ORIGINAL ARTICLE

Sociodemographic factors, environmental, community mobility and health indicators associated with the spread of COVID-19 and case fatality rate in Indonesia: an ecological study

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Received: 6 October 2021 **Revised:** 15 December 2021 **Accepted:** 18 December 2021 **Available online:** May 2022
DOI: 10.55131/jphd/2022/200202

ABSTRACT

On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a global pandemic due to its Case Fatality Rate (CFR) and numerous determining factors. Therefore, this study aims to identify the sociodemographic, environmental, community mobility, and health indicators associated with the pandemic and CFR. The design applied is an ecological study with data collected from 34 provinces in Indonesia and analyzed using the Spearman correlation. The results showed that independent variables such as population, density, the number of workers engaged in micro and small enterprises, hotel rooms, stroke, diabetes, general practitioners, specialists, nurses, PHC per district, PHC plus, and COVID-19 referral hospitals were positive and significant to the COVID-19 cases (p<0.01). Poverty in rural areas, elderly in rural and urban areas, sanitation, and hypertension were positive and significant to COVID-19 cases (p<0.05). Retail and recreation, grocery and pharmacy, transit stations, and residential areas were negative and significant to COVID-19 cases (p<0.01). Population growth rate, workplaces, and poverty in rural areas were negative and significant to COVID-19 cases (p<0.05). Elderly in rural and urban areas, urban slum households, immunization, and hypertension were positive and significant to CFR (p<0.05). The government needs to prevent the spread of the virus in provinces, especially in areas with high population and density, increased elderly population, low immunization rate, poor sanitation, and a significant number of residents living with comorbidities, such as stroke, hypertension, and diabetes. Furthermore, beds, tents, emergency buildings, oxygen cylinders, and multilevel referral systems between health facilities need to be provided. The government also needs to limit the inflow of people abroad, optimize the Work from Home (WFH) policy, and limit community mobility outside the home, especially in Bali.

Key words:
COVID-19; case fatality rate; sociodemographic; environmental; community mobility; health indicators; Indonesia

Citation:
O. Rachmat, S. Setyadi , A. Kustanto. Sociodemographic factors, environmental, community mobility and health indicators associated with the spread of COVID-19 and case fatality rate in Indonesia: an ecological study. J Public Hlth Dev. 2022;20(2):12-31. (https://doi.org/10.55131/jphd/2022/200202)

INTRODUCTION

The COVID-19 pandemic was first recorded in a 55-year-old man living in Hubei Province, China, towards the end of 2019[1], and on March 11, 2020, it was declared a global pandemic by the World Health Organization (WHO)[2]. The first two cases in Indonesia were announced on March 2, 2020, with both victims comprising women aged 64 and 32 years[3]. According to studies, both patients are residents of Depok, West Java, and had close contact with positively infected Japanese citizens[4].

Countries worldwide are still struggling to reduce the infection rate of this pandemic even after its existence for more than one year. In Indonesia, this pandemic has proven to be the worst economic and social pressure in the last 20 years[5]. The country is currently struggling to deal with the ever-increasing rate of infection[6,7]. Based on Worldometer's data on September 21, 2020, it was ranked 9th in Asia, with approximately 244,676 cases[8]. The partial lockdown policy by the government against the total lockdown implemented by other countries was to avoid enabling the continuation of economic activities[9].

Many factors are responsible for the increase in positive cases and CFR, such as sociodemographic factors, environmental conditions, and increase in human contact. The high population and density in an area, which increases close human contact, makes it difficult to maintain social distance in public[10], thereby increasing the transmission rate[11]. The increase in transmissions rate is also due to the low level of public education, thereby leading to their refusal to undergo the COVID-19 test[12]. According to the Central Bureau of Statistics survey results, 17% of respondents stated that it was impossible to be infected with the virus[13].

Households with low environmental factors, such as inadequate access to clean water and proper sanitation, risk spreading the virus[14–16]. This is because clean water supplies are essential for frequent washing the hands after various activities and coming in contact with positive patients or contaminated surfaces[17,18]. Therefore, access to clean water for sanitation and proper drinking water is critical during the pandemic[19].

The community mobility restriction policy has changed its name and format several times, starting with the terms Large-scale Social Restrictions (PSBB), Transitional Large-scale Social Restrictions (PSBB Transisi), Emergency Public Activity Restrictions (PPKM Darurat), up to PPKM levels 3 and 4 towards the end of July[20]. The PSBB policy is not implemented in all Indonesian regions, instead only in areas with a high number of positive cases[21]. This is because it is not yet considered effective in reducing the number of COVID-19 cases[22]. The ineffectiveness of the PSBB policy intervention is shown by the high mobility of people going out of their houses.

In June 2021, the COVID-19 Response Acceleration Task Force stated that Indonesia was entering the second wave of the pandemic due to the emergence of several new variants[23]. The first and second peaks were exacerbated in three provinces, namely Jakarta, West, and East Java, due to the high mobility of people. Therefore, on July 3-20, 2021, the government issued a PPKM Darurat Java-Bali policy. According to the Worldometer's report, Indonesia recorded a total death rate of 18,000 as of December 9, 2020[24], making it the third-highest in Asia after India and Iran. On September 16, 2021, the total number of deaths increased to 139,682[25], changing the position to second-highest.

