



Influencing factors of COVID-19 spreading: a case study of Thailand

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Abstract

Aim A novel corona virus disease 2019 (COVID-19) was declared as pandemic by WHO as global level and local levels in many countries. The movement of people might be one influencing factor, this paper aims to report the situation COVID-19 and spreading in Thailand, including influencing factors of spreading and control.

Subject and method Infected, confirmed COVID-19 data were obtained from the official website of the Department of Disease Control, Ministry of Public Health. Tourist data was downloaded from Ministry of Tourism and Sports. Researchers analyzed the situation from the first found case in Thailand until 15 April 2020 with the timeline of important influencing factors. Correlation coefficients of tourist data and infected case was calculated by person correlation coefficient.

Results The number of infected cases was significant associated (correlation coefficient > 0.7) with economic factor, namely; number of visitors, generated income from both Thai and foreigner tourist (p value < 0.01). The influencing factors of slow increased rate were the enforcement and implementation of both central and local government regulation, the strength of the Thai health care system, the culture and social relation, the partnership among various governmental and private sectors.

Conclusion We found that the number of tourist and their activities were significant associated with number of infected, confirmed COVID-19 cases. The public education and social supporting were the key roles for regulation enforcement and implementation.

Keywords COVID-19 · Thailand · Influencing factors · Disease spreading · Tourist factors

Introduction

A novel corona virus disease 2019 was officially detected in Wuhan, China in December 2019 (Chappell 2020; Kiesha et al. 2020). A novel corona virus disease was named as COVID-19 a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the outbreak of it has been spread to all countries. WHO (World Health Organization) has declared that COVID-19 was a pandemic disease since 11 March 2020 because it has swept into at least 114 countries

and killed more than 4000 people (Chappell 2020; Jebriil 2020; WHO 2020a). On April 14, 2020, it was reported that total confirmed accumulated infected cases were 1,844,863 whereas new confirmed infected case was 71,779 with 117,021 death cases (WHO 2020b). COVID-19 spreading in different countries were varied depends on various factors namely; climatic factor such as temperature or the migration of people. This might be the cause of a different growth rate in a different zone. At the initial stage, the number of infected cases was slightly increased, however, after reaching 100 confirmed infected cases, the growth rate was rapidly or slightly change. The majority of confirmed COVID-19 cases were reported from European Region 423,946 (56.45%) and followed by American Region 163,014 (21.70%), the remaining were other regions (Ayoub et al. 2020). Currently, as we have known the vaccine for COVID-19 is not available, many research and academic institutes started to develop the drugs and vaccine for COVID-19 (Kenzie 2020). That was the challenging of each country to control the increasing rate of COVID-19 disease. The outbreak of COVID-19 caused the economic disruption worldwide, in Thailand more than 10 million people would be facing the unemployment. As of 13

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April, 8 million Thais have already lost their jobs (Reuters 2020). Some researchers indicated the climate factors such as temperature were associated with the disease spreading (Altamimi and Ahmed 2019; Jingui and Yongjian 2020; Tang et al. 2020). However, the spreading of disease from one city to other cities or other countries were from the movement of people as globalization. We can fly from the East country to West Country within 24 h with human modern technology. In addition, the different spreading was detected in each country or region, it was observed the slow increase in some countries whereas it was increased as the exponential growth rate in some countries. That might be some internal and external influencing factors. Key factors to control the spreading of the disease such as intervention and mitigation measures, social adaptation and other related issues might be a key role. This paper aims to analyze and highlight the spreading of the COVID-19 disease in Thailand and its influencing factors and the intervention from governmental regulation enforcement.

Method

Distribution of infected COVID-19 confirmed case

The data concerning the new daily infected cases and accumulated cases was collected from the official website of the Department of Disease Control, Ministry of Public Health (<http://www.ddc.moph.go.th/>). The distribution of infected case in the country is intended to highlight the occurrence of COVID-19 disease in the kingdom of Thailand, the distribution map was carried out by QGIS program. The descriptive statistics were used to analyze the general information of COVID-19 by using licensed SPSS. Tourist information was downloaded from the official website of the Ministry of Tourism and Sports. (Sports 2019) We used the Pearson correlation to calculate the correlation coefficient of economic issues from tourism and test the significance of tourist parameters and confirmed infected COVID cases in each province.

