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Descriptive epidemiology of COVID-19 in Palembang, Indonesia

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ABSTRACT

Background and purpose: Indonesia ranks the first highest mortality rate of COVID-19 in Southeast Asia with an average case fatality rate (CFR) of 2.7%. South Sumatra is ranked 14th out of 34 provinces in Indonesia, with a CFR value related to COVID-19 reaching 5.1%, per June 21, 2021. This study aims to determine the descriptive epidemiology of COVID-19 in Palembang City.

Methods: This research used a descriptive epidemiology approach and spatial analysis with the geographic information system. Then the secondary data were collected from the Palembang City Surveillance Report from March 2020 to February 2021 with a total of 7,423 cases, as well as geographic data on the coordinates of health services for all hospitals and public health centers (PHCs) in Palembang City.

Results: The data shows that the age group of 25 to 39 years old dominated the COVID-19 cases. The morbidity and mortality rates in men was higher than women, and much higher at the age of above 60 years old. The most dominant symptom in the deceased COVID-19 patients was shortness of breath and the comorbid history increased the risk of death for patients with COVID-19. The highest number of confirmed cases of COVID-19 was found in the sub-district with the highest population, including the PHC of Padang Selasa, Ilir Barat I (393 patients), while the lowest number of cases was reported in Karyajaya PHC, Kertapati (7 patients).

Conclusion: This study highlights the need in preventing mature deaths of COVID-19 patients by prioritizing elderlies who suffered from comorbidities at the family level and health services to support the government programs.

Keywords: COVID-19, descriptive epidemiology, elderly, comorbidity, Indonesia

INTRODUCTION

The new coronavirus disease or COVID-19, which initially identified in Wuhan (China), has spread worldwide. On March 11, 2020, the World Health Organization (WHO) declared a pandemic, or an extraordinary outbreak of a particular disease in a society or region that spreads to many countries widely.[1,2] As of January 28, 2021, COVID-19 has spread to 221 countries, with positive cases of COVID-19 reaching more than 101 million people and a fatality rate (CFR) of 2% or 2 million deaths and 73.5 million recovered cases in less than one year.[3] Several countries are in the top five with the highest number of cases, including America, India, Brazil, Russia, and the United Kingdom.

Indonesia ranks first out of 11 countries in Southeast Asia, with the highest death rate with an average CFR reaching 2.7%, which signified three deaths among 100 COVID-19 cases per July 2021. Reported cases per day tended to increase and reached their peak in December 2020 and January 2021, when reported COVID-19 cases reached an average of 10 thousands patients per day. The daily reported cases tended to decrease from February to April 2021. In June 2021, the trend of COVID-19 increased significantly reaching over 12,000 patients per day, and in July 2021, there were about 30 to 50,000 reported COVID-19 cases daily.[3]

In the first year of the COVID-19 pandemic in Indonesia, the recovery rate was below 20% in the first two months, which was improved, to almost 95% in April 2021. Unfortunately, the opportunity to access COVID-19 tests in Indonesia was at the lowest position compared to other countries in Southeast Asia, so tracking of new cases was limited. Per April 2021, newly reported cases in Indonesia were only 20 cases per 1 million Indonesian populations, compared to Malaysia and Thailand, with new case findings reaching 300 new cases per 1 million. Therefore, under-reported cases might be rampant in Indonesia.[3]

South Sumatra was ranked 14th among 34 provinces in Indonesia for the highest positive confirmed cases of COVID-19, about 27,119 patients with a total of 137 COVID-19-related deaths.[4,5] The CFR in South Sumatra was in the top three in Indonesia, and the rate was higher than the national at 5.07%, as of 20 June 2021. New cases reached 100 cases per day in January-June 2021 and spread across 17 districts/cities. Nearly 50% of confirmed cases were in Palembang, the capital of South Sumatra, a town with reasonably high population mobility.[5]

Descriptive epidemiology of the spread of COVID-19 in Palembang City is essential as the basis for making COVID-19 policies according to the right target and based on data and scientific evidence. The previous studies have shown the epidemiology trend in each country,[6–9] including Indonesia.[4,10] In China studies, epidemiology analysis helps to measure the effectiveness of public health intervention.[11,12]

Within the decentralized governance of Indonesia, it is vital to provide epidemiology measurement per city, particularly Palembang City, one of cities with the highest CFR in Indonesia. By answering the question of "where", geographic information system (GIS) can help us understand and relate to the "what", "when", "how", and "why" of the world's various problems. GIS aims to organize, analyze, visualize, and share information from various historical periods and scales. For example, an epidemiologist can use GIS to locate the focal point of a deadly disease outbreak. During the COVID-19 pandemic, it was also proven that geospatial techniques (such as mapping) have helped in COVID-19's disease pattern detection in order to make a quick public health decision in a specific location.[13] This study can serve as a scientific basis for the Palembang City Health Office to prioritize targets for the COVID-19 program and as an early preparedness to face the next wave of COVID-19 and other new-emerging diseases in the future. Therefore, this study aims to provide the descriptive epidemiology of COVID-19 cases in Palembang City supported by a geospatial analysis.