The WHO stated that smokers are at a 50% higher risk of severe illness and

death when infected with the virus[26]. This is detrimental to Indonesia, which has a high number of smokers suffering from various tobacco-related diseases[27], hence it is a challenge for this category of people[28]. In 2019, Indonesia recorded 60.8 and 3.7 million adult males and females, respectively[29]. The Indonesia Basic Health Research 2018 survey results showed that 62.9% of men and 4.8% of women aged 15 years overuse tobacco[30]. According to all surveys conducted in the last decade, nearly 2 out of 3 adult males smoked[28].

Poor public health management systems, regional disparities, and lack of preparedness to face a pandemic are some of the causes of a high number of deaths due to the pandemic[6,31]. Interregional developments show that regions on the island of Java generally experience faster economic growth than those outside[32,33]. Economic development leading to growth before the Asian Financial Crisis from 1997 to 98 has not entirely overcome the disparity between regions[34].

One of the reasons for not handling surveillance systems and responses to infectious diseases such as COVID-19 is due to poor health infrastructure[35]. The poor conditions of health infrastructure in African countries lead to the rapid spread of the pandemic within the early weeks of exposure[36–38]. Eastern Indonesia still experiences poor health status because the health workers are not evenly distributed[39,40]. The Manpower Research result in Health Sector 2017 (Risnakes) noted that out of 9,669 public health centers, more than 90% had doctors, nurses, and midwives[41]. However, between 25%-60% do not have dentists, public health human resources, poor environmental conditions, nutrition and pharmaceutical workers, and medical laboratory technology experts (ATLM). By province, the highest number of health centers without a doctor is in eastern Indonesia, namely Papua, Moluccas, West Papua, Southeast Sulawesi, and East Nusa Tenggara (>20%-45%).

Previous ecological studies have shown a province with a high sociodemographic status for COVID-19 cases and a high CFR[42-46].Other ecological studies also look at the role of population, economy, health inequality, and community mobility on COVID-19 cases and mortality rates[47–49]. Several studies also discuss how environmental conditions such as households that do not have access to proper sanitation and clean water contribute to COVID-19 cases[19,50,51]. In addition, there is previous evidence that most people exposed to the COVID-19 virus with severe symptoms leading to death are people with comorbidities[52–54].

Faced with the COVID-19 pandemic, it shows that the health system in Indonesia is still vulnerable to pandemics. Testing, tracing, and isolation are still limited, the disease surveillance system is not yet integrated and not real-time, and the laboratory testing capacity is still weak. Health and pharmaceutical facilities and medical equipment are not ready. There was a shortage of personal protective equipment, isolation rooms, treatment rooms, and ICU rooms. The capacity of health workers is limited, and many have contracted and died due to COVID-19. Previous studies reported that health, sociodemographic and geographical inequalities affect the rate of spread of the COVID-19 virus and result in deaths[55,56].

With this ecological study, we aim to identify potential sociodemographic factors, environmental conditions, community mobility, and provincial-level health indicators of the COVID-19 virus and CFR spread based on data from 34 provinces in Indonesia.

METHODS

The design of this study uses an ecological study. An ecological study is a research design that focuses on the

characteristics of population groups rather than individual members. Because this study design observes the characteristics of population groups based on place, this study design is included in a multi-group comparison.

COVID-19 is caused by the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2). The virus can be transmitted from person to person and has spread widely in China and more than 190 other countries and territories. COVID-19 is a health problem and impacts sociodemographics, environment, and so on, which can be measured using ecological factors.

The strength of ecological studies lies in making comparisons and identifying associations at the population level, and examining spatial or temporal patterns of disease transmission and exposure. The strength of the ecological study in this study is that it includes a wide geographic area, namely 34 provinces, and contributes to an understanding of sociodemographic factors, environmental conditions, community mobility, and health indicators, looking at their relationship with COVID-19 cases and CFR.

We obtained sociodemographic data, community mobility, and health indicators from the Central Bureau of Statistics, Google Mobility Trends, Indonesia Basic Health Research 2018, and Indonesian Health Profile 2019. Meanwhile, the COVID-19 cases and CFR data were obtained from the COVID-19 Response Acceleration Task Force on September 5, 2021. All data we collected for this study are publicly accessible. A total of 34 provinces in Indonesia which are located on five large islands and four islands, are included in the unit of analysis, with details of 10 provinces on Sumatra Island, six provinces on Java Island, three provinces on Lesser Sunda Island, five provinces on Kalimantan Island, six provinces on Sulawesi Island, two provinces on Moluccas Island, and two provinces on Papua Island.

The indicators related to COVID-19 in this study are classified as indicators of new case findings, and CFR was obtained on September 5, 2021. Sociodemographic indicators in this study included the Gini ratio in rural and urban areas, poverty in rural and urban areas, percentage of elderly in rural and urban areas, population, density, population growth rate, mean years of schooling, number of workers engaged in small and micro enterprises, urban slum households, and rooms in hotels. These sociodemographic indicators were chosen for analysis due to evidence from previous studies on the number of COVID-19 cases and CFR by sociodemographic factors.