Regulation announcement and implementation

The related act, regulation both central and local governments about the COVID-19 disease were collected and synthesized for gaining insights the spreading of disease.

Results and discussion

Situation of infected COVID-19 cases

The COVID-19 case has been officially reported in Thailand since January 22, 2020, this case was imported from China.

After the finding of the first case, we found 3 cases in Thailand within 1 day. The lesson learned from Wuhan, China indicated that the increasing rate was slightly increased at the first period but was sharply raised after reaching 100 infected cases. Since the first case was confirmed on December 31, 2019, China has had 81,960 confirmed cases as of 20 March 2020, including 3293 people who died and 74,196 people who were cured. The country has also had 541 imported cases. The national mortality rate is 4% (McClean 2020). That is the starting point of the Thai government to set up the response team for fighting COVID-19. The confirmed accumulate cases were reaching 100 cases after 53 days from the initial confirmed case. It was 114 for accumulating infected, confirmed case on 15 March 2020. We classified this period as the first phase (22 January to 15 March 2020), the average growth rate was 13.2%. We also found the sharp increase at 39% growth rate from 14 March (82 cases) to 15 March 2020(114 cases). On March 22, 2020 the new infected case was increased 45 from March 21, 2020, therefore self-quarantine and/or governmental provided quarantine were actively performed to prevent the rapid spreading of disease. We found that on 26 March 2020, a new infected case was sharp increased again from the previous day. After reaching 100 accumulated infected cases, Thai government concerned about the sharply increase as detected in many countries who had been facing the situation before, then many campaigns were launched in both central and local areas throughout the country. A capital city of Bangkok also announced and enforced the regulation to control the outbreak, this caused the movement of people living in Bangkok in other provinces.

Distribution of infected cases

The first infected female case was officially reported in Bangkok, a capital city of Thailand, her nationality is Chinese. She migrated from China to Thailand as a tourist. All first 15 infected cases in Thailand were a Chinese nationality and was detected from 12 January to 31 January, it was 19 days for spreading from 1 to 15 cases. The first case in other areas was found in Nakhonpachom Province, located in the west of Bangkok and Nonthaburi in the north direction, both provinces were connected to Bangkok. The disease transmission from 1 case in Bangkok to 100 cases in 9 provinces (15 March 2020) was 63 days, however, it was increased as double (200 cases) in 23 provinces within only 3 days (18 March 2020). The spreading was expanded from one place to other places in a short period. It was reported that 400 accumulated infected cases were reached on 21 March that was only 3 days from 200 cases. It was surprising again that number of cases were double 2 times within 3 days, we found 800 cases on 24 March. After sharp increase, it was double again (1600 cases) on 31 March, it was 7 days of this period.

Current situation of COVID-19 cases in Thailand can be presented in Table 1. Up to April 15, 2020, there were confirm infected cases of 2643 (accumulate cases), 43 total deaths or 1.6% of infected cases, 1497 total recovered cases (56.6%). The recovered cases rate in Thailand was greater than global level about 2 times and the death rate was approximately 4 times lower than global level. Up to April 15, 2020, 50 % of infected cases were detected in Bangkok a capital city and about 9% was other nationalities or unidentified cases as presented in Figs. 1 and 2. It was surprising that the number of infected cases was distributed in tourist attractive provinces for example Bangkok (maximum case), Chonburi (Pattaya beach and other areas), Yala (connecting to Malaysia), Phuket. The number of infected, confirmed cases in each province was illustrated in Fig. 3, we calculated the Pearson correlation coefficient of the economic factor from the tourist sector by using 2019 data, namely; number of overnight staying, the number of tourists (Total, Thai and Foreigner tourist), number of visitors (Total, Thai and Foreigner tourist), income generated from tourist (total, Thai, and Foreigner). We found that all above mentioned parameters were significantly associated with the number of COVID-19 cases. The correlation coefficients of COVID-19 confirmed case and number of tourists staying overnight, the number of total visitors, Thai and foreigner, generated income from total, Thai and foreigner tourist were 0.83, 0.91, 0.89, 0.84, 0.80, 0.94, 0.93 and 0.690, respectively (P values <0.01).

