Rocz Panstw Zakl Hig 2022;73(3):333-340
http://wydawnictwa.pzh.gov.pl/roczniki_pzh/ https://doi.org/10.32394/rpzh.2022.0220

ORIGINAL ARTICLE

EFFECT OF COVID-19 PANDEMIC ON GENDER ASSOCIATED WITH RISK FACTORS: A RETROSPECTIVE DATA ANALYSIS, THAILAND

Jadsada Kunno[1], Busaba Supawattanabodee[1], Chavanant Sumanasrethakul[2], Budsaba Wiriyasirivaj[3], Sathit Kuratong[4], Chuthamat Kaewchandee[1], Pataraporn Yubonpunt[5]

[1]Department of Research and Medical Innovation, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand
[2]Department of Urban Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand
[3]Department of Obstetrics and Gynecology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand
[4]Department Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand
[5]Department of Public Health, Faculty of Public and Environmental Health, Huachiew Chalermprakiet University, Samut Prakan, Thailand

ABSTRACT

Background. The COVID-19 pandemic is having a serious impact around the world. Many countries have experienced a two or three wave pattern in reported cases. The virus's spread in Thailand was a cluster event distributed over multiple locations, multi-spender, and multiple waves of outbreaks.

Objective. This study aims to study gender associated with age, risk factors, and nationality during coronavirus pandemic in Thailand.

Material and methods. A retrospective cohort study was conducted from January 2020 to May 2021 (17 months) to determine the number of confirmed cases and identify gender associated with, age, various risk factors and nationality were analyzed by chi square test and binary logistic regression analyses.

Results. The results show that the number of cases increased by over 100,000 over the course of three waves of outbreaks. The logistic regression analysis revealed that genders were significantly related with age, various risk factors, and nationality across different waves ($p < 0.01$). Across the primary risk factors were community risk, community cluster and close contact with a previously confirmed patient on confirmed cases during COVID-19 pandemic

Conclusion. Significant differences between genders were significantly associated with age, various risk factors, and nationality may be due to weak social distancing policies and the lack of public health interventions. A COVID-19 vaccination plan is needed for people who are at risk of suffering severe symptoms as well as the general population in outbreak areas to increase immunity.

Key words: *COVID-19, pandemic waves, gender, age, various risk factors*

INTRODUCTION

Coronavirus (COVID-19) is a pandemic found all over the world today. Globally, there have been more than 177 million cases, with an average of around 490,000 cases reported each day and over 50,000 deaths per week [1, 2]. As COVID-19 continues its rapid global spread, increased understanding of the underlying levels of transmission and infection severity are crucial for guiding the pandemic response [3].

According to the literature, many countries have experienced multiple waves of COVID-19 outbreaks. During the 2020 pandemic, empirical data show that characteristics varied between waves [4]. In comparison with the second wave, the proportion of local clusters (24.8% vs. 45.7%) was lower in the third wave, and personal contact transmissions (38.5% vs. 25.9%) and unknown routes of transmission (23.5% vs. 20.8%) were higher [5]. Consequently, many governments and health authorities, including the World Health Organization (WHO), have been

Corresponding author: Busaba Supawattanabodee, Department of Research and Medical Innovation, Faculty of Medicine, Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand, Tel.: +66-2244-3125 e-mail: sbusaba@nmu.ac.th

actively educating people to take preventive measures to reduce the spread of the virus, including lockdown measures [6, 7, 8].

Multiple waves in Thailand [9, 10, 11] have been traced to super-spreading events at entertainment establishments, pubs, bars, karaoke lounges, and various types of gambling venues in different regions of the country. These events led to an expansion of spread of COVID-19 to many provinces since the risk locations were sites that attracted crowding, extended interactions, and high turnover. For example, clusters of outbreaks during the first wave of coronavirus have been traced to super-spreader events in sports venues or indoor entertainment establishments. An outbreak in March 2020 was associated with attendees at a boxing stadium in Bangkok, who spread the virus to other provinces as they travelled home or on business. The origin of the second wave has been traced to a wholesale shrimp market. Most of the initial infections beginning in mid-December 2020 were among Thai residents and non-Thai migrants who live and work in that locality.