Indicators of environmental conditions are the percentage of households with access to proper sanitation and the households with access to clean water and proper drinking water. During the pandemic, sanitation and water also play an essential role in stopping the spread of the COVID-19 virus. This study's community mobility indicators are retail and recreation, grocery and pharmacy, parks, transit stations, workplaces, and residential areas. Community mobility is intended to see movement trends by region and their impact on COVID-19 cases. Indicators of health conditions in this study are immunization, percentage of smokers, the prevalence of asthma, congenital heart disease (CHD), hypertension, stroke, diabetes, and tuberculosis. Health conditions mean that the elderly with comorbidities are highly vulnerable to exposure to the COVID-19 virus, resulting in death.

The health workers' indicators are the number of general practitioners, specialists, and nurses. Furthermore, the indicators for health infrastructure are the ratio of PHC per district, PHC plus, COVID-19 referral hospitals, and hospital bed ratio per 1000 population. The health

workers' indicator is intended to see the availability of primary health services in 34 provinces, while health infrastructure is intended to reflect the availability of secondary and tertiary care.

The data analysis is presented in maps, tables, and graphs based on the distribution of the dependent and independent variables. Data were then analyzed using correlation tests, such as Spearman for abnormally distributed data and linear regression[45]. Bivariate analysis with the Spearman correlation test was conducted to determine the relationship between independent and dependent variables in 34 provinces[46].

RESULTS

Table 1 shows Indonesia's sociodemographic factors, environmental conditions, community mobility, health conditions, workers, and infrastructure inequality. The average poverty rates in rural and urban areas are 13.15% and 7.46%. Approximately 7% of the world's population consists of people above 60 years, with 8.72% and 7.98% of this number living in rural and urban areas. The distribution of Indonesia's population is uneven, with more than half concentrated on the island of Java, with an average density of 742 people/km^2 per 7,929 people. Furthermore, the average population growth rate due to tourism is 1.71%, with 10,689 hotel rooms.

The average household with access to proper sanitation and safe drinking water is 79.81% and 78.32%. Community mobility on September 5, 2021, showed that when the PPKM Java-Bali was implemented, the mobility in parks, transit stations, and workplaces decreased. Meanwhile, several provinces revealed increased mobility in retail and recreation, residential and grocery, and pharmacy areas.

Indonesia's general health condition is influenced by environmental factors, behavior, health services, and immunization, with an average coverage rate of 56.18%. Furthermore, the average number of smokers, asthma prevalence, CHD, hypertension, stroke, diabetes, and tuberculosis are 23.49%, 2.48%, 1.43%, 8.18%, 10.08%, 1.37%, and 0.38%. The availability of health workers in Indonesia is not evenly distributed to all regions. The average numbers of general practitioners, specialists, and nurses are 4,224, 1185, and 10,162. Meanwhile, the availability of health infrastructure such as the PHC ratio per district is 1.57, the average PHC with complete health personnel is 131, while COVID-19 referral hospitals are 2.94, and the ratio of 1,000 population per bed is 1.28.

Table 1 Descriptive statistics of sociodemographic factors, environmental conditions, community mobility, health conditions, and health infrastructure in 34 provinces in Indonesia

Variable	Obs.	Mean	S.D.	Min	Max
Sociodemographic Factors					
Gini ratio in rural	34	0.29	0.06	0	0.41
Gini ratio in urban	34	0.35	0.04	0.27	0.43
Poverty in rural	34	13.15	7.84	0	35.69
Poverty in urban	34	7.46	3.19	3.43	15.06
Percentage of elderly in rural areas	34	8.72	3.44	0	19.19
Percentage of elderly in urban areas	34	7.96	2.10	4.5	13.18
Population	34	7929	11253	708	49565
Density	34	742	2708	9	15900
Population growth rate	34	1.71	0.64	0.62	3.84
Mean years of schooling	34	9.08	0.83	6.96	11.17

Variable	Obs.	Mean	S.D.	Min	Max
Number of workers engaged in micro-enterprise	34	216563	367926	11826	1470717
Number of workers engaged in Small-enterprise	34	65067	172081	611	919662
Urban slum households	34	14.05	7.60	3.79	42.73
Available rooms in classified hotels	34	10689	16666	323	70146
Environmental Conditions					
Percentage of households to sanitation	34	79.81	9.95	40.31	96.96
Percentage of households to drinking water	34	78.32	12.45	44.95	99.8
Community Mobility					
Retail and recreation	34	0.82	10.46	-34	25
Grocery and pharmacy	34	59.85	15.92	-13	74
Parks	34	-12.5	17.90	-48	31
Transit stations	34	-24.82	19.67	-73	21
Workplaces	34	-17.26	5.96	-32	-4
Residential areas	34	2.91	5.78	-10	13
Health Condition					
Complete basic immunization coverage	34	56.18	16.86	19.5	92.1
Percentage of smokers	34	23.49	2.60	18.8	28.1
Prevalence of asthma	34	2.48	0.76	1	4.5
Prevalence of congenital heart disease	34	1.43	0.34	0.7	2.2
Prevalence of hypertension	34	8.18	1.87	4.39	13.21
Prevalence of stroke	34	10.08	2.70	4.1	14.7
Prevalence of diabetes	34	1.37	0.50	0.6	2.6
Prevalence of tuberculosis	34	0.38	0.15	0.09	0.77
Health Workers					
Number of General Practitioners	34	4224	5694	171	22083
Number of Specialists	34	1185	1815	47	7613
Number of Nurses	34	10162	11508	1150	48164
Health Infrastructure					
Ratio of PHC per district	34	1.57	1.03	0.28	7.16
PHC with complete health workers	34	131	126	30	613
Number of COVID-19 referral hospitals	34	2.94	2.25	0	10
Hospital bed ratio per 1000 population	34	1.28	0.35	0.74	2.24