METHODS

Setting and study location

The City of Palembang has 1,662,893 people with an area of 400.61 km^2, meaning that in every km^2, there are 4,150.9 inhabitants. The City of Palembang has 41 public health centers (PHC/*puskesmas)*, which are divided into three inpatient PHC and 38 non-inpatient PHC. For clinics, there are 179 clinics which divided into 171 primary clinics (*klinik pratama*) and 8 main clinics (*klinik utama*), and others are private clinics, consisting of 312 private medical practices and 77 private dentistry practices.[14]

Study design and data analysis

This research was conducted for three months, starting from February to April 2021, and the location of the study was focused in Palembang City, South Sumatera Province. The target population in each analysis was all residents of Palembang, whom the government had registered. The data source is all reported COVID-19 cases from COVID-19 surveillance data from the Palembang City Health Service database and data from *Epidemiological Surveillance Information System* or *Sistem Informasi Surveilans Epidemiologi (SISUGI)* history. The designs of this study are both descriptive and analytic epidemiology with three ways of analysis. The first step was to investigate the epidemiology aspects from person, place and time related to COVID-19 cases, the second is analysis of risk factors related to deaths of COVID-19 patients and the third is spatial analysis of cumulative confirmed cases and cumulative death cases of COVID-19 in Palembang City based on each public health centre's working area. More detailed information about each analysis is as follows:

1. Epidemiology of all COVID-19 measures

To analyze the epidemiological measures, we used Palembang City's COVID-19 surveillance reports recorded from March 2020 to February 2021 provided by the Palembang City Health Office. The inclusion criteria for the data included in this analysis is all complete data of each individual from March 2020 until the newest case available in Palembang City per 16th February 2021. There were 7,423 reported cases, consisting of 3,892 males and 3,892 females, with 319 deaths (193 men and 126 women). The following measurements were performed in descriptive epidemiology calculation formulas.[15]

COVID-19-related Crude Death Rate

The crude mortality rate is an estimate of the proportion of people who die in a population over a certain period.

$$\textbf{Crude Mortality Rate} = \frac{\textbf{Number of Death Cases related to COVID} - \textbf{19}}{\textbf{Number of population at risk of death}} \textbf{x1000}$$

Specific Mortality Rates related to COVID-19

Mortality rates were calculated based on specific groups in the population, such as age, race, gender, occupation, geographic location, or particular deaths from certain diseases (comorbidities).

$$\textbf{Specific Mortality Rate} = \frac{\sum \textbf{Deaths that occur in a specific group} *}{\textbf{Estimation} \sum \quad \textbf{population in a specific group} *} x1000$$

*population that has been determined at a certain period

Case Fatality Rate (CFR)

Case Fatality Rate (CFR) is the number of people who died related to COVID-19 from the total people who were confirmed COVID-19 based on laboratory results.

$$\textbf{Case Fatality Rate} = \frac{\textbf{number of people who died from COVID} - \textbf{19}}{\textbf{number of positive cases of COVID} - \textbf{19}} x1000$$

Attack Rate

The attack rate or number (rate) of attacks related to COVID-19 is used to estimate COVID-19 cases per certain period compared to the population at risk of contracting COVID-19 per 100,000 populations in outbreak conditions, such as the current pandemic. The reported number of new COVID-19 cases is divided by the number of people who may have contracted COVID-19 simultaneously, in percent or per mile.

$$\textbf{Attack rate} = \frac{\sum \text{The number of new cases of COVID} - 19 \text{ at one time}}{\sum \quad \text{people infected with COVID} - 19 \text{ at that time}} \textbf{x100000}$$

2. Descriptive Epidemiology of symptomatic COVID-19 patients with outcomes of death or recovery

To observe epidemiological data based on symptoms, we took secondary data from the SISUGI website. The inclusion criteria for the data in this analysis including: every case confirmed positive to COVID-19 with completed epidemiological investigation (e.g symptoms related to COVID-19 and comorbidities), and the latest status of each individual has been categorized into recovered or passed away. We extracted the data from March 1st, 2020 - March 13th, 2021. On March 13th, 2021, there were a total 8,309 of COVID-19 cases in the SISUGI database. After we cleaned the data, only 3,180 COVID-19 cases have completed data on comorbidities. We analyzed the recovered and death cases with a total of 1,227 cases. We produced graphs to understand the risk factors of death related to COVID-19 in Indonesia. Chi-square was undertaken for crosstabs calculation.