All correlation coefficients were high with the value of greater than 0.8 as presented in Table 2.

Discussion

The cause of the increasing case was initiated by a tourist group in Bangkok, they came together in air conditional bus and spent their time together in many areas. Even the ambient air temperature of Bang was high, the corona virus might be suffering from hot temperature, but in closed ventilation like

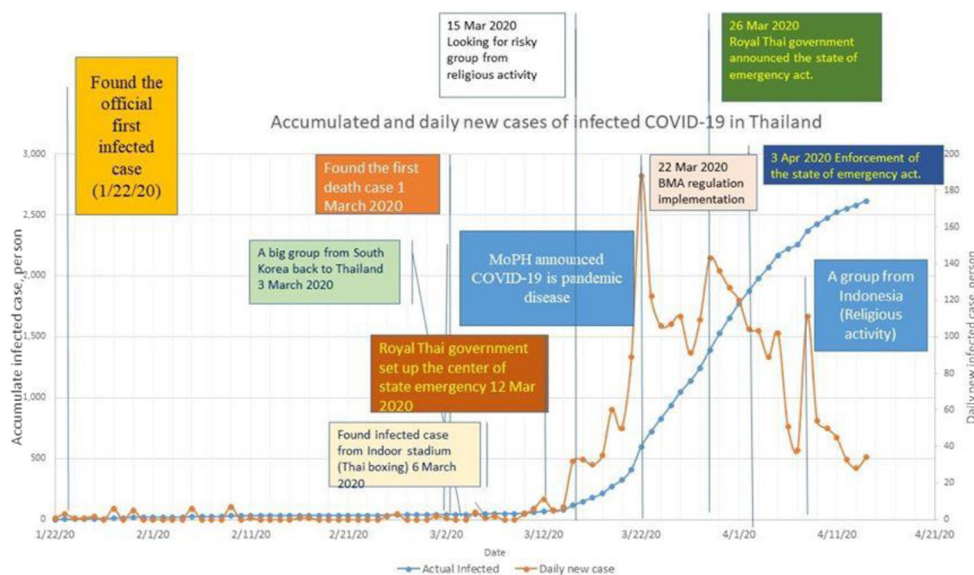
air conditioner bus was stimulating factor of disease spreading. Based on the published papers about other coronaviruses, experts believed COVID-19 primarily spreads from person-to-person through close contact (approximately 2 m) by respiratory droplets (Chavez et al. 2020; Network 2020; WHO 2020c, d). A big group of infected Thai citizen originated from the spreader who joined the indoor boxing stadium. We found the infected case who attended the boxing competition in indoor stadium that were the crowd community with the varieties of people, nation and cultures. The close ventilation system and close contact were the key factors of disease transmission since it has been identified as an airborne transmission disease as mentioned above. The people who attended the boxing competition were a big group that could spread the disease to others, beside this Thai government decided to set up the center of state emergency on March 12, 2020. The preparation and response to the disease should be set up, therefore, the system and regulation was initiated. The 39% growth rate from 14 March to 15 March 2020 was the imported case from the participation of religious ceremony and activities abroad. That was the turning point, the Ministry of Public Health declared that COVID-19 was pandemic disease in Thailand. Central and local government started to set their regulation to control the spreading of disease for example Bangkok Metropolitan Administrative (BMA) announced and implemented the regulation to control the crowd areas namely; restaurant, entertainment zone, spa and massage shop, hair salon shop, department store (except only food, beverage and drugs store), social gathering and other crowd places on March 22, 2020 since the growth rate of infected case was 45 from previous day (March 21, 2020)(Thanthong-Knight 2020). Self-quarantine and supporting quarantine by government and private were employed in all province if the confirmed case was found. After the enforcement and implementation of BMA regulation, the growth rate is decreased (REPORTERS 2020b). The consequences of regulation implementation caused many people (both Thai and migrant) moved from the big city particularly Bangkok a capital of