Figure 1 shows a map of the number of positive cases in 34 provinces, which is approximately 4,129,020, from March 2 to September 5, 2021. Based on Worldometer's data, Indonesia has the fourth-highest number of positive cases in Asia. The provinces with the most significant number of COVID-19 cases were Jakarta (852,692), followed by West Java (694,714), Central Java (473276), East Java (387,060), East Kalimantan (152,721), Yogyakarta (151,664), and Banten (129,765).

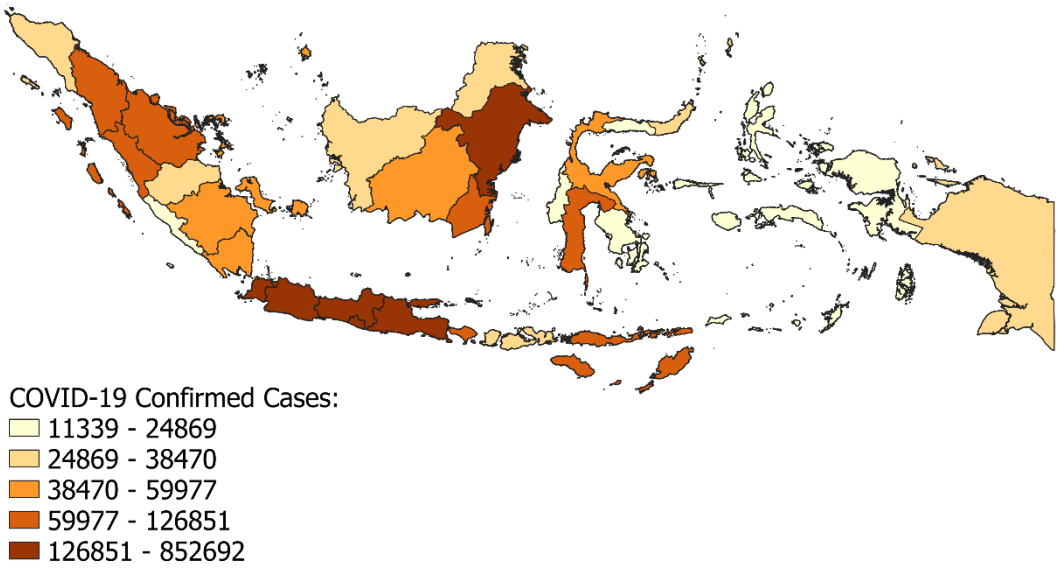

Figure 1 Map of the COVID-19 cases in 34 provinces in Indonesia per September 5, 2021

By September 5, 2021, a total of 135,861 deaths due to the COVID-19 were recorded in 34 provinces in Indonesia, at a CFR rate of 3.29% from March 2, 2020, to September 5, 2021. According to studies, approximately 24 provinces had a CFR above the global standard of 2.2%, namely Lampung (7.55%), East Java (7.41%), and Central Java (6.12%). This means that Papua has the lowest CFR at 1.10%, followed by West Papua at 1.53%, and Jakarta at 1.57%, as shown in Figure 2.

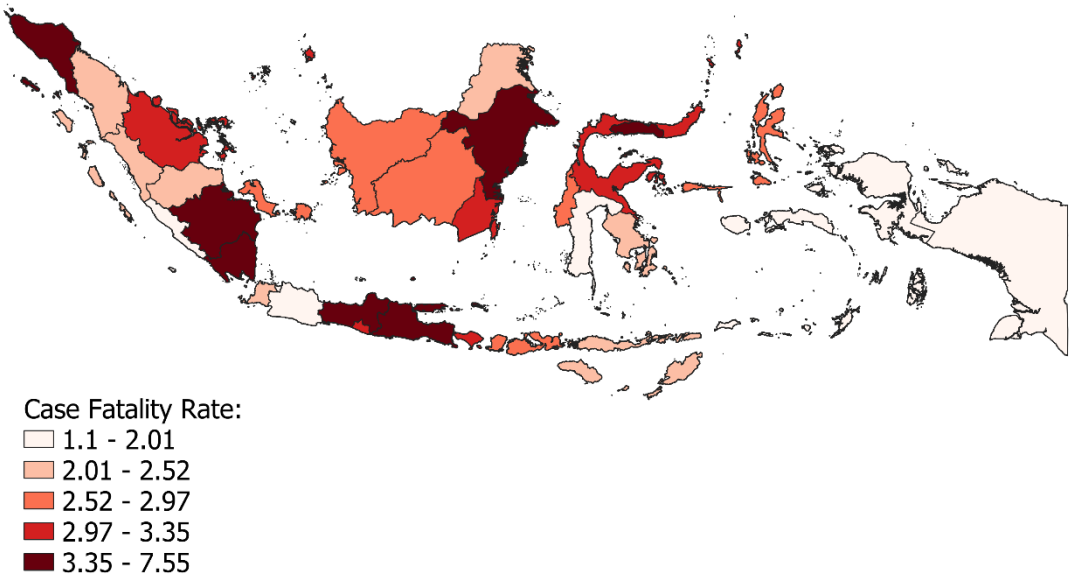

Figure 2 Map of the case fatality rate (CFR) in 34 provinces in Indonesia per September 5, 2021

