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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

First-generation Cluster of Coronavirus Disease 2019 (COVID-19) Related to Boxing Stadiums in Bangkok and the Bangkok Metropolitan Region, March 2020

Nichakul Pisitpayat[1]*, Ram Rangsin[2], Kanlaya Jongcherdchootrakul[2], Chawetsan Namwat[1], Anek Mungaomklang[3], Wanna Hanshaoworakul[1]

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

2 Department of Military and Community Medicine, Phramongkutklao College of Medicine, Thailand

3 Institute for Urban Disease Control and Prevention, Department of Disease Control, Ministry of Public Health, Thailand

*Corresponding author email: pisitpayat.n@gmail.com

Abstract

In March 2020, clusters of COVID-19 cases were reported among attendees of a boxing stadium in Bangkok. This study aimed to investigate and describe the outbreak and identify its source. We conducted a descriptive analysis of cases and transmission patterns, performed a walk-through survey and interviewed stadium staffs for possible factors related to disease spreading. COVID-19 cases were those who had a history of visiting Bangkok or the Bangkok Metropolitan boxing stadiums, or contacting confirmed cases visiting boxing stadiums within 14 days of developing symptoms with laboratory confirmation using the RT-PCR method. An active case finding was accomplished through social media and the national disease surveillance system. High-risk contacts were self-quarantined and nasopharyngeal specimens were collected. Attack rate among boxing event attendees on 6 Mar 2020 was 11.0% (268/2,431). Attack rate among contacts of the first generation was 5.4% (110/2,024), and the second-generation contacts was 2.6% (6/229). Behavioral risks during the event included cheering and gambling among attendees. Some did not wear face masks. We recommend postponing all sporting matches as the most reasonable practice during an epidemic. To prevent and control future outbreaks, gambling should be restricted or limited to online payment and strict control measures should be considered.

Keywords: COVID-19, boxing stadiums, Thailand

Introduction

Coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has become a global threat, with over 800,000 confirmed cases and over 40,000 deaths worldwide up to early April 2020.[1] On 3 Jan 2020, Thailand established an Emergency Operation Center (EOC) and implemented the COVID-19 surveillance system at airports and hospitals. Anyone who met the criteria for a patient under investigation (PUI) would be tested for COVID-19 and reported through the system.[2] In Thailand, there were 1,875 cases with 15 deaths at the beginning of April 2020. Ten percent of all cases were related to boxing stadiums.[3]

Traditional Thai boxing is a popular sport in Thailand with many tourists attending boxing camps and stadiums each year.[4] On the sixth of March, 2020 a large boxing event was held at Lumpinee Stadium, one of well-known boxing stadiums in Thailand.[5] On 13 Mar 2020, the master of ceremonies (MC) at this event announced that he was infected with COVID-19.[6]

On 15 Mar 2020, a positive SARS-CoV-2 cluster was notified among persons who visited boxing stadiums. We aimed to confirm the diagnoses, identify the source of the outbreak, and describe its epidemiological characteristics.

Methods

A PUI was anyone with a body temperature ≥37.5 °C or a history of fever with one of the following symptoms during 23 Feb–7 Apr 2020: cough, rhinorrhea, sore

throat, difficult breathing or dyspnea; or anyone with a confirmed diagnosis of pneumonia. Those who had a history of visiting a boxing stadium in Bangkok or the Bangkok Metropolitan or contacting a confirmed case who visited a boxing stadium within 14 days before developing symptoms, were also investigated. A confirmed case was a PUI with laboratory confirmation of SARS-CoV-2 by reverse transcription-polymerase chain reaction (RT-PCR) method. Asymptomatic infections were defined as anyone without symptoms but had laboratory confirmation of SARS-CoV-2 by the RT-PCR method. A high-risk contact was defined as a person who had close activities, i.e., sharing food and drinks, talking, or working with a case within a 1-meter distance for more than 5 minutes or being coughed or sneezed at directly without wearing appropriate personal protective equipment (PPE); or persons who came into contact with a case within a 1-meter distance for more than 15 minutes without wearing appropriate PPE. These criteria were adapted from the national COVID-19 investigation guideline.[7]