Table 1 Statistical data of COVID-19 in Thailand as of April 15, 2020

Item	Thailand		Global	
	Number	Percent of total accumulate case	Number	Percent of total accumulate case
New daily confirmed case	43	1.63	16,694	0.83
New daily death case	3	0.11	998	0.05
Accumulate Death	43	1.63	127,598	6.33
Critical case	61		51,527	2.56
Accumulate discharge (recovered case)	1497	56.64	491,498	24.40
Accumulate confirmed case	2643	–	2,014,554	

Source: <https://ddcportal.ddc.moph.go.th/portal/apps/opsdashboard/index.html#/20f3466e075e45e5946aa87c96e8ad65>

Fig. 1 Timeline of important event for COVID-19 spreading and control in Thailand up to April 14, 2020



Thailand to their mother home since the employment was critical. This period also caused the transmission of disease from a capital to other provinces and neighboring countries, we found many cases in other provinces that might be from this event and also imported cases from abroad in some areas. The growth rate was increased again, then Thai government decided to announce the state of emergency act on 26 March 2020 and enforce this act on April 32,020 (Pulitzer 2020). The important timeline of COVID-19 cases and the related influencing factors were illustrated in Fig. 1.

Tourist issue was also critical for disease transmission, Thai government released the regulation to screen tourist at the airport or connecting point to neighboring countries and enforced it (TAT 2020). The tourist industry has been the major income of Thailand for long time ago, we have been working to encourage the increasing number of tourists for the whole country. Tourists in Thailand were classified as Thai and other citizens, we always recorded a number of tourist, number of staying day, expenditure. From the analysis above, we found strong correlation of tourist factors and number of COVID-19 that would be base line information for the Thai government to consider for future tourist promotion. We could

not imagine the reemerging of infectious disease like COVID-19 or other diseases from the tourist.

After we reached the 100 accumulated cases, many researchers and scientist mentioned that the number of infected cases might be increased as exponential growth rate as found in many countries such as China, EU countries and USA. Thai government aware of this issue, then many intervention and health system were launched effectively including other mitigation measures, preparedness and response. The Thai health system was unique, Thailand gained worldwide recognition for the quality of its healthcare services, as sixth in its' 2019 list of countries with the best healthcare systems (Bangkok-Post 2019). Health system in Thailand has been categorized as a central, regional, provincial, districts, sub-district and community or village levels. For disease control in Thailand, it has been classified into 12 zones covering the whole country, moreover department of disease control located in Bangkok identified as central unit consisted of the varieties job and unit. All supporting units in this department would also support the regional disease control. The transforming of policy has been carried out in different organizations such as for health policy under Ministry of Public Health, administrative policy under the Ministry of Interior covering 76 provinces, and other indirect organization to support the policy transforming. They have been working together as a partnership.

