**BUKTI KORESPONDENSI**

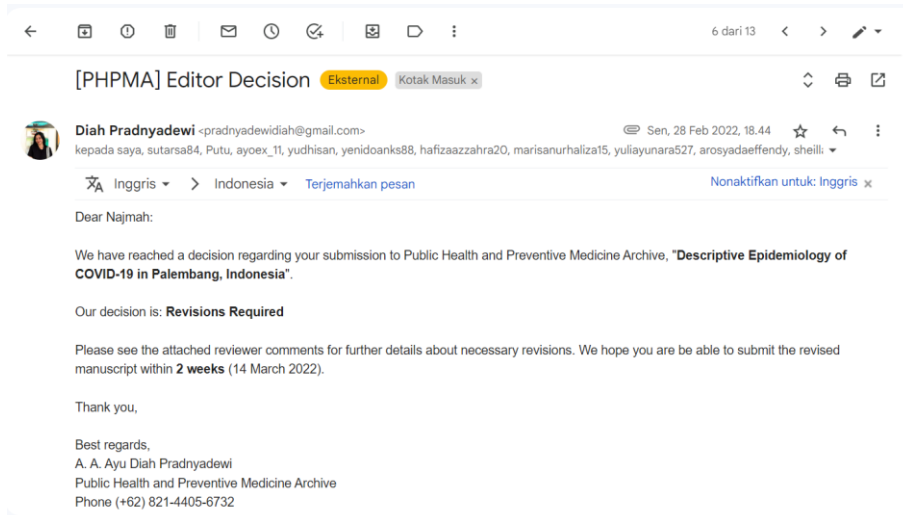**Descriptive epidemiology of COVID-19 in Palembang, Indonesia (Penulis Pertama dan Korespondensi), SINTA 2**

Kegiatan	Tangga;
Submission	**26 Agustus 2021**
Masukan dari reviewer 1 dan 2	**28 Februari 2022**
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==**[SUBMISSION], 26 AGUSTUS 2021**==

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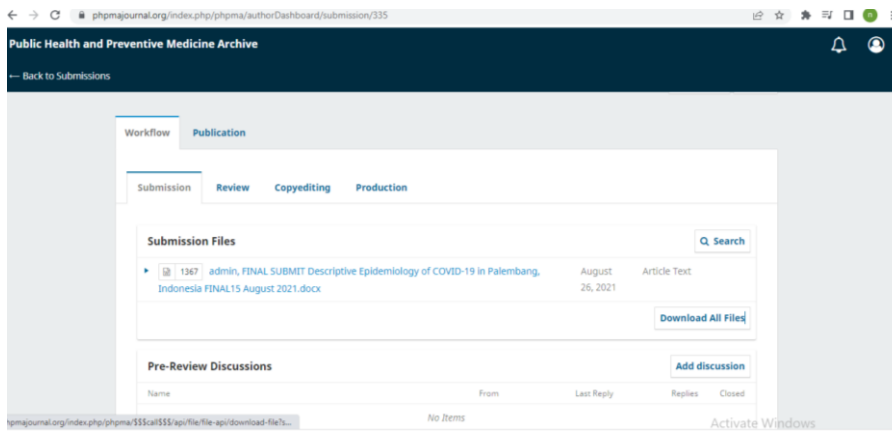
==**[Masukan dari reviewer 1], 28 Februari 2022**==

DESCRIPTIVE EPIDEMIOLOGY OF COVID-19 IN PALEMBANG, INDONESIA

Abstract

Indonesia ranks the first highest mortality rate in Southeast Asia with an average case fatality rate (CFR) of 2.7 %. South Sumatra is ranked 14th out of 34 provinces in Indonesia,w ith 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. This research method 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 7423 cases, as well as geographic data on the coordinates of health services for hospitals and health centers in Palembang City. The descriptive epidemiological results showed that the age group above 25 to 39 year old still dominated COVID-19 cases. The morbidity and mortality rates in men was higher than in women, and these rate were much more higher at the age of above 60 years old. The most dominant symptoms in the deceased patients with COVID-19 were shortness of breath, and the most comorbid of the patients was hypertension and diabetes. Unfortunately, the comorbid history increase the risk of death for patients with COVID-19. Based on place, the health center with the highest number of confirmed cases of COVID-19 was the sub-discritcs with highest population, including the Public health center Padang Selasa, Ilir Barat I (393 patients), while the lowest case report was Public health center Karyajaya, Kertapati (7 patients). The community's resilience is the spirit of cooperation in preventing COVID-19 at the family level to support the government programs. By maximizing the non-communicable disease program and outreach to the Integrated Non-Communicable Disease Development Post (POSBINDU-PTM) and vaccination in the elderly group, it can help reduce the risk of death for COVID-19 patients comorbidity.

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INTRODUCTION

The new coronavirus or COVID-19, which initially came from Wuhan (China), has spread to more than many countries worldwide. As a result, this virus was declared a pandemic on March 11, 2020, by the World Health Organization (WHO), or an extraordinary outbreak in a society or region from a particular disease spread 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 and an average CFR reaching 2.7%, which means that among 100 COVID-19 cases, there are three out of 100 COVID-19 patients more likely to pass away (see Table 1). Reports of cases per day tend to increase and reach their peak in December 2020 and January 2021, where reported COVID-19 cases reach an average of 10 thousand patients per day. The daily reported cases tend to decrease from February to April 2021 (Table 1). In June 2021, the trend of COVID-19 tend to increase significantly reach over 12,000 patients per day, and in July 2021, about 30 to 50,000 reported COVID-19 cases daily (Figure 1).

In the first year of the COVID-19 pandemic in Indonesia, fortunately, the recovery rate almost reached 95% in April 2021, compared to the recovery rate of still was below 20% in the first two months, after the first case was announced in Indonesia as of March 2, 2020, by President Joko Widodo[3]. Unfortunately, the opportunity to access COVID-19 tests is also at the lowest position compared to neighboring countries, so tracking of new cases was limited. Per April 2021, new reported cases in Indonesia are only 20 cases per 1 million Indonesian population, compared to Malaysia and Thailand, with new case findings reaching 300 new cases per 1 million. Therefore, unreported cases might be rampant in Indonesia.

South Sumatra is ranked 14th out of 34 provinces in Indonesia for the highest positive confirmed cases of COVID-19, about 27119 patients with a total of 137 COVID-19-related deaths[4,5]. The case fatality rate in South Sumatra is in the top three in Indonesia, and the rate is higher than the national CFR (CFR=5.07%, as of 20 June 2021). New cases have reached 100 cases per day in January-June 2021 and are spread across 17 districts/cities. Nearly 50% of confirmed cases are 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 (Evidence-based policies and practices). The previous studies have shown the epidemiology trend in each country[6–9], including Indonesia [4,10], however, within the decentralisation of Indonesia, it is vital to provide epidemiology measurement per city, particularly Palembang city, one of the highest CFR in Indonesia. This article is 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.

METHODS

This study uses 3 different methods, epidemiology of all COVID-19 measures and spatial analysis using data from the Palembang City Health Service database and epidemiological data descriptive of symptomatic COVID-19 patients using data from Epidemiological Surveillance Information System (Sisugi).

1. **Epidemiology of all COVID-19 measures**

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Surveillance reports recorded from March 2020 to February 2021 provide data for all patients from Palembang City to analyse Epidemiological measures. There were 7423 cases, consisting of 3892 males and 3892 females, with 319 deaths (193 men and 126 women) per 15th February 2021. The following measurements are performed in descriptive Epidemiology calculation formulas[11].

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.

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

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 (comorbid).

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

*pop

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.

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

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.

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

2. **Epidemiological data descriptive of symptomatic COVID-19 patients**

To observe Epidemiological data based on symptoms, secondary data from the Epidemiological Surveillance Information System (Sisugi) were extracted from 1 March 2020-13 March 2021. On 13 March 2021, of the 8309 data on COVID-19 cases in the Sisugi database, 3180 data on COVID-19 cases with information about co-morbidities after cleaning the data. 1227 cases with who were recovered or died were analysed. Graphs were produced 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 quantitative descriptive study using aggregated data on cumulative confirmed cases and cumulative death cases of COVID-19 from the Palembang City Health Service database as of February 16th, 2021. Data then categorized based on public health center's work area in Palembang City. For the spatial data, researchers access **http://geoportal.sumselprov.go.id/** to obtain the shapefile map of Palembang City per urban village area. Then researchers used open-sourced spatial application called QGIS (3.10.10 version) to perform spatial analysis.

Firstly, researchers defined the class for cumulative confirmed and death case data of COVID-19 with QGIS application then divided into 3 classes using the Classify tool with Equal Count (Quartile) mode and for Legend format with a Precision -2 value. Then researchers transformed the Palembang city map per urban village area into public health center's work area based on the division of work area from the Palembang city health office. Then researchers obtained the coordinate points of health service address from google maps. A digital map 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 categorized 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.

RESULTS

Overview of Palembang City

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 Community Health Centers (*Puskesmas*), which are divided into three inpatient health centers and 38 non-inpatient health centers. For Clinics, there are 179 Clinics which are divided into 171 Primary Clinics and 8 Main Clinics, and others are private clinics, consisting of 312 private medical practices and 77 private practices dentistry[12].

The morbidity rate

The crude morbidity rate shows that there is 5 COVID-19 cases within 1000 population. Figure 6 shows that the morbidity rate tends to increase as the population ages. The lowest morbidity rate is in toddlers; one toddler infected with COVID-19 per 1000 and aged 5-9 years, two children infected with COVID-19 per 1000 population. The risk of getting sick is the range of 5-11 people per 1000 population among the productive age group (above 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.

Mortality rate

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 (Table 3).

Though the number of COVID-19 patients is higher at productive age group compared to the older age group (Figure 3), the mortality rate is much more higher at the age of over 50 years old (Figure 4). 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. Specific mortality rates per 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 double in the male population than in the female population (Table 3; Figure 5).

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 6). There is a possibility of a spike in cases during school holidays and religious holidays, despite policies to reduce crowds or guidelines to limit mobilization from red zone areas to other zones (*orange, yellow, dan green zone*).

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Dominant symptoms and Comorbidity history in COVID-19 Patients in Palembang

Figure 7 and 8 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, fever. In the patients who were recovered, the most predominant symptom is cough, followed by fever and runny nose.

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

Spatial analysis of COVID-19 per public health centres (puskesmas) in Palembang

Figure 9 focuses on the spatial analysis on reported cumulative cases of COVID-19. Based on the Figure 9, out of a total of 7423 cumulative confirmed cases of COVID-19 in Palembang City, with 19 Public Health Centers whose working areas gotten the cumulative confirmed cases more than 200 cases. The public health centers with the highest reported cases includes *puskesmas* Padang Selasa (393 cases), *puskesmas* Sosial (339 cases), *puskesmas* Sukarami, and *puskesmas* Kalidoni (331 cases). At the same time, the lowest cumulative confirmed cases reported of COVID-19 were *puskesmas* Karyajaya, 7 Ulu, and 5 Ilir at 7, 37, and 49 cases, respectively.

Figure 10 shows the spatial analysis on reported cumulative death cases of COVID-19. There are 9 Public health centers whose gotten more than 10 cases of cumulative COVID-19 death. The public health centers with the highest COVID-19 deaths includes Kenten Health Center, Sekip Health Center, Sabokingking Health Center, and Padang Selasa Health Center at 21, 19, and 18 reported cases. In contrast, the lowest reported COVID-19 deaths were Talang Betutu Health Center, 5 Ilir health center, and Keramasan health center with only 1-2 cases.

DISCUSSION

The pandemic of COVID-19 has become a health problem in Indonesia. The mutated virus leads to the massive spread of the virus in the community and leads to death. 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 Epidemiologic 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 the 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 would impact on the susceptibility of the elderly in this area[13,14]. Research conducted by Hikmawati et al. and national data from Ministiry of Health highlights that four to five out of 10 deceased patients related COVID-18 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 death and transmitting it to more vulnerable groups, such as the elderly[13,14]. Furthermore, the comorbidity condition including history of diabetes, hypertension might exacerbate the risk of death among the elderly.

In terms of the symptoms most often had by 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

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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 [6,9,15]. Meanwhile, data based on comorbid conditions, 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 [6,9,15,16].

CONCLUSIONS

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 death. Spatial analysis information based on *Puskesmas* helps policymakers to focus on COVID-19 services in *puskesmas* with high mortality rates and attack rate figures. Therefore, these desriptive epidemiology information contribute to complexity of risk of death related to COVID-19 in Indonesia, including the older age, the comorbid history and the lack of awareness of COVID-19 symptoms that are similar to seasonal cough and flu. Based on time, the peak season of COVID-19 cases was generaly on holiday season and religious celebration days. In Indonesian context, the belief of COVID-19 might reduce and the society focus on economic's support, COVID-19 mitigation needs to involve the support of all parties. Therefore, In dealing with COVID-19 cases, according to a review conducted by Al- Shafi[17] in the Asian context and research by Najmah et al.[18,19]

1. We are communicating the risk of COVID-19 with religious leaders that the COVID-19 pandemic has not ended
2. Community resilience is the spirit of cooperation in preventing COVID-19 at the family level, especially those with elderly family members.
3. Maximizing the non-communicable disease (PTM) program for the age group above 50 years and also the vaccination program for vulnerable groups, especially the elderly (with comorbidities or 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.
4. We are strengthening the health system and providing complete decentralization for each region to innovate in handling COVID-19 based on the local context.

