

COVID-19 OUTBREAK IN A RELIGIOUS SECONDARY SCHOOL IN SETIU DISTRICT, TERENGGANU STATE OF MALAYSIA: INCIDENCE AND ASSOCIATED FACTORS

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ABSTRACT

Background: Coronavirus disease (COVID-19) has become a major public health threat in Malaysia. The infection has spread not only in community, but also in educational institutions among students. This study aimed to estimate the incidence of COVID-19 infection and its associated factors among students and staff in Setiu district religious high school in Terengganu state.

Materials and Methods: This study was a comparative cross-sectional study between the COVID-19 case and contact groups conducted in SM α (an anonymized name) high school in Setiu district, Terengganu. All notified cases that fulfilled the inclusion and exclusion criteria from 1st May 2021 until 24th May 2021 were included in the study. Descriptive statistics, simple and multiple logistic regressions were used for data analysis.

Result: From 1st May 2021 until 24th May 2021, there were 124 COVID-19 cases and 569 contacts to COVID-19 cases registered in Setiu. The incidence of COVID-19 infection throughout the SM α COVID-19 cluster was 17.89% (95%CI: 0.12, 0.25). Female gender, exposure to infected person in hostel, being quarantine in hostel, being quarantined in centralized quarantine station and presence of symptoms were the significant factors associated with COVID-19 infection in SM α COVID-19 cluster with an adjusted odds ratio (AOR) of 381.19 (95%CI: 33.66, 1987.22; $p < 0.001$), 85.63 (95%CI: 44.21, 251.73; $p = 0.003$), 101.25 (95%CI: 42.31, 301.22; $p < 0.001$), 57.61 (95%CI: 24.52, 198.71; $p < 0.001$), and 56.92 (95%CI: 15.73, 73.85; $p < 0.001$), respectively

Conclusion: Emphasis should be given to the identified risk factors for COVID-19 infection to facilitate timely detection of cases and avert COVID-19 transmission in community.

Keywords: COVID-19, school, associated factors, Terengganu, Malaysia.

1.0 Introduction

Coronavirus disease 2019 (COVID-19) which originated from the city of Wuhan, Hubei Province, Central China has spread quickly worldwide. COVID-19 is caused by a novel coronavirus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Li, Liu, Yu, Tang, & Tang, 2020). Globally, as of 25 June 2021, there have been 179,686,071 confirmed cases of COVID-19 including 3,899,172 deaths reported to the World Health Organization (WHO) (World Health Organization, 2021).

In Malaysia, there have been a total of 696,408 confirmed cases of COVID-19 in Malaysia as of 20th June 2021. Of the 2623 clusters identified in Malaysia since the start of the pandemic, 834 are currently active (World Health Organization, 2021). The Malaysian Ministry of Health reported that in the first quarter of 2021, there were 41 COVID-19 clusters involved educational institutions of which 15 clusters involved higher institution center, 11 clusters involved secondary schools, 10 clusters involved preschool and primary schools, and five clusters involved religious school (known as madrasah and Tahfiz centres) (Ministry of Health, 2021b).

Terengganu state of Malaysia, a state in the east coast of peninsular Malaysia recorded 11,160 cases of COVID-19 as of 28th June 2021 with 75 deaths. Setiu district which is one of the eight districts in Terengganu recorded 1,110 cases of COVID-19 with 5 deaths. Setiu district recorded 7 COVID-19 clusters which 4 clusters originated from Setiu itself while 3 other clusters originated from other districts in Terengganu (Awang, Hamzah, *et al.*, 2021; Ning, Awang, *et al.*, 2021). One of the recently large COVID-19 clusters in Setiu involved a religious secondary school named anonymously as SM α .

The first case of COVID-19 in SM α was identified from a teacher who was infected from her relative from a neighbouring district which was designated as a red zone district (district with COVID-19 cases of more than 40 within the latest 14 days) for COVID-19. SM α is situated in the centre of Setiu district and consists of 597 students, 62 teachers and 34 staff. This school provided hostel for 354 students while another 243 students resided outside with families. This SM α COVID-19 cluster infected a total of 124 individuals from the period of 1st May 2021 until 24th May 2021. The aim of this study is to determine the associated factors for COVID-19 infection among SM α students and staff to improve clinical and public health management in future should more COVID-19 clusters in secondary schools occur.

