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An Outbreak of SARS-CoV-2 in a Garment Factory near the Thailand–Myanmar Border, Tak Province, Thailand, August–September 2021

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Abstract

On 16 Sep 2021, Thailand's Division of Epidemiology, was notified of an outbreak of coronavirus disease 2019 (COVID-19) in a garment factory in Tak Province. An outbreak investigation was conducted to determine epidemiological characteristics of cases, identify risk factors associated with infection, and recommend appropriate preventive measures. A review of COVID-19 surveillance data and outbreak reports was performed. An active case finding was conducted among the factory workers. We interviewed the manager and workers of the factory and performed an environmental observation and conducted a case-control study. Logistic regression models were employed. Of 242 workers tested for severe acute respiratory syndrome coronavirus 2 by rapid antigen test kit, 90 (37.2%) were found positive. The attack rate was highest in the sewing department (47.4%) and among female workers (53.8%). The prevalence of asymptomatic infection was 15.6%. One case with pneumonia was found and there were no deaths. Working in the sewing department was a significant risk factor [adjusted odds ratio (OR) 3.15, 95% confidence interval (CI) 1.01–9.79] while mask wearing [adjusted OR 0.34, 95% CI 0.14–0.82] was a protective factor. Overcrowding and poorly ventilated conditions were observed in the workplace. Our investigation confirmed a COVID-19 outbreak in a garment factory. Reorienting the environment and strengthening individual protective measures, such as mandatory mask wearing and physical distancing amongst the workers, are recommended.

Keywords: COVID-19, outbreak, garment factory, sewing department, face mask

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). People infected with the virus mainly experience mild to moderate respiratory illnesses.[1] Common symptoms are fever, cough, tiredness, and loss of taste. Around 15% of COVID-19 cases develop serious complications such as pneumonia and respiratory failure.[1,2]

Globally, as of 1 Oct 2021, there have been 233,503,524 confirmed cases and 4,777,503 deaths.[3] The study in Malaysia suggests that immediate action taken by the employer and the health officer to identify and investigate those who had close contact with the index case was important in preventing further transmission.[4] In Thailand, from 1 Jan 2020 to 1 Oct 2021, there were 1,615,229 confirmed cases of COVID-19 with 16,850 deaths.[5] An increasing trend was seen due to outbreaks in factories and business establishments.[4,6,7] Sporadic outbreaks in other places such as school and restaurant have also been reported.[8,9]

On 16 Sep 2021, Thailand's Department of Disease Control, Ministry of Public Health, was notified of an outbreak with about 50 COVID-19 suspected cases in a garment factory at Mae Sot District, which is a metropolitan district close to the Thai–Myanmar border in Tak Province. At the time of the investigation, the factory was functioning in containment mode

under supervision of occupational health personnel. The investigation team, deputed from the Department of Disease Control, conducted an investigation from 18 to 22 Sep 2021. The objectives of the investigation were to: (i) describe the epidemiological characteristics of the outbreak, (ii) determine possible risk factors, and (iii) provide appropriate prevention and control measures in the factory.

Methods

Descriptive Study

The surveillance data on COVID-19 cases and outbreaks in 2021, as well as the preliminary outbreak report of the investigated factory, were reviewed. The medical records of all workers in the factory were examined.

The occupational health officer of Maesot General Hospital and the factory manager were interviewed. The factory manager was asked about the production chain, working nature and workers' behaviour during the COVID-19 pandemic.

Active Case Finding

An active case finding was conducted in the factory using the following case definitions. A probable case was worker that showed positive SARS-CoV-2 detection from an antigen test kit (ATK) from nasopharyngeal swab from 7 Aug to 3 Oct 2021 period, whereas a confirmed case was a probable case with laboratory confirmation by viral ribonucleic acid detection of SARS-CoV-2 by reverse transcription polymerase chain reaction (RT-PCR). Those eligible to undertake nasopharyngeal swab were workers in the investigated factory who had symptoms compatible with COVID-19, such as fever, cough, sore throat, runny nose and myalgia, or were asymptomatic but had a contact history with a probable/confirmed case from 7 Aug to 3 Oct 2021.

Laboratory Investigation

Nasopharyngeal samples collected from symptomatic workers or asymptomatic workers who had history of contact with probable or confirmed cases were tested for SARS-CoV-2 by ATK. Only the specimens from the patient with pneumonia referred to the hospital were re-examined by RT-PCR in accordance with the Thai national guideline on COVID-19 case management.[6]

Environmental Observation

Environmental conditions of the factory were observed to identify possible risk factors. Areas surrounding the factory, isolation area of the cases, and the quarantine area of the close contacts were observed to determine possible epidemiological linkage.