An active case finding was performed utilizing media announcements by the government to attendees of the boxing match on 6 Mar 2020 at Lumpinee Stadium. Some attendees were tested for COVID-19 by government services while others were tested at a private hospital. Since all COVID-19 cases must be reported to the EOC system, we searched for cases in the EOC database. We also used Facebook to identify cases using a snowball technique in case they were not reported to the EOC system. We investigated individuals by telephone or field investigation if the number of high-risk contacts was excessive. During our investigations, we determined the individual's relationship with the boxing stadium (visitor, competitor, staff), symptoms (if any), their 14-day travel history before symptoms onset, exact location (zone) in the stadium during the event, COVID-19 test history and result, and history of patient contact. Only high-risk contacts were traced, tested, and monitored during their 14-day self-quarantine period.

An environmental survey searched for potential sources of disease spread in the stadium, especially during the event. We observed the building structure and ventilation system, capacity and seating/zoning arrangements, number of restrooms, and availability of sanitizers. We interviewed boxing stadium officers about COVID-19 measures on the event day, the cleaning of boxing materials, and the participants' activities. At the boxing stadium we observed the surroundings, and the airflow.

After entering the data into a spreadsheet, we double-checked its completeness and cleaned it before analysis. We imported the cleaned data into Stata and performed descriptive statistics showing percentages to measure the magnitude and describe epidemiological characteristics of the outbreak.[8] Mean with minimum and maximum was used to describe age. We categorized cases into three generations but detailed only the first generation. We classified the cases by participant type, location of hospital, and presence of symptoms. We performed a retrospective cohort study of high-risk contacts to explore risk factors of being a COVID-19 case. We included all high-risk contacts of the first- and second-generation cases related to this event who had complete data on gender, age, and relationship with a case (household member or not). We followed these contacts and if they had a positive SARS-CoV-2 result, then they were defined as a case; otherwise, a non-case. We performed logistic regression to identify factors associated with being a case, presenting crude and adjusted odds ratios with 95% confidence interval (CI). *P*-values <0.05 were considered statistically significant.

Results

Attack rate among boxing event attendees on 6 Mar 2020 was 11.0% (268/2,431). This was the first-generation case who were linked to boxing stadiums and classified into six groups: 1) boxing fan, 94 cases; 2) MC or reporter, 5 cases; 3) staff or merchant, 43 cases; 4) attendant, 123 cases; 5) boxer, 2 cases; 6) unidentified, 1 case. We monitored 2,024 high-risk contacts and identified 110 confirmed cases (second generation), attack rate was 5.4%. The second-generation cases were household contacts (44.6%), colleagues (24.6%), close contacts from activities (22.7%), health care workers (1.8%), passengers traveling on the same flight with a case (0.9%), and unidentified (5.4%). Consequently, there were 229 high-risk contacts of second-generation cases of which we identified six confirmed third-generation cases, attack rate was 2.6%. We discovered that 83.3% of the cases were household contacts and 16.7% had a history of close contact activities (Figure1).

Since attendees came from several provinces of Thailand, some were hospitalized outside of Bangkok. We were able to obtain their isolation place at 82% (220/268), and we discovered three cases isolated in their home. As shown in Figure 2, the majority of cases, however, were contained in Bangkok and the Bangkok Metropolitan hospitals.