2.0 Materials and Methods

From 1st June 2021 until 20th June 2021, we conducted a comparative cross-sectional study in Setiu district, Terengganu state between the COVID-19 confirmed cases; and contacts to COVID-19 cases based on retrospective record review for all individuals investigated for COVID-19 notified to Setiu District Health Office, Terengganu from the period of 1st May 2021 until 24th May 2021.

The reference populations were all COVID-19 cases who studied or worked in SM α and the study samples were all COVID-19 cases and contacts to COVID-19 cases in SM α notified to

Setiu District Health Office between 1st May 2021 until 24th May 2021 who fulfilled study inclusion and exclusion criteria. The inclusion criteria for case group were individuals with laboratory (reverse transcription polymerase chain reaction (RT-PCR)) confirmed positive test for COVID-19 (Ministry of Health, 2021a). Meanwhile, the inclusion criteria for control group were contacts with epidemiological link to COVID-19 cases and laboratory (RT-PCR) confirmed negative test for COVID-19 (Ministry of Health, 2021a). Samples with incomplete record of 30% variables will be excluded from the study.

The sample size was calculated for each variable of associated factors for COVID-19 infection using power and sample size calculation software (Dupont & Plummer Jr, 1990) as well by comparison of two independent proportions. The largest estimated sample for each group was 321 using the proportion of COVID-19 contact status by the factor of female (0.51) (Awang, Yaacob, *et al.*, 2021), an estimated proportion of 0.4, 5% type 1 error, and 80% power. Therefore, the minimal sample size required is 642 individuals investigated for COVID-19.

Data were collected from Setiu district's CDCIS e-Notifikasi online registry (an online database for infectious diseases under the governance of Ministry of Health Malaysia) and recorded in patient's proforma. The retrieved information for independent variables included socio-demographic and clinical characteristics such age, gender, close contact status in hostel, place of quarantine and presence of symptoms. The dependent variable will be the COVID-19 status either confirmed cases or contacts to COVID-19 cases.

As for the operational definitions of the study, presence of symptom was defined as having symptoms of suspected COVID-19 case as outlined in the latest Malaysian COVID-19 guideline which are 1) having at least two of the following symptoms - fever, chill, rigor, myalgia, headache, sore throat, nausea, vomiting, diarrhea, fatigue, nasal congestion); or 2) any one of the following symptoms – cough, shortness of breath, difficulty in breathing, sudden onset of anosmia, sudden onset of ageusia; or 3) having severe respiratory illness (Ministry of Health, 2021a). Exposure in hostel is defined as being in close proximity or sharing the same hostel/classroom environment with a COVID-19 patient (Ministry of Health, 2021a).

Data entry and analysis were done by using SPSS Statistics (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp). Descriptive statistics with mean and standard deviation (SD), frequency and percentages were calculated. Simple and multiple logistic regression analysis were used to determine factors associated with COVID-19 infection among SMA students and workers. All significant variables with a *p*-value <0.25 from univariable analysis and clinically important variables were chosen for multiple logistic regression analysis. A *p*-value<0.05 was considered statistically significant.

3.0 Result

From 1st May 2021 until 24th May 2021, there were 693 persons in SMA were screened as part of contact tracing process with RT-PCR for COVID-19 after one confirmed case of COVID-19 (a teacher) was detected in the school. The female teacher taught Quran recitation to female students in hostel during evening session daily. Over the three weeks period, the

incidence of COVID-19 infection in SM α was 17.89% (95%CI: 0.12, 0.25) or 124 students with positive RT-PCR test were identified from contact tracing. No staff or teacher was detected to be positive of COVID-19 besides the index case. The remaining RT-PCR results for 569 contacts were negative. As for the inferential study, all 693 cases and contacts were recruited. Majority of COVID-19 cases were female, had exposure in school hostel, had no symptom and quarantined in school hostel prior to COVID-19 detection. Details are summarized in Table 1.