The impact of gender and age may as a dependent risk factor, one study indicated that men are at higher risk of contracting the novel coronavirus than women [12, 13]. Males have lagged females in taking up social distancing measures. Males' poorer compliance with public health containment measures may help explain their higher COVID-19 mortality. Moreover, the relative share of infections among young, older, and debilitated people may shape the observed proportion of deaths in different demographic groups and the overall fatality rate in the total population [18]. When adjusting for sex, age and the presence of comorbidities, that study found that mortality significantly increased among elderly men, which is consistent with other regional studies [14]. Different age groups have experienced the pandemic in distinct ways [15, 16]. Physical distancing means that children must spend more time within the household, and it sharply reduces opportunities for young children to play with their peers, engage in typical rough-and-tumble learning, or develop empathy [15, 17].

Thus, the COVID-19 pandemic is a multi-spender, and outbreaks affect everyone living in Thailand, including citizens, migrant workers, and other foreign nationals. Various risk factors associated with multiple waves of coronavirus outbreaks include close contact with a previously confirmed patient, community risk, and clustered communities as well as socio-demographic factors such as nationality, gender, and age. Hence, the aim of this study was to investigate the effect of COVID-19 pandemic on gender associated with age, various risk factors and nationality in Thailand.

MATERIAL AND METHODS

Study design

We conducted a retrospective data study of all cases of COVID-19 in Thailand. Information was recorded between January 2020 and May 2021 [9, 10, 11]). All records were fully anonymized before the researchers accessed them. This study was approved by the ethics committee of Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand, (COE: 011/2021X).

Data collection

COVID-19 data gathered by the Department of Disease Control, Ministry of Public Health, Thailand were collected, including time period, number of confirmed cases by PCR test for SARS-CoV-2, and sociodemographic characteristics, specifically gender, age, various risk factors and nationality. The study period was stratified based on the months of test screenings and diagnoses to identify temporal trends in cases. Population data were divided between five phases: Phase I: January–February 2020, Phase II: March–May 2020 (First wave), Phase III: June–November 2020, Phase IV: December 2020–March 2021 (Second wave), and Please V: April–May 2021 (Third wave).

Study population

The COVID-19 infection database was queried to identify all recorded ages, gender, nationality, and various risk factors. Cases in which such information was missing were excluded.

We stratified the population based on age (< 20, 21 – 40, 41 – 60, and > 60 years). Gender (males and females). We stratified nationality into Thai and non-Thai including migrant worker (Myanmar, Khmer, Laotian), and foreigner categories. Population various risk factors were stratified on the basis of close contact with a previously confirmed patient (risk 1), community cluster (risk 2), community risk (risk 3, such as enclosed space), active-community surveillance (risk 4), and other risk factors (risk 5) (Figure 1).

Statistical analysis

We summarized the characteristics of the categorical data. Characteristics were compared using descriptive statistics, and categorical data were compared using a chi square test. We used binary logistic regression to test the association between gender and age, various risk factors, and nationality on confirmed cases of COVID-19. The level of statistical significance was set at p-value < 0.05 was considered to indicate statistical significance. Statistical analysis