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DECLARATIONS

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Attachment: TABLES AND FIGURES

Table 1. Distribution of COVID-19 cases in the top five highest number of Covid-19 in Southeast Asia

Countries in Southeast Asia	Total Tests that have been done (million)	Test access opportunity*	Cumulative number of positive cases	Number of Deaths	Number of recovered cases	Fatal Mortality Rate (%)	Cumulative number of new cases	Incidence Rate (new cases)*
Indonesia	14	49.793	1.594.722	43.196	1.444.229	2,7	5363	20
Singapora	9	1.535.140	60.769	30	60.446	0,05	34	6
Philipine	7.7	69.738	914.971	15.738	705.757	1,7	10.726	1.4
Malaysia	8.5	259.168	198.208	1365	154.299	0,7	2551	300
Thailand	8,1	116.173	39.038	97	28.480	0,25	1585	227

*per 1 million population

Total population: Indonesia-276 million; Singapore-5.9 million; Philippines-111 million; Malaysia-33 million; Thailand-70 million
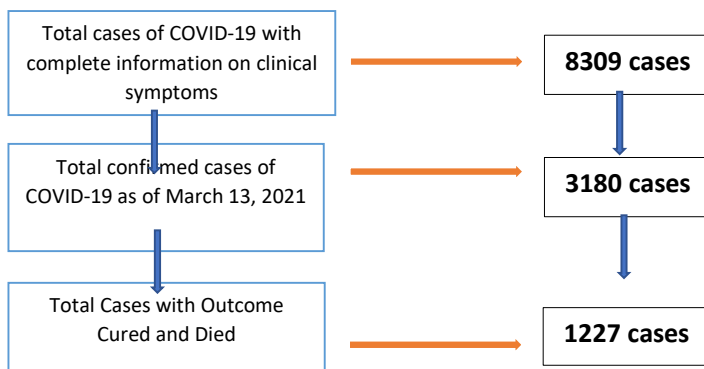
Source: Worldmeter, 2021, April 17th, 8 A.M[3]

Figure 2. Number of COVID-19 cases with complete clinical symptom information

Source: The Epidemiological Surveillance Information System (Sisugi) (https://sisugi.com/tentang-sisugi/)
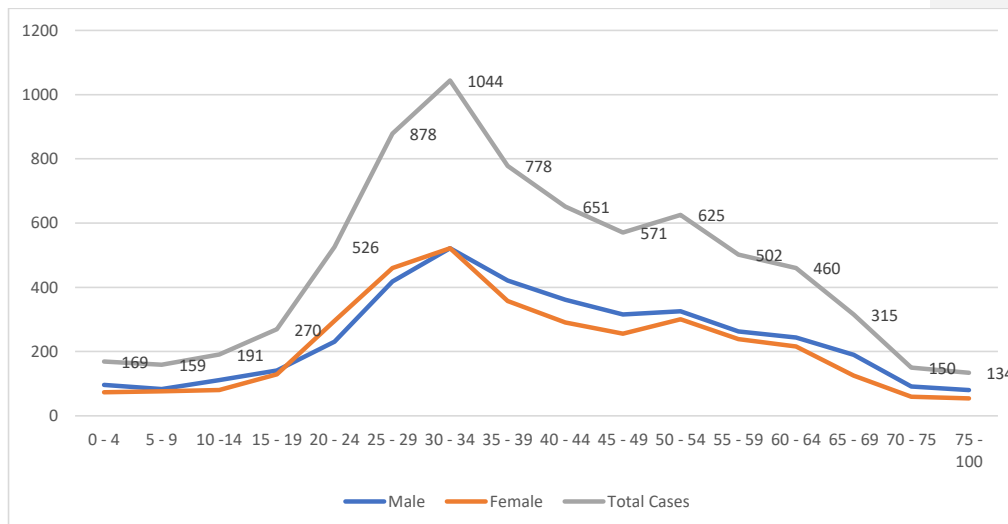

Figure 3. Number of COVID-19 Cases in Palembang per age groups
March 2020 – March 2021
Source: Palembang City Health Office COVID-19 Surveillance Data as of March 15, 2021

Figure 4. Morbidity rates related to COVID-19 per gender and age group in Palembang City
Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021
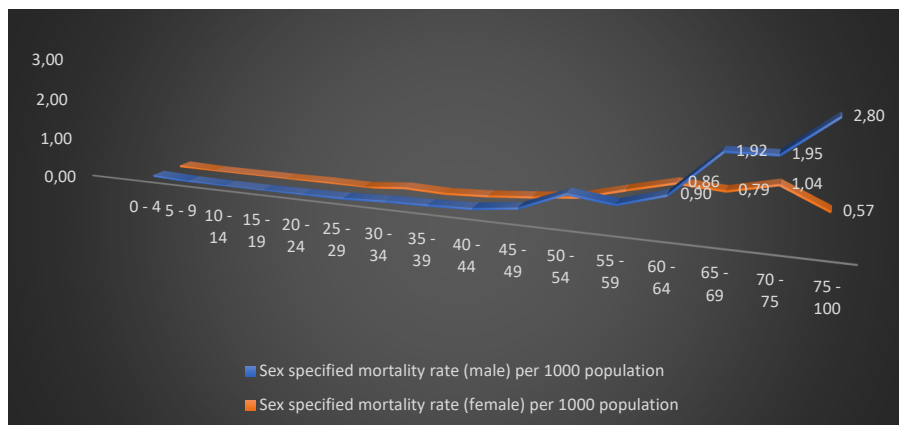

Figure 5. Mortality rate per sex group per 1000 population

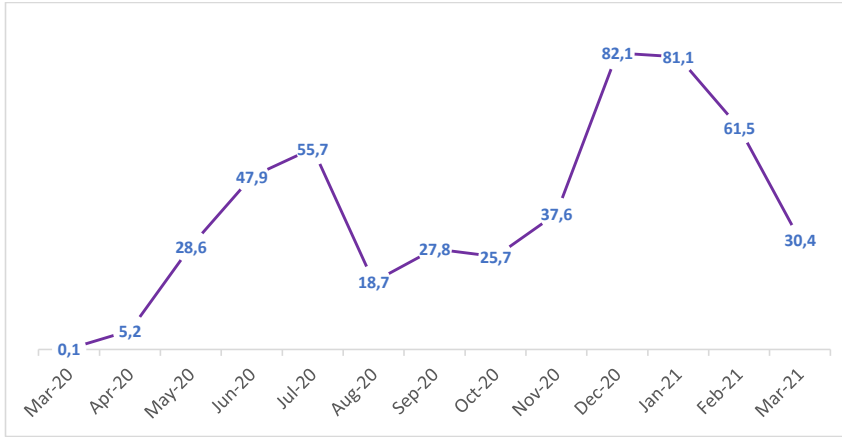*Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021*

Figure 6. Trend of COVID-19 Attack Rate per 100,000 residents per month in Palembang City from March 2020 - March 15, 2021

Source: Surveillance Section of Palembang City Health Office, March 2020-15 March 2021

Note: Number of population at risk: 1,662,893 March 2021, data as of March 15, 2021(Source Profile of the Health Office 2019)
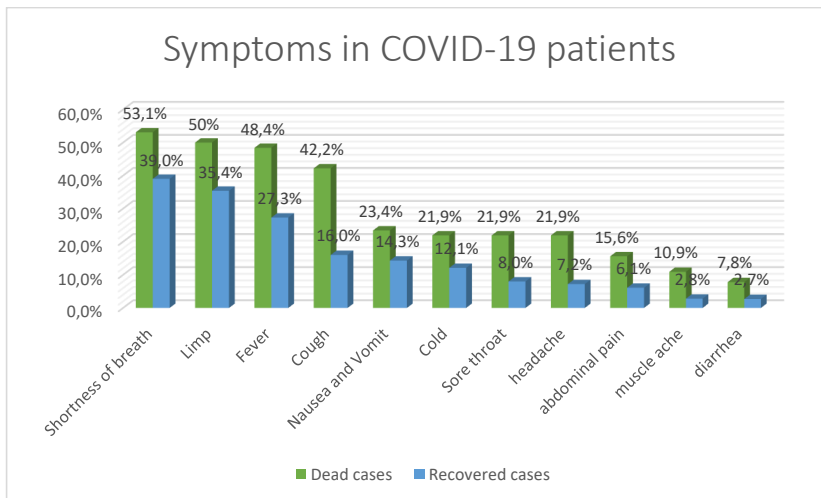

Figure 7. Status of Symptoms in COVID-19 Patients who passed away and recovered between March 2020 – March 2021 in Palembang

Source: Epidemiological Surveillance Information System (SISUGI), March 2020 – March 2021
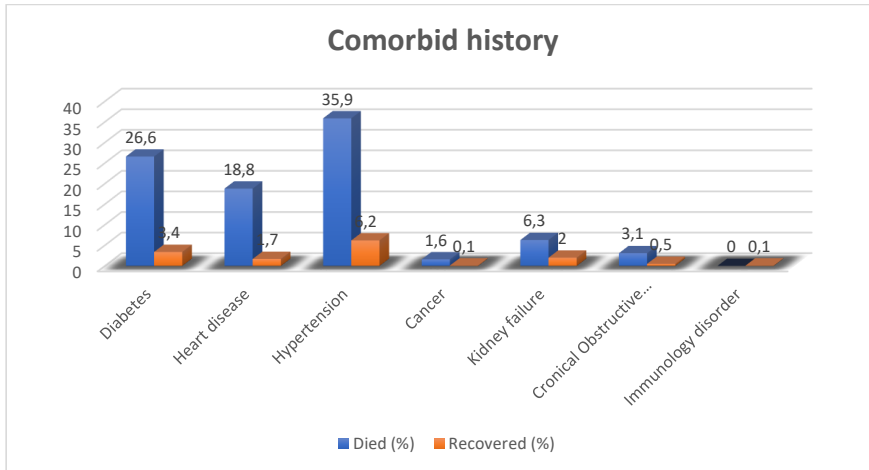
Figure 8. Comorbid Data on COVID-19 Patients in Palembang City Based on Last Healed and died Status

March 2020 - March 2021

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

Note: Diabetes, RR 7.4 (95 % Confidence Interval 4.6-12.1, p. <0.001); Heart disease, RR 8.6 (95% CI 5.1-14.5, p. <0.001); Hypertension, RR 6.7 (95% CI 4.2-10.6, p. <0.001); Cancer, RR 9.7 (95% CI 2.4-29.7, p. 0.1); Kidney failure, RR 13.6 (95% 7.3-25.1, p. <0.001); Cronical Obstuctive pulmonary disease, RR 4.9 (95% CI 1.4-16.7, p.0.06); and Immunology disorder (p.1)
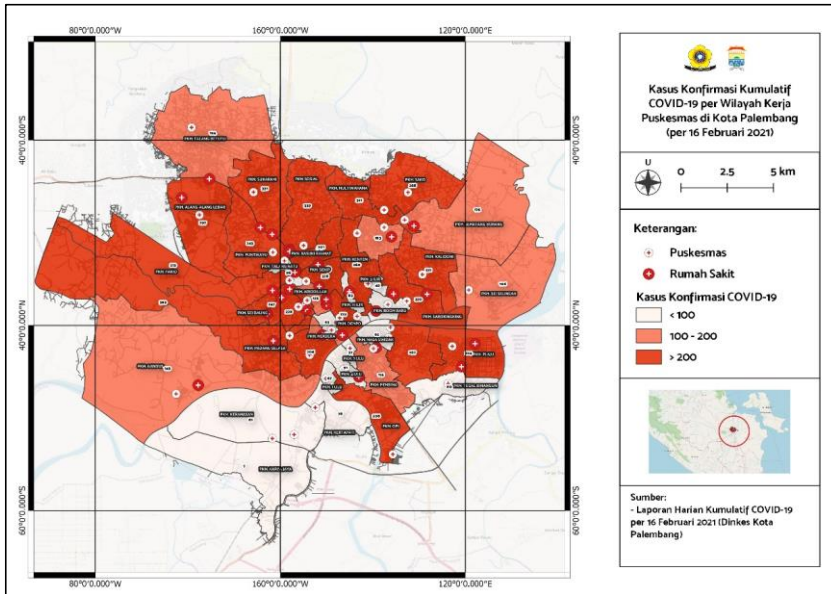
Figure 9. Distribution Map of Cumulative COVID-19 based on the Work Area of the Community
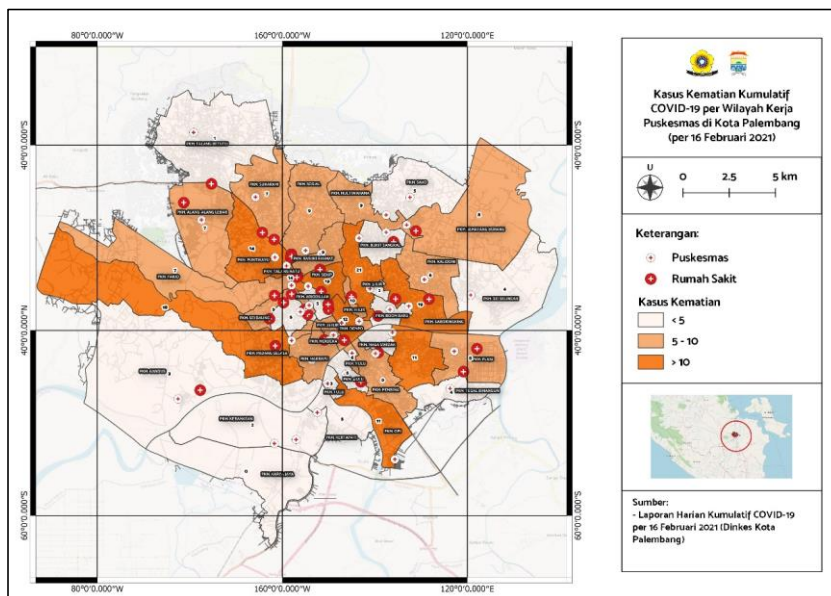Health Center in Palembang

Figure 10. Distribution Map of Cumulative Death Cases by Health Center Work Area in Palembang
City

DESCRIPTIVE EPIDEMIOLOGY OF COVID-19 IN PALEMBANG, INDONESIA

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Abstract

Indonesia ranks the first highest mortality rate in Southeast Asia with an average case fatality rate (CFR) of 2.7 %. South Sumatra is ranked 14th out of 34 provinces in Indonesia, ith 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. This research method 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 7423 cases, as well as geographic data on the coordinates of health services for hospitals and health centers in Palembang City. The descriptive epidemiological results showed that the age group above 25 to 39 year old still dominated COVID-19 cases. The morbidity and mortality rates in men was higher than that in women, and these rate were much more higher at 60 years old and above. The most dominant symptoms in the deceased patients with COVID-19 were shortness of breath, and the most comorbid of the patients was hypertension and diabetes. Unfortunately, the comorbid historyincreased the risk of death for patients with COVID-19. Based on place, the health center with the highest number of confirmed cases of COVID-19 was the sub-discritcs with highest population, including the Public health center Padang Selasa, Ilir Barat I (393 patients), while the lowest case report was Public health center Karyajaya, Kertapati (7 patients). The community's resilience is the spirit of cooperation in preventing COVID-19 at the family level to support the government programs. By maximizing the non-communicable disease program and outreach to the Integrated Non-Communicable Disease Development Post (POSBINDU-PTM) and vaccination in the elderly group, it can help reduce the risk of death for COVID-19 patients comorbidity.

Keywords: COVID-19, Descriptive Epidemiology, elderly, Comorbidity, Palembang, Indonesia

INTRODUCTION

The new coronavirus or COVID-19, which initially came from Wuhan (China), has spread to more than many countries worldwide. As a result, this virus was declared a pandemic on March 11, 2020, by the World Health Organization (WHO), or an extraordinary outbreak in a society or region from a particular disease spread 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.

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Indonesia ranks first out of 11 countries in Southeast Asia, with the highest death rate and an average CFR reaching 2.7%, which means that among 100 COVID-19 cases, there are three out of 100 COVID-19 patients more likely to pass away (see Table 1). Reports of cases per day tend to increase and reach their peak in December 2020 and January 2021, where reported COVID-19 cases reach an average of 10 thousand patients per day. The daily reported cases tend to decrease from February to April 2021 (Table 1). In June 2021, the trend of COVID-19 tend to increase significantly reach over 12,000 patients per day, and in July 2021, about 30 to 50,000 reported COVID-19 cases daily (Figure 1).

In the first year of the COVID-19 pandemic in Indonesia, fortunately, the recovery rate almost reached 95% in April 2021, compared to the recovery rate of still was below 20% in the first two months, after the first case was announced in Indonesia as of March 2, 2020, by President Joko Widodo[3]. Unfortunately, the opportunity to access COVID-19 tests is also at the lowest position compared to neighboring countries, so tracking of new cases was limited. Per April 2021, new reported cases in Indonesia are only 20 cases per 1 million Indonesian population compared to Malaysia and Thailand, with new case findings reaching 300 new cases per 1 million. Therefore, unreported cases might be rampant in Indonesia.