3. Spatial Analysis Approach

This section is a descriptive ecological study about COVID-19 cases using spatial analysis. The purpose of this study was to spatially describe cumulative confirmed cases and cumulative death cases of COVID-19 in Palembang City based on each PHC's working area. This study uses aggregated data from a population group as a research unit, the population group studied was 41 PHCs' working areas in Palembang. The study used secondary data, 2 types of data used in this analysis were spatial and attribute data. For spatial data, we used digital maps of Palembang City per urban village area from The Government of Palembang City's website (Geoportal Pemerintah Kota Palembang: **http://geoportal.sumselprov.go.id/)** and coordinates of PHCs and hospitals in Palembang City from Google Maps. For attribute data, we used cumulative confirmed cases and cumulative death cases of COVID-19 from Palembang City's COVID-19 Surveillance Reports per 16 February

2021 provided by the Palembang City Health Office. The criteria for the data included in this analysis was it has to be complete data of each individual, the cases lived in Palembang City and all cases were taken (from the beginning until the newest case available in Palembang City). We used an open-sourced spatial application QGIS (3.10.10 version) to perform the analysis.

Firstly, researchers defined the class for cumulative confirmed and death case data of COVID-19 with QGIS application then divided it into 3 categories using the Classify tool with Equal Count (Quartile) mode and for Legend format with a Precision-2 value. Then we transformed the Palembang City map per urban village area into PHC's working area based on the division of work area from the Palembang City Health Office. Then we obtained the coordinate points of health service's addresses from Google Maps. A digital map was created by overlaying the data on confirmed and death cases of COVID-19, coordinate points for health centers and hospitals, the Palembang City Road Network, and the Open Street Map. The cumulative confirmed cases are classified into three: <100, 100-200, and >200 cases, while three categories of the cumulative death cases are <5 cases, 5-10 cases, and >10 cases of death.

Ethical approval for the study was obtained from the Ethics Committee of University of Sriwijaya number: 039/UN9.FKM/TU.KKE/2020.

RESULT

Characteristics of COVID-19 patients

The characteristics of the participants in Table 1 showed that based on the patient's age, the proportion of patients who died was higher among those over 60 years old (17.5%) than those under 60 years of age (3.3%). Based on the gender of the patient, we found that more male patients (6.2%) died than females (4.1%). While based on the occupational status, we found that working patients (7.8%) have more deceased cases than those who did not work (4.1%). Results from the analysis of COVID-19 symptoms proved that patients who had symptoms (7.4%) have a higher proportion of deceased cases compared to those without symptoms (1.2%). Based on the history of comorbidities, we found that patients with 1 (20.6%) or more (37%) comorbidities have a higher proportion of deaths than those without comorbidity (2.4%).

Table 1. COVID-19 cases' characteristics

Variables		Patient's health outcomes				Total
		Deceased (n=61)		Recovered (n=1163)		
		n	%	n	%	
Age	>60	29	17.5%	137	82.5%	166
	≤60	35	3.3%	1026	96.7%	1061
Sex	Male	40	6.2%	605	93.8%	645
	Female	24	4.1%	558	95.9%	582
Working status	Yes	29	7.8 %	344	92.2%	373
	No	35	4.1 %	819	95.9 %	854
Symptoms of COVID-19	Asymptomatic	5	1.2 %	420	98.8%	425
	Symptomatic	59	7.4 %	743	92.6 %	802
Comorbidity history	No Comorbidity	26	2.4%	1053	97.6%	1079
	1 Comorbidity	21	20.6%	81	79.4%	102

>1 Comorbidity	17	37%	29	63%	46

Source: Epidemiological Surveillance Information System (SISUGI), March 2020 – March 2021

The morbidity and mortality rate

Figure 1 shows the number of new cases of COVID-19, morbidity rate, and mortality rate related to COVID-19. Based on the number of cases, the highest number of COVID-19 cases is in the age group between 24 to 40 years old, however, based on the morbidity and mortality rate, the highest mortality and morbidity rate related to COVID-19 is among elderlies.