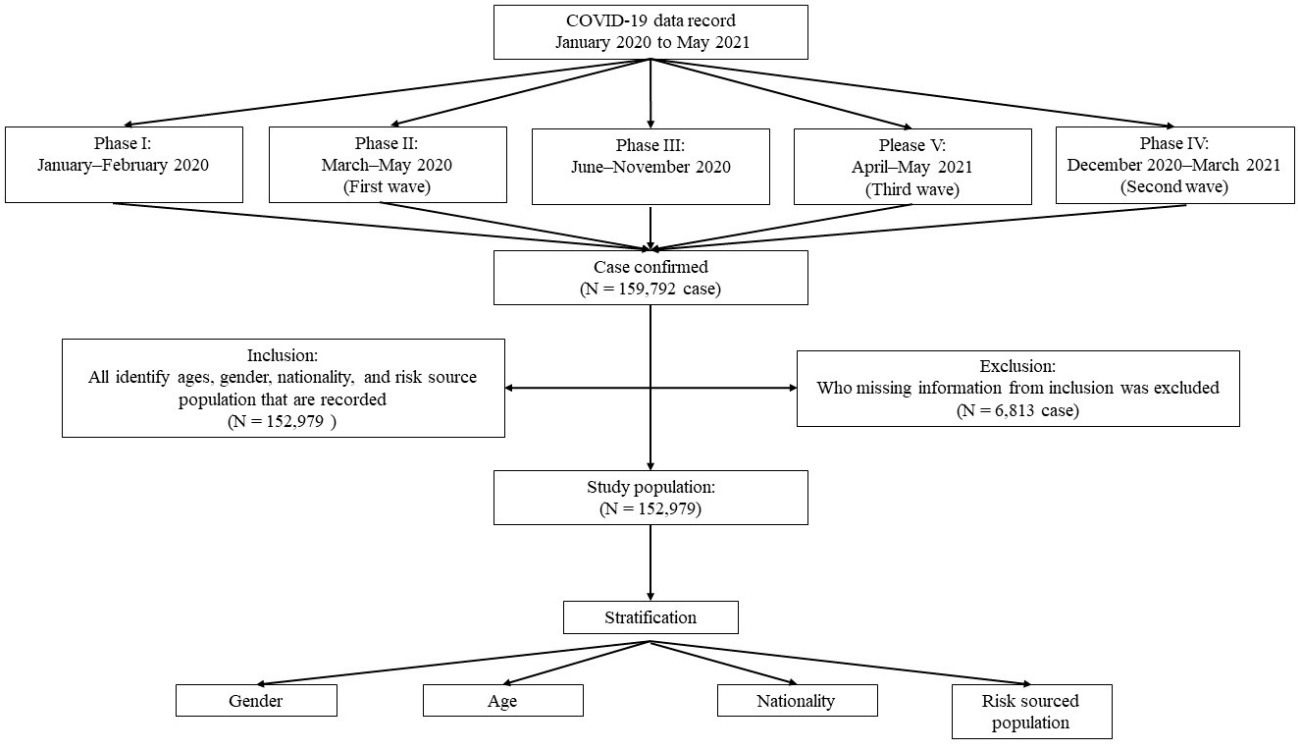

Figure 1. Derivation of study population

was performed using the Statistical Package for the Social Sciences Program (SPSS), version 22.

RESULTS

Socio-demographic characteristics during different phases during COVID-19 pandemic

The Chi-square results showed that the different phases of the COVID-19 pandemic in Thailand were significantly difference with gender, age, various risk factors and nationality (P-value < 0.01) (Table 1).

There were approximately 150,000 confirmed cases within the 17-month period from January 2020 to May 2021. During phase I (January–February 2020), there were approximately 42 confirmed cases. During the first wave in phase II (March–May 2020), the number of new cases increased to approximately 3,040. Phase III (June–November 2020) was characterized by low levels of new cases (approximately 938 cases); however, a second wave occurred during Phase IV (December 2020–March 2021), when the number of new cases increased to more than 20,000. A third wave–which continues into the present–can be observed during Phase V (April–May 2021), when the number of new cases increased to more than 100,000 (Table 1).