South Sumatra is ranked 14th out of 34 provinces in Indonesia for the highest positive confirmed cases of COVID-19, about 27119 patients with a total of 137 COVID-19-related deaths[4,5]. The case fatality rate in South Sumatra is in the top three in Indonesia, and the rate is higher than the national CFR (CFR=5.07%, as of 20 June 2021). New cases have reached 100 cases per day in January-June 2021 and are spread across 17 districts/cities. Nearly 50% of confirmed cases are 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 (Evidence-based policies and practices). The previous studies have shown the epidemiology trend in each country[6–9], including Indonesia [4,10], however, within the decentralisation of Indonesia, it is vital to provide epidemiology measurement per city, particularly Palembang city, one of the highest CFR in Indonesia. This article is 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.

METHODS

This study uses 3 different methods, epidemiology of all COVID-19 measures and spatial analysis using data from the Palembang City Health Service database and epidemiological data descriptive of symptomatic COVID-19 patients using data from Epidemiological Surveillance Information System (Sisugi).

4. **Epidemiology of all COVID-19 measures**

Surveillance reports recorded from March 2020 to February 2021 provide data for all patients from Palembang City to analyse Epidemiological measures. There were 7423 cases, consisting of 3892 males and 3892 females, with 319 deaths (193 men and 126 women) per 15th February 2021. The following measurements are performed in descriptive Epidemiology calculation formulas[11].

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.

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

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 (comorbid).

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

*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.

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

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.

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

5. **Epidemiological data descriptive of symptomatic COVID-19 patients**

To observe Epidemiological data based on symptoms, secondary data from the Epidemiological Surveillance Information System (Sisugi) were extracted from 1 March 2020-13 March 2021. On 13 March 2021, of the 8309 data on COVID-19 cases in the Sisugi database, 3180 data on COVID-19 cases with information about co-morbidities after cleaning the data. 1227 cases with who were recovered or died were analysed. Graphs were produced to understand the risk factors of death related to COVID-19 in Indonesia. Chi-square was undertaken for crosstabs calculation.

6. **Spatial Analysis Approach**

This section is a quantitative descriptive study using aggregated data on cumulative confirmed cases and cumulative death cases of COVID-19 from the Palembang City Health Service database as of February 16th, 2021. Data then categorized based on public health center's work area in Palembang City. For the spatial data, researchers access **http://geoportal.sumselprov.go.id/** to obtain the shapefile map of Palembang City per urban village area. Then researchers used open-sourced spatial application called QGIS (3.10.10 version) to perform spatial analysis.

Firstly, researchers defined the class for cumulative confirmed and death case data of COVID-19 with QGIS application then divided into 3 classes using the Classify tool with Equal Count (Quartile) mode and for Legend format with a Precision -2 value. Then researchers transformed the Palembang city map per urban village area into public health center's work area based on the division of work area from the Palembang city health office. Then researchers obtained the coordinate points of health service address from google maps. A digital map 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 categorized 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.

RESULTS

Overview of Palembang City

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 Community Health Centers (*Puskesmas*), which are divided into three inpatient health centers and 38 non-inpatient health centers. For Clinics, there are 179 Clinics which are divided into 171 Primary Clinics and 8 Main Clinics, and others are private clinics, consisting of 312 private medical practices and 77 private practices dentistry[12].

The morbidity rate

The crude morbidity rate shows that there is 5 COVID-19 cases within 1000 population. Figure 6 shows that the morbidity rate tends to increase as the population ages. The lowest morbidity rate is in toddlers; one toddler infected with COVID-19 per 1000 and aged 5-9 years, two children infected with COVID-19 per 1000 population. The risk of getting sick is the range of 5-11 people per 1000 population among the productive age group (above 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.

Mortality rate

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 (Table 3).

Though the number of COVID-19 patients is higher at productive age group compared to the older age group (Figure 3), the mortality rate is much more higher at the age of over 50 years old (Figure 4). 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. Specific mortality rates per 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 double in the male population than in the female population (Table 3; Figure 5).

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 6). There is a possibility of a spike in cases during school holidays and religious holidays, despite policies to reduce crowds or guidelines to limit mobilization from red zone areas to other zones (*orange, yellow, dan green zone*).

Dominant symptoms and Comorbidity history in COVID-19 Patients in Palembang

Figure 7 and 8 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, fever. In the patients who were recovered, the most predominant symptom is cough, followed by fever and runny nose.

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

Spatial analysis of COVID-19 per public health centres (puskesmas) in Palembang

Figure 9 focuses on the spatial analysis on reported cumulative cases of COVID-19. Based on the Figure 9, out of a total of 7423 cumulative confirmed cases of COVID-19 in Palembang City, with 19 Public Health Centers whose working areas gotten the cumulative confirmed cases more than 200 cases. The public health centers with the highest reported cases includes *puskesmas* Padang Selasa (393 cases), *puskesmas* Sosial (339 cases), *puskesmas* Sukarami, and *puskesmas* Kalidoni (331 cases). At the same time, the lowest cumulative confirmed cases reported of COVID-19 were *puskesmas* Karyajaya, 7 Ulu, and 5 Ilir at 7, 37, and 49 cases, respectively.

Figure 10 shows the spatial analysis on reported cumulative death cases of COVID-19. There are 9 Public health centers whose gotten more than 10 cases of cumulative COVID-19 death. The public health centers with the highest COVID-19 deaths includes Kenten Health Center, Sekip Health Center, Sabokingking Health Center, and Padang Selasa Health Center at 21, 19, and 18 reported cases. In contrast, the lowest reported COVID-19 deaths were Talang Betutu Health Center, 5 Ilir health center, and Keramasan health center with only 1-2 cases.

DISCUSSION

The pandemic of COVID-19 has become a health problem in Indonesia. The mutated virus leads to the massive spread of the virus in the community and leads to death. 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 Epidemiologic 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 the 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 would impact on the susceptibility of the elderly in this area[13,14]. Research conducted by Hikmawati et al. and national data from Ministiry of Health highlights that four to five out of 10 deceased patients related COVID-18 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 death and transmitting it to more vulnerable groups, such as the elderly[13,14]. Furthermore, the comorbidity condition including history of diabetes, hypertension might exacerbate the risk of death among the elderly.

In terms of the symptoms most often had by 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 [6,9,15]. Meanwhile, data based on comorbid conditions, 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 [6,9,15,16].

CONCLUSIONS

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 death. Spatial analysis information based on *Puskesmas* helps policymakers to focus on COVID-19 services in *puskesmas* with high mortality rates and attack rate figures. Therefore, these

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also discuss more about results from geographic distribution, which may contributes to case in early/ederly ages. maybe some region have more ederly people than others, etc. Write naration based on the link between characteristics spatial/geographic to sociodemografi of the population that may contributes to increase risk/attack rates.

desriptive epidemiology information contribute to complexity of risk of death related to COVID-19 in Indonesia, including the older age, the comorbid history and the lack of awareness of COVID-19 symptoms that are similar to seasonal cough and flu. Based on time, the peak season of COVID-19 cases was generaly on holiday season and religious celebration days. In Indonesian context, the belief of COVID-19 might reduce and the society focus on economic's support, COVID-19 mitigation needs to involve the support of all parties. Therefore, In dealing with COVID-19 cases, according to a review conducted by Al- Shafi[17] in the Asian context and research by Najmah et al.[18,19]

5. We are communicating the risk of COVID-19 with religious leaders that the COVID-19 pandemic has not ended
6. Community resilience is the spirit of cooperation in preventing COVID-19 at the family level, especially those with elderly family members.
7. Maximizing the non-communicable disease (PTM) program for the age group above 50 years and also the vaccination program for vulnerable groups, especially the elderly (with comorbidities or 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.
8. We are strengthening the health system and providing complete decentralization for each region to innovate in handling COVID-19 based on the local context.

DECLARATIONS

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

Competing interest: The authors declare that they have no competing interests.

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Authors contributions:
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. FZ and MS were responsible in supervising data analysis and writing methodology and discussion parts.

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Attachment: TABLES AND FIGURES

Table 1. Distribution of COVID-19 cases in the top five highest number of Covid-19 in Southeast Asia

Countries in Southeast Asia	Total Tests that have been done (million)	Test access opportunity*	Cumulative number of positive cases	Number of Deaths	Number of recovered cases	Fatal Mortality Rate (%)	Cumulative number of new cases	Incidence Rate (new cases)*
Indonesia	14	49.793	1.594.722	43.196	1.444.229	2,7	5363	20
Singapora	9	1.535.140	60.769	30	60.446	0,05	34	6
Philipine	7.7	69.738	914.971	15.738	705.757	1,7	10.726	1.4
Malaysia	8.5	259.168	198.208	1365	154.299	0,7	2551	300
Thailand	8,1	116.173	39.038	97	28.480	0,25	1585	227

*per 1 million population

Total population: Indonesia-276 million; Singapore-5.9 million; Philippines-111 million; Malaysia-33 million; Thailand-70 million

Source: Worldmeter, 2021, April 17th, 8 A.M[3]

Figure 2. Number of COVID-19 cases with complete clinical symptom information

Source: The Epidemiological Surveillance Information System (Sisugi) (https://sisugi.com/tentang-sisugi/)

Figure 3. Number of COVID-19 Cases in Palembang per age groups
March 2020 – March 2021
Source: Palembang City Health Office COVID-19 Surveillance Data as of March 15, 2021
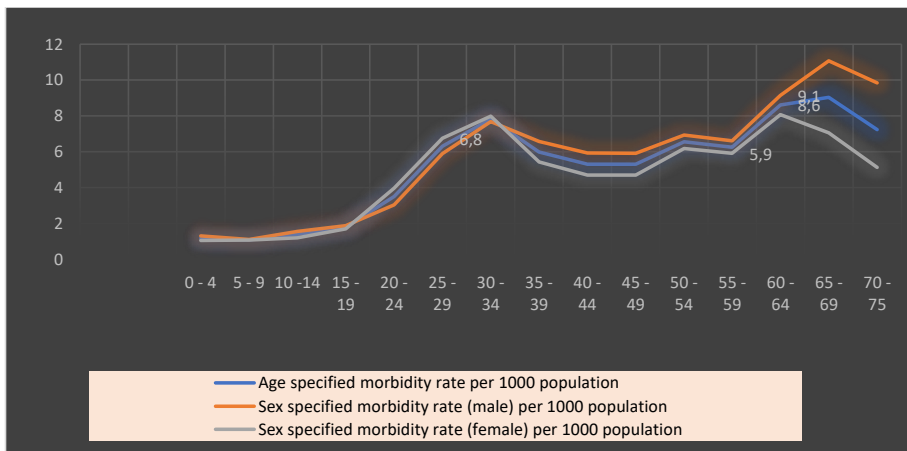

Figure 4. Morbidity rates related to COVID-19 per gender and age group in Palembang City
Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021
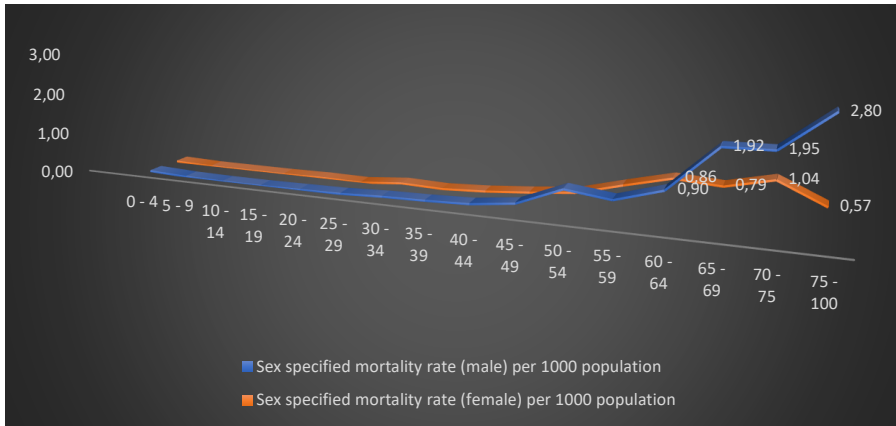
Figure 5. Mortality rate per sex group per 1000 population

Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021

Figure 6. Trend of COVID-19 Attack Rate per 100,000 residents per month in Palembang City from March 2020 - March 15, 2021

Source: Surveillance Section of Palembang City Health Office, March 2020-15 March 2021

Note: Number of population at risk: 1,662,893 March 2021, data as of March 15, 2021(Source Profile of the Health Office 2019)

Figure 7. Status of Symptoms in COVID-19 Patients who passed away and recovered between March 2020 – March 2021 in Palembang

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

Figure 8. Comorbid Data on COVID-19 Patients in Palembang City Based on Last Healed and died Status

March 2020 - March 2021

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

Note: Diabetes, RR 7.4 (95 % Confidence Interval 4.6-12.1, p. <0.001); Heart disease, RR 8.6 (95% CI 5.1-14.5, p. <0.001); Hypertension, RR 6.7 (95% CI 4.2-10.6, p. <0.001); Cancer, RR 9.7 (95% CI 2.4-29.7, p. 0.1); Kidney failure, RR 13.6 (95% 7.3-25.1, p. <0.001); Cronical Obstuctive pulmonary disease, RR 4.9 (95% CI 1.4-16.7, p.0.06); and Immunology disorder (p.1)
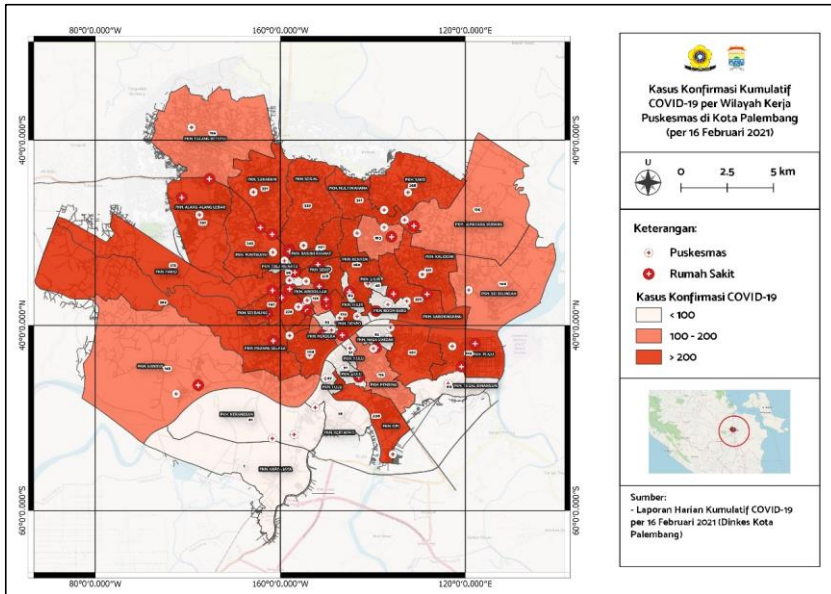
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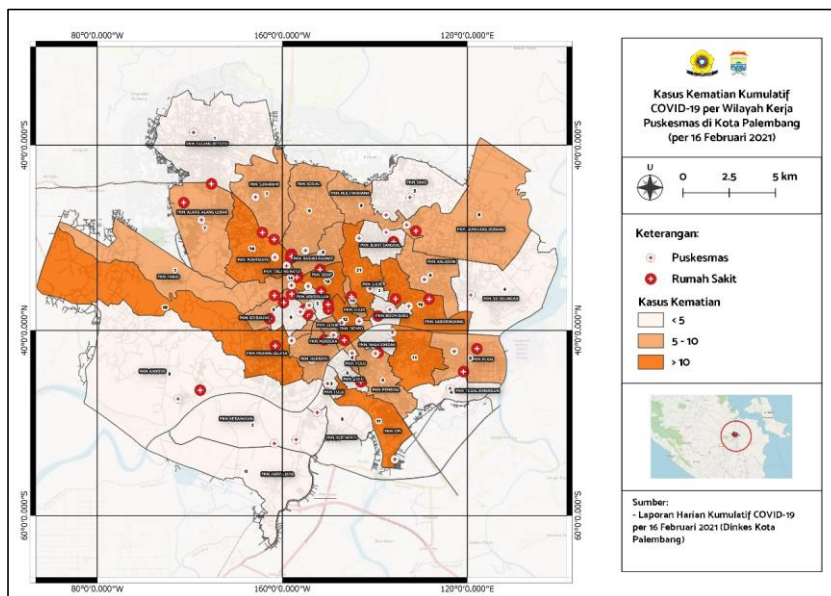

