU-EC-OO-0-098/65).

Population

The subjects included 1,685 students aged 3-18 years old who were actively enrolled and attended onsite classes during the school's reopening. Roughly thirty percent of the student body identified as Thai, while the rest consisted of multicultural and multinational expats from 57 different countries. The student population was divided according to school division: Elementary School (n=675), Middle School (n=416), and High School (n=594). Elementary School included children in classes from Pre-kindergarten to grade 5, Middle School included students enrolled in grades 6 to 8, and High School included grades 9 to 12.

Inclusion and Exclusion Criteria

The inclusion criteria were all students with COVID-19 test results (ATK or RT-PCR) who attended the on-campus according to the on-site schedule during the study period. Students who did not perform COVID-19 tests according to the school mitigation policy were excluded.

Implementation of COVID-19 Mitigation Measures

COVID-19 mitigation measures implemented in the school were guided by the Ministry of Public Health and the Ministry of Education. These included social distancing (i.e. setting student desks a minimum of 1.5 meters apart), decreasing the numbers of students per square footage in the cafeteria, ensuring adequate room ventilation utilizing a pre-pandemic ventilation system, wearing facial masks, and promoting personal hygiene[4]. In addition, all students were required to perform an Antigen Test Kit (ATK) for COVID-19 twice a week according to the school

COVID-19 surveillance protocol. The evidence of ATK test completion was linked to the student ID access, thus if they failure to submit their ATK test results, prevented access to the grounds. The ATK tests were fully funded by the school. The standards of these measures were regularly reinforced by the school personnel, and were also evaluated by the Ministry of Public Health, whose officers completed a site visit before in-person learning was approved. Students were constantly under adult supervision to ensure adherence to the mitigation measures and school administrators met weekly to ensure mitigation measures were being followed.

Data Collection

Parents or guardians of the students were responsible for submitting the ATK results via the school electronic database with informed consent. RT-PCR for COVID-19 was performed in disputable cases. The electronic database was confidential and accessible only to the school medical personnel and administration. To localize the source of infection, contact tracing was performed by the school registered nurses. Phone calls with parents or guardians of students who tested positive or were in close contact to COVID-19 cases were done subsequently.

Students who tested positive for COVID-19 infection were divided into two groups based on contact-tracing information: inside or outside the school. “Close contact” was defined as within 2 meters unmasked for greater than 5 minutes or having history of interacting, mingling, or living in the same household with a probable or confirmed case of COVID-19 in addition to exposure to their respiratory secretions[4].

Results

A total of 52,757 ATK tests were performed by 1,685 students who attended the school campus throughout the study period. There were 237 (0.45%) positive ATK tests with no evidence of reinfection. Out of 237 infected students, 13.5% (32/237) reported being in close contact to COVID-19 cases inside the school campus. All close contacts inside the school were classmates of the students (see Table 1). High school students accounted for more than half (19/32) of this number, followed by seven and six infected students from elementary and middle schools, respectively (see Table 1). Meanwhile, 86.5% (205/237) of the students were infected from sources outside the school; elementary school students accounted for most of the cases (82/205), followed by 73 and 50 high and middle school students, respectively (see Table 1). Additionally, results provided that 138 cases were related to community infection, while 65 cases

were related to household infection. During the first 12 weeks of the study period, there were only 8 infected students (one elementary school student, one middle school student, and six high school students) whom all had history of COVID-19 contact from an interaction outside the school. Whereas the last 12 weeks of the study period, 229 students, including 88 elementary school students, 55 middle school students, and 86 high school students) tested positive for COVID-19.

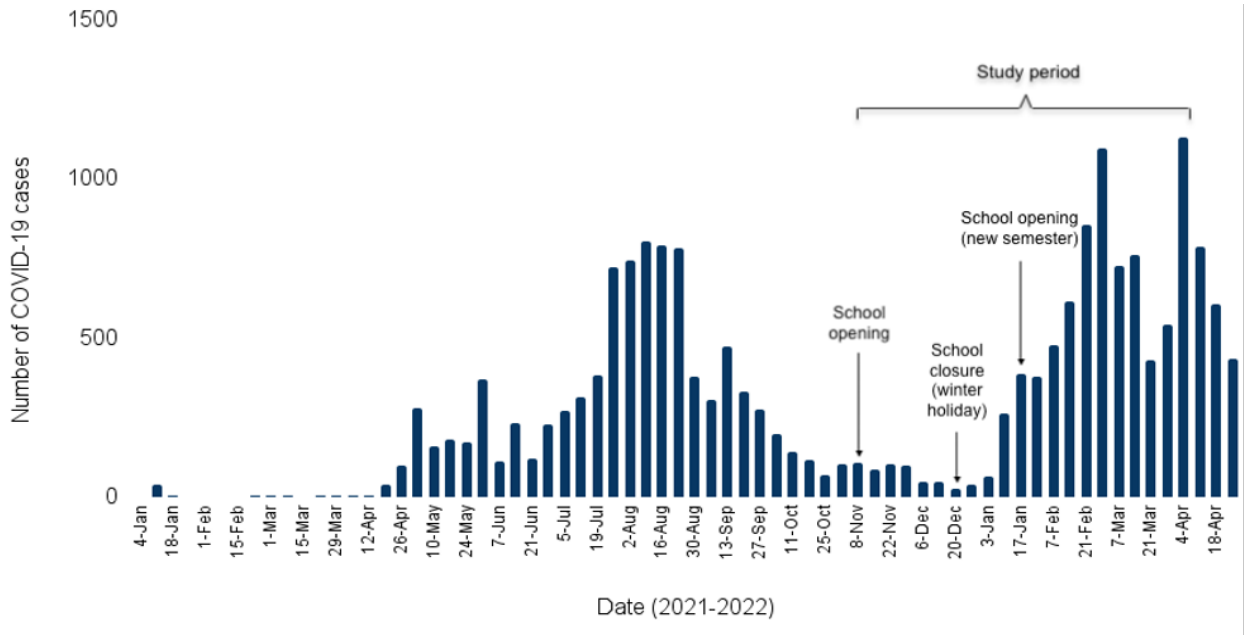
Based on contact-tracing information, a total of 736 students reported history of close contact to COVID-19 cases: 488 contacts from outside school, and 248 contacts from inside school (see Table 2). Results showed that 42.0% (205/488) of students with contact from outside school were infected (see Table 2). Meanwhile, only 12.9% (32/248) of students with contact from within the school were infected (see Table 2).