The number of cases according to female 74,170 and male 78,809 cases. The mean age was 35 ± 14.01 years. Table 1 presents Thais were the main nationality impacted by the coronavirus, with 118,391 cases, distantly followed by non-Thai nationality with 34,588 cases. Data of various risk factors revealed that most tested individuals had been in risk1 accounted for the largest number of cases (n = 67,214), followed risk2 (n = 39,377), and risk3 (n = 13,002), and risk4 (n = 30,456). In addition, 2,969 cases occurred due to other risks, Hence, the COVID-19 pandemic had a deep impact on all socio-demographic groups living in Thailand, including Thai, migrant workers and foreigners across genders and all stages of life. The most prominent risk factors were close contact with a previously confirmed patient and community risk.

Association between gender and variable factors during COVID-19 pandemic within Phase I - Phase V

The binary logistic regression test showed gender were significantly associated with age (*P*-value < 0.01**)** (Table 2). Therefore, gender was significantly associated with risk factors inducing community cluster, community risk and active-community surveillance (*P*-value < 0.01), while gender were likely significant association with close contact with a previously confirmed patient (*P*-value > 0.05). However, gender was not significantly associated with nationality (*P*-value > 0.05).A multivariate analysis (Table 2), All ages were significantly associated with gender (*p*-value < 0.01), whereby male prosperity risk more than female (OR = 1.103 – 1.140, 95%CI 1.054 – 1.200). Risk factor at community clusters were significantly associated with gender (*p*-value < 0.01), whereby male prosperity risk more than female (OR = 1.971, 95%CI 1.828 – 2.125). Factors

Table 1. Socio-demographic characteristics during different phases of the COVID-19 pandemic in Thailand

Characteristics	Phases of the COVID-19 pandemic across 17 months												
	Phase I - January - February 2020		Phase II First wave March – May 2020		Phase III - June - November 2020		Phase IV Second wave December 2020 - March 2021		Phase V Third wave April – May, continues 2021		Total		*P*-value
Gender	n (%)												
Female	19	0.0	1,374	1.9	375	0.5	12,745	17.2	59,657	80.4	74,170	100.0	< 0.01
Male	23	0.0	1,666	2.1	563	0.7	9,228	11.7	67,329	85.4	78,809	100.0	
Total	42	0.0	3,040	2.0	938	0.6	21,973	14.4	126,986	83.0	152,979	100.0	
Age (years)													
< 20	3	0.0	228	1.4	82	0.5	1,458	8.7	15,072	89.5	16,843	100.0	< 0.01
21 – 40	18	0.0	1,554	1.7	530	0.6	14,964	16.8	72,083	80.9	89,149	100.0	
41 – 60	8	0.0	964	2.6	264	0.7	4,698	12.5	31,576	84.2	37,510	100.0	
> 60	13	0.1	294	3.1	62	0.7	853	9.0	8,255	87.1	9,477	100.0	
Total	42	0.0	3,040	2.0	938	0.6	21,973	14.4	126,986	83.0	152,979	100.0	
Risk factors													
Risk 1	32	0.0	1,599	2.4	276	0.4	2,773	4.1	62,534	93.0	67,214	100.0	< 0.01
Risk 2	0		0		0		17,587	44.7	21,790	55.3	39,377	100.0	
Risk 3	8	0.1	1,146	8.8	16	0.1	567	4.4	11,265	86.6	13,002	100.0	
Risk 4	0		55	0.2	0		332	1.1	30,069	98.7	30,456	100.0	
Risk 5	2	0.1	240	8.1	661	18.2	718	24.2	1,348	45.4	2,969	100.0	
Total	42	0.0	3,040	2.0	938	0.6	21,973	14.4	126,986	83.0	152,979	100.0	
Nationality													
Thai	17	0.0	2,734	2.3		0.6	7,922	6.7	107,029	90.4	118,391	100.0	< 0.01
Others	25	0.1	306	0.9		0.7	14,051	40.6	19,957	57.7	34,588	100.0	
Total	42	0.0	3,040	2.0		0.6	21,973	14.4	126,986	83.0	152,979	100.0	

Risk1: close contact with a previously confirmed patient; Risk2: community cluster; Risk3: community risk; Risk4: active-community surveillance Risk5: others. Statistical analysis was performed by chi square test. *P*-value < 0.05 was considered to indicate statistical significance.