Figure 10. Distribution Map of Cumulative Death Cases by Health Center Work Area in Palembang City

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Dear mbak Diah

thank you very much we will revise as soon as possible

thank you for the chance for us

Najmah

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najmah unsri <najmah@fkm.unsri.ac.id>   Sen, 14 Mar 2022, 10.13
kepada Diah

Dear Ibu Diah,

Ibu, I need additional one week for revision, would you mind to extend our revision time?

thank you

Najmah

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Diah Pradnyadewi <pradnyadewidiah@gmail.com>   14 Mar 2022, 19.54
kepada saya

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Dear Ibu Najmah

Silahkan Bu, saya harap file revisi dapat segera diunggah ke sistem kami. Terima kasih.

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najmah unsri <najmah@fkm.unsri.ac.id>   Min, 27 Mar 2022, 02.56
kepada Diah, Yeni, sutarsa84, Putu, ayoex_11, yudhisan, hafizaazzahra20, Marisa, yulia, amrina, sheillafansi, misnaniarti

Dear Ibu Diah aand Ibu Ayu

thank you for your charming help

Najmah and team

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DESCRIPTIVE EPIDEMIOLOGY OF COVID-19 IN PALEMBANG, INDONESIA

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Abstract

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. This research method 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 7423 cases, as well as geographic data on the coordinates of health services for all hospitals and health centers in Palembang City. The descriptive epidemiological results showed that the age group above 25 to 39 year old still dominated COVID-19 cases. The morbidity and mortality rates in men was higher when compared with in women, and these rate were much more higher at the age of above 60 years old. The most dominant symptoms in the deceased patients with COVID-19 were shortness of breath, and the most comorbid of the patients was hypertension and diabetes. Unfortunately, the comorbid history increase the risk of death for patients with COVID-19. Based on place, the health center with the highest number of confirmed cases of COVID-19 was the sub-discritcs with highest population, including the Public health center Padang Selasa, Ilir Barat I (393 patients), while the lowest case report was Public health center Karyajaya, Kertapati (7 patients). This study highlights a need in preventing mature death of COVID-19 patients by prioritizing elderly COVID-19 pateitns who suffered from comorbid at the family level and health services to support the government programs.

Keywords: COVID-19, Descriptive Epidemiology, elderly, Comorbidity, Palembang, Indonesia

INTRODUCTION

The new coronavirus or COVID-19, which initially came from Wuhan (China), has spread to more than many countries worldwide. As a result, this virus was declared a pandemic on March 11, 2020, by the World Health Organization (WHO), or an extraordinary outbreak in a society or region from a particular disease spread 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.

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This study highlights the community's a need in preventing mature death of COVID-19 patients by prioritizing elderly COVID-19 pateitns who suffered from comorbid at the family level and helath servicesto support the government programs.

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Indonesia ranks first out of 11 countries in Southeast Asia, with the highest death rate and an average CFR reaching 2.7%, which means that among 100 COVID-19 cases, there are three out of 100 COVID-19 patients more likely to pass away (see Table 1). Reports of cases per day tend to increase and reach their peak in December 2020 and January 2021, where reported COVID-19 cases reach an average of 10 thousand patients per day. The daily reported cases tend to decrease from February to April 2021. In June 2021, the trend of COVID-19 tend to increase significantly reach over 12,000 patients per day, and in July 2021, about 30 to 50,000 reported COVID-19 cases daily.

In the first year of the COVID-19 pandemic in Indonesia, fortunately, the recovery rate almost reached 95% in April 2021, compared to the recovery rate of still was below 20% in the first two months, after the first case was announced in Indonesia as of March 2, 2020, by President Joko Widodo[3]. Unfortunately, the opportunity to access COVID-19 tests is also at the lowest position compared to other countries in Southeast Asia, so tracking of new cases was limited. Per April 2021, new reported cases in Indonesia are only 20 cases per 1 million Indonesian population, compared to Malaysia and Thailand, with new case findings reaching 300 new cases per 1 million. Therefore, unreported cases might be rampant in Indonesia.

South Sumatra is ranked 14th out of 34 provinces in Indonesia for the highest positive confirmed cases of COVID-19, about 27119 patients with a total of 137 COVID-19-related deaths[4,5]. The case fatality rate in South Sumatra is in the top three in Indonesia, and the rate is higher than the national CFR (CFR=5.07%, as of 20 June 2021). New cases have reached 100 cases per day in January-June 2021 and are spread across 17 districts/cities. Nearly 50% of confirmed cases are 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 (Evidence-based policies and practices). The previous studies have shown the epidemiology trend in each country[6–9], including Indonesia[4,10]. In China studies, epidemiology analysis help to measure the effectiveness of public health intervention[11,12].

Within the decentralization of Indonesia, it is vital to provide epidemiology measurement per city, particularly Palembang city, one of the highest CFR in Indonesia. By answering the question of "where", a 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 a 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 article is 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.

METHODS

This research was conducted for three months, starting from February to April 2021, and the location of the study focused on Palembang city, South Sumatera Province. The target population in each analysis were all residents of Palembang, whom the government had registered. The data source is all reported COVID-19 data from COVID-19 surveilans data from the Palembang City Health Service database and data from Sistem Informasi Surveilans Epidemiologi (SISUGI) history. The design of this study are both descriptive and analytic epidemiology with three ways of analysis. The first step is to investigate epidemiology aspects from men, place an time related COVID-19 cases, the second is analysis of risk factors related to death 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 center's work area. More detailed information about each analysis is as follows:

7. **Epidemiology of all COVID-19 measures**

To analyze in 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 7423 reported cases, consisting of 3892 males and 3892 females, with 319 deaths (193 men and 126 women). The following measurements are performed in descriptive epidemiology calculation formulas[14]:

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.

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

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 (comorbid).

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

*pop

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.

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

Attack

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.

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

8. **Epidemiological data descriptive of symptomatic COVID-19 patients with outcomes death or recovery**

To observe epidemiological data based on symptoms, we took secondary data from the SISUGI website. The inclusion criteria for the data for this analysis including: every case confirmed positive to COVID-19 with completed epidemiological investigation (e.g symtomps related to COVID-19 and comorbid), and the latest status of each individual has been categorized into recovered and passed away. We extracted the data from March 1st, 2020 - March 13th, 2021. On March 13th, 2021, there were a total 8309 of COVID-19 cases in the SISUGI database. After we cleaned the data, only 3180 COVID-19 cases have completed data on comorbidities. We analyzed the recovered and passed-away cases with a total of 1227 cases (see Figure 1). We produced graphs to understand the risk factors of death related to COVID-19 in Indonesia. Chi-square was undertaken for crosstabs calculation.

9. **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 public health center's work area. This study uses aggregated data from a population group as a research unit, the population group studied was 41 public health centers' work 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 Bapppeda of Palembang City's website (Geoportal Pemerintah Kota Palembang, access in **http://geoportal.sumselprov.go.id/**) and coordinated points of health centers 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 were it has to be complete data of each individual, the people reported in cases lived in Palembang City and all cases taken (from the beginning until the newest case available in Palembang city). We used an open-sourced spatial application called 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 public health center's work area based on the division of work area from the Palembang city health office. Then we obtained the coordinate points of health service 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.

RESULTS

Overview of Palembang City

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 community health centers (*PUSKESMAS)*, which are divided into three inpatient health centers and 38 non-inpatient health centers. For Clinics, there are 179 Clinics which are divided into 171 Primary Clinics and 8 Main Clinics, and others are private clinics, consisting of 312 private medical practices and 77 private practices dentistry[15].

The characteristics of the participants showed that based on the patient's age, 17.5% of the patients who died were over 60 years old, and only 3.3% of the patients who died were under 60 years of age. Based on the gender of the patient, we found that more male patients died than females (namely 6.2%). While based on the occupational status, we found that working patients have more died cases than those who did not work (namely 7.8%). Results from the analysis of Covid-19 symptoms proved that most patients who died showed symptoms of Covid-19 compared to those who did not show symptoms, which was 7.4%. Based on the history of comorbidities, we found that most patients who died had more than one comorbid, and only 2.4% of patients had no comorbidities.

The morbidity rate

The crude morbidity rate shows that there is 5 COVID-19 cases within 1000 population. Figure 2 shows that the morbidity rate tends to increase as the population ages. The lowest morbidity rate is in toddlers; one toddler infected with COVID-19 per 1000 and aged 5-9 years, two children infected with COVID-19 per 1000 population. The risk of getting sick is the range of 5-11 people per 1000 population among the productive age group (above 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 3).

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Mortality rate

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 4).

Though the number of COVID-19 patients is higher at productive age group compared to the older age group (Figure 3), the mortality rate is much more higher at the age of over 50 years old (Figure 4). 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. Specific mortality rates per 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 double in the male population than in the female population (Figure 4).

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 5).

Dominant symptoms and Comorbidity history in COVID-19 Patients in Palembang

Table 6 and 7 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, 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 and 26.6 % of those with diabetes and 18.8 % of those with hear disease passed away. On the other hand, there is lower percentage of these comorbid condition for recovered patients.

Spatial analysis of COVID-19 per Community Health Centres (PUSKESMAS) in Palembang

Figure 8 focuses on the spatial analysis of reported cumulative cases of COVID-19. Based on Figure 8, out of 7423 cumulative confirmed cases of COVID-19 in Palembang City, 19 out of 41 community health centers whose working areas have gotten the cumulative confirmed cases exceeding 200. Padang Selasa (393 cases), Sosial (339 cases), Sukarami, and Kalidoni (331 cases) were the health centers with the highest number of cases reported. Meanwhile Karyajaya, 7 Ulu, and 5 Ilir health centers have reported the least cumulative COVID-19 cases, with 7, 37, and 49 cases reported.

Figure 9 shows the spatial analysis of reported cumulative death cases of COVID-19. There are 9 community health center whose gotten more than 10 cases of cumulative COVID-19 deaths. The community health center with the highest COVID-19 deaths include Kenten, Sekip, Sabokingking, and Padang Selasa at 21, 19, and 18 reported cases. In contrast, the lowest reported COVID-19 deaths were Talang Betutu, 5 Ilir, and Keramasan health center, with only 1-2 cases.

DISCUSSION

The pandemic of COVID-19 has become a health problem in Indonesia. The mutated virus leads to the massive spread of the virus in the community and leads to death. 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 Epidemiologic 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 the 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 impact on the susceptibility of the elderly in this crowded areas[16,17]. Research conducted by Hikmawati et al. and national data from Ministry of Health highlights that four to five out of 10 deceased patients related COVID-19 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 death and transmitting it to more vulnerable groups, such as the elderly[16,17]. Furthermore, the comorbidity condition including history of diabetes, hypertension might exacerbate the risk of death among elderly.

The increasing numbers of COVID-19 in Indonesia 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 attach 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 that 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[19-21]. Unfortunately, we argue the quick changes of COVID-19 in Indonesia may contribute the increase of attact rate over periods of time.

In terms of the symptoms most often had by 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[6,9,22]. Meanwhile, data based on comorbid conditions, 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[6,9,22,23].

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 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 community health center's work area with the highest COVID-19 positive cases is also part of the sub-district high in social vulnerability status. The area is Padang Selasa health center (part of Ilir Barat I sub-district)[24]. A previous study found that the higher number of elderly in a population, the higher death cases related to COVID-19[25]. So we can conclude that the social vulnerability in an area can affect the amount of COVID-19 cases.