Table 1: Characteristics of students and workers in SM α , Setiu district, Terengganu (n=693)

Characteristics	Frequency, n (%)	
	COVID-19 Cases (n=124)	COVID-19 Contacts (n=569)
Age*	15.55 (\pm 2.88)	19.18 (\pm 11.06)
Gender		
Male	1 (0.8)	283 (49.7)
Female	123 (99.2)	286 (50.3)
Exposure in hostel		
No	5 (4.0)	430 (75.6)
Yes	119 (96.0)	139 (24.4)
Place of quarantine		
House	5 (4.0)	430 (75.6)
Hostel	106 (85.5)	109 (19.2)
Quarantine station	13 (10.5)	30 (5.2)
Symptomatic		
No	99 (79.8)	562 (98.8)
Yes	25 (20.2)	7 (1.2)

*Mean (\pm SD)

In the final model, multiple logistic regression analysis revealed female gender, history of exposure to infected person in hostel, being quarantine in hostel, being quarantined in centralized quarantine station and presence of symptoms were the significant factors associated with COVID-19 infection in SM α COVID-19 cluster with an adjusted odds ratio (AOR) of 381.19 (95%CI: 33.66, 1987.22; p <0.001), 85.63 (95%CI: 44.21, 251.73; p =0.003), 101.25 (95%CI: 42.31, 301.22; p <0.001), 57.61 (95%CI: 24.52, 198.71; p <0.001), and 56.92 (95%CI: 15.73, 73.85; p <0.001), respectively. Details are shown in Table 2.

Table 2: Factors associated with COVID-19 infection among students and workers in SM α , Setiu district, Terengganu by simple and multiple logistic regression (n=693).

Factors	Crude OR (95% CI) ^a	p-value ^a	Adjusted OR (95% CI) ^b	p-value ^b
Age	0.94 (0.90, 0.98)	0.001*	1.02 (0.95, 1.23)	0.629
Gender				
Male	1.00		1.00	
Female	121.71 (16.89, 876.91)	<0.001*	381.19 (33.66, 1987.22)	<0.001*
Exposure in hostel				
No	1.00		1.00	
Yes	73.63 (29.49, 183.82)	<0.001*	85.63 (44.21, 251.73)	0.003*
Place of quarantine				
House	1.00		1.00	
Hostel	83.63 (33.29, 210.12)	<0.001*	101.25 (42.31, 301.22)	<0.001*
Quarantine station	37.27 (12.46, 111.48)	<0.001*	57.61 (24.52, 198.71)	<0.001*
Symptomatic				
No	1.00		1.00	
Yes	20.27 (8.53, 48.15)	<0.001*	56.92 (15.73, 73.85)	<0.001*

*p-value <0.05 ^aSimple logistic regression ^bMultiple logistic regression

No multicollinearity and no interaction found.

Hosmer Lemeshow test, p-value=0.174

Classification table 94.2% correctly classified.

Area under Receiver Operating Characteristics (ROC) curve was 96.8%.

4.0 Discussion

The incidence of COVID-19 infection among all identified contacts in SM α was 17.89% (95%CI: 0.12, 0.25). For regional comparison in term of COVID-19 incidence in educational institutions, the incidence for COVID-19 infection in a higher educational institution in Sabah state of Malaysia was 0.96%, or 161 detected confirmed cases out of 16762 screened students and staff (Salvaraji *et al.*, 2020). Lower incidence of COVID-19 infection in the Sabah setting could be due to larger denominator of screened contacts, as the higher educational institute in Sabah comprised larger number of students and staff as compared to SM α which is merely a secondary school.

Our multivariable analysis showed that female group was significantly associated with COVID-19 infection as compared to male group when other confounders were adjusted. On the contrary, few of the previously published local studies reported on the significant association between male and COVID-19 infection (Awang, Hamzah, *et al.*, 2021; Sim *et al.*, 2020). Female group is postulated to be less susceptible to COVID-19 infection due to lower expression of ACE-2 protein and also protective effect of estrogen hormone (Klein *et al.*, 2020). The extensive spread of COVID-19 among female students during this cluster was due to close and repetitive contact between index case (female teacher) with female students every day during the Quran recitation sessions within a confined hostel room, of which being in close proximity in the same environment is well-known as a strong predictor for SARS-CoV-2 transmission (Awang, 2021; Awang, Yaacob, *et al.*, 2021). Hence, it is less surprising for students who had exposure to confirmed COVID-19 cases in the hostel to be at higher risk to get COVID-19 as reported in this current study. Further epidemiological investigation of the single case involving one male student revealed that he had stronger epidemiological link to his household family member diagnosed with COVID-19 as compared to epidemiological link to his COVID-19 positive female classmates, since household exposure posed higher risk for COVID-19 infection (Lei, Xu, Xiao, Wu, & Shu, 2020).