Table 2 shows the Spearman correlation test result from sociodemographic factors, consisting of 14 independent variables, with 9 having a significant relationship. The result showed that population, density, the number of workers engaged in micro and small enterprises, and available rooms in classified hotels have a positive and significant impact on the pandemic (p<0.01). Meanwhile, the elderly in rural and urban areas have a positive and significant effect on the pandemic (p<0.05). Conversely, poverty in rural areas and population growth rates has a negative and significant effect on cases (p<0.05).

Table 2 Correlation coefficient between sociodemographic factors, environmental conditions, community mobility, health conditions, and health infrastructure determinants with COVID-19 cases and case fatality rate (CFR) in 34 provinces in Indonesia

Variable	Correlation Coefficient (ρ)			
	COVID-19 Cases		**Case Fatality Rate**	
Sociodemographic Factors	Coefficient	*p*-value	Coefficient	*p*-value
Gini ratio in rural areas	-0.1873	0.2889	0.0106	0.9524
Gini ratio in urban areas	0.1740	0.3249	0.2350	0.1810
Poverty in rural areas	-0.3612	0.0358*	-0.0354	0.8425
Poverty in urban areas	-0.0590	0.7404	0.1650	0.3511
Percentage of elderly in rural areas	0.3885	0.0232*	0.3981	0.0197*
Percentage of elderly in urban areas	0.3659	0.0333*	0.3279	0.0197*
Population	0.7800	0.0000**	0.1635	0.3555
Density	0.6186	0.0001**	0.1985	0.2604
Population growth rate	-0.3916	0.0220*	-0.2223	0.2064
Mean years of schooling	0.1086	0.5408	-0.1734	0.3266
Number of workers engaged in micro-enterprise	0.6889	0.0000**	0.3496	0.0427
Number of workers engaged in small-enterprise	0.7491	0.0000**	0.3635	0.0346
Percentage of urban slum households	-0.0530	0.7659	-0.3920	0.0219*
Available rooms in classified hotels	0.8646	0.0000**	0.1780	0.3138
Environmental Conditions				
Percentage of households to sanitation	0.3867	0.0239*	0.2222	0.2066
Percentage of households to drinking water	0.3192	0.0658	0.5552	0.1048
Community Mobility				
Retail and recreation	-0.4027	0.0001**	-0.0604	0.7345
Grocery and pharmacy	-0.6215	0.0001**	-0.2401	0.1714
Parks	-0.2090	0.2354	0.0641	0.7308
Transit stations	-0.4607	0.0061**	-0.0832	0.6399
Workplaces	-0.4220	0.0129*	0.0091	0.9592
Residential areas	0.7073	0.0000**	0.1798	0.3088
Health Conditions				
Complete basic immunization coverage	0.3436	0.0466*	0.3574	0.0380*
Percentage of smokers	-0.0235	0.8949	0.1812	0.3082
Prevalence of asthma	0.2385	0.1744	0.1625	0.3585
Prevalence of CHD	0.2356	0.1797	0.1731	0.3276

Variable	Correlation Coefficient (ρ)			
	COVID-19 Cases		Case Fatality Rate	
Prevalence of hypertension	0.3665	0.0330*	0.3570	0.0382*
Prevalence of stroke	0.5279	0.0013**	0.3094	0.0750
Prevalence of diabetes	0.5009	0.0026**	0.3062	0.0782
Prevalence of tuberculosis	-0.1624	0.3588	-0.3029	0.0816
Health Workers				
Number of general practitioners	0.8448	0.0000**	0.1835	0.2988
Number of specialists	0.8591	0.0000**	0.2222	0.2066
Number of nurses	0.7940	0.0000**	0.2416	0.1687
Health Infrastructure				
Ratio of PHC per district	0.5115	0.0020**	-0.1224	0.4903
PHC with complete health workers	0.4860	0.0036**	0.2835	0.1042
Number of COVID-19 referral hospitals	0.8554	0.0000**	0.2214	0.2084
Hospital bed ratio per 1000 population	0.0943	0.5958	0.0365	0.8378

*Note: **Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed)*

Environmental factors, such as improved sanitation by households, have a significant relationship with the spread of the pandemic (p<0.05). Community mobility recorded by Google Mobility Trends shows that retail and recreation, grocery and pharmacy, and transit stations have a negative and significant effect on the COVID-19 cases (p<0.01). Community mobility in the area workplaces has a negative and significant effect on the COVID-19 cases (p<0.05). Meanwhile, residential areas have a positive and significant impact on the COVID-19 cases (p<0.0.1).

Furthermore, health conditions in Indonesia, such as the prevalence of stroke and diabetes, trigger the spread of COVID-19 (p<0.01). In addition, the prevalence of hypertension and immunization have a positive correlation (p<0.05). The number of health workers and health facilities, such as general practitioners, specialists, nurses, the ratio of PHC per district, PHC plus, and COVID-19 referral hospitals, have a strong positive correlation with the number of COVID-19 cases (p<0.01). Figure 3 shows that out of the 37 independent variables, 25 were significant correlations, as depicted by the scatterplot.