CONCLUSIONS

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 death. Spatial analysis information based on *Puskesmas* helps policymakers to focus on COVID-19 services in *puskesmas* with high mortality rates and attack rate figures. Therefore, these desriptive epidemiology information contribute to complexity of risk of death related to COVID-19 in Indonesia, including the older age, the comorbid history and the lack of awareness of COVID-19 symptoms that are similar to seasonal cough and flu. This study recommends that maximizing the non-communicable disease (PTM) program for the age group above 50 years and also the vaccination program for vulnerable groups, especially the elderly (with comorbidities or 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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DECLARATIONS

Ethical approval

Authors contributions:
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. FZ and MS were responsible in supervising data analysis and writing methodology and discussion parts.
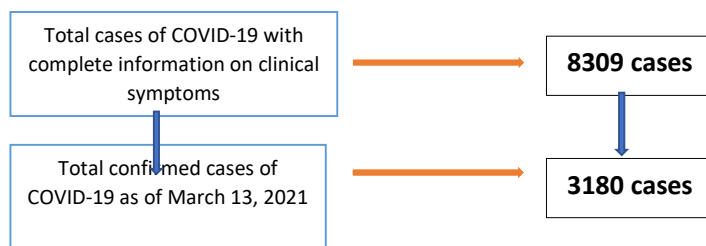
Acknowledgements

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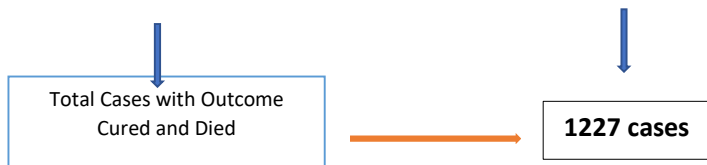
Attachment: TABLES AND FIGURES

Figure 1. Number of COVID-19 cases with complete clinical symptom information

Source: The Epidemiological Surveillance Information System (Sisugi) (https://sisugi.com/tentang-sisugi/)
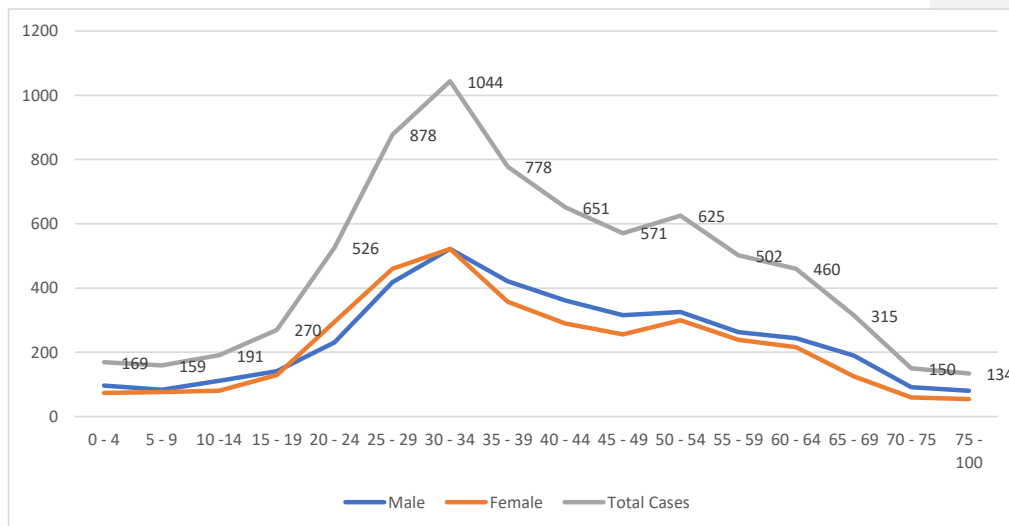

Figure 2. Number of COVID-19 Cases in Palembang per age groups
March 2020 – March 2021
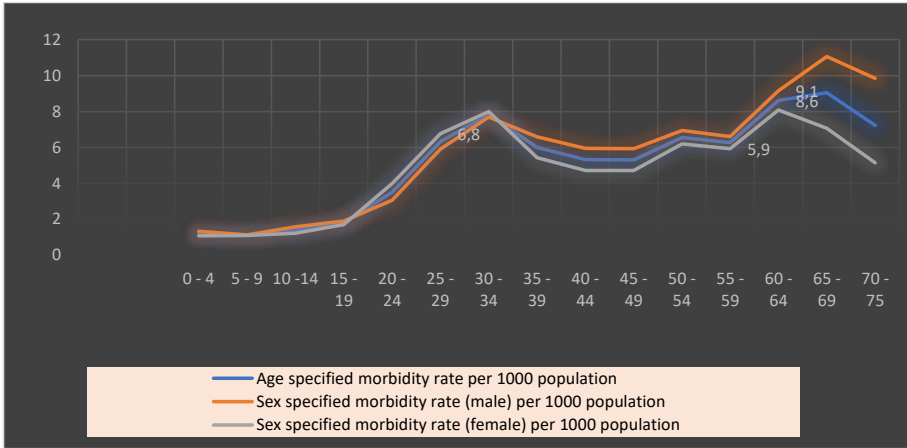*Source: Palembang City Health Office COVID-19 Surveillance Data as of March 15, 2021*

Figure 3. Morbidity rates related to COVID-19 per gender and age group in Palembang City
Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021
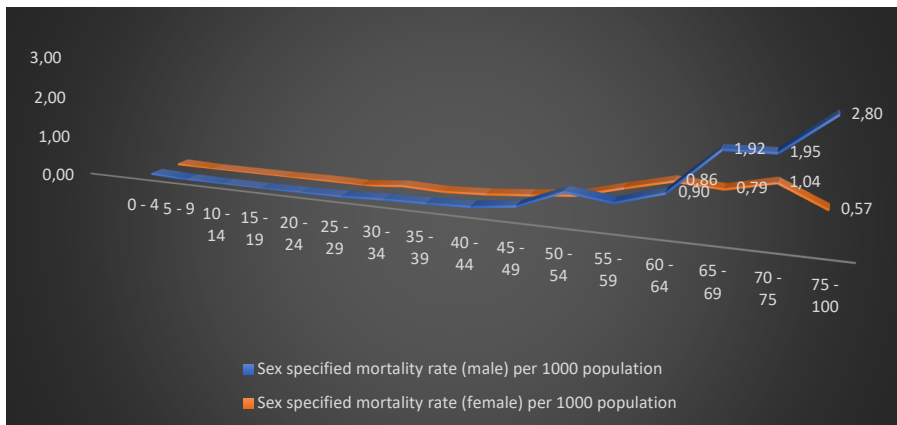

Figure 4. Mortality rate per sex group per 1000 population

Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021
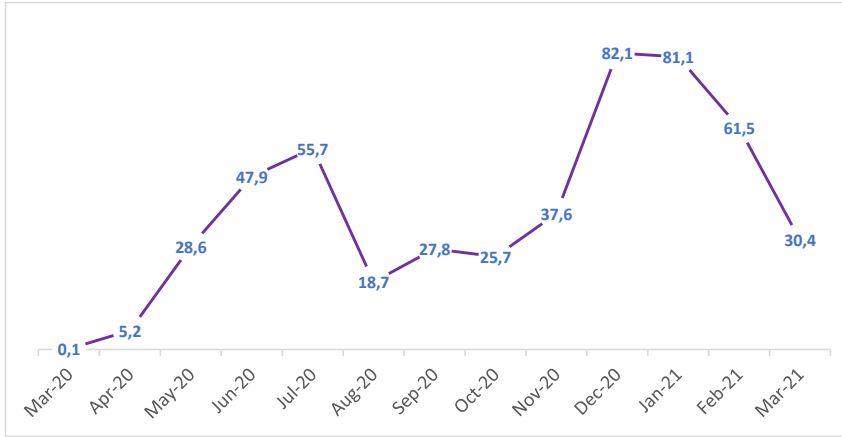
Figure 5. Trend of COVID-19 Attack Rate per 100,000 residents per month in Palembang City from March 2020 - March 15, 2021

Source: Surveillance Section of Palembang City Health Office, March 2020-15 March 2021
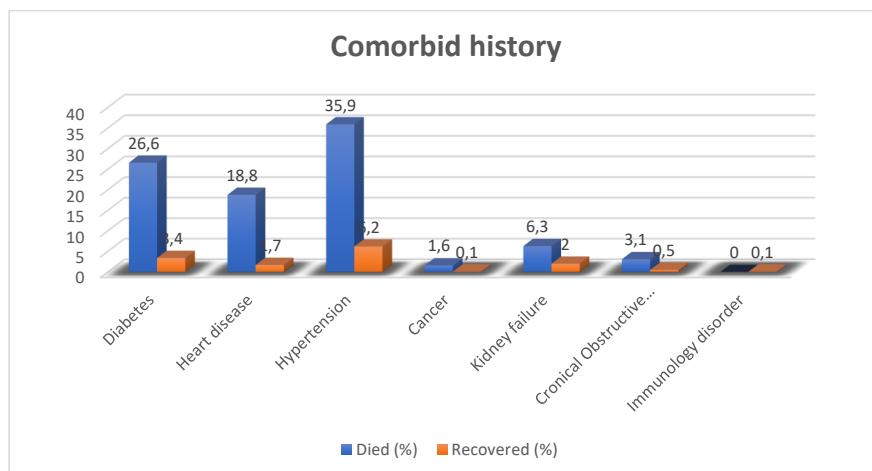
Note: Number of population at risk: 1,662,893 March 2021, data as of March 15, 2021 (Source Profile of the Health Office 2019)

Status of Symptoms in COVID-19 Patients based on recovery status	Yes		No	
	Frequencies	Percentage	Frequencies	Percentage
Dead cases (n=64) :				
Shortness of breath	34	53.1	30	46.9
Limp	32	50	32	50
Fever	31	48.4	33	51.6
Cough	27	42.2	37	57.8
Nausea and vomit	15	23.4	49	76.6
Cold	14	21.9	50	78.1
Sore throat	14	21.9	50	78.1
Headache	14	21.9	50	78.1
Abdominal pain	10	15.6	54	84.4
Muscle ache	7	10.9	57	89.1
Diarrhea	5	7.8	59	92.2
Recovered cases (n=1163)				
Shortness of breath	93	8	1070	92
Limp	141	12.1	1022	87.9
Fever	412	35.4	751	64.6
Cough	453	39	710	61
Nausea and vomit	71	6.1	1092	93.9
Cold	317	27.3	846	72.7
Sore throat	186	16	977	84
Headache	166	14.3	997	85.7
Abdominal pain	32	2.8	1131	97.2

Muscle ache	84	7.2	1079	92.8
Diarrhea	31	2.7	1132	97.3

Table 6. Status of Symptoms in COVID-19 Patients who passed away and recovered between March 2020 – March 2021 in Palembang

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

Comorbid in COVID-19 Patients based on recovery status	Yes		No	
	Frequencies	Percentage	Frequencies	Percentage
Dead cases (n=64) :				
Diabetes	17	26.6	47	73.4
Hearth disease	12	18.3	52	81.3
Hypertension	23	35.9	41	64.1
Cancer	1	1.6	63	98.4
Kidney failure	4	6.3	60	93.8
Chronical obstructive	2	3.1	62	96.9
Immunology disorder	0	0	64	100
Recovered cases (n=1163)				
Diabetes	40	3.4	1123	96.6
Hearth disease	20	1.7	1143	98.3
Hypertension	72	6.2	1091	93.8
Cancer	1	0.1	1162	99.9
Kidney failure	2	0.2	1161	99.8
Chronical obstructive	6	0.5	1157	99.5
Immunology disorder	1	0.1	1162	99.9

Table 7. Comorbid Data on COVID-19 Patients in Palembang City Based on Last Healed and died Status

March 2020 - March 2021

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

Note: Diabetes, RR 7.4 (95 % Confidence Interval 4.6-12.1, p. <0.001); Heart disease, RR 8.6 (95% CI 5.1-14.5, p. <0.001); Hypertension, RR 6.7 (95% CI 4.2-10.6, p. <0.001); Cancer, RR 9.7 (95% CI

2.4-29.7, p. 0.1); Kidney failure, RR 13.6 (95% 7.3-25.1, p. <0.001); Cronical Obstuctive pulmonary disease, RR 4.9 (95% CI 1.4-16.7, p.0.06); and Immunology disorder (p.1)
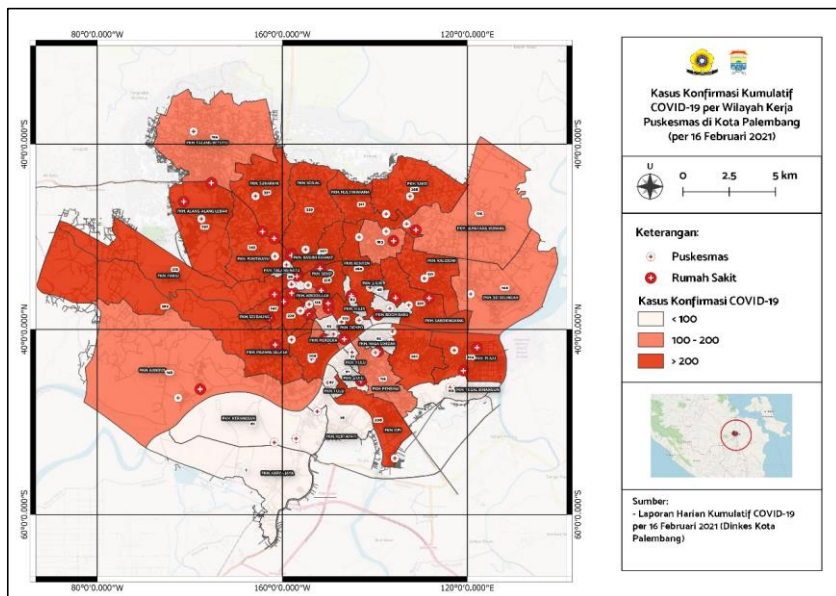

Figure 8. Distribution Map of Cumulative COVID-19 based on the Work Area of the Community health center in Palembang
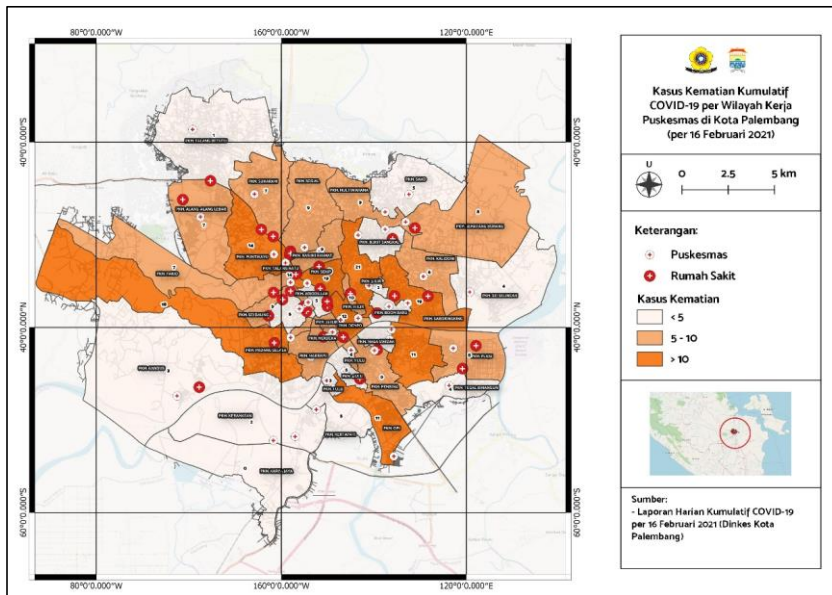
Figure 9. Distribution Map of Cumulative Death Cases by Health Center Work Area in Palembang City

Additional Attachment:

Table 1. Distribution of COVID-19 cases in the top five highest number of Covid-19 in Southeast Asia

Countries in Southeast Asia	Total Tests that have been done (million)	Test access opportunity*	Cumulative number of positive cases	Number of Deaths	Number of recovered cases	Fatal Mortality Rate (%)	Cumulative number of new cases	Incidence Rate (new cases)*
Indonesia	14	49.793	1.594.722	43.196	1.444.229	2,7	5363	20
Singapora	9	1.535.140	60.769	30	60.446	0,05	34	6
Philipine	7.7	69.738	914.971	15.738	705.757	1,7	10.726	1.4
Malaysia	8.5	259.168	198.208	1365	154.299	0,7	2551	300
Thailand	8,1	116.173	39.038	97	28.480	0,25	1585	227

*per 1 million population

Total population: Indonesia-276 million; Singapore-5.9 million; Philippines-111 million; Malaysia-33 million; Thailand-70 million

Source: Worldmeter, 2021, April 17th, 8 A.M[3]

Participant's characteristics

Variabel		Status pasien Covid	Total

		Meninggal		Sembuh		
		n	%	n	%	n (%)
Age	> 60	29	17,5%	137	82,5%	166 (100)
	≤ 60	35	3,3%	1026	96,7%	1061 (100)
Sex	Male	40	6,2%	605	93,8%	645 (100)
	Female	24	4,1%	558	95,9%	582 (100)
Working status	Yes	29	7.8 %	344	92.2%	373 (100)
	No	35	4.1 %	819	95.9 %	854 (100)
Symptoms of COVID-19	Asymptomatic	5	1.2 %	420	98.8%	425 (100)
	Symptomatic	59	7.4 %	743	92.6 %	802 (100)
Comorbid history	No Comorbid	26	2.4%	1053	97,6%	1079 (100)
	1 Comorbid	21	20..6%	81	79.4%	102 (100)
	>1 Comorbid	17	37%	29	63%	46 (100)

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 method 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 7423 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 showed that the age group 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 at the sub-district with the highest population, including the PHC Padang Selasa, Ilir Barat I (393 patients), while the lowest case report was PHC Karyajaya, Kertapati (7 patients).

