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Field Epidemiology Training Program, Division of Epidemiology
Department of Disease Control, Ministry of Public Health, Thailand
Tel: +6625903894, Fax: +6625903845, Email: osireditor@osirjournal.net, http://www.osirjournal.net

An Investigation of a SARS-CoV-2 Omicron Variant Cluster Linked to Nightclubs, Kalasin Province, Thailand, December 2021

Krittinan Boonrumpai[1]*, Chawisar Janekrongtham[1], Pichaya Sonthiporn[1], Orathai Suwanchairob[1], Prangsiri Nalam[1], Chonlada Siri[1], Wanich Rungram[2], Phanthanee Thitichai[1], Thanit Rattanathumsakul[1]

1 Division of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand

2 Kalasin Provincial Public Health Office, Ministry of Public Health, Thailand

*Corresponding author email: krittinan.boon@cpird.in.th

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Abstract

In December 2021, an outbreak of the SARS-CoV-2 Omicron variant linked to two nightclubs was reported in Kalasin Province, Thailand. This outbreak investigation aimed to understand its epidemiological characteristics, identify sources of infection, assess vaccine effectiveness, and provide control measure recommendations. This study analyzed investigation reports, interviewed all confirmed/probable cases, engaged in active case findings, assessed vaccine effectiveness among high-risk contacts, and surveyed the nightclub environment. This study found 246 confirmed and 338 probable cases, with a median age of 29 years (quartile1–quartile3 25–38 years). Over 40% (271/584) of cases had received at least two doses of vaccination. No severe cases or deaths were reported. Index cases were a Thai couple who traveled from Belgium and visited a nightclub, where the disease spread to 75% (12/16) of nightclub workers before reaching communities. High-risk contacts who received a booster vaccination significantly reduced SARS-CoV-2 infection risk compared with unvaccinated. (vaccine effectiveness 87.5%, 95% confidence interval 59.5–96.1). One of the suspected nightclubs was air-conditioned, crowded, and lacked compliance with measures, which were potential factors contributing to the outbreak. This study strongly recommends that individuals receive booster doses of the SARS-CoV-2 vaccine. Nightclub owners should adhere to COVID-19 public health measures to prevent disease transmission to the communities.

Keywords: COVID-19, SARS-CoV-2 Omicron variants, COVID-19 vaccines, disease outbreaks

Background

Coronavirus disease 2019 (COVID-19), a respiratory disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is a global health threat that mutates over time.[1] Some strains alter the transmissibility, virulence, and effectiveness of public health measures, defined as variants of concern (VOCs).[2] SARS-CoV-2 outbreaks emerged in Thailand in March 2020, and Thailand faced the first SARS-CoV-2 VOCs, Alpha variant, since December 2020.[3] By December 2021, almost all circulating VOCs were Delta.[4] The SARS-CoV-2 Omicron variant (B1.1.529) was detected in Africa in November 2021 and became the latest VOCs.[1,5] Evidence suggested the variant's potential to spread globally and overwhelm the healthcare system despite less severity.[1,5] While the reference method to detect the omicron variant is whole-genome sequencing (WGS), polymerase chain reactions (PCR)-based techniques, including single nucleotide polymorphism (SNP) genotyping and S-gene target failure (SGTF), were used as a proxy of Omicron variant detection.[5,6]

Transmissions of the Omicron variant have been reported in Thailand since 6 Dec 2021, in a man travelled from Spain.[7] The first locally transmitted Omicron cases were found on 20 December.[7] Nevertheless, no cluster of cases had been reported in Thailand.

On 23 Dec 2021, the Kalasin Provincial Public Health Office notified a group of Omicron variant cases linked to two nightclubs located in Mueang Kalasin District,

Kalasin Province. This investigation, conducted from 24 Dec 2021 to 7 Jan 2022, aimed to confirm the outbreak, characterize its epidemiological aspects, potential sources of infection, and the efficacy of vaccinations, and formulate suggestions for control measures.