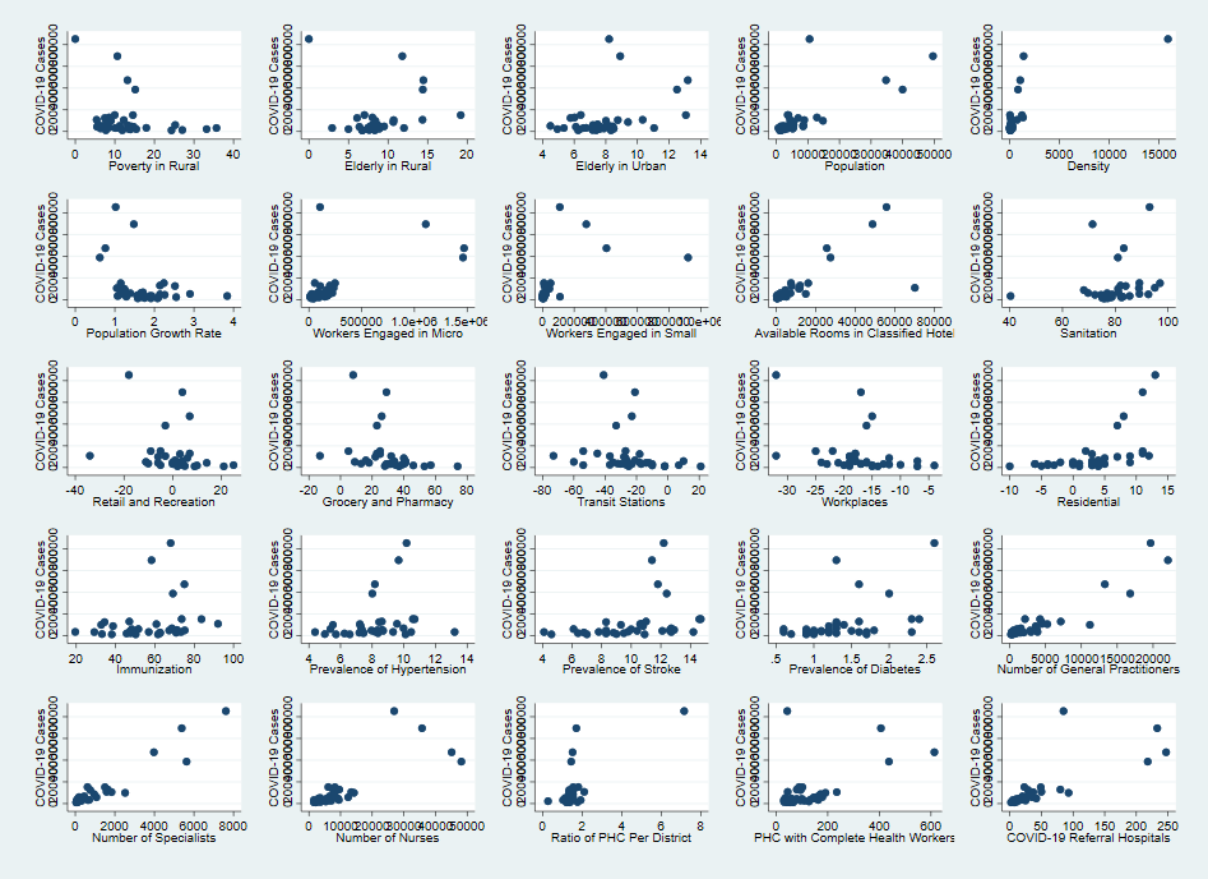

Figure 3 Scatterplot and Spearman correlation coefficient (ρ) of sociodemographic, environmental, community mobility, health conditions, health workers, and health infrastructure determinants with COVID-19 cases per September 5, 2021

In addition, of the 37 independent variables with CFR, only 5 have a negative and significant relationship (Figure 4). Sociodemographic factors, such as the percentage of the elderly in rural and urban areas, have a positive correlation with CFR (p<0.05), while for urban slum households, it is negative. Health conditions, such as immunization and prevalence of hypertension, have a positive and significant correlation with CFR (p<0.05).