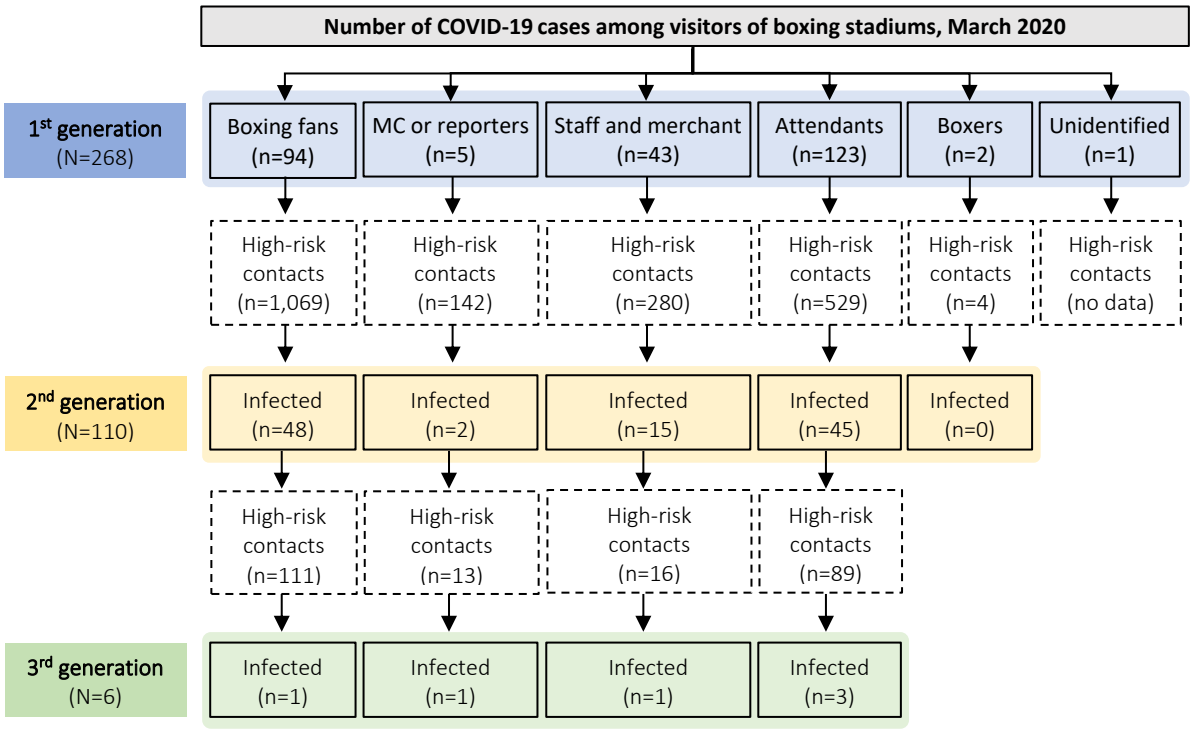
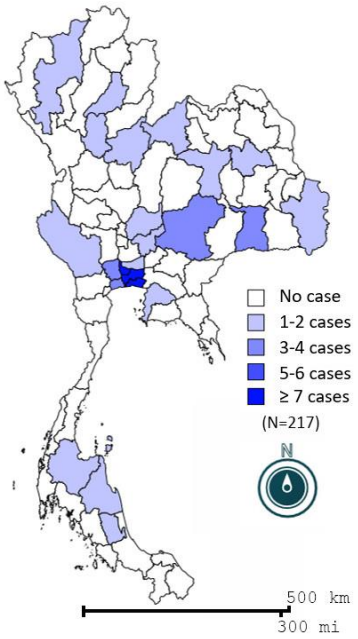


Figure 1. Number of confirmed COVID-19 cases liked to boxing stadiums in Bangkok and the Bangkok Metropolitan, March 2020

Province	Number of cases	Population[a]	Incidence rate per 100,000 population
Nonthaburi	54	1,276,745	4.2
Bangkok	107	5,588,222	1.9
Samut Prakan	14	1,351,479	1.0
Samut Sakhon	5	586,199	0.9
Phatthalung	2	523,077	0.4
Nakhon Pathom	3	920,729	0.3
Chonburi	4	1,566,885	0.3
Pathum Thani	3	1,176,412	0.3
Phrae	1	437,350	0.2
Surin	3	1,378,221	0.2
Surat Thani	2	1,067,726	0.2
Sukhothai	1	587,883	0.2
Loei	1	638,736	0.2
Saraburi	1	643,828	0.2
Nakhon Ratchasima	4	2,633,207	0.2
Songkhla	2	1,428,609	0.1
Chachoengsao	1	720,718	0.1
Lopburi	1	742,928	0.1
Phitsanulok	1	849,481	0.1
Kanchanaburi	1	891,976	0.1
Chiang Mai	2	1,784,370	0.1
Kalasin	1	977,175	0.1
Nakhon Si Thammarat	1	1,550,721	0.1
Khon Kaen	1	1,794,531	0.1
Ubon Ratchathani	1	1,866,697	0.1