Table 2. Bivariate and multivariate analysis of gender associated with age, risk factors and nationality on confirmed cases of COVID-19 within Phase I - Phase V

Variable factors	Gender		Bivariate		Multivariate	
	%		OR (95%CI)	*P*-value	OR (95%CI)	*P*-value
Age (years)	Female	Male				
< 20	11.3	10.7	1.115 (1.060 – 1.172)	< 0.01	1.140 (1.084 – 1.200)	< 0.01
21 – 40	57.4	59.1	1.213 (1.162 – 1.265)	< 0.01	1.113 (1.066 – 1.162)	< 0.01
41 – 60	24.5	24.5	1.182 (1.130 – 1.236)	< 0.01	1.103 (1.054 – 1.154)	< 0.01
> 60	6.7	5.7	Ref.		Ref	
Risk factors						
Risk 1: close contact with a previously confirmed patient	48.3	39.8	1.056 (0.980 – 1.136	0.151	1.069 (0.992 – 1.151)	0.079
Risk 2: community cluster	20.5	30.6	1.910 (1.772 – 2.059)	< 0.01	1.971 (1.828 – 2.125)	< 0.01
Risk 3: community risk	8.7	8.3	1.218 (1.124 – 1.319)	< 0.01	1.226 (1.132 – 1.328)	< 0.01
Risk 4: active-community surveillance	20.3	19.6	1.239 (1.149 – 1.337)	< .0.01	1.263 (1.171 – 1.363)	< 0.01
Risk 5: others	2.2	1.7	Ref.		Ref	
Nationality						
Thai	77.4	77.3	1.006 (0.982 – 1.031)	0.611	0.890 (0.868 – 0.913)	< 0.01
Others	22.6	22.7	Ref.		Ref	

Female = 0, Male = 1; Ref = reference group; OR = odds ratio; CI = confidence interval. Significant at *P*-value < 0.05.

community risk were significantly associated with gender (*p*-value < 0.01), whereby male might risk more than female (OR = 1.226, 95%CI 1.132 – 1.328). Factors on active-community surveillance were significantly associated with gender (*p*-value < 0.01), whereby male might risk more than female (OR = 1.263, 95%CI 1.171 – 1.363). In addition, who close contact with a previously confirmed patient were neatly significantly associated with gender (*p*-value =0.079). However, Thai nationality were significantly associated with gender (*p*-value < 0.01), whereby male prosperity risk lower than female (OR = 0.890, 95%CI 0.868 – 0.913). Hence, gender associated with age, risk factors and nationality on confirmed cases during COVID-19 pandemic.

DISCUSSION

The current reports the results of a retrospective cohort study of all confirmed cases of the COVID-19 pandemic in Thailand from January 2020 to May 2021. The results show that there were over 152,979 confirmed cases of COVID-19 during that 17-month period, including approximately 74,170 cases among females and 78,809 cases among males. Our study did not investigate socio-demographic differences in mortality rates due to limitations in data and time; however, age and gender are well-established risk factors for COVID-19; for example, over 90% of deaths in the UK to date have occurred among people aged over 60 years, and men account for 60% of deaths [12].

This study found significant differences between the three waves of the COVID-19 pandemic in Thailand. Our results indicate that the third wave is more serious than previous waves, which may be due to a lack of strong social distancing policies and public health interventions. Our findings differ from other studies that found that first wave of COVID-19 pandemic had the most negative impact on public health, whereas the second wave evinced more stable evolutionary dynamics [18]. Sufficient epidemiologic investigations and contact tracing could not be performed during the third wave, and there was a marked increase in the proportion of unknown routes of transmission [10, 12].