The crude morbidity rate shows that there are five COVID-19 cases within 1000 population. Figure 1 shows that the number of COVID-19 new cases, morbidity rate and mortality rate related to COVID-19 tended to increase as the population ages. The lowest morbidity rate is in toddlers, where one toddler infected with COVID-19 per 1000, while among those aged 5-9 years, two children infected with COVID-19 per 1000 population. The risk of getting sick is at the range of 5-11 people per 1000 population among the productive age group (25 years-50 years) and the elderly group (above 50 years). Based on the gender, the morbidity rate in men is higher than in women in the age group above 30 years, ranging from 7 to 11 illnesses per 1000 population (Figure 1).

The crude death rate related to COVID-19 in Palembang City is around 0.19 per 1000 population or 19 deaths per 100,000 populations at risk of being infected with COVID-19. The CFR for COVID-19 patients reached 43 deaths per 1000 patients or 430 per 100,000 populations infected with COVID-19 in Palembang City (Figure 1).

Though the number of COVID-19 patients is higher at productive age group compared to the older age group, the mortality rate is much more higher at the age of over 50 years old (Figure 1). For instance, per 1000 population at risk of getting infected COVID-19, there was about one patient with COVID-19 passed away at the age group of 60-64 and increase to almost two fold at age group of 65-69 and 70-75. The age group of children under five and adolescents has a very low mortality rate, ranging from 0 to 10 people per 100,000 populations at risk. For specific mortality rates by sex, the risk of mortality tends to be higher in men than women in almost all age groups, especially over the age of 65 years; the risk of death is almost doubled in the male population than in the female population (Figure 1).