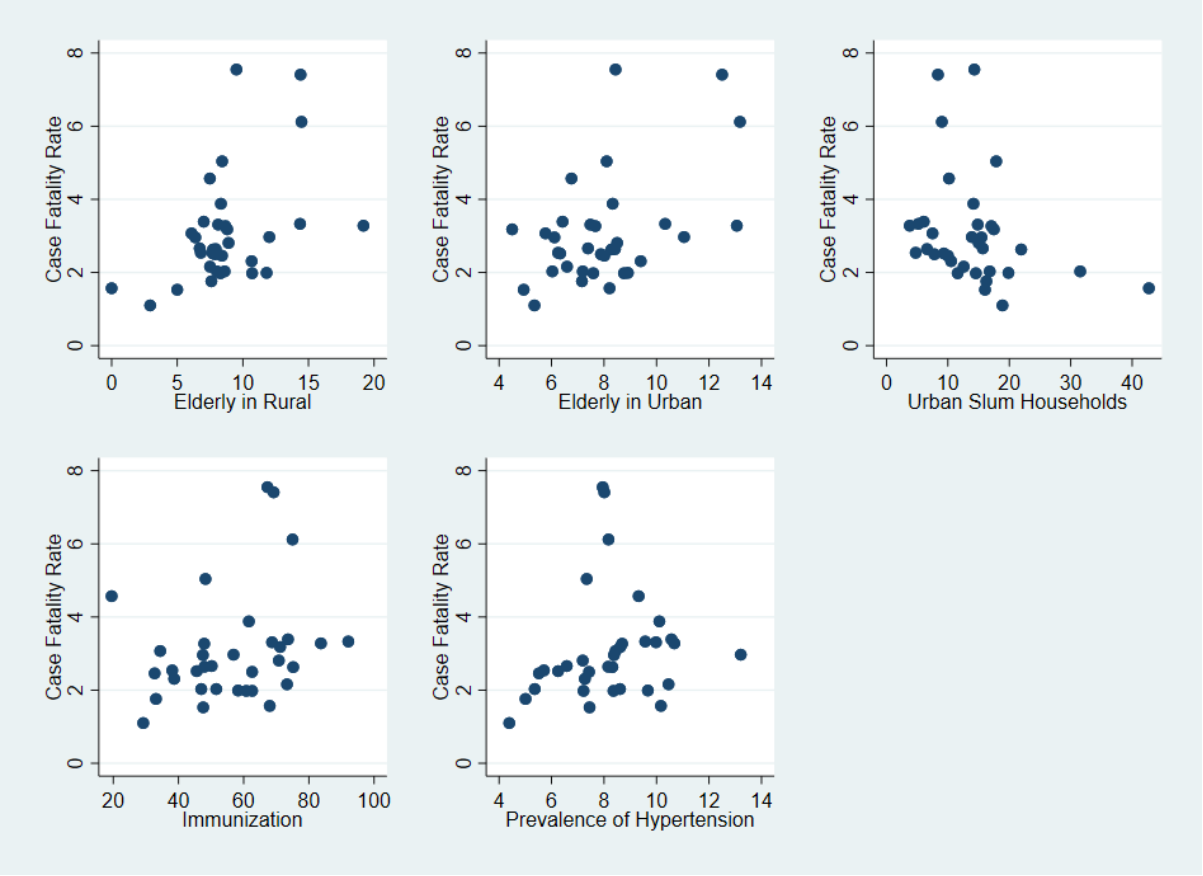

Figure 4 Scatterplot and Spearman correlation coefficient (ρ) of sociodemographic and health conditions with case fatality rate (CFR) per September 5, 2021

DISCUSSION

This study showed that sociodemographic factors, environmental conditions, community mobility, health conditions, health workers, and infrastructure were the determinants associated with the increase or decrease in the number of confirmed cases of COVID-19 and CFR. Furthermore, provinces with a high population and density have higher chances of spreading the virus through direct human contact. Presently, Jakarta has the highest number of positive cases due to its significant population rate[47]. In line with previously disclosed studies[48–51], the virus spreads more in areas with high density.

Everyone has the potential to be exposed to the pandemic, although certain age groups have a higher susceptibility to death[52]. For instance, the elderly in rural and urban areas stand an increased risk of exposure to the virus due to their weakened immune system and underlying chronic diseases[53,54]. Subsequently, the COVID-19 pandemic also has impacted several sectors, increasing the number of unemployed workers that engage in small and micro-enterprises, thereby increasing poverty and their inability to access health services[55].

The risk of transmitting the virus in hotels, especially from contaminated surfaces or objects and through physical contact, is high. At the end of March 2020, a laboratory study reported that the virus could survive on items made of plastic and stainless steel[56]. This study sparked headlines and numerous advice from experts on ways to decontaminate everything from doorknobs to groceries. The results confirmed the guidelines compiled by WHO in February 2020 that the COVID-19 virus spreads through contaminated surfaces, known as fomites[57].

It also confirms that available rooms in hotels can be a cluster for its spread.

Furthermore, those living in rural areas are vulnerable to the pandemic due to inadequate sanitation and unclean drinking water, poor ventilation, malnutrition in toddlers, and polluting fuels to cook their daily meals. The greater the population in a province, the higher their risk of being infected with the virus[58]. Access to improved sanitation is crucial for epidemic prevention[19,50,51]. According to the WHO/UNICEF, Indonesia has a population that still defecates openly, which pollutes the environment, thereby affecting public health[60].

This study was carried out using Google Mobility Trends data which monitors community movements such as retail and recreation places, grocery and pharmacy, parks, transit stations, workplaces, and residential areas on September 3, 2021. However, despite the decline in community mobility during the implementation of the PPKM Level 3 policy in the Java-Bali, the virus spread from family members or people living in the same house[61,62].

A study conducted by the Institute for Policy Development at the Universitas Gadjah Mada revealed that PPKM Darurat succeeded in increasing the activities carried out in East Java by 2.71%[63]. Meanwhile, activities in Central Java, West Java, and Banten were only increased by less than 1%. This means that with the PPKM Darurat, community activities in the workplace also appear to have decreased significantly. However, in the breakdown, it turns out that not all provinces experienced a decline, as was the case in Central Java, which increased by 0.57%.