Analytical Study

An unmatched case-control study was carried out. Sample size calculation was applied using the formula for comparing two proportions with a case to control ratio equal to 1:1.[10] The sample size was adjusted to allow for a 10–20% rate of missing data. Cases were workers identified as either probable or confirmed cases. Controls were defined as workers who were identified as neither close contact with case nor having symptoms of COVID-19 in previous two weeks by questionnaire. We used the following parameters: alpha 0.05, power 80%, proportion of controls with exposure 65%, proportion of cases with exposure 88.1%, odds ratio (OR) 3.99. With these parameters, we required 55–60 cases and controls each. Finally, we were able to obtain 59 cases and 59 controls. A systematic random sampling technique was used to select participants. The median age of cases and non-cases were compared with the rank-sum test. Univariable and multivariable logistic regression models were employed to determine associated factors. Variables which were likely to be risk factors from literature with a *p*-value less than 0.05 from the univariable analysis were included in the multivariable analysis by rule of thumb. Crude OR, adjusted OR, and 95% confidence intervals (CI) were presented. Stata version 16 was used for data analysis.

Ethics

Participants provided consent verbally. Names of participants in this study were coded to ensure anonymity. This study was conducted as part of an emergency public health response. There were no invasive procedures in this investigation.

Results

Epidemiological Characteristics of the Outbreak

Among 242 factory workers, 90 met the case definition (89 probable cases and one confirmed case) resulting in an overall attack rate of 37.2%. Of the 90 cases, 68 (75.6%) were identified from the occupational health officers of the hospital between 30 August and 15 September and 22 (24.4%) were identified by active case finding by the factory. The aim of the investigation was to detect asymptomatic cases after passive screening. One case was admitted to hospital due to pneumonia and there were no deaths. During the investigation, the first case, a worker in the the sewing department, developed symptoms on 11 Aug 2021. The epidemic curve shown in Figure 1 depicts two peak infection periods, one from 31 August to 3 September, the other one from 13 to 20 September. A propagated curve pattern was seen after the report of the outbreak.