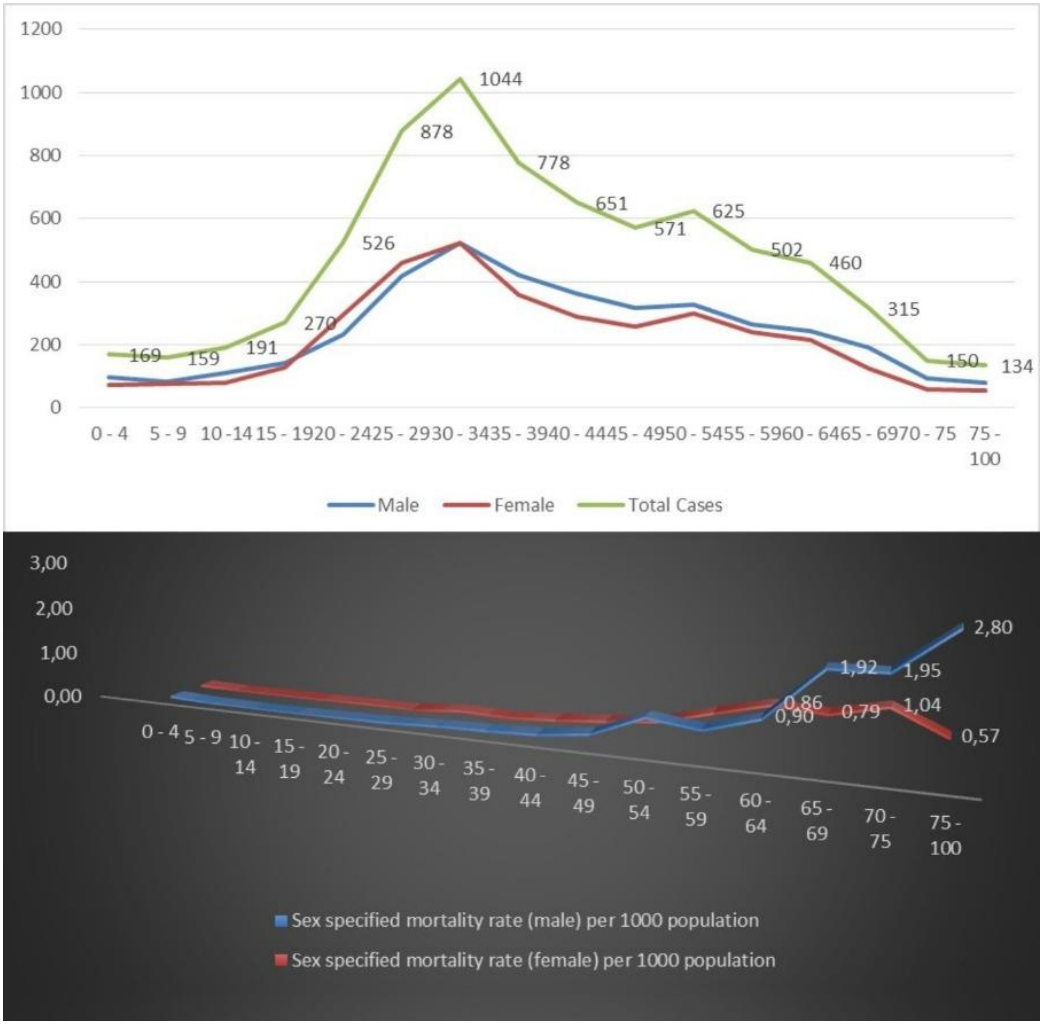

Figure 1a. Number of cases related to COVID-19 based on age and gender; 1b. Mortality rates based on gender and age group in Palembang City

Attack rate of COVID-19 in Palembang

The average number of new cases recorded tends to increase from March to July 2020, reaching 56 new cases per 100,000 residents of Palembang City at risk of contracting COVID-19. New case discoveries tended to decline from August to November 2020. Still, they experienced an increase in the number of new cases reaching 80 new cases per 100,000 residents of Palembang City from December 2020 to January 2021 (Figure 2).

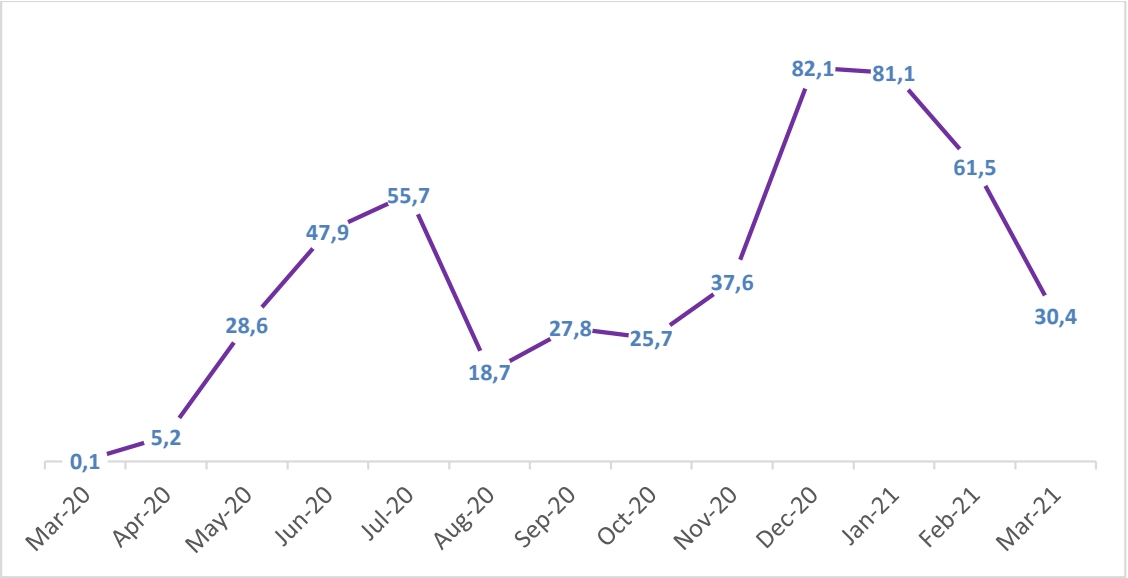

Figure 2. Trend of COVID-19 Attack Rate per 100,000 residents per month in Palembang City from March 2020 - March 15, 2021

Dominant symptoms and comorbidity history in COVID-19 patients in Palembang

Overview common symptoms in COVID-19 patients, both deceased and recovered, including cough and fever. For the groups of deceased cases, the most dominant symptom was shortness of breath, followed by weakness and fever. In the patients who were recovered, the most predominant symptom is cough, followed by fever and runny nose.

The data also highlights that comorbidity contribute to risk of death among COVID-19 patients. There are about 35.9% COVID-19 patients with hypertension, 26.6 % of those with diabetes and 18.8% of those with heart disease passed away. On the other hand, there is lower percentage of these comorbidities for recovered patients.