Association between gender associated with age, risk factors and nationality on confirmed cases of COVID-19 within Phase I - Phase V

In fact that gender was significantly associated with age, risk factors and nationality (*P*-value < 0.01), and more cases occurred in males than females. We found that clusters risk might play an important role in modifying transmission patterns of COVID-19. The presence of gender was associated with age (*P*-value <0.01), based on distribution of COVID-19 fatalities remained steady across the three waves, this was

difference with previous study showed that females and age were found to be at greater risk for being COVID-19 infected [19].

In this study reported that elderly individuals over 60 years of age accounted for approximately 9,477 COVID-19 cases. Although COVID-19 has an extremely steep risk gradient for death across age groups [12], increasing age has been strongly associated with risk, with people aged 80 or over having a more than 20-fold-increased risk compared with 50–59-year-olds (fully adjusted HR 20.60; 95%CI 18.70–22.68) [12]. However, strategies specifically focused on protecting high-risk elderly individuals should be considered in managing the pandemic [14]. Case reports indicate a mean age range for fatalities of 50–60 years, and studies have demonstrated that younger patients tend to exhibit milder symptoms [20]. One study found that the median age of the infected was 42 in men and 39 in women, and the most affected age group was that aged 19–50 years, which represented 59.6% of the entire cohort, almost double the prevalence among the same age group in Italy (24.0%) and very similar to the age distribution in China [14, 21].

To the best of our knowledge, gender was significantly associated with risk factors inducing community cluster, community risk, active-community surveillance, and close contact with a previously confirmed patient (*P*-value <0.01). As the same our presented one study indicated that men are at higher risk of contracting the COVID-19 than women [12, 13]. Another study found that men accounted for 55.4% (n = 5,247) of all cases with an incidence rate of 60.5 per 100,000, whereas women accounted for 44.6% of cases (n = 4,221) and an incidence of 47.2 per 100,000 [21]. Males have lagged females in taking up social distancing measures. Males' poorer compliance with public health containment measures may help explain their higher COVID-19 mortality.

Our study considered ethnicity as an independent risk factor. This study found gender were significantly associated with nationality (*P*-value <0.01). However, a systematic review and meta-analysis could not confirm ethnicity as an independent risk factor for negative outcomes in COVID-19 patients [22]. It is time to learn from the lessons of past disease outbreaks. Given the low-to-high-quality evidence indicating that ethnicity is not an independent risk factor, COVID-19 risk assessments should only consider ethnicity in conjunction with other risk factors such as age or comorbidities. Following the second wave of the pandemic in Thailand, screening and surveillance have been expanded to try to detect potential outbreaks before they could ignite, and more outreach testing has been conducted, especially among the migrant worker population and their contacts. It is important to learn from prior experiences and strategies to reduce observed disparities [22], and resources must be invested in the hardest-hit communities [23].

There are currently limited retrospective studies addressing the nationality and risk factors were not directly estimated, and some gender and age information are missing. Therefore, our results must be taken with caution. However, we believe that the findings are relevant, as they represent a national-level study of risk factors and socio-demographic impacts across Thailand, and limited information is currently available on this issue.

CONCLUSIONS

The best results of the present study show an effect of different waves during the COVID-19 pandemic on gender associated with age, risk factors and nationality in Thailand, which may be attributable to a lack of strong social distancing policies and public health interventions. The main risk factors were close contact with a previously confirmed patient and community risk. We recommend an acceleration of screening among workers so that they can enter the health service system as soon as possible and confirmed cases can be isolated. The likelihood of replication and mutation increases when a virus is widely circulating and causing many infections in a population [24, 25, 26, 27]. Priority should be given to vaccinating high-risk groups to maximize global protection against new variants and minimize the risk of transmission [28]. As more people get vaccinated, virus circulation is expected to decrease, which will in turn result in fewer mutations [26]. Generally, control measures have been tightened around the country, and people have been strongly admonished to wear masks, practice hand-washing hygiene, and socially distance while outside the home.