Note: [a]Population in 2020 was obtained from the Department of Provincial Administration Registration.[9]

Figure 2. Distribution of admission of the cases linked to boxing stadiums in Bangkok and the Bangkok Metropolitan in Thailand, March 2020 (n=217)

Of the first-generation cases, the male-to-female ratio was 11 to 1. The mean (min–max) age was 49 (14–84) years. The most common symptoms included fever (59%), cough (48%), myalgia (34%), and sore throat (24%). Other symptoms included diarrhea (20%), fatigue (20%), anorexia (20%), headache (19%), runny nose (18%), sputum production (15%), and difficult breathing (12%) and there were 35 asymptomatic infections. Nine (3%) developed respiratory failure and needed a respirator. Five cases died; resulted in the case fatality ratio 1.9% (5/268).

Figure 3 shows the epidemic curve of the first-generation cases with the 35 asymptomatic patients excluded. The first cluster of cases occurred on 7 Mar 2020 after they visited multiple boxing stadiums. After the closing of Lumpinee and Rajadamnern stadiums and the investigation began, the number of cases declined.

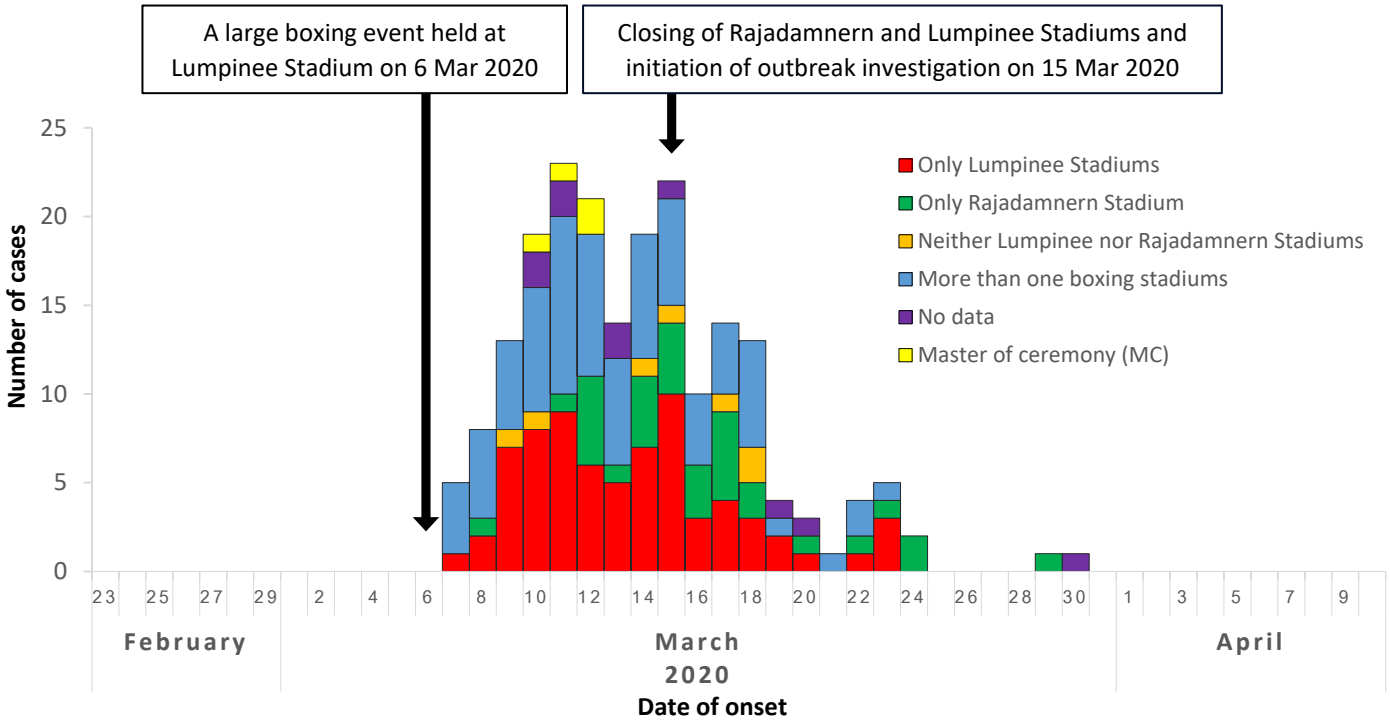


Figure 3. Number of confirmed COVID-19 cases linked to boxing stadiums in Bangkok and the Bangkok Metropolitan Region during March 2020 by date of onset (n=202)

Lumpinee Boxing Stadium staff mentioned that the event was held from 6 PM to midnight. The stadium capacity was 5,000 persons. Food courts and souvenir shops were located outside the stadium. Boxing matches are normally held on Tuesdays, Fridays, and Sundays with approximately 200 attendees per round. At the event on 6 Mar 2020, there were 2,431 attendees distributed in four distinct zones: a very important person zone (20 persons), the ringside (272 persons), zone 2 (500 persons), and zone 3 (1,639 persons). The highest attack rate occurred in zone 2 (6%, 30/500) where most of the boxing fans were packed. Their behaviors included cheering and gambling. Some did not wear face masks. The attack rate of the very important person zone was 5% (1/20). Some of the attendees of the event went to the stage to receive awards and were interviewed by the MC. The