Populasi

Sociodemographic and Health-related Determinants of COVID-19 Prevalence and Case Fatality Rate in Indonesia

Izza Suraya[1], Mochamad Iqbal Nurmansyah[2], Nia Musniati[1], Elia Nur Ayunin[1], Catur Rosidati[2], and Ibrahim Isa Koire[3]

[1]Faculty of Health Sciences, Universitas Muhammadiyah Prof. Dr. Hamka, Jakarta,
[2]Faculty of Health Sciences, Universitas Islam Negeri Syarif Hidayatullah, Jakarta,
[3]Institute of Science, Istanbul University, Turkey

Corresponding Author: Mochamad Iqbal Nurmansyah
(email: iqbalnurmansyah@uinjkt.ac.id)

Abstract

Indonesia is a country with the highest COVID-19 confirmed cases and mortality rate among southeast Asian countries. This study was conducted to identify the correlation between sociodemographic factors and the number of confirmed cases and mortality rates due to COVID-19 in Indonesia. This research is an ecological study where secondary data published by the Indonesian government was used. Spearman correlation were used in this study. This study showed that sociodemographic conditions in Indonesia varied greatly. Spearman correlation test results showed that a significant relationship (p-value < 0.05) between the number of COVID-19 confirmation cases with population density, population growth, decreased mobility outside the home, hypertension and diabetes prevalence, number of health workers (general practitioners, specialist doctors, and nurses) as well as the number of COVID-19 specialized hospitals. Significant correlations (p-value < 0.05) were also shown by the relationship between COVID-19 mortality rates and a dense population, a large decrease in mobility to the workplace, number of smokers, and number of health workers. Equitable development is expected to reduce sociodemographic and health disparities so that each region has good preparedness in dealing with outbreaks without the occurrence of areas that are more severely affected by outbreaks compared to other regions.

Keywords: Case Fatality Rate; COVID-19; Indonesia; sociodemographic

Introduction

In the middle of December 2020, with more than 600 thousand confirmed cases, Indonesia became the country with the most confirmed COVID-19 cases among Southeast Asian countries (Dezan Shira and Associates, 2020). In terms of policy intervention, the Indonesian government chose to implement partial lock down instead of total lockdown owing to the economic considerations (Pasley, 2020). It chose to implement large scale social restrictions (*Pembatasan Sosial Berskala Besar/PSBB*) that are not implemented in all regions of Indonesia, but merely on various regions with high cases of COVID-19. However, a study has shown that these interventions have

Izza Suraya, Mochamad Iqbal Nurmansyah, Nia Musniati, Elia Nur Ayunin,
Catur Rosidati, and Ibrahim Isa Koire

not been effective in reducing COVID-19 cases in several regions in Indonesia (Ariawan, 2020). The ineffectiveness of the interventions was indicated by the continued high mobility of the population in various regions in Indonesia (Ariawan, 2020). Indonesia's COVID-19 case mortality at the middle of December were at the highest death toll in the Southeast Asian region with a total of 19,248 fatalities, surpassing other ASEAN countries' COVID-19 deaths (Dezan Shira and Associates, 2020).

The high number of smokers and presence of underlying diseases are factors that contribute to the high number of COVID-19 deaths in Indonesia (Brake et al., 2020; WHO Indonesia, 2020). Based on the 2018 Indonesian Basic Health Survey, 63% Indonesian adult men were smoker (Health Research and Development Agency of the Republic of Indonesia, 2019). The report also stated that cardio vascular diseases and diabetes were among the highest disease burdens of the country Health Research and Development Agency of the Republic of Indonesia, 2019).

Regional disparities within its health system was allegedly responsible for the high number of COVID-19 cases (Wahyuni, 2020). Indonesia has the sixth worst wealth inequality in the world (Gibson, 2017). The growth of cities seems to occur more rapidly in Java and the western part of Indonesia compared to outside Java and other eastern Indonesian regions (Wilonoyudho et al., 2017). World Health Organization highlighted differences in health statuses and distribution of health resources across the sub-national regions of Indonesia (World Health Organization, 2017). In the context of numbers and distribution of doctors, DKI Jakarta province as the capital city has the highest number of doctors as well as the highest ratio of doctors to population (Mahendradhata et al., 2017). In contrast, West Sulawesi province which is located in the eastern part of Indonesia, has both the lowest absolute number of general practitioners' doctors (GPs) and the lowest doctors per 1000 population (Mahendradhata et al., 2017). The distribution of medical specialist was more concentrated in large provinces on the island of Java and Bali, while the three provinces with the lowest distribution of medical specialists were North Maluku, West Sulawesi, and East Nusa Tenggara (NTT) with 3.9, 3.5, 3.2 per 100.000 population respectively (Slamet, 2018). WHO stated that geographical inequality in health facility and personnel is high in Indonesia (World Health Organization, 2017). In addition, complete basic immunization coverage was low nationally, and demonstrated a large inequality, especially depending on sub-national region and economic status (World Health Organization, 2017). Under-five mortality rates in the eastern regions of Indonesia (West Sulawesi, Maluku, and West Nusa Tenggara) were more than four times higher than those in the western regions (Central Java and Yogyakarta) (Johar et al., 2018). Therefore, with lower levels of several health indicators, the eastern regions of Indonesia tend to be at a more disadvantage (World Health Organization, 2017).