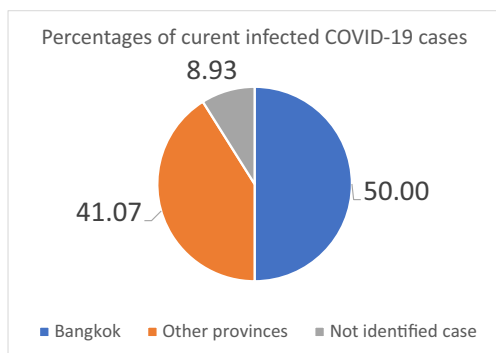
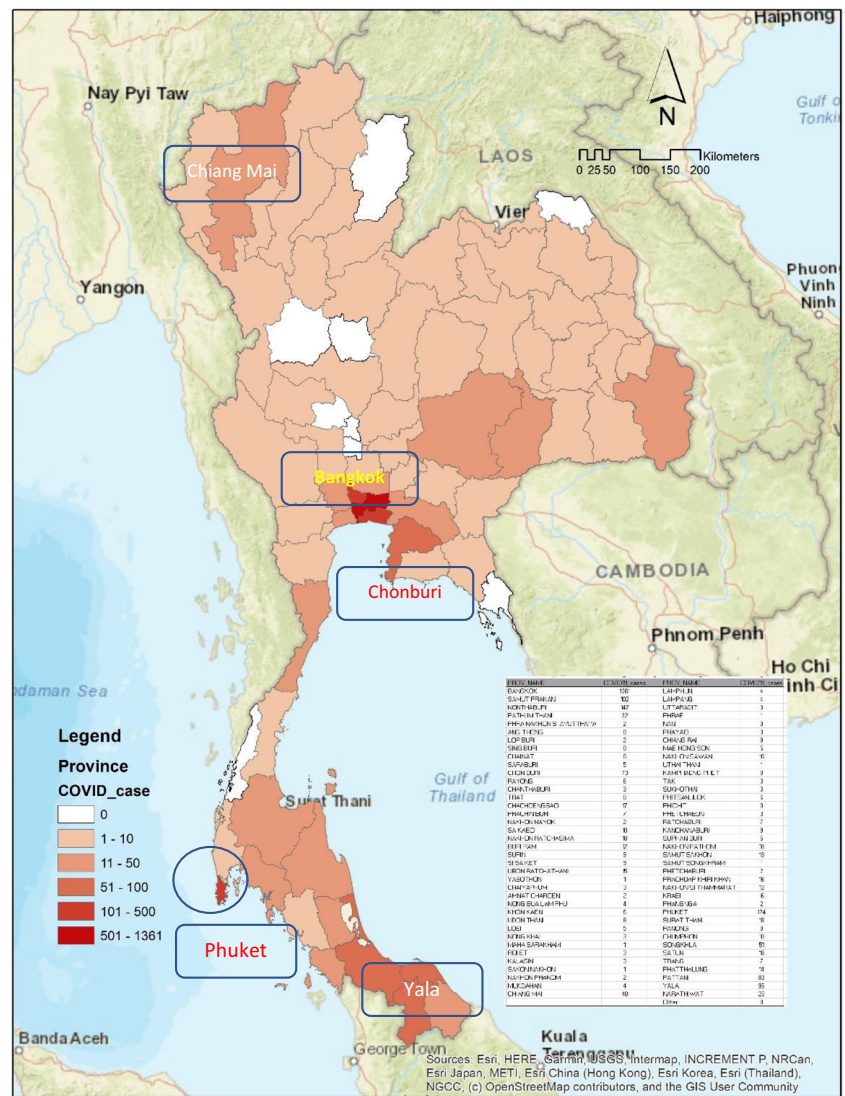


Fig. 2 Percentages of infected COVID-19 cases in Thailand

The transforming of health policy

The policy has been decentralized to local authority both direct and indirect organizations. The smallest unit of health system was the community that working closely with the citizen. Community or village health volunteer was initiated in Thailand since 1977, they have not gained the salary at the first period since the word of “volunteer” (Kauffman and

Fig. 3 Distribution of COVID-19 cases in Thailand (source of data: Disease control department, Ministry of Public Health)



Myers 1997). Right now, the government provided the salary for each volunteer approximately 30 US\$ per month. The community health volunteers were the key persons to implement the Ministry of Public Health policy, Government action plan. The strengths of health volunteers in Thailand were (i) taking care of citizen as relatives (ii) covering all household in the community (iii) working with their mind (iv) working with happiness for their motherland. All health volunteer was trained effectively prior to work in their communities. The knowledge and medical distribution to rural areas were performed by community health volunteers as reported by WHO that the success of the primary health care program in Thailand over the past three decades was attributed by the role of community health volunteers (Treerutkuarkul 2008). They worked as the front liner group to screen the people entering into their community. We used the thermal scan for everyone entering into the workplace, community, hospital, store and other places particularly in the international or local airport

(REPORTERS 2020a). Alcohol liquid or gel was provided in everywhere. Thai culture also supported each other by donating their money or things to the poor or less opportunity people. In addition, Buddhist monks also have been strongly involved in health promotion and education, particularly in remote, rural communities. Thai people also respected to the Buddhist monk according to their culture and believe. A key factor to reduce the spreading of disease was Thai greeting culture, “Wai” has been carried out for greeting, thank you and apologize by pressing the hands together instead of shaking hands like other culture. We can reduce the contacting to the others that we could not identify the infection status.