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

Keywords: COVID-19, Descriptive Epidemiology, elderly, Comorbidity, Palembang, Indonesia

INTRODUCTION

The new coronavirus disease or COVID-19, which initially came from Wuhan (China), has spread ~~to more than many countries~~ worldwide~~. As a result, this virus was declared a pandemic~~ On March 11, 2020, the World Health Organization (WHO) declared a pandemic, or an extraordinary outbreak in a society or region from a particular disease spread 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 signify three death among 100 COVID-19 cases. (see Table 1). Reports of cases per day tend to increase and reach their peak in December 2020 and January 2021, where reported COVID-19 cases reach an average of 10 thousand patients per day. The daily reported cases tend to decrease from February to April 2021. In June 2021, the trend of COVID-19 tends to increase significantly reach over 12,000 patients per day, and in July 2021, about 30 to 50,000 reported COVID-19 cases daily.

In the first year of the COVID-19 pandemic in Indonesia, the recovery rate was below 20% in the first two months, which is improved , to almost reached 95% in April 2021,. Unfortunately, the opportunity to access COVID-19 tests is at the lowest position compared to other countries in Southeast Asia, so tracking of new cases was limited. Per April 2021, new reported cases in Indonesia are only 20 cases per 1 million Indonesian population, 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.

South Sumatra is ranked 14th of 34 provinces in Indonesia for the highest positive confirmed cases of COVID-19, about 27119 patients with a total of 137 COVID-19-related deaths[4,5]. The case fatality rate in South Sumatra is in the top three in Indonesia, and the rate is higher than the national CFR (CFR=5.07%, as of 20 June 2021). New cases have reached 100 cases per day in January-June 2021 and are spread across 17 districts/cities. Nearly 50% of confirmed cases are 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 the highest CFR in Indonesia. By answering the question of "where", a 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 a 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 aimed to provide the descriptive epidemiology of COVID-19 cases in Palembang city supported by geospatial analysis.

METHODS

This research was conducted for three months, starting from February to April 2021, and the location of the study focused on Palembang city, South Sumatera Province. The target population in each analysis were all residents of Palembang, whom the government had

registered. The data source is all reported COVID-19 data from COVID-19 surveillance data from the Palembang City Health Service database and data from *Sistem Informasi Surveilans Epidemiologi (SISUGI)* history. The design of this study are both descriptive and analytic epidemiology with three ways of analysis. The first step is to investigate epidemiology aspects from person, place an time related COVID-19 cases, the second is analysis of risk factors related to death 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 center's catchment area. More detailed information about each analysis is as follows:

10. **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 7423 reported cases, consisting of 3892 males and 3892 females, with 319 deaths (193 men and 126 women). The following measurements are performed in descriptive epidemiology calculation formulas[14]:

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.

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

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 (comorbid).

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

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.

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

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.

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

11. **Epidemiological data descriptive of symptomatic COVID-19 patients with outcomes death or recovery**

To observe epidemiological data based on symptoms, we took secondary data from the SISUGI website. The inclusion criteria for the data for this analysis including: every case confirmed positive to COVID-19 with completed epidemiological investigation (e.g symtomps related to COVID-19 and comorbid), and the latest status of each individual has been categorized into recovered and passed away. We extracted the data from March 1st, 2020 - March 13th, 2021. On March 13th, 2021, there were a total 8309 of COVID-19 cases in the SISUGI database. After we cleaned the data, only 3180 COVID-19 cases have completed data on comorbidities. We analyzed the recovered and death cases with a total of 1227 cases (see Figure 1). We produced graphs to understand the risk factors of death related to COVID-19 in Indonesia. Chi-square was undertaken for crosstabs calculation.

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12. **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 public health center's catchment area. This study uses aggregated data from a population group as a research unit, the population group studied was 41 public health centers' catchment 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 Bapppeda of Palembang City's website (Geoportal Pemerintah Kota Palembang, **http://geoportal.sumselprov.go.id/**) and coordinats of health centers 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 people cases lived in Palembang City and all cases 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 public health center's catchment area based on the division of work area from the Palembang city health office. Then we obtained the coordinate points of health service 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.

RESULTS

Overview of Palembang City

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 (*PUSKESMAS)*, which are divided into three inpatient health centers and 38 non-inpatient health centers. For Clinics, there are 179 Clinics which are divided into 171 Primary Clinics and 8 Main Clinics, and others are private clinics, consisting of 312 private medical practices and 77 private practices dentistry[15].

The characteristics of the participants showed that based on the patient's age, 17.5% of the patients who died were over 60 years old, and only 3.3% of the patients who died were under 60 years of age. Based on the gender of the patient, we found that more male patients died than females (namely 6.2%). While based on the occupational status, we found that working patients have more died cases than those who did not work (namely 7.8%). Results from the analysis of Covid-19 symptoms proved that most patients who died showed symptoms of Covid-19 compared to those who did not show symptoms, which was 7.4%. Based on the history of comorbidities, we found that most patients who died had more than one comorbid, and only 2.4% of patients had no comorbidities.

The morbidity rate

The crude morbidity rate shows that there is 5 COVID-19 cases within 1000 population. Figure 2 shows that the morbidity rate tends to increase as the population ages. The lowest morbidity rate is in toddlers; one toddler infected with COVID-19 per 1000 and 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 3).

Mortality rate

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 4).

Though the number of COVID-19 patients is higher at productive age group compared to the older age group (Figure 3), the mortality rate is much more higher at the age of over 50 years old (Figure 4). 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. Specific mortality rates per 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 double in the male population than in the female population (Figure 4).

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,

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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 5).

Dominant symptoms and Comorbidity history in COVID-19 Patients in Palembang

Table 6 and 7 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, 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 and 26.6 % of those with diabetes and 18.8 % of those with hear disease passed away. On the other hand, there is lower percentage of these comorbid condition for recovered patients.

Spatial analysis of COVID-19 per Community Health Centres (PUSKESMAS) in Palembang

Figure 8 focuses on the spatial analysis of reported cumulative cases of COVID-19. Based on Figure 8, out of 7423 cumulative confirmed cases of COVID-19 in Palembang City, 19 out of 41 community health centers whose working areas have gotten the cumulative confirmed cases exceeding 200. Padang Selasa (393 cases), Sosial (339 cases), Sukarami, and Kalidoni (331 cases) were the health centers with the highest number of cases reported. Meanwhile Karyajaya, 7 Ulu, and 5 Ilir health centers have reported the least cumulative COVID-19 cases, with 7, 37, and 49 cases reported.

Figure 9 shows the spatial analysis of reported cumulative death cases of COVID-19. There are 9 community health center whose gotten more than 10 cases of cumulative COVID-19 deaths. The community health center with the highest COVID-19 deaths include Kenten, Sekip, Sabokingking, and Padang Selasa at 21, 19, and 18 reported cases. In contrast, the lowest reported COVID-19 deaths were Talang Betutu, 5 Ilir, and Keramasan health center, with only 1-2 cases.

DISCUSSION

The pandemic of COVID-19 has become a health problem in Indonesia. The mutated virus leads to the massive spread of the virus in the community and leads to death. 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 Epidemiologic 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 the 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 impact on the susceptibility of the elderly in this crowded areas[16,17]. Research conducted by Hikmawati et al. and national data from Ministry of Health highlights that four to five out of 10 deceased patients related COVID-19 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 death and transmitting it to more vulnerable groups, such as the elderly[16,17]. Furthermore, the comorbidity condition including history of diabetes, hypertension might exacerbate the risk of death among elderly.

The increasing numbers of COVID-19 in Indonesia 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 attach 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 that 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[19-21]. Unfortunately, we argue the quick changes of COVID-19 in Indonesia may contribute the increase of attack rate over periods of time.

In terms of the symptoms most often had by 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[6,9,22]. Meanwhile, data based on comorbid conditions, 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[6,9,22,23].

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 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 community health center's work area with the highest COVID-19 positive cases is also part of the sub-district high in social vulnerability status. The area is Padang Selasa health center (part of Ilir Barat I sub-district)[24]. A previous study found that the higher number of elderlies in a population, the higher death cases related to COVID-19[25]. So, we can conclude that the social vulnerability in an area can affect the amount of COVID-19 cases.

CONCLUSIONS
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 death. Spatial analysis information based on *Puskesmas* helps policymakers to focus on COVID-19 services in *puskesmas* with high mortality rates and attack rate figures. Therefore, these desriptive epidemiology information contribute to complexity of risk of death related to COVID-19 in Indonesia, including the older age, the comorbid history and the lack of awareness of COVID-19 symptoms that are

similar to seasonal cough and flu. This study recommends that maximizing the non-communicable disease (PTM) program for the age group above 50 years and also the vaccination program for vulnerable groups, especially the elderly (with comorbidities or 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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Attachment: TABLES AND FIGURES
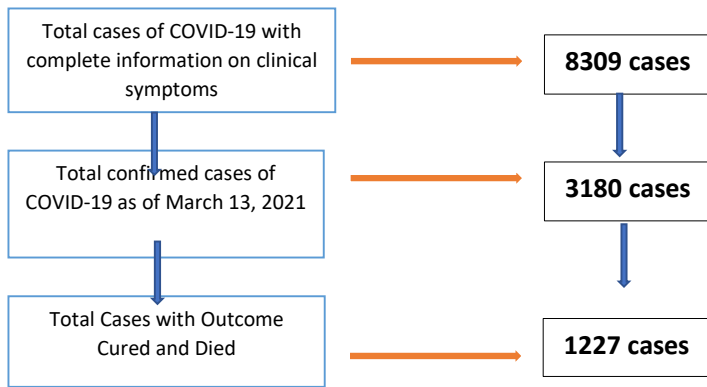
Figure 1. Number of COVID-19 cases with complete clinical symptom information

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Source: The Epidemiological Surveillance Information System (Sisugi)
(https://sisugi.com/tentang-sisugi/)
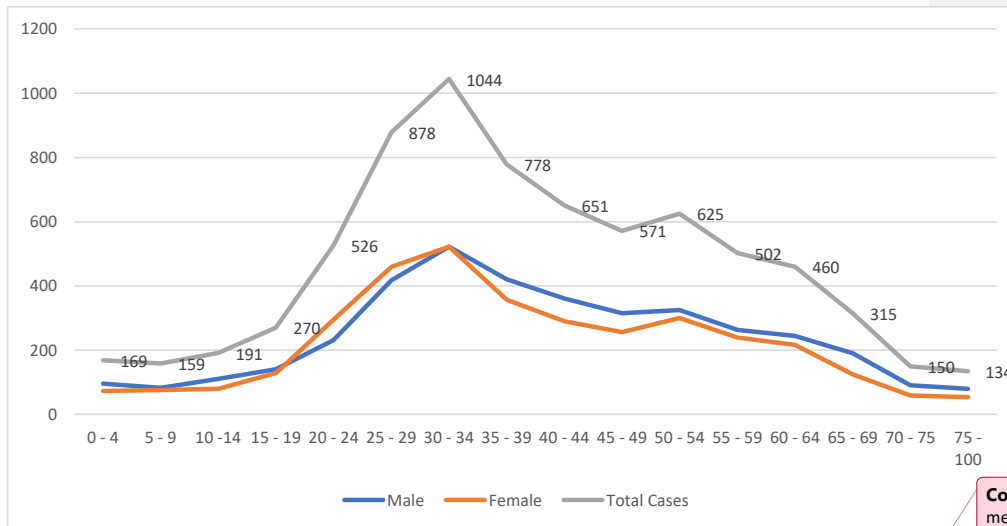
Figure 2. Number of COVID-19 Cases in Palembang per age groups

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March 2020 – March 2021
Source: Palembang City Health Office COVID-19 Surveillance Data as of March 15, 2021

Figure 3. Morbidity rates related to COVID-19 per gender and age group in Palembang City
Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021

Figure 4. Mortality rate per sex group per 1000 population

Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021

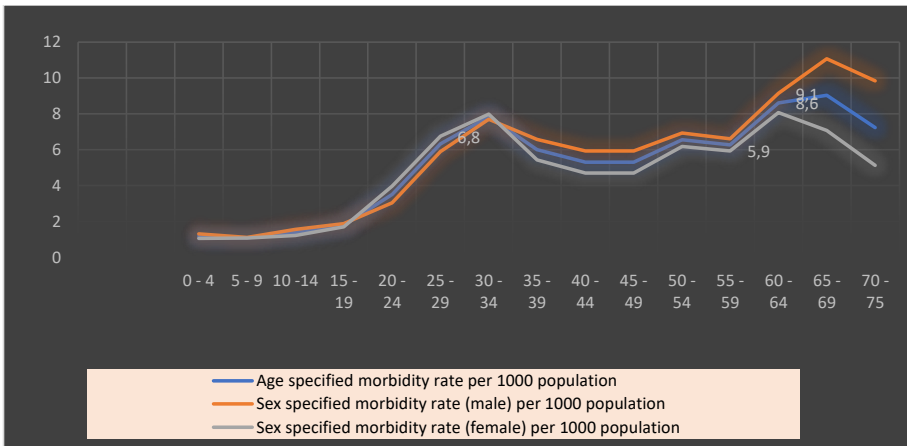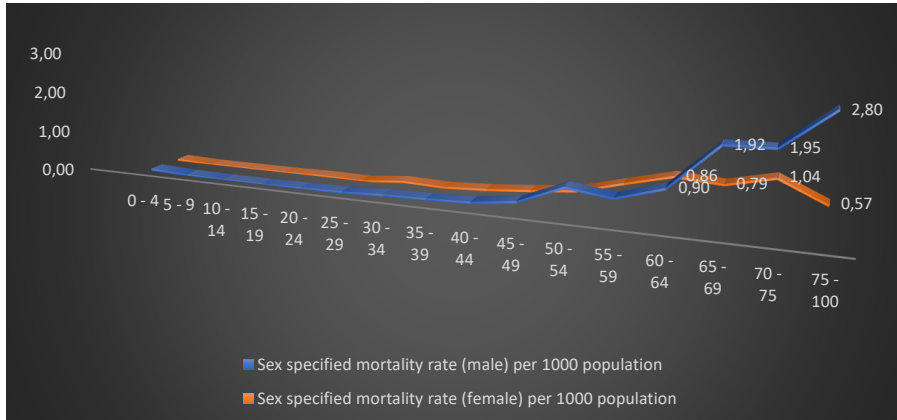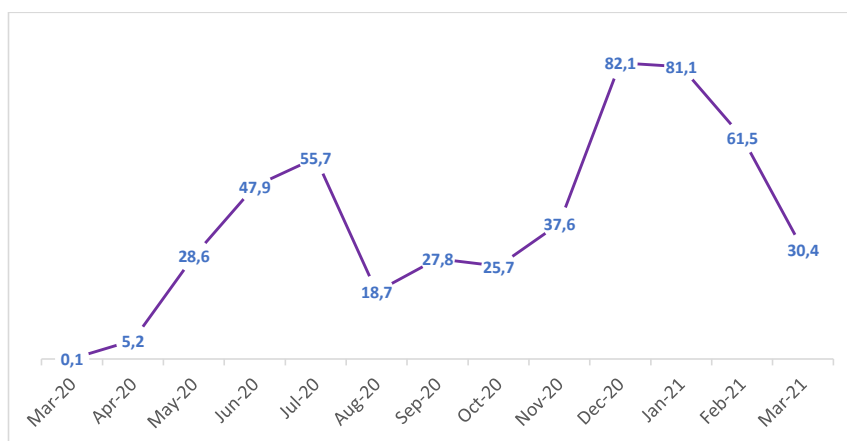Figure 5. Trend of COVID-19 Attack Rate per 100,000 residents per month in Palembang City from March 2020 - March 15, 2021