Methods

Operational Definition

The patient under investigation for SARS-CoV-2 Omicron variant (Omicron-PUI) was any person with a positive reverse-transcriptase polymerase chain reaction (RT-PCR) for SARS-CoV-2 from 9 Dec 2021 to 7 Jan 2022, who were close contacts with confirmed/probable cases or had histories of visiting community areas that had been reported for COVID-19. The confirmed case was Omicron-PUI with a variant analysis result resembling Omicron variant from either SNP genotyping or WGS. The probable case was Omicron-PUI with a positive SGTF result by RT-PCR. Omicron-PUI with variant analysis indicated other variants than Omicron were excluded. The degree of separation from index cases for each case was classified. First-degree cases, second-degree cases and third-degree cases were those that had close contact with the index cases, first-degree and second-degree cases, respectively. Unknown-degree cases were cases without clearly linked to other cases. Individuals compatible with multiple degrees were placed in the degree closest to the index cases. Close contact was defined as any person who had contact with cases by either face-to-face contact within two meters for more than five minutes, in contact with secretions, or staying in the same closed space for at least 30 minutes. Close contacts who did not report wearing proper personal protective equipment were classified as high-risk contact (HRC), whereas those who did were classified as low-risk contact (LRC).

Descriptive Study

This study reviewed the COVID-19 situation in Kalasin Province, reviewed case investigations and laboratory reports of the index cases, interviews of the index cases via telephone, conducted source case investigation, contact tracing, and active case finding using methods complied with the Department of Disease Control (DDC) guidelines.[8] Active findings were conducted by announcing those suspected to be in close contact with the cases or had symptoms of fever, cough, sore throat, malaise, headache, muscle pain, nausea, vomiting, diarrhea, anosmia, or ageusia, to get RT-PCR for SARS-CoV-2. This study interviewed all cases via telephone using investigation forms and in-depth interviews with all first-degree cases, including symptoms and onset. The incubation period was calculated for symptomatic cases with information on last exposure date, defined as the number of days between the last exposure and the onset of symptoms.

Laboratory Collection

For Omicron-PUI, nasopharyngeal swabs were collected and placed into a sterile transport tube containing 2–3 mL of the viral transport medium, packaged at 2–8 °C, and sent to Kalasin Hospital for RT-PCR with SGTF detection or affiliate laboratory for RT-PCR test. Some positive specimens were sent to confirm the presence of the Omicron variant at the Regional Medical Sciences Center 7 Khon Kaen by SNP genotyping technique or at the National Institute of Health by WGS technique. HRCs were tested for SARS-CoV-2 via RT-PCR up to three times: at the time HRCs were identified, day 7, and day 14 after the last contact with cases. If SARS-CoV-2 was detected, this study processed those specimens following the same procedures as for Omicron-PUI.

Environmental Study

Two nightclubs linked to the index cases were surveyed using direct observation and worker interviewing using a checklist developed from the COVID-Free Setting framework, a COVID-19 measures bundle from the Department of Health.[9] Actual customers and nightclub density, while index cases have been contacted, were estimated. The unit “per 4 square meters” was used in density calculation to compare with the physical distancing standard provided by the Department of Health.[9] Environmental swabs were collected by purposive sampling at high-touch areas and air conditioners. Specimens were packed the same as Omicron-PUI specimens and transferred to the National Institute of Health for SARS-CoV-2 PCR.

Analytic Study

A retrospective cohort study was conducted to calculate vaccine effectiveness (VE) against Omicron variant infection among HRCs who had visited Nightclub K. Interesting exposures were vaccination status, dose of vaccine, and vaccine formula received at least 14 days before the test date obtained from the Ministry of Public Health Immunization Center Database. Principal outcome was SARS-CoV-2 detection using RT-PCR within 14 days after the last contact with cases. Analysis was done using univariable logistic regression for vaccination status, vaccine formula, age group, and gender (reporting in odds ratio (OR) with 95% confidence interval (CI)) and multivariate logistic regression for vaccine doses and formula adjusted by age group and gender (reported as adjusted OR with 95% CI). VE was calculated using

1–adjusted OR from the multivariate analysis. The sample size was calculated using the World Health Organization formula.[10] Given the expected attack rate in the unvaccinated group at 50%, anticipated VE of 65.9%, type I error of 5%, and desired precision width of 30%, 124 participants per group were expected for the analysis.[11]

Ethics Consideration

This study kept the information about the participants and the outbreak confidential and complied with the ethical principles in the Declaration of Helsinki. This study was done following the routine mission of responding to a public health emergency, so ethical approval was exempted.