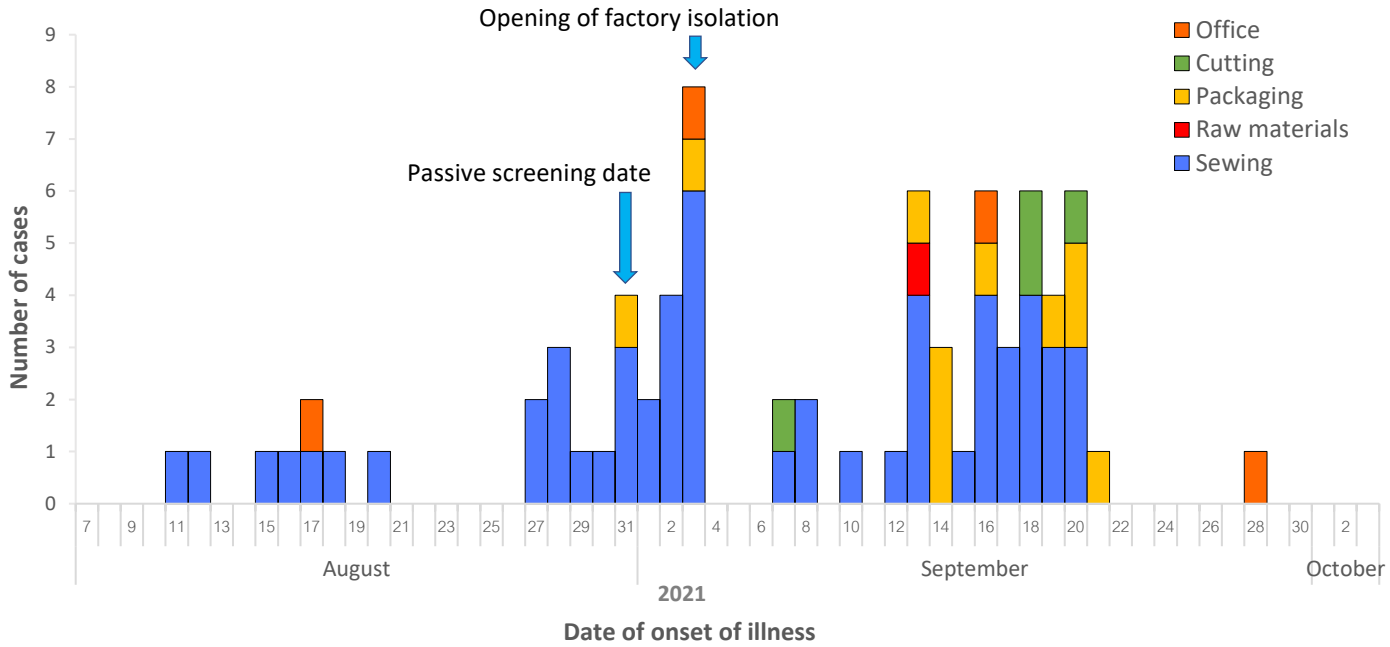

Figure 1. Epidemic curve of COVID-19 cases stratified by work department in the factory, August–September 2021 (only symptomatic cases are shown in the graph) (n=76)

The proportion of asymptomatic cases was 15.6%. Loss of smell and taste was the most common presenting symptom (45.6%), followed by fever (40.0%), runny nose (37.8%) and myalgia (36.7%) (Figure 2).

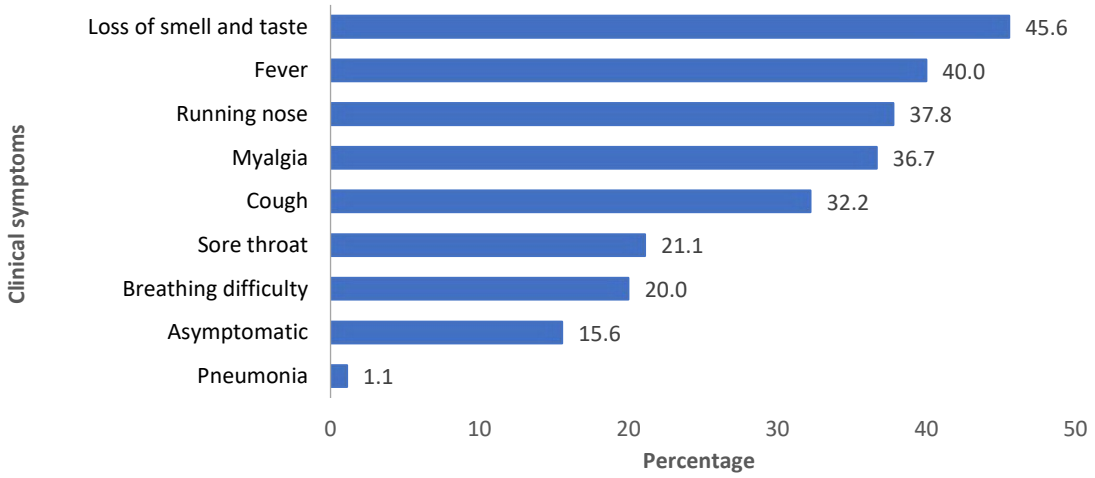

Figure 2. Percentage of COVID-19 cases by clinical symptoms (n=76)

The attack rate was highest in the sewing department (47.4%), followed by the raw materials department (28.6%) (Table 1).

The attack rates of COVID-19 stratified by gender, age group and nationality are shown in Table 2. The attack rate in female workers was about two times higher compared to male workers. Workers aged 25–35 years had the highest attack rate. Burmese were four times higher risk than Thais (Table 3).

Table 1. Number of cases and attack rate of COVID-19 by department of the factory, August–September 2021

Department	Number of cases	Number of workers	Attack rate (%)
Sewing	74	156	47.4
Raw materials	2	7	28.6
Packaging	7	33	21.2
Cutting	3	20	15.0
Office	4	26	15.4
Total	**90**	**242**	**37.2**

Table 2. Number of cases and attack rate of COVID-19 by gender, age, and nationality in the factory, August–September 2021 (n=90)

Characteristics	Number of cases	Total number of workers	Attack rate (%)	Prevalence ratio (95% CI)	*P*-value
Gender					
Female	57	106	53.8	2.22 (1.57–3.13)	<0.001
Male	33	136	24.3	Ref	
Age (years)					
<25	44	114	38.6	2.47 (1.07–5.71)	0.015
25–35	41	96	42.7	2.73 (1.18–6.32)	0.006
>35	5	32	15.6	Ref	
Nationality					
Burmese	85	191	44.5	4.54 (1.94–10.59)	<0.001
Thai	5	51	9.8	Ref	

Laboratory Findings

Of 242 factory workers that were tested by ATK, 90 (37.2%) were positive for COVID-19. Among these, one case (the pneumonia case) underwent RT-PCR due to the protocols of the factory and Maesot General Hospital.