Table 1 Number of students who tested positive for COVID-19 infection

School Division	Number of students tested positive for COVID-19 infection		
	Inside school	Ouside school	Total
Elementary School	7	82	89
Middle School	6	50	56
High School	19	73	92
Total	32	205	237

Table 2 Number of students who reported close contact history to COVID-19 cases

School Division	Number of students with close contact history to COVID-19		
	Inside school	Ouside school	Total
Elementary School	64	184	248
Middle School	53	125	178
High School	131	179	310
Total	248	488	736



[a] Information from an open database for COVID-19 cases in Thailand, provided by Department of Disease Control, Ministry of Public Health, Thailand. Available from: https://ddc.moph.go.th/covid19-dashboard/.

Figure 1 Daily number of confirmed COVID-19 cases in Nonthaburi, Thailand [a], by date of reporting, January 4 2021–June 27 2022 (n = 19,253)

Discussion

Previous studies have been done aiming to identify the secondary transmission rate of COVID-19 infection amongst students in educational settings. COVID-19 transmission rates were found to be low within Australian and Italian educational settings, where an overall attack rate from all child cases to child contacts was 0.3 percent and 3.2 percent respectively. (5-6) Similarly, a cross-sectional analysis of COVID-19 outbreaks in England and contact-tracing studies from Ireland and Germany found low or even no onward student-to-student transmission, concluding that child-to-child transmission in educational settings is not the primary cause of COVID-19 outbreaks. (7-9) Nevertheless, a systematic review of the previously mentioned studies has concluded that there is limited high-quality data to quantify the extent of COVID-19 infection in schools. (2) Objective evidence of COVID-19 results from the subjects was missing in many studies as the COVID-19 data was retrieved from simple contact tracing. Moreover, most studies were performed during the lowest points of the COVID-19 pandemic, where the national restrictions for COVID-19 containment were able to ease after a long period of school closures[5,9].

In contrast to most literature, findings from Israel demonstrated mass COVID-19 transmission among high school students after school reopening[10]. Contact-tracing was performed to collect COVID-19 infection status, although without obtaining objective COVID-19 results. In addition, the study did not attempt to investigate the source of infection, therefore it was difficult to conclude whether the positive cases were infected from inside or outside the educational setting.

In the current study, a low percentage of on-campus COVID-19 infection was found at the height of the COVID-19 pandemic, where there were more than 25,000 confirmed cases per day in Thailand[11]. A larger number of infected students during the last 12 weeks of the study mirrors the overall increased number of COVID-19 infection in the community within Nonthaburi province (see Figure 1) and Thailand. Unlike the previous literature, our study subjects consisted of a heterogeneous group of multicultural and multinational students. The strength of the study was the collection of objective COVID-19 results via frequent ATK testing to confirm COVID-19 infection statuses. In addition, enhanced contact-tracing was performed to localize the source of infection. Therefore, the percentage of COVID-19 positive cases inside the school campus was represented more accurately than previous instances.

Regardless, reliance on parents or guardians to provide accurate ATK test results as well as contact-tracing information remain a limitation of the study. Since the parents or guardians had to perform ATK tests and provide results electronically, human error does exist with self-reporting. Moreover, this same concern can occur during contact-tracing, which was done via phone calls. Confounding factors such as individual risky behaviors and vaccination status were noted amid the mitigation measures taken by the school. Nursing remarks had indicated high risk behavior including shared eating utensils, leading to all individuals testing positive for COVID-19 thereafter. Vaccination status amongst students at the time was low as stock of valid vaccinations had yet to reach Thailand[13]. With a larger distribution of vaccination, the percentage of COVID-19 transmission is anticipated to be even lower within the educational setting.

Although the COVID-19 pandemic seems to be of less concern overtime, the next wave of mass transmission remains unpredictable. With newer burgeoning variants of Omicron occurring, the end of COVID-19 has not been clearly marked. Additionally, with the World Health Organization labeling monkeypox as a new infectious disease of concern, we are assured of

other pandemics[12]. Therefore, it is important to achieve effective mitigation measures in case of such unexpected events of any infectious disease in the future.

Conclusion

COVID-19 mitigation measures can effectively provide an environment where viral infection is low, despite a rise of infected cases in the community. The study demonstrates a protocol which can be used to heighten safety for students to continue onsite learning when a disease outbreak occurs.

Ethical Approval Statement

The study was approved by the Ethical Committee at Faculty Medicine, Thammasat University, Thailand. Approved in 2022 (MTU-EC-OO-0-098/65).

Author Contributions

BS and DS contributed to the study conceptualization, methodology, and data curation. BS and KK analyzed the data and wrote the original draft. BS, DS, and KK contributed in writing, reviewing, and editing of the manuscript. All authors read the manuscript and approved the manuscript prior to submission for publication.

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Conflicts of Interest

None declared.

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