Abbreviations

Coronavirus disease (COVID-19); Risk1 (previously confirmed patient) referred to as "direct contact", this is when one person is physically close enough to an infected individual to come into direct contact with their bodily fluids, including respiratory droplets; Risk2 (community cluster) referred to cluster occurs when there is a concentration of infections in the same area at the same time such as occurs at village, district, district and province; Risk3 (community risk) referred to workplace, not public-facing, bar, childcare facility, health care, restaurant etc. or other hand refer to enclosed space; Risk4 (active-community surveillance) referred to when members of a community actively participate in detecting, reporting, responding to and monitoring health events in their community; Risk5 (other risk factors) referred to state quarantine; WHO: World

Health Organization; OR: Odds Ratio; CI: Confidence Interval.

Acknowledgments

The authors would like to acknowledge the COVID-19 data gathered by the Department of Disease Control, Ministry of Public Health, Thailand. Information was recorded between January 2020 and May 2021 (17 months).

Ethics approval and consent to participate

This study was approved by the ethics committees of Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand. (Approval no. COE: 011/2021X).

Funding

None

Consent for publication

Not applicable

Declaration of competing interest

The authors declare that they have no conflicts of interest.

Availability of data and materials

The data sets generated and analyzed during the current study are not publicly available due to identifiable information but are available from the corresponding author on reasonable request answering the survey. The secondary analyses from announcement regarding the COVID-19 from the Department of Disease Control in Thailand data used to support the findings of this study are included within the article. Data are available from announcement regarding the COVID-19 from the Department of Disease Control in Thailand for researchers who meet the criteria for access to confidential data. The data used to support the findings of this study have been deposited in the Department of Disease Control in Thailand repository from: https://ddc.moph.go.th/viralpneumonia/eng/file/main/en_Thailand%20Covid-19%20plan_MOPH_2021.pdf. For more information, https://ddc.moph.go.th/viralpneumonia/eng/announcement.php.

Authors' contributions

JK., contributed to study design, data collection, data analysis, interpretation, writing and revision of the manuscript. BS., contributed to study design, data analysis, interpretation. CS., contributed to study design, data analysis, interpretation. BW., contributed to study design, data analysis, interpretation. SK., contributed to study design, data analysis, interpretation. CK., contributed to study design, data analysis, interpretation. PY., contributed to data analysis, interpretation, and writing. All authors read and approved the final manuscript.

REFERENCES

1. WHO, Coronavirus disease (COVID-19) Weekly Epidemiological Update and Weekly Operational Update. 2021: World Health Organization, https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports.
2. WHO, Coronavirus disease (COVID-19). 2020, World Health Organization, https://www.who.int/emergencies/diseases/novel-coronavirus-2019.
3. *O'Driscoll, M.*, et al., Age-specific mortality and immunity patterns of SARS-CoV-2. Nature, 2021. 590(7844):140-145.
4. *Iftimie, S.*, et al., First and second waves of coronavirus disease-19: A comparative study in hospitalized patients in Reus, Spain. PLOS ONE, 2021. 16(3): e0248029.
5. *Seong, H.,* et al., Comparison of the second and third waves of the COVID-19 pandemic in South Korea: Importance of early public health intervention. Int J Infectious Diseases, 2021;104:742-745.
6. *Godman, B.,* et al., Rapid Assessment of Price Instability and Paucity of Medicines and Protection for COVID-19 Across Asia: Findings and Public Health Implications for the Future. Public Health Front. 2020;8:585832-585832.
7. *Farooq, H.Z.,* et al., Real-world SARS CoV-2 testing in Northern England during the first wave of the COVID-19 pandemic. J. Infect, 2021.
8. *Alrasheedy, A.A.*, et al., Knowledge, Attitude and Practice About Coronavirus Disease (COVID-19) Pandemic and Its Psychological Impact on Students and Their Studies: A Cross-Sectional Study Among Pharmacy Students in Saudi Arabia. Risk Manag Healthc Policy, 2021;14:729-741.
9. Thailand, M.P.H., Strategy: Managing the new wave of the Covid-19 Epidemic. 2021, https://ddc.moph.go.th/viralpneumonia/eng/situation.php: Department of Disease Control,
10. Thailand, D.D.C., Thailand Situation, (Report) 2021, https://ddc.moph.go.th/viralpneumonia/eng/situation.php: Department of Disease Control, Thailand, https://ddc.moph.go.th/viralpneumonia/eng/situation.php.
11. Thailand, D.D.C., Thailand Situation, (COVID-19). 2021: Department of Disease Control, Thailand, https://ddc.moph.go.th/viralpneumonia/eng/index.php
12. *Williamson, E.J.*, et al., Factors associated with COVID-19-related death using OpenSAFELY. Nature, 2020. 584(7821): p. 430-436.
13. *Williamson, E.*, et al., OpenSAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients. medRxiv, 2020: p. 2020.05.06.20092999.
14. *Ioannidis, J.P.A.*, C. Axfors, and D.G. Contopoulos-Ioannidis, Population-level COVID-19 mortality risk for non-elderly individuals overall and for non-elderly individuals without underlying diseases in pandemic epicenters. Environ Res 2020;188:109890-109890.