ticketing system of the stadium is paper-based. Fever screening was performed using environmental handheld thermometers. Boxing equipment was cleaned once a week, and shared microphones were used by the MC. During the walk-through survey, we noticed the stadium lacked an airflow ventilation system. There were also no sanitizers, tissue paper, nor hand-washing facilities in the restrooms.

We identified 411 high-risk contacts of first- and second-generation cases who had complete important information and found 42 additional cases. As shown in Table 1, after adjusting for age and gender, the only significant risk factor for COVID-19 infection among high-risk contacts was being a household member (adjusted odds ratio=2.04, 95% CI: 1.01–4.15).

Table 1. Risk factors of developing COVID-19 among high-risk contacts of cases related to boxing stadiums in Bangkok and the Bangkok Metropolitan, Thailand, March 2020

Factors	Cases, n (%) n=42	Non-case, n (%) n=369	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Gender (n=410)				
Female	26 (61.9)	170 (46.2)	Reference	
Male	16 (38.1)	198 (53.8)	0.56 (0.31, 1.02)	0.77 (0.40, 1.49)
Age group (years) (n=411)				
≤14	3 (7.1)	34 (9.2)	Reference	
>14–30	8 (19.1)	88 (23.6)	1.03 (0.29, 3.67)	1.21 (0.34, 4.28)
>30–45	14 (33.3)	82 (22.2)	1.80 (0.55, 5.90)	2.04 (0.62, 6.68)
>45–60	15 (35.7)	121 (32.8)	1.36 (0.42, 4.45)	1.80 (0.55, 5.93)
>60	2 (4.8)	44 (11.9)	0.54 (0.09, 3.04)	0.67 (0.12, 3.78)
Household member of a case (n=411)				
No	13 (31.0)	190 (51.5)	Reference	
Yes	39 (69.1)	179 (48.5)	2.18 (1.17, 4.08)	2.04 (1.01, 4.15)

Discussion

This COVID-19 outbreak, which may have originated in a boxing stadium in Bangkok, was widespread as attendees were from many provinces of Thailand. Droplets, direct contact, aerosols, and fomite transmission are possible ways to spread respiratory infection in sports settings.[10,11] Additionally, in an overcrowded stadium, there were no effective social distancing measures established.[12] Similarly, a COVID-19 outbreak in San Siro Stadium in Italy was reported to be due to an insufficient safe distance between attendees and a prolonged exposure time among potentially infected cases.[13]