Source: Surveillance Section of Palembang City Health Office, March 2020-15 March 2021

Note: Number of population at risk: 1,662,893 March 2021, data as of March 15, 2021 (Source Profile of the Health Office 2019)

Status of Symptoms in COVID-19 Patients based on recovery status	Yes		No	
	Frequencies	Percentage	Frequencies	Percentage
Dead cases (n=64) :				
Shortness of breath	34	53.1	30	46.9
Limp	32	50	32	50
Fever	31	48.4	33	51.6
Cough	27	42.2	37	57.8
Nausea and vomit	15	23.4	49	76.6
Cold	14	21.9	50	78.1
Sore throat	14	21.9	50	78.1
Headache	14	21.9	50	78.1
Abdominal pain	10	15.6	54	84.4
Muscle ache	7	10.9	57	89.1
Diarrhea	5	7.8	59	92.2
Recovered cases (n=1163)				
Shortness of breath	93	8	1070	92
Limp	141	12.1	1022	87.9
Fever	412	35.4	751	64.6
Cough	453	39	710	61
Nausea and vomit	71	6.1	1092	93.9
Cold	317	27.3	846	72.7
Sore throat	186	16	977	84
Headache	166	14.3	997	85.7

Abdominal pain	32	2.8	1131	97.2
Muscle ache	84	7.2	1079	92.8
Diarrhea	31	2.7	1132	97.3

Table 6. Status of Symptoms in COVID-19 Patients who passed away and recovered between March 2020 – March 2021 in Palembang
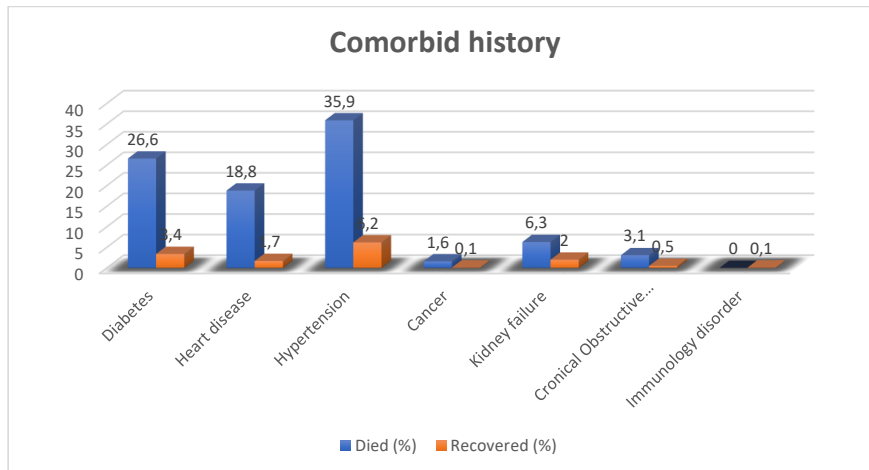
Status of Symptoms in COVID-19 Patients based on recovery status	Dead cases (n=61)		Recovered cases (n=1163)	
	Frequencies	Percentage	Frequencies	Percentage
Symptoms				
Shortness of breath	34	53.1	93	8
Limp	32	50	141	12.1
Fever	31	48.4	412	35.4
Cough	27	42.2	453	39
Nausea and vomit	15	23.4	71	6.1
Cold	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
Comorbid				
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
Chronical obstructive	2	3.1	6	0.5
Immunology disorder	0	0	1	0.1

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

Comorbid history

Comorbid in COVID-19 Patients based on recovery status	Yes		No	
	Frequencies	**Percentage**	**Frequencies**	**Percentage**
Dead cases (n=64) :				
Diabetes	17	26.6	47	73.4
Hearth disease	12	18.3	52	81.3
Hypertension	23	35.9	41	64.1
Cancer	1	1.6	63	98.4
Kidney failure	4	6.3	60	93.8
Chronical obstructive	2	3.1	62	96.9
Immunology disorder	0	0	64	100
Recovered cases (n=1163)				
Diabetes	40	3.4	1123	96.6
Hearth disease	20	1.7	1143	98.3
Hypertension	72	6.2	1091	93.8
Cancer	1	0.1	1162	99.9
Kidney failure	2	0.2	1161	99.8
Chronical obstructive	6	0.5	1157	99.5
Immunology disorder	1	0.1	1162	99.9

Table 7. Comorbid Data on COVID-19 Patients in Palembang City Based on Last Healed and died Status

March 2020 - March 2021

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

Note: Diabetes, RR 7.4 (95 % Confidence Interval 4.6-12.1, p. <0.001); Heart disease, RR 8.6 (95% CI 5.1-14.5, p. <0.001); Hypertension, RR 6.7 (95% CI 4.2-10.6, p. <0.001); Cancer, RR 9.7 (95% CI 2.4-29.7, p. 0.1); Kidney failure, RR 13.6 (95% 7.3-25.1, p. <0.001); Cronical Obstuctive pulmonary disease, RR 4.9 (95% CI 1.4-16.7, p.0.06); and Immunology disorder (p.1)
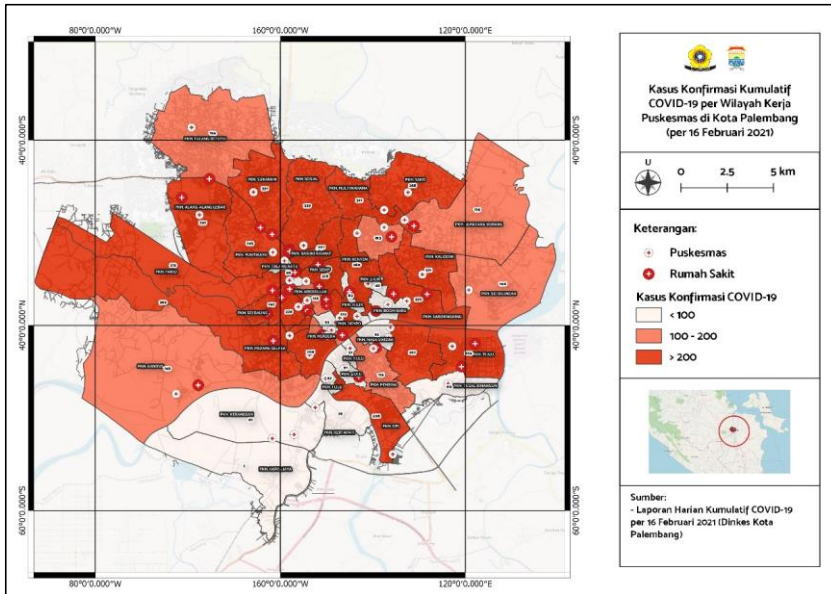
Figure 8. Distribution Map of Cumulative COVID-19 based on the Work Area of the Community health center in Palembang
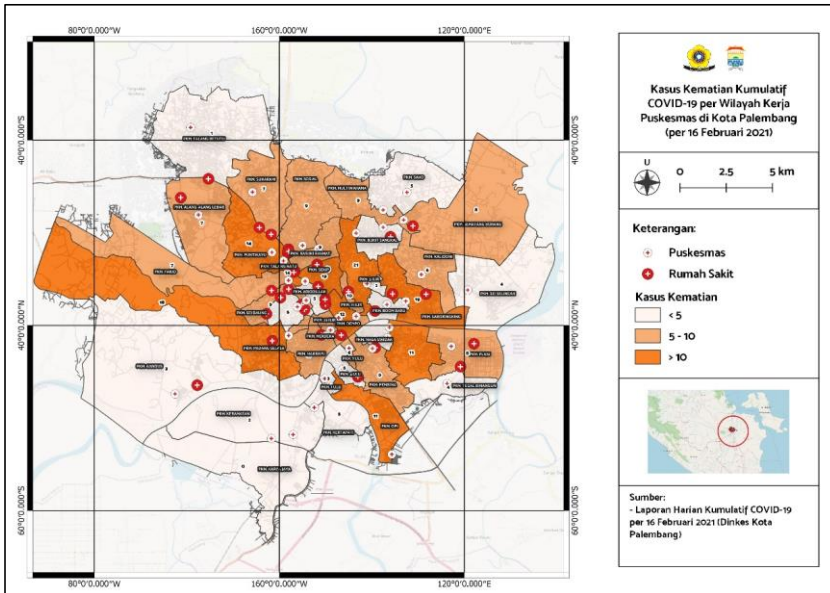
Figure 9. Distribution Map of Cumulative Death Cases by Health Center Work Area in Palembang City

Additional Attachment:

Table 1. Distribution of COVID-19 cases in the top five highest number of Covid-19 in Southeast Asia

Countries in Southeast Asia	Total Tests that have been done (million)	Test access opportunity*	Cumulative number of positive cases	Number of Deaths	Number of recovered cases	Fatal Mortality Rate (%)	Cumulative number of new cases	Incidence Rate (new cases)*
Indonesia	14	49.793	1.594.722	43.196	1.444.229	2,7	5363	20
Singapora	9	1.535.140	60.769	30	60.446	0,05	34	6
Philipine	7.7	69.738	914.971	15.738	705.757	1,7	10.726	1.4
Malaysia	8.5	259.168	198.208	1365	154.299	0,7	2551	300
Thailand	8,1	116.173	39.038	97	28.480	0,25	1585	227

*per 1 million population

Total population: Indonesia-276 million; Singapore-5.9 million; Philippines-111 million; Malaysia-33 million; Thailand-70 million

Source: Worldmeter, 2021, April 17th, 8 A.M[3]

Participant's characteristics

Variabel		Status pasien Covid				Total
		Meninggal		Sembuh		
		n	%	n	%	n (%)
Age	> 60	29	17,5%	137	82,5%	166 (100)
	≤ 60	35	3,3%	1026	96,7%	1061 (100)
Sex	Male	40	6,2%	605	93,8%	645 (100)
	Female	24	4,1%	558	95,9%	582 (100)
Working status	Yes	29	7.8 %	344	92.2%	373 (100)
	No	35	4.1 %	819	95.9 %	854 (100)
Symptoms of COVID-19	Asymptomatic	5	1.2 %	420	98.8%	425 (100)
	Symptomatic	59	7.4 %	743	92.6 %	802 (100)
Comorbid history	No Comorbid	26	2.4%	1053	97,6%	1079 (100)
	1 Comorbid	21	20..6%	81	79.4%	102 (100)
	>1 Comorbid	17	37%	29	63%	46 (100)

najmah unsri <najmah@fkm.unsri.ac.id>

kepada Diah, Yeni, yudhisan, hafizaazzahra20, Marisa, yulia, amrina, sheillafansi, misnaniarti ▾

Rab, 22 Jun 2022, 03.25 ☆ ↩ ⋮

terimakasih mbak Diah for your charming help

we will revise it

Najmah et al

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najmah unsri <najmah@fkm.unsri.ac.id>

kepada Diah, Yeni, yudhisan, hafizaazzahra20, Marisa, yulia, amrina, sheillafansi, misnaniarti ▾

🖉 Jum, 24 Jun 2022, 10.02 ☆ ↩

Dear A. A. Ayu Diah Pradnyadewi

here we attach the final revision of the paper. we attach the cleaned version and the track and changes version

heap gratitude for charming help from the team editor and reviewers to help us to revise this paper

Najmah et al

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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 method 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 7423 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 showed that the age group 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 at the sub-district with the highest population, including the PHC Padang Selasa, Ilir Barat I (393 patients), while the lowest case report was PHC Karyajaya, Kertapati (7 patients).

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

Keywords: COVID-19, Descriptive Epidemiology, elderly, Comorbidity, Palembang, Indonesia

INTRODUCTION

The new coronavirus disease or COVID-19, which initially came from Wuhan (China), has spread worldwide. On March 11, 2020, the World Health Organization (WHO) declared a pandemic, or an extraordinary outbreak in a society or region from a particular disease spread 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 signify three death among 100 COVID-19 cases per July 2021. Reports of cases per day tend to increase and reach their peak in December 2020 and January 2021, where reported COVID-19 cases reach an average of 10 thousand patients per day. The daily reported cases tend to decrease from February to April 2021. In June 2021, the trend of COVID-19 tends to increase significantly reach over 12,000 patients per day, and in July 2021, 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 is improved , to almost reached 95% in April 2021. Unfortunately, the opportunity to access COVID-19 tests is at the lowest position compared to other countries in Southeast Asia, so tracking of new cases was limited. Per April 2021, new reported cases in Indonesia are 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 is ranked 14th of 34 provinces in Indonesia for the highest positive confirmed cases of COVID-19, about 27119 patients with a total of 137 COVID-19-related deaths[4,5]. The case fatality rate in South Sumatra is in the top three in Indonesia, and the rate is higher than the national CFR (CFR=5.07%, as of 20 June 2021). New cases have reached 100 cases per day in January-June 2021 and are spread across 17 districts/cities. Nearly 50% of confirmed cases are 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 the highest CFR in Indonesia. By answering the question of "where", a 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 a 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 aimed to provide the descriptive epidemiology of COVID-19 cases in Palembang city supported by 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

(*PUSKESMAS*), which are divided into three inpatient health centers and 38 non-inpatient health centers. For Clinics, there are 179 Clinics which are divided into 171 Primary Clinics and 8 Main Clinics, and others are private clinics, consisting of 312 private medical practices and 77 private practices dentistry[15].

Study design and data analysis

This research was conducted for three months, starting from February to April 2021, and the location of the study focused on Palembang city, South Sumatera Province. The target population in each analysis were all residents of Palembang, whom the government had registered. The data source is all reported COVID-19 data 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 is to investigate epidemiology aspects from person, place an time related COVID-19 cases, the second is analysis of risk factors related to death 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 catchment area. More detailed information about each analysis is as follows:

13. **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 7423 reported cases, consisting of 3892 males and 3892 females, with 319 deaths (193 men and 126 women). The following measurements are performed in descriptive epidemiology calculation formulas[14]:

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.

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

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 (comorbid).

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

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.

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

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.