15. *DeGrace, S.*, et al., Sex differences in maladaptive emotional and behavioral responses to COVID-19: What is the role of personality? Personality and Individual Differences, 2021:178:110834.
16. *Díaz, A., Á. Beleña, and J. Zueco,* The Role of Age and Gender in Perceived Vulnerability to Infectious Diseases. International Journal of Environ Res Publ Health, 2020;17(2):485.
17. *Mendoza-Jiménez, M.J., Hannemann T.V., Atzendorf J.:* Behavioral Risk Factors and Adherence to Preventive Measures: Evidence From the Early Stages of the COVID-19 Pandemic. Frontiers in Public Health, 2021. 9(679).
18. *Coccia, M.,* The impact of first and second wave of the COVID-19 pandemic in society: comparative analysis to support control measures to cope with negative effects of future infectious diseases. Environ Res 2021;197:111099.
19. *Kushwaha, S.*, et al., Biological attributes of age and gender variations in Indian COVID-19 cases: A retrospective data analysis. Clin Epidemiol Global Health, 2021;11:100788.
20. *Verity, R.*, et al., Estimates of the severity of coronavirus disease 2019: a model-based analysis. Lancet Infect Dis, 2020;20(6):669-677.
21. *Ortiz-Prado, E.*, et al., Epidemiological, socio-demographic and clinical features of the early phase of the COVID-19 epidemic in Ecuador. PLOS Neglected Tropical Diseases, 2021;15(1): e0008958.
22. *Raharja, A., Tamara A., Ko L.T.:* Association Between Ethnicity and Severe COVID-19 Disease: a Systematic Review and Meta-analysis. J Racial Ethn Health Disparities 2020;1-10
23. *Bibbins-Domingo, K.*, This Time Must Be Different: Disparities During the COVID-19 Pandemic. Annals of Internal Medicine, 2020;173(3):233-234.
24. *Plante, J.A.*, et al., The variant gambit: COVID-19's next move. Cell Host & Microbe, 2021;29(4):508-515.
25. *Samadizadeh*, S., et al., COVID-19: Why does disease severity vary among individuals? Respiratory Medicine, 2021;180:106356.
26. Peiffer-Smadja, N., et al., COVID-19 vaccines: A race against time. Anaesthesia Critical Care & Pain Medicine, 2021;40(2):100848.
27. *Jhaveri, R.,* The Next Set of COVID-19 Vaccines: Leveraging New Development Platforms to Increase Access for More People Around the World. Clin Ther 2021.
28. *Forman, R.*, et al., COVID-19 vaccine challenges: What have we learned so far and what remains *to be done?* Health Policy, 2021;125(5):553-567.

Received: 27.04.2022
Accepted: 21.07.2022
Published online first: 12.08.2022