Table 2. Symptoms and comorbid of COVID-19 patients in Palembang based on health outcome status

Symptoms	Deceased (n=61)		Recovered (n=1163)	
	f	%	f	%
Symptoms				
Shortness of breath	34	53.1	93	8
Limp	32	50	141	12.1
Fever	31	48.4	412	35.4
Cough	27	42.2	453	39
Nausea and vomit	15	23.4	71	6.1
Cold	14	21.9	317	27.3
Sore throat	14	21.9	186	16
Headache	14	21.9	166	14.3
Abdominal pain	10	15.6	32	2.8
Muscle ache	7	10.9	84	7.2
Diarrhea	5	7.8	31	2.7
Comorbidities				
Diabetes	17	26.6	40	3.4
Hearth disease	12	18.3	20	1.7

Hypertension	23	35.9	72	6.2
Cancer	1	1.6	1	0.1
Kidney failure	4	6.3	2	0.2
Chronic obstructive	2	3.1	6	0.5
Immunology disorder	0	0	1	0.1

Spatial analysis of COVID-19 by PHCs in Palembang

Figure 3 focuses on the spatial analysis of reported cumulative cases of COVID-19. Based on Figure 3, there were 19 out of 41 PHCs whose working areas had the cumulative confirmed cases exceed 200, out of 7,423 cumulative confirmed cases of COVID-19 in Palembang City. Padang Selasa (393 cases), Sosial (339 cases), Sukarami, and Kalidoni (331 cases) were the PHCs with the highest number of reported cases. Meanwhile Karyajaya, 7 Ulu, and 5 Ilir PHCs have reported the least cumulative COVID-19 cases, with 7, 37, and 49 reported cases.

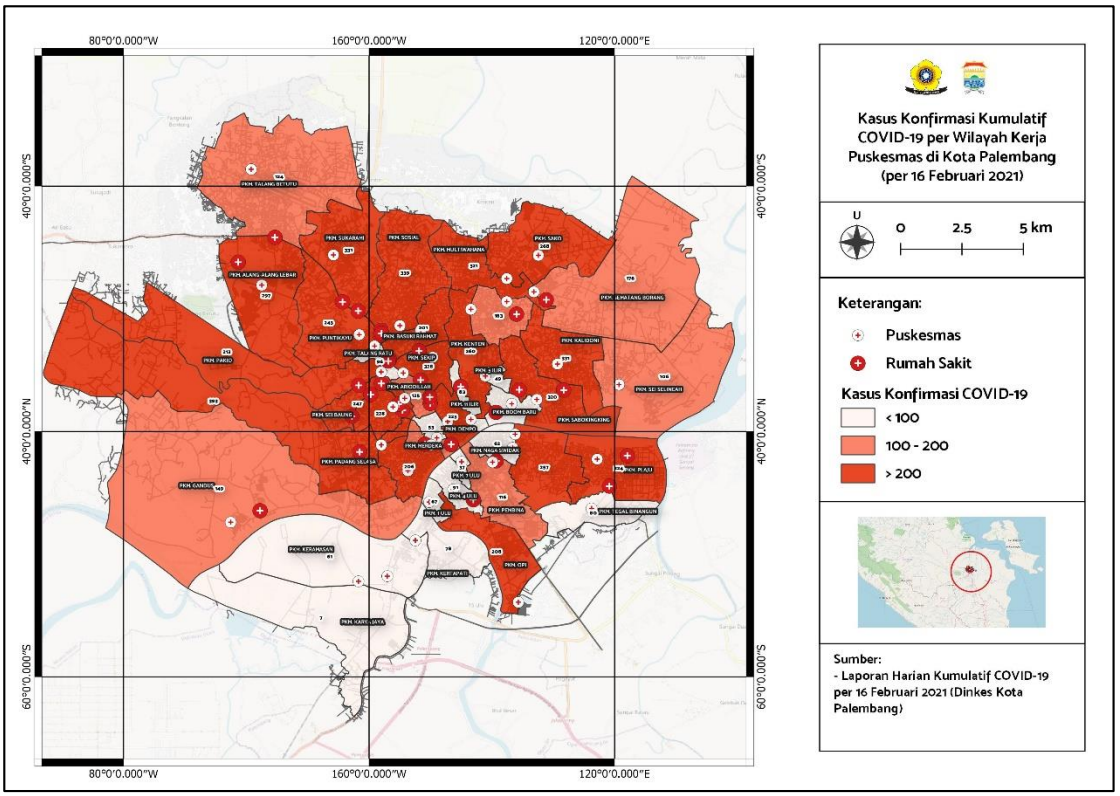

Figure 3. Distribution map of cumulative COVID-19 cases based on the working area of the PHCs in Palembang

Figure 4 shows the spatial analysis of reported cumulative death cases of COVID-19. There were 9 PHCs which had more than 10 cases of cumulative COVID-19 deaths. The PHCs with the highest COVID-19 deaths included Kenten, Sekip, Sabokingking, and Padang Selasa with 21, 19, and 18 reported cases. In contrast, the lowest reported COVID-19 deaths were Talang Betutu, 5 Ilir, and Keramasan PHCs, with only 1-2 cases.