In outbreaks of infectious diseases, hard social and economic conditions contribute to the unpreparedness of different groups of people to respond to these outbreaks (Bolin & Kurtz, 2018). Therefore, it may be worthwhile to address how health inequalities between sub-national regions in Indonesia affected and contributed in the COVID-19 cases and deaths. The study may help to understand the demographic impact on different patterns of case numbers and mortality between regions (Balbo et al., 2020). Thus, this study aimed at assessing correlation between sociodemographics and health related conditions with COVID-19 cases and deaths in Indonesia.

Method

This ecological study used secondary data from the Indonesian government's published report. The dependent variable in this study was the cumulative cases of COVID-19 and Case fatality rates for the 34 provinces that were reported by Indonesian Ministry of Health on 17 June 2020 (Ministry of Health of the Republic of Indonesia 2020). Independent variables were comprised of five big variables; sociodemographic conditions in each province, mobility of people, health-related condition, health workers distribution, and health facilities distribution. Demographic variables included population number, annual population growth rate, population density, percentage of older population, percentage of poor population, percentage of +15 years old cigarette smoker and percentage of village number in each province. Demographic variables data were obtained from the Central Bureau of Statistics Indonesia 2020 Report (BPS Statistics Indonesia, 2020). Mobility data was obtained from big data Google which showed the mobility across 34 provinces in Indonesia on 6 June 2020 (Google, 2020). The mobility included mobility of community to retail and recreation, grocery and pharmacy, parks, transit stations, workplaces and residential. The mobility data showed how visits and length of stay at different places changed compared to a baseline.

The third variable was health related conditions, which included percentage of children under five years old who received a complete basic immunization, the prevalence of asthma, coronary heart disease, hypertension, stroke and diabetes for all ages in each province as obtained from the Indonesian Basic Health Survey 2018 (Badan Penelitian dan Pengembangan Kesehatan,

2019). The variables related to distribution of health-care included; government primary health-care ratio per district in each province, percentage of government primary health-care with all the 5 types of health workers (pharmacist, public health worker, health environment worker, nutritionist and medical laboratory workers), number of COVID-19 special hospital and beds ratio per 1000 population in each province. We also identified health workers' conditions in each province by assessing the number of physicians, medical specialist and nurse who worked in COVID-19 special hospital in each province. The data related to health facility and health workers were obtained from the Indonesian Ministry of Health (Board of Development and Empowerment Human Resources of Health, 2020).

Descriptive statistics was employed to measure mean, variance, range, minimum and maximum variables for the independent variables. Bivariate analysis was performed with the Spearman correlation test to determine the relationship between independent variables and the dependent variable using statistical software.