In our study, the second-generation cases were mostly household members of confirmed cases. This implies limited spread across the community. We found that being a household member of a case was a significant risk factor for developing COVID-19. Many outbreaks reported secondary attack rates ranging from 0.5–6.6% and estimated household secondary attack rates ranging from 19–50%.[14–16] However, since household specimens are routinely collected due to Thailand's national guidelines and are easily traceable from patients. The results might show a higher positivity rate among households, compared with the other groups, which could inflate the association of being a case among household away from the null.

The case fatality rate of this outbreak (1.9%) was higher than the national rate (1.3%) as of 10 Apr 2020.[17] This might be due to the age of the attendees of this boxing event being higher than the national average. COVID-19 fatality is also known to be associated with increasing age.[18]

Cheering, gambling, and lack of fixed seating arrangements allowed participants to walk around the stadium freely, all of which could be risk behaviors for disease transmission. Cheering or having loud conversations releases micrometer particles into the air, which carry viruses that can cause infection.[19] Additionally, shared microphones and contaminated boxing equipment support fomite transmission which may also play a role in disease transmission; however, the relative importance of this route of transmission versus direct exposure to respiratory droplets remains unknown.[20,21]

The first cluster of cases had visited multiple boxing stadiums and developed symptoms one day after the event. The incubation period of COVID-19 ranged from 1–18 days, therefore, one day after the event is at the low end of the scale if they were infected during the event.[22] COVID-19 can be transmitted by asymptomatic carriers during the incubation period.[23] Asymptomatic patients in their incubation period or those with mild symptoms who previously went to many boxing stadiums before attending the boxing event on the sixth of March could transmit the disease during a long exposure time if attendees already had SARS-COV-2 infection. [24]

This study had limitations which should be mentioned. First, some patients sought treatment at private hospitals, which may not report to the national surveillance system. However, we identified some cases via social media to reduce this shortfall. Second, low-risk contacts were not traced which could bias the results. However, national guidelines state that low-risk contacts should observe their symptoms for 14 days and seek treatment if any symptoms appear. Third, the source of infection was not clearly identified because attendees had traveled from many provinces in Thailand. Finally, we conducted most interviews over the phone resulting in somewhat limited data collection.

Recommendations

Postponing all sports matches during a pandemic is recommended. The Tokyo 2020 Summer Olympic and Paralympic Games in Japan were postponed due to COVID-19.[25,26] Use of an electronic ticketing system would be a feasible strategy for tracing attendees.[24] In the stadiums, a standard ventilation system and fixed seats should also be installed. Additionally, gambling should be limited to an online system to improve social distancing. An appropriate handheld thermometer is recommended. We recommend installing sanitizers, soap dispensers, tissue paper, and hand-washing facilities at all boxing stadiums. Boxing equipment should be cleaned frequently, especially during outbreaks. This evidence could lead to Thailand's decision to contain the outbreak, and strict control measures, i.e., compulsory wearing of face masks, limiting the number of participants at sporting events to practice social distancing should be considered, particularly during an epidemic.

Conclusions

A large outbreak investigation in March 2020 involving 2,431 attendees of a boxing stadium in Bangkok was conducted. We reviewed and traced cases through the national surveillance system and social media. We identified 268 COVID-19 cases linked to a boxing event. Most high-risk contacts were household members of the cases. Some attendees cheered and gambled during the event, increasing the risk of disease transmission. During an epidemic, we recommend that all sports events be postponed. Gambling should be limited to an online payment system. Screening participants' temperatures may not be as effective for disease prevention as mask-wearing and limiting the number of participants.[27,28]

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Disclaimer

The findings, figures, and opinions expressed in this paper are those of the authors and do not necessarily reflect the position of the Ministry of Public Health, Thailand.

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