Environmental Observation

The size of the factory building was very large with a high roof and multiple fans installed. It had a large open space with no partitions between working departments. Male and female restrooms were separated. The sewing department contained over 100 workers working less than one meter apart. It was the most crowded working place in the factory and poor air ventilation was observed. Hot and humid conditions were observed. There were about ten lines for working and each line contained about ten workers. The equipment for sewing procedures was not properly arranged. According to an interview with the factory manager, some workers did not wear a face mask properly during and after work. Hand washing stations with soap were provided.

The factory isolation area was a dormitory spread over two floors. Separate male and female restrooms were situated outside the dormitories. Each floor had 16 rooms. The lower floor was designated for the close contacts and the upper floor for the ATK-positive cases. The remaining workers were instructed to remain inside the factory separated from the isolation area. There was a telemedicine room for COVID-19 cases on the upper floor. The rooms in the isolation area were crowded and sanitation was poor. There was no physical barrier that separated between the floors. The restrooms for the isolation area were not adequate.

Case-Control Study

Fifty-nine cases and 59 controls were interviewed. The median age of the cases was 25.5 years and that of non-cases was 26.0 years (p-value 0.05). Based on the univariable analysis, working in the sewing department was a significant risk factor, and wearing mask, during and after work, were protective factors (Table 3).

Table 3. Univariable analysis on possible risk factors of COVID in the factory, August–September 2021

Factors	Cases (n=59) n (%)	Controls (n=59) n (%)	Crude OR (95% CI)	*P*-value
Works in the sewing department				
Yes	48 (81.4)	31 (52.5)	3.94 (1.72–9.05)	0.001
No	11 (18.6)	28 (47.5)	Ref	
Always wore a mask during work before the outbreak				
Yes	48 (82.8)	57 (96.6)	0.17 (0.04–0.81)	0.026
No	10 (17.2)	2 (3.4)	Ref	
Always wore a mask after work before the outbreak				
Yes	23 (39.7)	37 (62.7)	0.39 (0.18–0.82)	0.013
No	35 (60.3)	22 (37.3)	Ref	

Table 3. Univariable analysis on possible risk factors of COVID in the factory, August–September 2021 (cont.)

Factors	Cases (n=59) n (%)	Controls (n=59) n (%)	Crude OR (95% CI)	*P*-value
Stayed with a known COVID-19 patient in the same house				
Yes	4 (6.9)	8 (13.8)	0.46 (0.13–1.63)	0.231
No/not sure	54 (93.1)	50 (86.2)	Ref	
History of contact with a known COVID-19 patient in a nearby house				
Yes	7 (12.3)	15 (25.9)	0.40 (0.15–1.08)	0.069
No/not sure	50 (87.7)	43 (74.1)	Ref	
Dined with a known COVID-19 patient outside the factory				
Yes	6 (10.5)	7 (12.1)	0.86 (0.27–2.73)	0.794
No/not sure	51 (89.5)	51 (87.9)	Ref	
Dined with a known COVID-19 patient in the factory				
Yes	20 (35.1)	16 (27.1)	1.45 (0.66–3.20)	0.355
No/not sure	37 (64.9)	43 (72.9)	Ref	
Ever had a social gathering with a known COVID-19 patient outside the factory				
Yes	3 (5.3)	9 (15.3)	0.31 (0.08–1.21)	0.091
No/not sure	54 (94.7)	50 (84.7)	Ref	
Ever had a social gathering with a known COVID-19 patient in the factory				
Yes	13 (22.8)	9 (15.3)	1.64 (0.64–4.21)	0.302
No/not sure	44 (77.2)	50 (84.7)	Ref	
Smoked socially with a known COVID-19 patient				
Yes	4 (7.0)	3 (5.1)	1.41 (0.30–6.59)	0.663
No/not sure	53 (93.0)	56 (94.9)	Ref	
Worked with a known COVID-19 patient in the same department				
Yes	19 (33.3)	26 (44.1)	0.63 (0.29–1.35)	0.237
No/not sure	38 (66.7)	33 (55.9)	Ref	

The results of multiple logistic regression are presented in Table 4. Working in the sewing department (Adjusted OR 3.15, 95% CI 1.01–9.79) and mask-wearing after work (Adjusted OR 0.34, 95% CI 0.14–0.82) remained significant after adjusting for all other variables in Table 4.