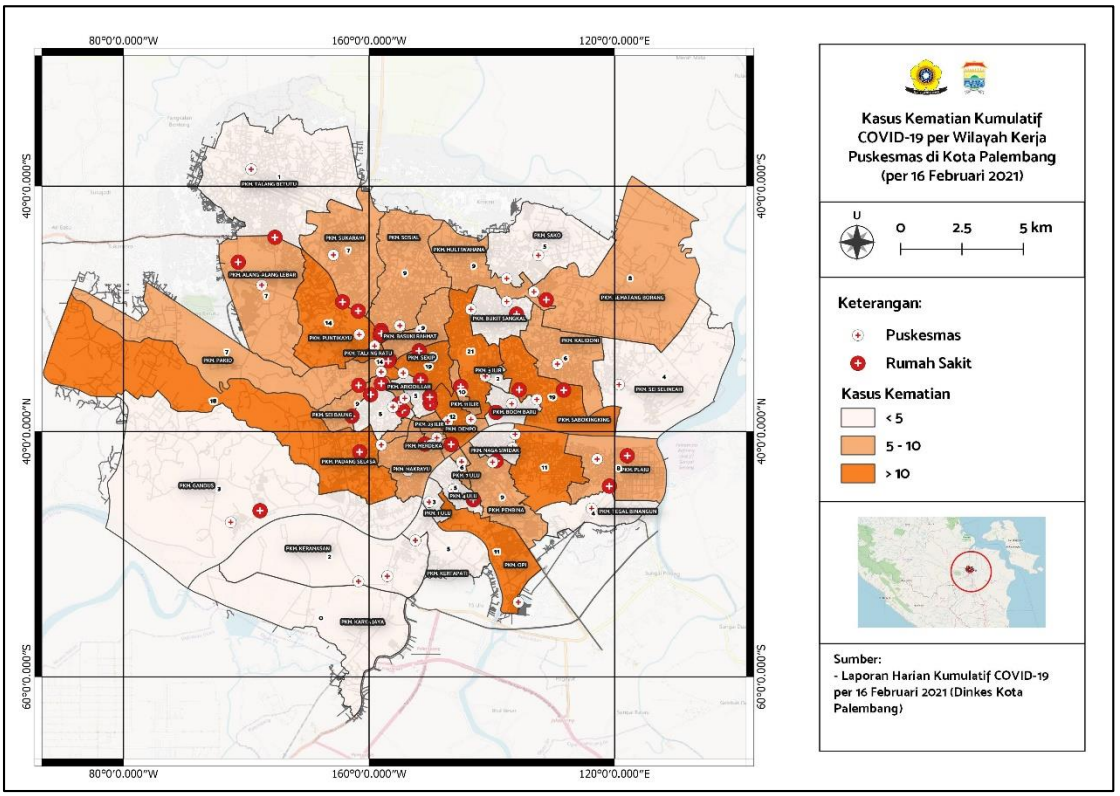

Figure 4. Distribution map of cumulative death cases by PHC's working area in Palembang City

DISCUSSION

The pandemic of COVID-19 has become a significant health problem in Indonesia. The mutated virus leads to the massive spread of the virus in the community and leads to deaths. In the current situation, the delta variant might contribute to the significant increase of COVID-19 that reached over 50,000 daily on 15th July 2021.[1,2] Descriptive epidemiology provides an overview of people, places, and times related to COVID-19 in Palembang City for the accuracy of handling COVID-19 mitigation in Palembang City based on local context emergency conditions.