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

14. **Epidemiological data descriptive of symptomatic COVID-19 patients with outcomes death or recovery**

To observe epidemiological data based on symptoms, we took secondary data from the SISUGI website. The inclusion criteria for the data for this analysis including: every case confirmed positive to COVID-19 with completed epidemiological investigation (e.g symptoms related to COVID-19 and comorbid), and the latest status of each individual has been categorized into recovered and passed away. We extracted the data from March 1st, 2020 - March 13th, 2021. On March 13th, 2021, there were a total 8309 of COVID-19 cases in the SISUGI database. After we cleaned the data, only 3180 COVID-19 cases have completed data on comorbidities. We analyzed the recovered and death cases with a total of 1227 cases. We produced graphs to understand the risk factors of death related to COVID-19 in Indonesia. Chi-square was undertaken for crosstabs calculation.

15. **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 public health centre's catchment area. This study uses aggregated data from a population group as a research unit, the population group studied was 41 public health centres' catchment 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 Bapppeda of Palembang City's website (Geoportal Pemerintah Kota Palembang, **http://geoportal.sumselprov.go.id/**) and coordinates of health centers 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 people cases lived in Palembang City and all cases 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 public health center's catchment area based on the division of work area from the Palembang city health office. Then we obtained the coordinate points of health service 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.

RESULTS

Overview of Palembang City

The characteristics of the participants in table 1 showed that based on the patient's age, 17.5% of the patients who died were over 60 years old, and only 3.3% of the patients who died were under 60 years of age. Based on the gender of the patient, we found that more male patients died than females (namely 6.2%). While based on the occupational status, we found that working patients have more died cases than those who did not work (namely 7.8%). Results from the analysis of Covid-19 symptoms proved that most patients who died showed symptoms of Covid-19 compared to those who did not show symptoms, which was 7.4%. Based on the history of comorbidities, we found that most patients who died had more than one comorbid, and only 2.4% of patients had no comorbidities.

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 COVID-19 is 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 5 COVID-19 cases within 1000 population. Figure 1 shows that the number new cases of COVID-19, morbidity rate and mortality rate related to COVID-19 tends to increase as the population ages. The lowest morbidity rate is in toddlers; one toddler infected with COVID-19 per 1000 and 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. Specific mortality rates per 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 double in the male population than in the female population (Figure 1).

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).

Dominant symptoms and Comorbidity history in COVID-19 Patients in Palembang

Table 2 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, 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 and 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 comorbid conditions for recovered patients.

Spatial analysis of COVID-19 per Community Health Centres (PUSKESMAS) in Palembang

Figure 3 focuses on the spatial analysis of reported cumulative cases of COVID-19. Based on Figure 3, 19 out of 41 community health centers whose working areas have gotten the cumulative confirmed cases exceed 200, out of 7423 cumulative confirmed cases of COVID-19 in Palembang City. Padang Selasa (393 cases), Sosial (339 cases), Sukarami, and Kalidoni (331 cases) were the health centers with the highest number of cases reported. Meanwhile Karyajaya, 7 Ulu, and 5 Ilir health centers have reported the least cumulative COVID-19 cases, with 7, 37, and 49 cases reported.

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

DISCUSSION

The pandemic of COVID-19 has become a health problem in Indonesia. The mutated virus leads to the massive spread of the virus in the community and leads to death. 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 Epidemiologic 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 the 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 impact on the susceptibility of the elderly in this crowded areas[16,17]. Research conducted by Hikmawati et al. and national data from Ministry of Health highlights that four to five out of 10 deceased patients related COVID-19 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 death and transmitting it to more vulnerable groups, such as the elderly[16,17]. Furthermore, the comorbidity condition including history of diabetes, hypertension might exacerbate the risk of death among elderly.

The increasing numbers of COVID-19 in Indonesia 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 attach 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 that 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[19-21]. Unfortunately, we argue the quick changes of COVID-19 in Indonesia may contribute the increase of attack rate over periods of time.

In terms of the symptoms most often had by 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[6,9,22]. Meanwhile, data based on comorbid conditions, 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[6,9,22,23].

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 community health center's work area with the highest COVID-19 positive cases is also part of the sub-district high in social vulnerability status. The area is Padang Selasa health center (part of Ilir Barat I sub-district)[24]. A previous study found that the higher number of elderlies in a population, the higher death cases related to COVID-19[25]. So, we can conclude that the social vulnerability in an area can affect the amount of COVID-19 cases.

CONCLUSIONS
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 death. Spatial analysis information based on *Puskesmas* helps policymakers to focus on COVID-19 services in *puskesmas* with high mortality rates and attack rate figures. Therefore, this descriptive epidemiology information

Commented [A86]: please add the discussion from the results of attack rate, that may affect the spread of the disease etc.

also discuss more about results from geographic distribution, which may contributes to case in early/ederly ages. maybe some region have more ederly people than others, etc. Write naration based on the link between characteristics spatial/geographic to sociodemografi of the population that may contributes to increase risk/attack rates.

Commented [A87R86]: Read

https://thorax.bmj.com/content/76/8/798

Commented [A88]: is there any data to prove this posibility? i.e to support the claim that a spike happened during/after schools holidays?
maybe indicating the time when there was a holidays and few days/weeks after followed with a spike.

Commented [A89R88]: Yes we added reference, we deleted the school holiday, thank you for the feedbacks.

Muhyiddin, M., & Nugroho, H. (2021). A Year of Covid-19: A Long Road to Recovery and Acceleration of Indonesia's Development. *Jurnal Perencanaan Pembangunan: The Indonesian Journal of Development Planning*, *5*(1), 1-19.

Commented [A90]: please write and summarise conclusions based on results found.

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contribute to complexity of risk of death related to COVID-19 in Indonesia, including the older age, the comorbid history and the lack of awareness of COVID-19 symptoms that are similar to seasonal cough and flu. This study recommends that maximizing the non-communicable disease (PTM) program for the age group above 50 years and also the vaccination program for vulnerable groups, especially the elderly (with comorbidities or 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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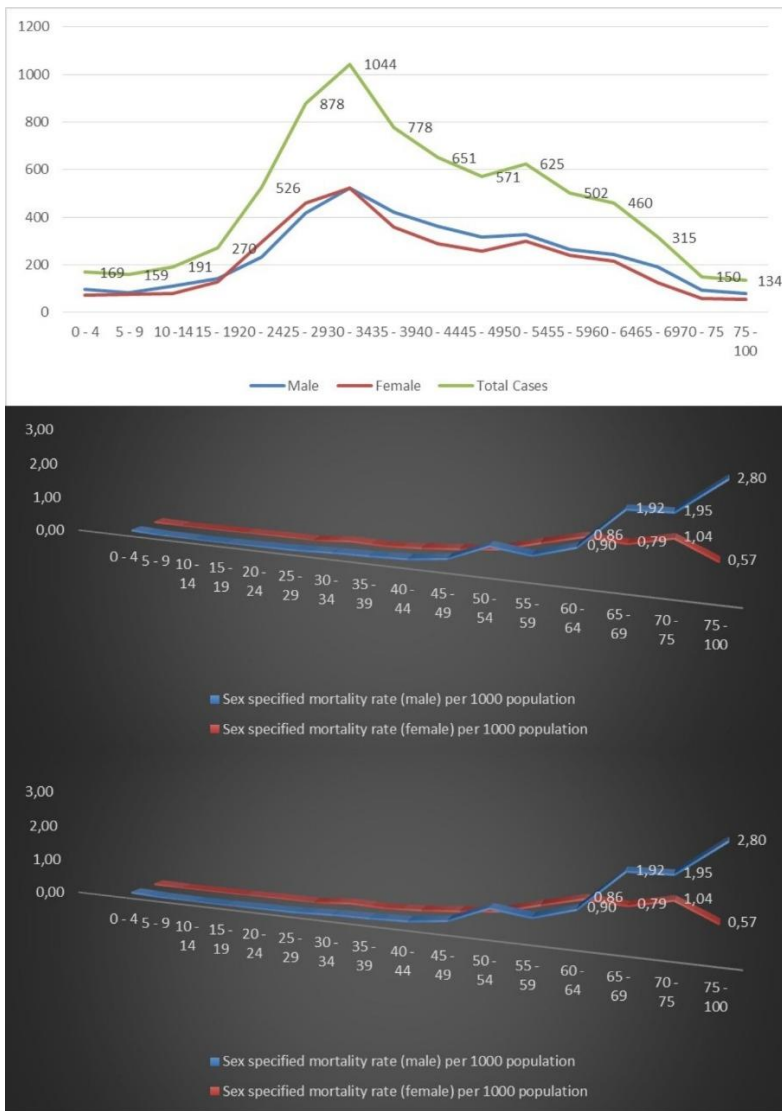
Figure 1. Number of cases related to COVID-19 and Morbidity and mortality rates and per gender and age group in Palembang City
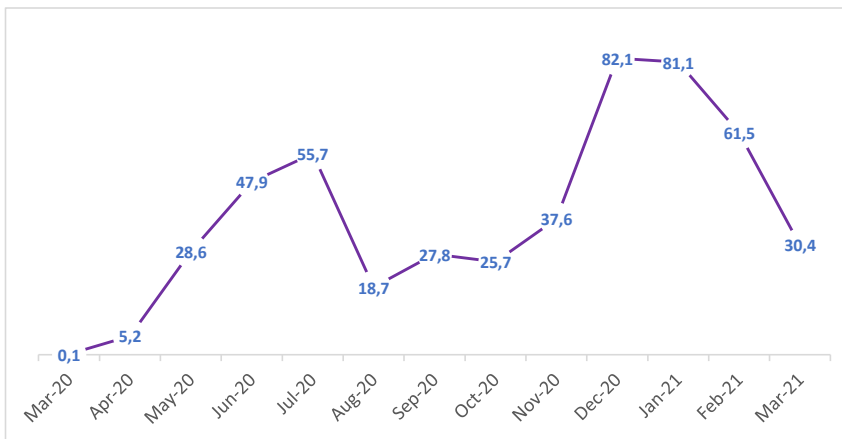*Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021*

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

Source: Surveillance Section of Palembang City Health Office, March 2020-15 March 2021

Note: Number of population at risk: 1,662,893 March 2021, data as of March 15, 2021 (Source Profile of the Health Office 2019)
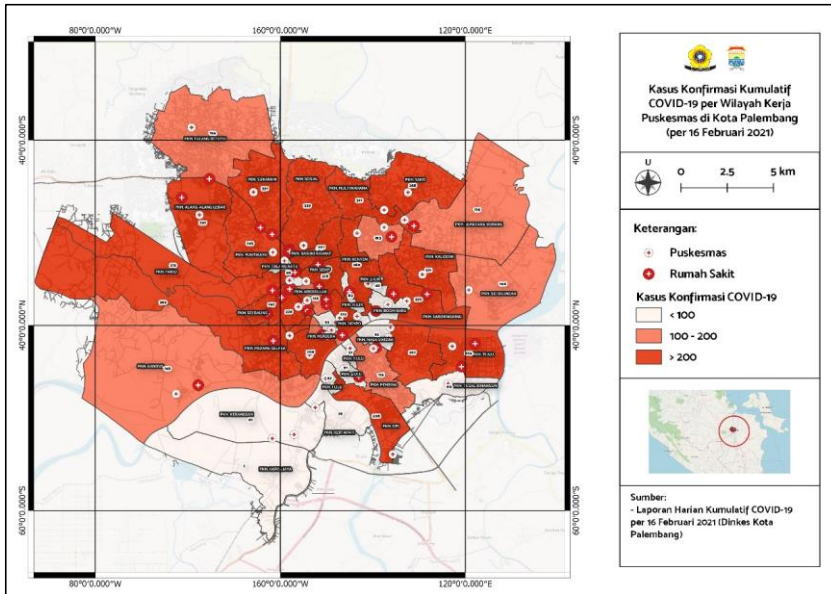
Figure 3. Distribution Map of Cumulative COVID-19 based on the Work Area of the Community health centers in Palembang

Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021
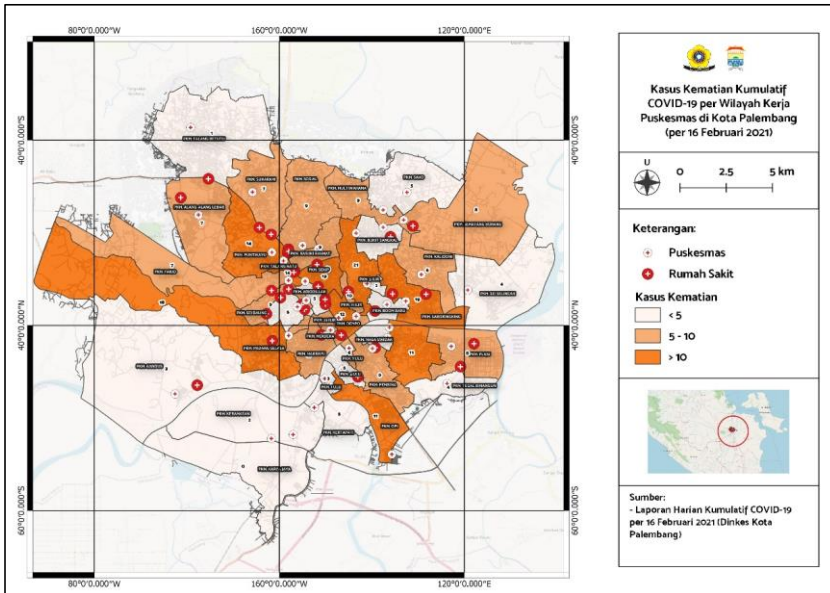
Figure 4. Distribution Map of Cumulative Death Cases by Health Center Work Area in Palembang City

Source: Surveillance Section of the Palembang City Health Office, March 2020-16 February 2021

Table 1. Participant's characteristics

Variables	Patient's health outcome		Total
	Dead cases (n=61)	**Recovered cases (n=1163)**	

		n	%	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
Comorbid history	No Comorbid	26	2.4%	1053	97,6%	1079
	1 Comorbid	21	20..6%	81	79.4%	102
	>1 Comorbid	17	37%	29	63%	46

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

Table 2. Status of Symptoms in COVID-19 Patients who passed away and recovered between March 2020 – March 2021 in Palembang

Status of Symptoms in COVID-19 Patients based on recovery status	Dead cases (n=61)		Recovered cases (n=1163)	
	Frequencies	Percentage	Frequencies	Percentage
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
Comorbid				
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
Chronical obstructive	2	3.1	6	0.5
Immunology disorder	0	0	1	0.1

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

Note: Diabetes, RR 7.4 (95 % Confidence Interval 4.6-12.1, p. <0.001); Heart disease, RR 8.6 (95% CI 5.1-14.5, p. <0.001); Hypertension, RR 6.7 (95% CI 4.2-10.6, p. <0.001); Cancer, RR 9.7 (95% CI 2.4-29.7, p. 0.1); Kidney failure, RR 13.6 (95% 7.3-25.1, p. <0.001); Cronical Obstuctive pulmonary disease, RR 4.9 (95% CI 1.4-16.7, p.0.06); and Immunology disorder (p.1)

Descriptive epidemiology of COVID-19 in Palembang, Indonesia

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