Results

Context and Situation in Kalasin Province

Kalasin Province is a province located in Northeastern Thailand with 975,790 population in mid-2021. In December 2021, around 52% of the population received at least two doses of COVID-19 vaccination, but only 10% received the booster. SAR-CoV-2 RT-PCR with SGTF detection was available in Kalasin Hospital's laboratory since October 2021. There were no confirmed cases of the Omicron variant before 16 Dec 2021.

Descriptive Study

This study identified 584 cases. The female-to-male ratio was 1.14:1. The median age was 29 years (interquartile range (IQR) 25–38 years). Five percent (31/584) of cases were elderly. Almost all cases lived in Kalasin Province, giving a provincial attack rate of 47 per 100,000 population. About 40 percent of identified cases had received at least two doses of COVID-19 vaccination, but only six percent had received booster doses (Table 1). This study identified 590 HRCs from 491 cases, and 15.8% (93/590) of HRCs became cases after follow-up. This study obtained clinical characteristics of 35.6% (208/584) of the cases. Around 60% (124/208) were symptomatic. The most common symptoms were cough (51.9%), sore throat (45.2%) and fever (34.1%), respectively. For symptomatic cases with known last exposure (n=38), the median incubation period was 4 days (IQR 3–5 days). There were no reports of fatal or severe cases requiring oxygen or intubation. All cases improved after mandatory 10 days hospitalization.

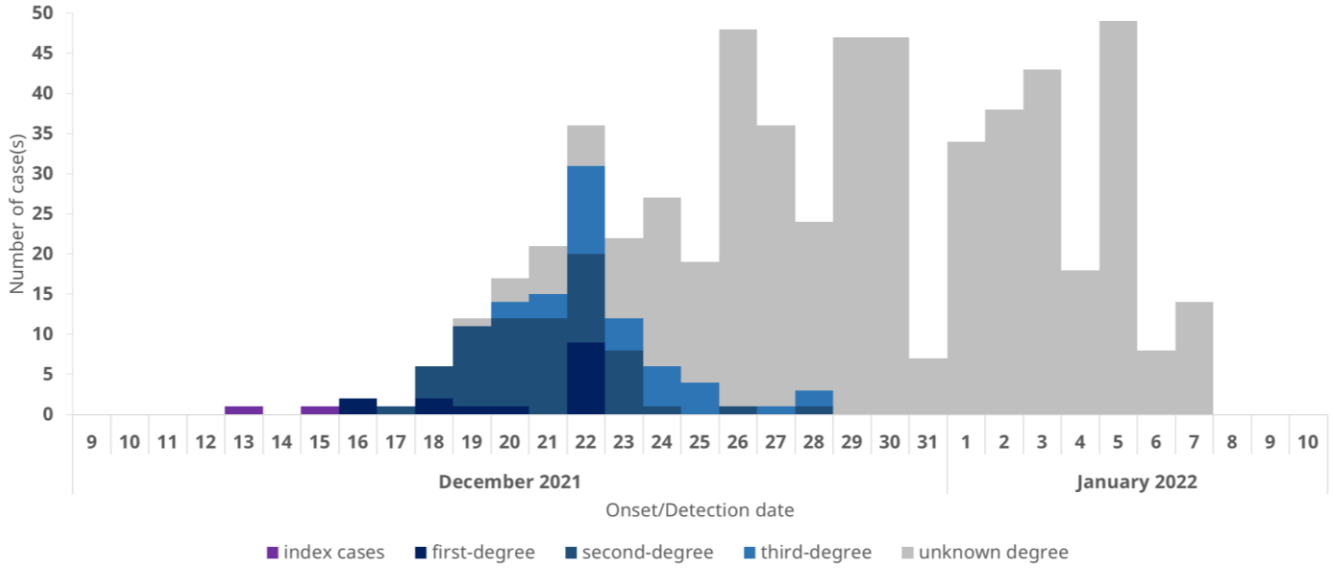
The index cases were a 47-year-old Thai couple who had received two doses of Comirnaty (BioNTech, Pfizer) vaccine. They worked at a nightclub in Belgium, denied close contact with people experiencing respiratory symptoms, and had a negative RT-PCR test for COVID-19 before traveled to Thailand via airplane. They arrived on 10 December and were tested again while quarantined in Bangkok Province. They were exempted from quarantine after negative testing on 11 December and took a plane to Khon Kaen Province before travelling by car with relatives to Kalasin Province. On 12 December, they dined with their family at Nightclub S and Nightclub K. They wore no masks and shared glasses with strangers while they were at Nightclub K. The index cases developed respiratory symptoms on 13 December and 16 December and were detected for SAR-CoV-2 with SGTF detection on 17 December. The specimens were sent for variant identification, which revealed the Omicron variant, sublineage BA.1 on 23 December. Source case investigation in the international airplane from Belgium to Bangkok Province and domestic airplane from Bangkok Province to Khon Kean Province revealed SARS-CoV-2 detection in four passengers, but no one had epidemiological linkage with the index cases.