Dominant cases occur at a young age, between 25 and 40 years in Palembang City. However, it should be noted that the increasing age contributes to the greater risk of death for patients infected with COVID-19. The crude death rate (CDR) and the case fatality rate (CFR) were dominated in the elderly group (over 50 years), men, and in groups with comorbidity. Previous research also highlights that the highest fatality rate for COVID-19 cases occurred in patients aged over 80 years at 14.8%, and for men, the fatality rate was 2.8%.[10] This study found COVID-19 tends to spread easily in the area with the largest population, such as in the Ilir Barat I in Palembang and the previous studies found that this condition would affect the susceptibility of the elderly in crowded areas.[16,17] Research conducted by Hikmawati et al. and national data from Ministry of Health highlight that four to five out of 10 deceased patients related COVID-19 were aged over 60 years old. The trend is also similar with other countries. For instance, in Thailand, China and Oman, the trend of the younger age group also dominates new COVID-19 cases, with the male gender dominating compared to the female group and the highest CFR on the older age grouprs.[7–9] The possible explanation that the male group is likely to be infected when they work, and the group has a history of comorbidities, increasing the risk of severe symptoms to deaths

and transmitting it to more vulnerable groups, such as the elderly.[16,17] Furthermore, the comorbidities which include history of diabetes and hypertension might exacerbate the risk of death among elderlies.

The increasing numbers of COVID-19 in Palembang is similar with the national level in Indonesia. The attack rate in this study highlight the increasing cases during the certain periods. There is a possibility of a spike in cases after the president's statement about new normal and relaxation of PSBB (*Pembatasan Sosial Berskala Besar* or large-scale social restrictions) in May 2020, religious holidays and Ied Islamic day in June and July 2020. The trend of increasing attack rate of COVID-19 cases reached the climax in November and December 2020 during New Year holiday and the campaign period for regional head election or *PILKADA*.[18] Prior studies have noted the importance of the public health intervention, such as the travel ban and closure of the affected areas to limit human movement and early tracking of COVID-19 cases, to reduce the spread of COVID-19.[11,12,19] Unfortunately, we argue that the quick changes of COVID-19 in Indonesia may contribute to the increase of attack rate over periods of time.

In terms of the symptoms most often occurred in adults with COVID-19 infection in Palembang City and comorbidities, they were almost identical to those reported at the national level. For example, in Palembang City, the dominant symptoms of COVID-19 patients are cough (39%), fever (35.4%), and runny nose (27.3%), while additional symptoms such as diarrhoea are less common (2.7%). At the national and international levels, such as China and Thailand, this is in line; the most common symptoms are cough, fever, and runny nose.[6,9,20] Meanwhile, data based on comorbidities shows that hypertension, diabetes, and heart disease in the elderly group are the highest risk factors for increasing symptoms of severe pneumonia to the risk of death both in Palembang City and at national and international levels.[6,9,20,21]

This study focused on finding which area has a higher or lower risk for the number of deaths related to COVID-19 and the number of total COVID-19 cases. The same study by Marisa Nurhaliza et al. explains further that some areas in Palembang City are more socially vulnerable than others. Sukarami, Ilir Barat I, Plaju, and Ilir Timur I, are among the sub-districts with high vulnerability status. One of the factors affecting COVID-19 cases in an area is the number of vulnerable populations (e.g. the elderly population). The spatial analysis results revealed that the PHC's working area with the highest COVID-19 positive cases is also part of the sub-district that high in social vulnerability status. The area is Padang Selasa PHC (part of Ilir Barat I Sub-district).[22] A previous study found that the higher number of elderlies in a population, the higher death cases related to COVID-19.[23] So, we can conclude that the social vulnerability in an area can affect the amount of COVID-19 cases.

CONCLUSION

The clinical epidemiology of COVID-19 in Palembang City predominantly resembles seasonal cough and flu symptoms with a cure rate of above 90%. However, what needs to be watched out for, are COVID-19 patients who have comorbidities and are over 50 years old, increasing the risk of severe pneumonia to deaths. Spatial analysis information based on PHCs helps policymakers to focus on COVID-19 services at PHCs with high mortality rates and attack rate figures. Therefore, this descriptive epidemiology information contributes to complexity of risk of deaths related to COVID-19 in Indonesia, including the older age, the comorbidities history and the lack of awareness of COVID-19 symptoms that are similar to seasonal cough and flu.

This study recommends maximizing the non-communicable disease (PTM) program for the age group above 50 years and also the vaccination program for vulnerable groups, especially the elderlies (with or without comorbidities), by increasing the outreach of the Integrated Non-Communicable Disease Development Post

(POSBINDU-PTM) by providing motivation and incentives to POSBINDU-PTM cadres and staff.

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AUTHOR CONTRIBUTION

The first six authors, NJ, YS, HA, MN, YY, YN, AR were responsible in data analysis, data interpretation and writing the articles. HA, MN and YY were responsible in data cleaning. YN was responsible as an advisor for data cleaning and coding. FZ, FA, and MS were responsible in supervising data analysis and writing methodology and discussion parts.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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