All the infected students in this current study attended schools during the COVID-19 cluster. As clusters and outbreaks are occurring in places where people interact with each other closely, transmission between adolescent students is likely to happen when schools are in operation, thus triggering a surge of cases in the community. As schools are operating on a normal basis even with strict COVID-19 standard operating procedures, we may anticipate increase contact rates among them particularly during their stay in hostel, decreasing the effectiveness of social distancing, which is the mainstay of the current mitigation strategy (Choe & Choi, 2020). Moreover, adolescents are known for their tendency to socialize and mobilize with their peers as part of their social developmental milestones (Awang, Ab Rahman, Sukeri, Hashim, & Nik Abdul Rashid, 2020a, 2020b; Awang, Ab Rahman, *et al.*, 2021). All these factors contributed to high transmission of SARS-CoV-2 virus among hostel dwellers which explained the high likelihood of extensive infection among students who were quarantined in hostel. Quarantine of students in hostel facilitated health authority in preventing SARS-CoV-2 from being spread to the family members and community.

As expected, our study reported that SARS-CoV-2 was 56 times more likely to be detected in symptomatic traced contacts as compared to asymptomatic traced contacts. This have been further confirmed with previous studies reporting that majority of COVID-19 patients initially presented with clinical symptoms which were mainly fever, cough, fatigue and expectoration (L. q. Li *et al.*, 2020; Zhu *et al.*, 2020). As for asymptomatic persons, study had reported development of symptoms later as disease progresses or during hospitalization (Yu *et al.*, 2020). This may be the case for asymptomatic traced contacts in this study but could not have been ascertained as we did not explore their disease progression. In the setting of communal or institutional clusters, anyone is at risk for acquisition of COVID-19, making it difficult to discern their epidemiological link or route of exposure. Hence, we need to prioritize screening among those who are symptomatic who presented to health facilities because they are more infective and pose significant threat of disease spread among the community, as reported by previous literature (Wu *et al.*, 2020).

There are some limitations that need to be acknowledged in this study. Data on comorbidities of students and staff were not explored as it was not recorded in the CDCIS e-Notifikasi

online registry. Moreover, laboratory findings for all confirmed cases were not studied and described as these data were recorded separately in cases' respective hospitals and were not shared in the CDCIS e-Notifikasi online registry.

5.0 Conclusion and recommendation

In conclusion, female gender, history of exposure to infected person in hostel, being quarantine in hostel, being quarantined in centralized quarantine station and presence of symptoms were the significant factors associated with COVID-19 infection in SMα COVID-19 cluster. Choe and Choi (2020) recommended substantial length of school closure (approximately 2 months) as part of broader community mitigation strategy in decreasing contact rates among adolescent students and community, and subsequently flattening the peak of epidemic curve. Healthcare providers should have high index of suspicion of COVID-19 if they encounter symptomatic patients (even they claim to have no epidemiological link to COVID-10 confirmed cases) and provide them with COVID-19 screening to increase case detection rate. As home quarantine is reported to be less effective in curbing the viral transmission, they should be isolated appropriately and early in centralized quarantine stations or in the same institutions for medical observation to curb the spread of virus to other close contacts and community effectively. As COVID-19 cases among adolescents in school frequently happens in Malaysia, COVID-19 vaccination to adolescents should be expedited prior to nationwide schools opening to prevent further increment of COVID-19 cases among adolescents.

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Declaration

Author(s) declare that we have no financial, consultative and institutional conflict of interest.

Authors contribution

Author 1: Conceptualization, data analysis, literature search, manuscript drafting and review

Author 2: Data entry, literature search, manuscript drafting

Author 3-8: Data collection, data entry, literature search

Author 9,10: Conceptualization, supervision, manuscript review

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