Table 1. Epidemiological characteristics of confirmed and probable cases in the outbreak (n=584)

Factors	Number of cases	Percentage
Case type		
Confirmed case	246	42.1
Probable case	338	57.9
Gender		
Female	311	53.3
Male	273	46.7
Age (years)		
<10	55	9.4
10–19	105	18.0
20–29	197	33.7
30–39	90	15.4
40–49	64	11.0
50–59	42	7.2
60–69	19	3.3
≥70	12	2.0
Nationality		
Thai	457	78.3
Laos	23	3.9
American	1	0.2
Unidentified	103	17.6
Place of residence		
In Kalasin Province	455	77.9
Outside Kalasin Province	15	2.6
Unidentified	114	19.5
COVID-19 vaccination status		
Unvaccinated	94	16.1
1 dose vaccinated	21	3.6
2 doses vaccinated	234	40.1
3 doses vaccinated	31	5.3
4 doses vaccinated	6	1.0
Unidentified	198	33.9

Fifteen first-degree cases were discovered between 16–22 December (Figure 1,2). Most of them were Nightclub K workers. Nightclub K had a total of 16 workers including six musicians, seven waiters, and three cooks, who denied departing Kalasin Province since 1 December. Twelve of 16 workers were infected, including 100% (6/6) of musicians, 86% (6/7) of waiters, and no cook was infected. The first case in Nightclub K was a singer who developed symptoms on 16 December and tested positive for COVID-19 with antigen test kit but did not take sick leave. Usual behaviors included no mask-wearing, close contact with customers, sharing beverages with customers, and sharing meals with others. The remaining first-degree cases were two index cases' friends and one index cases' family member. The attack rate among the index cases' families was 14.3% (1/7).

Sixty second-degree cases were identified. Almost all had visited Nightclub K between 13–20 December including university students. Then, a suspicious epidemiological link between Nightclub K with 167 unknown-degree cases linked to Concert H, a large music festival held between 17 and 19 December with more than 300 participants, was detected since some musicians in Nightclub K and Concert H studied at the same university. Additionally, this study discovered 36 third-degree cases and 304 unknown-degree cases (Figure 1,2).



Dates were recorded by onset date for symptomatic cases or detected date for asymptomatic cases

Figure 1. Epidemic curve of confirmed/probable cases in the cluster by case classification, 9 Dec 2021–7 Jan 2022 (n=584)