Table 4. Associated factors based on multiple logistic regression model of COVID-19 cases in the factory, August–September 2021

Factors	Adjusted OR	95% CI	*P*-value
Female (Ref=male)	1.37	0.58–3.24	0.47
Incremental age (years)	0.96	0.89–1.04	0.33
Burmese nationality (Ref=Thai)	2.28	0.44–11.73	0.32
Worked in the sewing department (Ref=other department)	3.15	1.01–9.79	0.047
Always wore a mask during work (Ref=not always wearing mask)	0.17	0.03–1.03	0.053
Always wore a mask after work (Ref=not always wearing mask)	0.34	0.14–0.82	0.016

Discussion

This COVID-19 outbreak in a Thai factory near a border where many migrant workers were employed was characterized by a delay in outbreak detection and notification. We suspect that the delays occurred due to communication barriers as the majority of workers were Burmese who could not speak Thai and nearly all of the cases had mild or asymptomatic infection. Our investigation also detected some COVID-19 cases after the opening of the factory isolation unit. This might point to a possible flaw in isolating the cases and quarantining the contacts as supported by our observation that there were no physical barriers to separate the cases on the upper floor from the contacts on the lower floor.

This study reaffirms the belief that COVID-19 outbreaks commonly take place in factories where workers are stationed in close proximity with each

other and there is poor air ventilation.[11–16] The United States (U.S.) Centers for Disease Control and Prevention recently reported COVID-19 infections among workers from 36 states.[15] In each state, the percentage of workers with COVID-19 ranged from 2.0%–43.5%.[15] Our study found that the attack rate of COVID-19 in the factory outbreak was 37.2%, similar to the U.S. Centers for Disease Control and Prevention report. The proportion of symptomatic infections was 84.4%, which is also similar to the figure of 83.2% in the U.S. study.[15]

It is well known that workers in high-density workplaces are at high risk for SARS-CoV-2 transmission.[11,13–16] The investigation of COVID-19 outbreaks in meat and poultry processing plants in Germany showed that employees who worked with a minimum distance of less than 1.5 meters had a higher chance of developing COVID-19 (adjusted OR 3.61; 95% CI 2.83–4 .6).[16] Hot and humid conditions and poor airflow was observed in the study factory, and these conditions can increase the spread of COVID-19.[15] We found that the highest attack rate occurred in the sewing department, the most crowded area in the factory. The case-control study indicated that working in the sewing department was a significant risk factor on univariable and multivariable analyses. Moreover, the factory manager also reported that some workers did not wear a mask during work because of the high temperature. Wearing a face mask is widely recommended to prevent transmission of SARS-CoV-2.[17,18] The World Health Organization recommends people to wear a properly fitted mask, especially when physical distancing is not possible or in poorly ventilated settings.[17] We found that the practice of always wearing a mask after work was a protective factor. We therefore encourage the continued use of a face mask among workers to prevent infection and to slow the transmission of SARS-CoV-2.

Limitations

According to the protocol of Maesot General Hospital's RT-PCR should be conducted only in a case with severe symptoms. In this outbreak, we found only one confirmed case. However, this finding should be interpreted with caution as the number of confirmed cases was driven by the testing protocol agreed by the factory and Maesot General Hospital. Additionally, we initially intended to collect the information on COVID-19 vaccine but as almost all workers in the factory had not been immunized, we decided to omit the vaccine history item from the questionnaire. In future outbreaks, questions about vaccination history should be included. There was a language barrier between the investigation team and many factory workers. Due to limited human resources, we asked health personnel at the hospital, who were not trained in interview techniques, to interview workers with the use of a translator. However, some misunderstandings may have occurred. Finally, information about the date of onset and some risk behaviours may have suffered from recall bias.

Recommendations

We recommended that the factory manager place a physical barrier such as a plastic partition to separate one worker from one another, particularly in the sewing department. The team discussed with the factory manager about a strict mandate on all workers to wear a properly fitted mask during and after work. Additionally, the surveillance and reporting systems in the factory should be strengthened to avoid delays in notification. The local occupational health team should regularly screen workers in the factory. The isolating area for the cases and the quarantine area for the contacts should be strictly separated, with close supervision by the factory manager, to reduce the risk of virus transmission from one area to another. We encourage the use of face masks among workers to reduce the risk of infection and to slow transmission of SARS-CoV-2.

Conclusion

This factory outbreak contained 89 probable cases and one confirmed case of COVID-19. Most of the cases had mild symptoms and there were no deaths. Working in the sewing department, where many persons worked close to each other, was a significant risk factor while mask wearing after work was a protective factor.

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Declaration of Conflicting Interests

All authors declare that there is no conflict of interest.

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