The other influencing factors policy

The concerning about a Thai New year was also concentrated to avoid the celebration, every year Thai New year was declared as a holiday from 13 to 15 April. The relatives always

Table 2 Pearson coefficient of correlations between COVID-19 case and the visitor information

Parameter	Number of overnight staying in province (2019)	Number of visitors 2019	Number of Thai visitors 2019	Number of the foreigner visitors 2019	Generated income in province 2019	Generated from Thai tourists 2019	Generated from foreigner tourists 2019	COVID-19 case
Number of overnight staying in province (2019)	1							
Number of visitors 2019	.968**	1						
Number of Thai visitors 2019	.897**	.967**	1					
Number of the foreigner visitors 2019	.959**	.934**	.812**	1				
Generated income in province 2019	.958**	.913**	.791**	.980**	1			
Income generated from Thai tourists 2019	.947**	.976**	.943**	.913**	.902**	1		
Income generated from foreigner tourists 2019	.908**	.833**	.682**	.951**	.984**	.810**	1	
COVID-19 case	.829**	.907**	.892**	.835**	.795**	.937**	.690**	1

Note: Pearson correlation coefficient (** p value <0.01)

went back to their hometown and celebrated with their family and friends. Thai government decided to stop the important ceremony celebration to avoid the crowded participation and mass gathering that might be the factors to transmit the disease and induce an outbreak (TheStar 2020).

Social distancing was regulated effectively with the collaboration of all sectors, work from home (WFH) program was launched in all levels with the support of the internet through the whole country. The enforcement of state of emergency act and other related regulation was strictly implemented to control the spreading of disease. Some provinces had announced and implemented their regulation according to their authority and role of state of emergency act, to control the disease spreading. Up to now (as April 15), there are no reported COVID19 cases in 9 provinces from 76 provinces (Control 2020). The interesting factor of top five confirmed infected cases in the provinces were the touristy places, a dense population zone and religious related infection like the first ranking was Bangkok with approximately 50% of total cases (1311 of 2643 of total cases) and second rank was 187 cases (about 7%). Phuket has been recognized as popular and attractive places for tourists, a case was originated from foreigners.

Conclusion

COVID-19 was declared as pandemic disease in Thailand. The first case was detected in Bangkok a capital city and was determined as imported cases. The maximum confirmed

case was found in Bangkok with the second rank of a worldwide tourist attraction area namely; Phuket Province. The spreading of disease was distributed from social activities and spread to rural areas due to the city lockdown policy and implementation of state of emergency. People moved back to their mother's hometown and some also brought the disease to their relatives. The number of confirmed infected cases were significantly to the economic factors of tourism in the country, namely; number of tourists staying overnight, the number of visitors, generated income from tourist activities.

The decreasing rate of infected case in Thailand was the consequences of various factors including the social distancing policy (work from home), Thai greeting culture, strengthening of Thai health care system, preparedness and response of both central and local government, the enforcement and implementation of regulation, awareness of people and public communication, update information and distribution through the kingdom, well-preparation and hardworking of medical and health personals, the partnership and supporting among various organizations.

Compliance with ethical standards

This study used the official published website data in general information and we conducted in accordance with the Declaration of Helsinki.

Conflict of interest The authors declare that they have no conflict of interest.