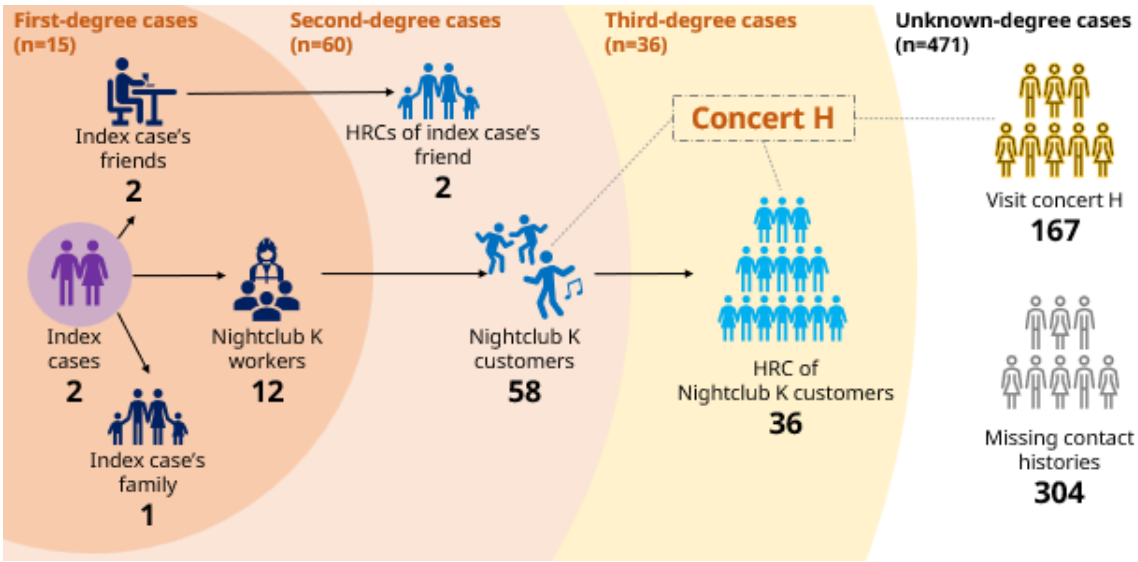


Figure 2. Epidemiological linkage of cases in the cluster by case classification, 9 Dec 2021–7 Jan 2022 (n=584)

Environmental Study

Nightclub K and S are air-conditioned nightclubs in Kalasin Province. Nightclub K has an area of 51.3 m^2 and can accommodate up to 90 people with estimated actual customers and densities of 90% and 6.32 persons/4 m^2, respectively. Although index cases spent 1.5 hours here, the attack rate among workers in Nightclub K was 75% (12/16). In contrast, Nightclub S has an area of 85.0 m^2 and can accommodate up to 40 people. The estimated actual customer and density were 20% and 0.16 persons/4 m^2, respectively. The index cases spent 2.5 hours in this nightclub, and no workers in Nightclub S became infected. Nightclub K had less compliance with COVID-19 measures compared to Nightclub S. Eighteen environmental specimens at Nightclub K were collected on 28 December, but none was positive for SARS-CoV-2.

Analytic Study

The analysis included 204 HRCs. From univariate analysis, vaccine dose, vaccine formula, age, and gender were associated with SARS-CoV-2 detection among HRCs (Table 2). Multivariate analysis showed that those receiving three or more doses of COVID-19 vaccination had less chance of SARS-CoV-2 detection compared to unvaccinated (VE 87.5%, 95% CI 59.5–96.1%, adjusted OR 0.12, 95% CI 0.04–0.40) while receiving one or two doses of COVID-19 vaccination showed no evidence of difference in SARS-CoV-2 detection compared to unvaccinated (adjusted OR 0.36, 95% CI 0.11–1.16 for one dose and adjusted OR 0.47, 95 % CI 0.19–1.16 for two doses). Multivariate analysis by vaccine formula revealed similar results among different formulas with the same number of doses (Table 3).

Table 2. Univariate analysis of detection of SARS-CoV-2 among HRCs within 14 days after the last contact with confirmed/probable cases (n=204)

Factor	Value	Attack rate (%)	Odds ratio	95% confidence interval	*P*-value
Dose received	≥3 (n=39)	18.0 (7/39)	0.12	0.07–0.65	0.03
	2 (n=110)	39.1 (43/110)	0.64	0.28–1.44	
	1 (n=25)	36.0 (9/25)	0.56	0.19–1.67	
	0 (n=30)	50.0 (15/30)	Reference		
Vaccine formula	SV+SV+AZ	15.3 (2/13)	0.12	0.02–0.65	0.01
	SV+SV+PZ	21.7 (5/23)	0.15	0.04–0.57	
	SV+AZ	41.9 (26/62)	0.50	0.19–1.30	
	PZ+PZ	28.0 (7/25)	0.34	0.20–3.17	
	SP+SP	53.9 (7/13)	0.80	0.10–1.13	
	Unvaccinated	50.0 (15/30)	Reference		
Age (years)	<18	14.3 (2/14)	0.27	0.06–1.23	0.11
	18–64	38.4 (71/185)	Reference	0.04–3.66	
	≥65	20.0 (1/5)	0.40		
Gender	Female	40.7 (46/113)	1.5	0.86–2.77	0.14
	Male	30.8 (28/91)	Reference		

SV: Sinovac. AZ: AstraZeneca. PZ: BioNTech/Pfizer. SP: Sinopharm.