The ineffectiveness of the PPKM Darurat does not come from a rule error, but rather from the lack of community compliance with the rules for implementing the health protocol[21,75,76]. Therefore, the continuous restriction of this policy tends to burden the finances of the public and business people[64]. Those who work in the informal sector need to continue operating their businesses to earn income to avoid losing their jobs. Workers with low levels of education have a higher risk of losing their jobs than those with higher education.

This study found that people with comorbidities such as hypertension, stroke, and diabetes are vulnerable to the virus. Patients suffering from comorbidities are prone to expose patients to other diseases and require more complex treatment[65,66]. Hypertension patients are more likely to contract the virus because it attacks people with weak immune systems and high blood pressure[67]. Furthermore, symptoms of COVID-19 and stroke can co-occur in patients, although this occurs in rare conditions due to the coagulation of blood vessels to the brain cells and tissue[68]. The population suffering from diabetes, especially those with high blood glucose levels, are also at risk of COVID-19 complications and death[69]. According to preliminary studies, people with diabetes have a higher risk of more severe symptoms and complications[70].

This study shows that hospitals, PHC, and health workers become clusters of transmission of the virus. The COVID-19 Response Acceleration Task Force on September 23 stated that the cluster of patients at the hospital was the highest in Jakarta, with 24,400 positive patients, which is about 63.46% of the total cases in the province[71]. Another study also revealed that there had been transmission by 14 health workers (HCWs) infected with the virus at the Wuhan Union Hospital, China[72]. Meanwhile, the elderly in rural and urban areas are reported to positively correlate with CFR because their low body immune system makes them more susceptible to various diseases. The pandemic has been shown to cause more

severe infections and death in the elderly than adults or children[73,74].

Complete basic immunization coverage, which is low, needs to be increased with public visits to health facilities[75]. According to the Ministry of Health and UNICEF data, more than 5,300 health facilities (84%) no longer conduct children's immunization services due to the pandemic[76]. This survey also indicates that complete basic immunization coverage in Indonesia in April 2020 decreased by 4.7% compared to April 2019. Meanwhile, Indonesia's national surveillance data have reported a mortality rate of 0.47% in children between 0 and 5 years due to the pandemic[77]. The latest national data for death owing to the virus is hypertension at 9.3%[77]. This high blood pressure disease can worsen the condition of people with COVID-19[78].

The correlation design in this study is limited to data valid only for specific populations, which do not describe or represent individuals. This study examines the independent and dependent variables, showing an overview of positive cases and CFR. Therefore, further studies are needed at the individual level, using cross-sectional case reports or cohort studies. Furthermore, independent variables such as income per capita, expenditure on health, food availability, poor nutritional status, distance from home to health facilities, social protection, and social isolation need to be added in subsequent studies.

CONCLUSION

This study found the correlation of several sociodemographic factors, environment, community mobility, and health indicators with COVID-19 cases and CFR. Provinces with a high population, high density, and high elderly in rural and urban areas were correlated with COVID-19 cases. Availability of hotel rooms, and employees working in the MSEs sector are also correlated with COVID-19 cases. Residents who have access to poor sanitation, a high percentage of smokers, visits to residential areas, and residents who have comorbidities such as hypertension, stroke, and diabetes were correlated to COVID-19 cases. In addition, health indicators such as general practitioners, specialists, nurses, the ratio of PHC per district, PHC plus, and COVID-19 referral hospitals were correlated with COVID-19 cases. Community mobility to areas such as retail and recreation, grocery and pharmacy, parks, transit stations, and workplaces negatively impacts COVID-19 cases. At the same time, the high CFR is influenced by the elderly population in rural and urban areas, low immunization, and hypertension. This correlation of sociodemographic factors, the environment, community mobility, and health indicators can help design measures to reduce the spread of COVID-19 cases and the high CFR in other countries that are still trying to end this pandemic.

RECOMMENDATIONS

The government needs to prevent the spread of COVID-19 in provinces with a high population and density, poor sanitation, low immunization, and high comorbidities by implementing policies and encouraging people to comply with health protocols. Furthermore, they need to continue preparing additional beds, tents, emergency buildings, and oxygen cylinders. They also recommended to use a multilevel referral system between health facilities based on patients' symptoms to minimize the accumulation of patients in health facilities. Limiting the inflow of people abroad, optimizing the Work from Home (WFH) policy, and community mobility outside the home, especially in Bali are also essential to be performed.

ACKNOWLEDGMENTS

The authors are grateful to the Ministry of Health, Central Bureau of Statistics, and COVID-19 Google Community Mobility Reports to provide the relevant data needed to conduct this study. The authors are also grateful to the editor and two anonymous reviewers for providing valuable feedback and inputs.

AUTHOR CONTRIBUTIONS

Omat Rachmat: conceptualization, formal analysis, writing–original draft, writing–review and editing, funding acquisition. **Sugeng Setyadi:** conceptualization, formal analysis, writing–original draft, writing–review and editing, funding acquisition. **Andi Kustanto:** conceptualization, formal analysis, data curation, writing–original draft, writing–review and editing.

CONFLICT OF INTEREST

The authors declared that no competing financial interests or personal relationships influenced this study.

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