References

- Altamimi A, Ahmed AE (2019) Climate factors and incidence of Middle East respiratory syndrome coronavirus. *J Infect Public Health*. <https://doi.org/10.1016/j.jiph.2019.11.011>
- Ayoub MS, Thamer A-K, Mahmood UA, Sultan MA, Klonoff DC, Hoang TD (2020) Biological and epidemiological trends in the prevalence and mortality due to outbreaks of novel coronavirus COVID-19. *J King Saud Univ- Sci*. <https://doi.org/10.1016/j.jksus.2020.04.004>
- Bangkok-Post (2019) Thailand's healthcare ranked sixth best in the world. <https://www.bangkokpost.com/thailand/general/1746289/thailands-healthcare-ranked-sixth-best-in-the-world>. Accessed 15 April 2020
- Chappell B (2020) Coronavirus: COVID-19 Is Now Officially A Pandemic, WHO Says. <https://www.npr.org/sections/goatsandsoda/2020/03/11/814474930/coronavirus-covid-19-is-now-officially-a-pandemic-who-says>. Accessed 25 April 2020
- Chavez S, Long B, Koyfinan A, Liang SY (2020) Coronavirus disease (COVID-19): a primer for emergency physicians. *Am J Emerg Med*. <https://doi.org/10.1016/j.ajem.2020.03.036>
- Control DoD (2020) Report and update the COVID-19 case in Thailand. <https://covid19.ddc.moph.go.th/>. Accessed 25 April 2020
- Jebri N (2020) World Health Organization declared a pandemic public health menace: a systematic review of the "COVID-19", up to 26 th march 2020. *SSRN Electronic J*
- Jingui X, Yongjian Z (2020) Association between ambient temperature and COVID-19 infection in 122 cities from China *Sci Total Environ* 724 doi:<https://doi.org/10.1016/j.scitotenv.2020.138201>
- Kauffman KS, Myers DH (1997) The changing role of village health volunteers in Northeast Thailand-an ethnographic field study. *Int J Nurs Stud* 34(4):249–255
- Kenzie DM (2020) The hunt for covid-19 drugs
- Kiesha P et al (2020) The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modelling study. *Lancet Public Health*. [https://doi.org/10.1016/s2468-2667\(20\)30073-6](https://doi.org/10.1016/s2468-2667(20)30073-6)
- McClellan D (2020) Disaster expert on COVID-19 lessons from China. <https://www.preventionweb.net/news/view/71056> Accessed 25 April 2020
- Network HA (2020) Update and Interim Guidance on Outbreak of 2019 Novel Coronavirus (2019-nCoV) in Wuhan, China. <https://emergency.cdc.gov/han/han00426.asp>. Accessed 20 April 2020
- Pulitzer G (2020) Thailand under a State of emergency – Prime Minister. Bangkok
- REPORTERS P (2020a) Govt ramps up Covid-19 measures. Bangkok
- REPORTERS P (2020b) New measures to combat virus. Bangkok
- Reuters (2020) Covid-19 outbreak 'could kill 10m Thai jobs'
- Sports MoTa (2019) Domestic Tourism Statistics (Classify by region and province 2019). https://www.mots.go.th/old/more_news.php?cid=525&filename=index. Accessed 20 April 2020
- Tang B, Wang X, Li Q, Bragazzi NL, Tang S, Xiao Y, Wu J (2020) Estimation of the transmission risk of the 2019-nCoV and its implication for public health interventions. *J Clin Med* 9:462
- TAT (2020) TAT update: Thailand Public Health Ministry updates list of ongoing local transmission areas
- Thanthong-Knight R (2020) Thailand to Impose Broad Lockdown to Fight Novel Coronavirus. <https://www.bloomberg.com/news/articles/2020-03-25/thailand-to-impose-broad-lockdown-to-fight-spread-of-coronavirus>. Accessed 18 April 2020
- TheStar (2020) Thailand's Songkran Festival Events Cancelled To Avoid Mass Gatherings On Covid-19 Spread. <https://www.malaysia-today.net/2020/03/07/thailands-songkran-festival-events-cancelled-to-avoid-mass-gatherings-on-covid-19-spread/>. Accessed 20 April 2020
- Treerutkuarkul A (2008) Thailand's unsung heroes. <https://www.who.int/bulletin/volumes/86/1/08-010108/en/>. Accessed 20 April 2020
- WHO (2020a) Coronavirus disease 2019 (COVID-19) Situation Report – 52
- WHO (2020b) Coronavirus disease (COVID-19) Pandemic. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>. Accessed 20 April 2020
- WHO (2020c) Q&A on coronaviruses. <https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>. Accessed 20 April 2020
- WHO (2020d) WHO. Director-General's remarks at the media briefing on COVID-2019 outbreak on 17 February 2020. <https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-covid-2019-outbreak-on-17-february-2020>. Accessed 19 April 2020

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