Table 3. Multivariate analysis of detection of SARS-CoV-2 among HRCs within 14 days after the last contact with confirmed/probable cases by vaccine formula (n=204)

Vaccine dose	Vaccine formula	Number of vaccinees	Number of vaccinees detected with SARS-CoV-2	Vaccine-to-test interval median (IQR)	AOR (95% CI)	Estimate VE % (95% CI)
3 or more	**SV+SV+PZ**	23	5	140 (136–141)	0.15 (0.04–0.57)	84.6 (43.1–95.8)
	SV+SV+AZ	14	2	56 (41–102)	0.10 (0.02–0.58)	89.6 (42.4–98.1)
	Others*	3	0	16 (14–18)	NA	NA
2	**SV+AZ**	62	26	69.5 (48–103)	0.51 (0.19–1.33)	49.3 (0.0–80.7)
	PZ+PZ	25	7	39 (34–56)	0.34 (0.10–1.13)	65.8 (0.0–89.6)
	SP+SP	13	7	55 (26–73)	0.79 (0.20–3.16)	20.5 (0.0–80.0)
	Others†	9	3	35 (22–100)	0.42 (0.08–2.26)	57.7 (0.0–92.1)
1	**AZ**	10	2	38.5 (35–41)	0.16 (0.03–0.95)	83.7 (5.0–97.2)
	Others‡	15	7	24 (20–62)	0.57 (0.15–2.13)	42.7 (0.0–84.6)
Unvaccinated	**Unvaccinated**	30	15	-	Reference	-

*The odds ratio calculation was adjusted with age and gender. *Other 3 or more vaccination doses consisting of: SP+SP+PZ (n=1), SV+AZ+MN (n=1), SV+SV+PZ+PZ (n=1). †Other 2 vaccination doses consisting of: AZ+AZ (n=5), AZ+PZ (n=3), MN+MN (n=1). ‡Other 1 vaccination doses consisting of: PZ (n=8), SV (n=4), MN (n=3). AOR: adjusted odds ratio. CI: confidence interval. VE: vaccine effectiveness. NA: not applicable. SV: Sinovac. AZ: AstraZeneca. PZ: BioNTech/Pfizer. MN: Moderna.*

Discussion

This investigation confirmed the SARS-CoV-2 Omicron variant outbreak in Kalasin Province. SARS-CoV-2 (B.1.1.529, sublineage BA.1) was detected in the index cases, indicated the first Omicron variant cluster in Thailand. Readiness of SARS-CoV-2 with SGTF in a local laboratory supported omicron variant detection, which has different SGTF properties than the previously circulated variant.[4,6] With reference standard assays, this study confirmed the Omicron variant detection within one week, demonstrating the importance of laboratory network. SGTF detection might be useful in the areas where SARS-CoV-2's dominant VOCs do not show SGTF. Several studies have used SGTF as a surrogate indicator for Omicron variant in the early period of the outbreak.[12,13] However, SGTF is not specific to Omicron. Some variants, such as Alpha, may present SGTF, and Omicron BA.1, BA.4, and BA.5 linage may not present SGTF.[6]

The outbreak occurred among healthy, vaccinated adults, with a low percentage of vulnerable individuals. Two-thirds of cases had received at least 2 doses of the COVID-19 vaccination, highlighting the ability of Omicron variant to evade immunity.[14,15] The secondary attack rate among HRCs in this cluster was around 16% which was higher than the usual attack rate in COVID-19 outbreaks from 2020 to mid-2021, suggesting that Omicron variant is contagious among vaccinated individuals.[16] The incubation period among cases was four days, consistent with research indicating a shorter incubation period than other variants.[17] Most cases presented typical symptoms of COVID-19. No fatal or severe case was reported, aligning with studies showing milder symptoms and lower mortality than the previously dominant Delta and Beta variants.[12,13,18,19] This could be attributed to both the lower virulence of the Omicron variant and the impact of previous vaccination among those infected.

Four potential sources of infection were hypothesized initially: getting infection in Belgium, on the plane to Thailand, on the plane from Bangkok Province to Kalasin Province, and at the nightclub in Kalasin Province. This investigation found no evidence of other epidemiological-linked cases on both international and domestic airplanes. Moreover, the strain detected in index cases has never been identified in Kalasin Province. Therefore, the index cases were likely to bring the Omicron variant strain into the province. Although confirmation could not be done, this study mostly suspected that the index cases were in contact with the disease during their stay in Belgium which has reported Omicron variant cases since December 2021.[20]

Nightclub K had a favorable environment for disease spreading. It is an air-conditioned nightclub with high customer density (>1 person/4 m^2), facilitating disease spread towards workers. Evidence shows that SARS-CoV-2 could transmit through airborne transmission in enclosed spaces with insufficient ventilation.[21] The workers of Nightclub K also acted as carriers because of their behaviors of not taking sick leave and having low adherence to preventive measures, led to disease spreading into communities. Some of the Nightclub K customers were later involved with Concert H and a hundred cases were later found among people who attended the concert. Several studies have indicated COVID-19 outbreaks are common in dense gatherings, including nightclubs.[22–24]

High-risk contacts who received two doses of COVID-19 vaccination have shown insufficient effectiveness in protecting against Omicron variant, while those who have received a booster dose of vaccination have reduced infection, regardless of vaccine formula they received. Evidence indicated that COVID-19 booster dose vaccination improves the efficacy against SARS-CoV-2 infection, including the Omicron variant.[25,26]

Nightclub S, which adhered to COVID-19 measures, reduced COVID-19 spreading despite longer contact time of index cases. A comparison of two nightclubs with exposure to index cases demonstrated the effectiveness of COVID-19 public health measures, resulting in no infection in the nightclub that followed the measures. These measures include environmental and administrative actions such as limiting customers to no more than 1 person/4 m^2 and regular screening among workers.[9] Evidence shows the effectiveness of this public health measure bundle against COVID-19 spreading.[27]

Limitations

There were limitations in this study. First, the definite source of the infection could not be identified due to information missing, such as the index cases could not recall prior exposure in Belgium. Second, vaccine formulation among some identified cases could not be specified due to database limitations, which only account for vaccination dose received. Third, this study lacks other vaccine determinants in the vaccine effectiveness study, such as past COVID-19 infection, socioeconomic status, healthcare access, and personal protective practices. Furthermore, vaccine-to-test intervals, a surrogate indicator of immunity waning effect, were not included in the multivariable model in vaccine effectiveness analysis to keep the model parsimonious, so the vaccine effectiveness between different vaccine groups could not be compared directly.

As vaccine-to-test intervals among people who received three or more doses of vaccine tended to be slightly more than other groups, this study could underestimate vaccine effectiveness among those who received three or more doses of vaccine, compared to the effectiveness of other vaccine groups. Lastly, vaccinees in each vaccine formula group were limited. This led to low statistical power in vaccine effectiveness calculation. Nevertheless, this preliminary finding from the outbreak could be a starting point for large-scale study in vaccine effectiveness calculation.

Recommendations

Nightclubs and public spaces owners should follow COVID-19 public health measures. Public health authorities should provide adequate access to COVID-19 booster doses and implement COVID-19 measures in crowd-gathering places. People should receive COVID-19 booster doses and adhere to personal protective measures. Variant identification should be carried out alongside the outbreak investigation according to the DDC policy. National public health agencies should strengthen laboratory capacities to detect changes in VOCs, provide equitable access to COVID-19 vaccination, and conduct a nationwide study of vaccine effectiveness against emerging VOCs. Finally, Research on air ventilation in nightclubs and indoor spaces should be conducted.

Conclusion

This investigation confirmed the first SARS-CoV-2 Omicron variant cluster in Thailand, involving nightclubs in Kalasin Province, which may have been imported from a European country. The outbreak mainly affected healthy, vaccinated adults, with above half of the cases presenting symptoms, but none presenting severe illness or death. The outbreak was aggravated by crowded environments and the nightclub workers as carriers for transmission. Booster doses of vaccination have 87.5% effectiveness in reducing Omicron variant infection. This study suggests that crowd-gathering places' owners should follow COVID-19 public health measures to mitigate the spread of COVID-19.

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