Results

Univariate Analysis

On June 17, 2020, the average COVID-19 confirmed cases across Indonesia was 1,218.56 cases, with the smallest number of cases in Aceh Province (37 cases) and the largest (9,349 cases) in Jakarta Province. While the average death rate was 3.9% with the lowest Case Fatality Rate 0.0% and the largest 8.02%. The highest CFR was owned by North Sulawesi Province (Figure 1 and Figure 2).
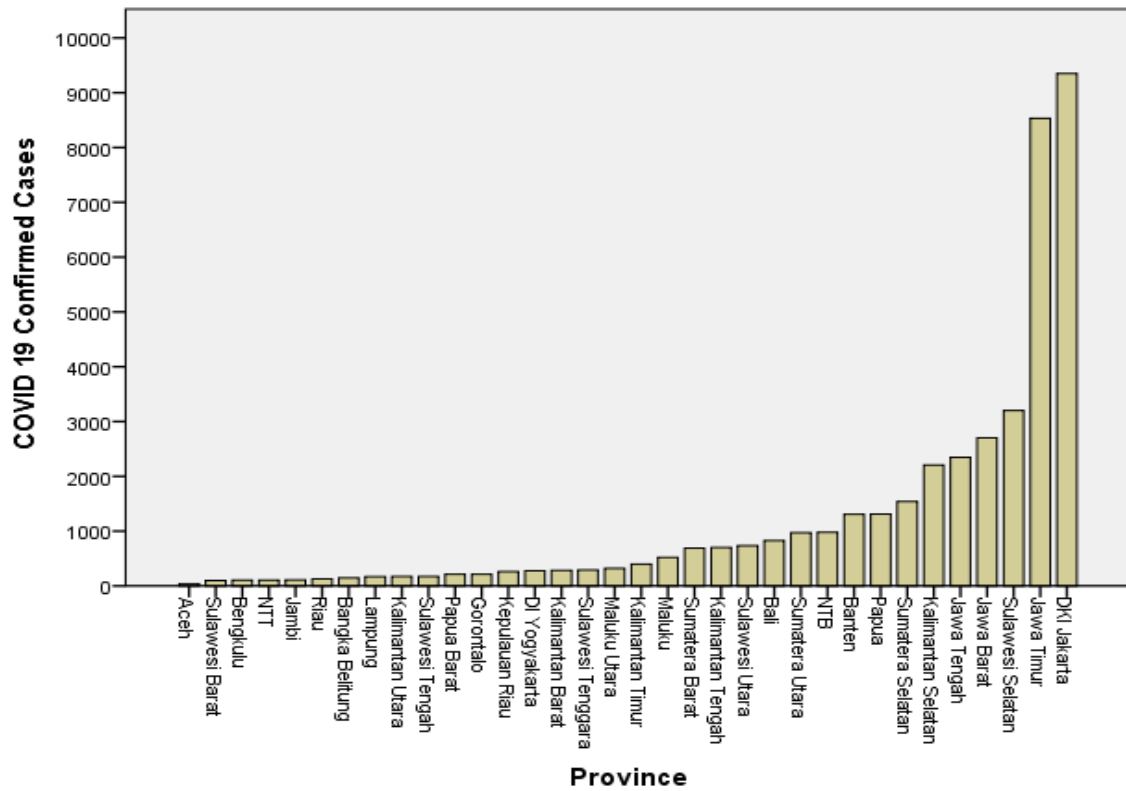
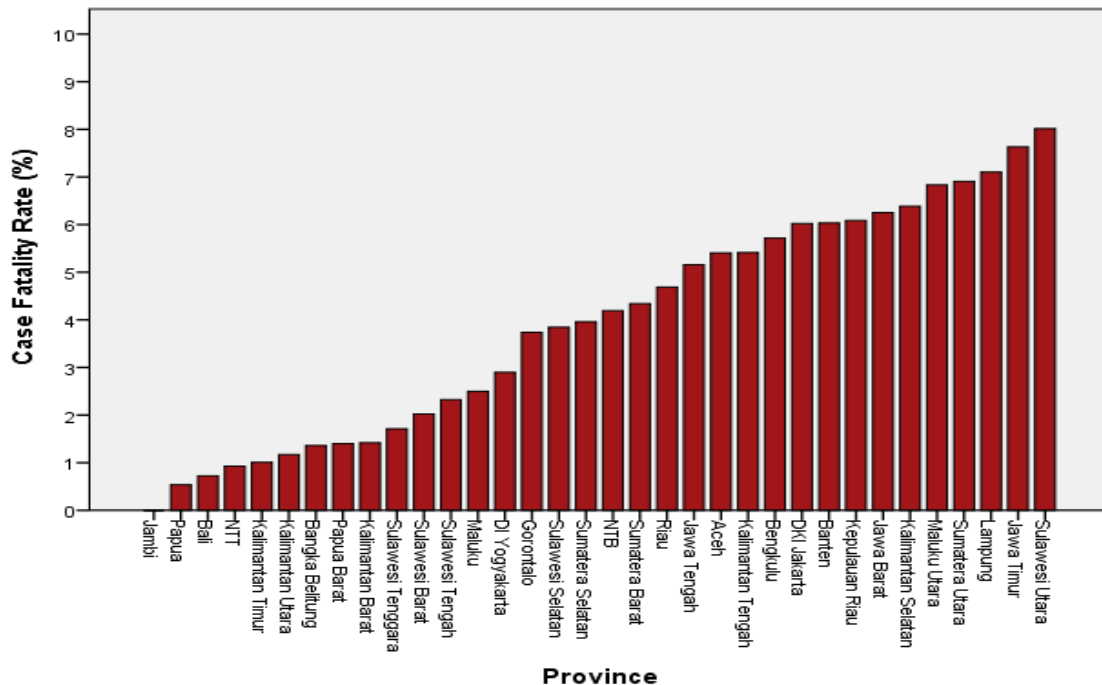**Figure 1.** COVID-19 Cases Number by Province in Indonesia (Per 17 June 2020)

Figure 2. COVID-19 Case Fatality Rate by Province in Indonesia (Per 17 June 2020)

Table 1 illustrates the imbalances in demographic conditions, mobility, health behavior, health workers, and health services in Indonesia. The distribution of population in Indonesia is uneven. This is indicated by the value of the variance of the population ($\sigma2 = 125,485,653.7$) which is far from the value of 0 and the average value. Population density in Indonesia also showed a high heterogeneity ($\sigma2 = 7,337,404.09$), with West Papua having a population density of 9 people/km^2 while Jakarta had 15,900 people/km^2. The percentage of poor people in each province also varied with a proportion of 3.42% to 26.55% ($\sigma2 = 30.47$). Likewise, the elderly proportion was indicated by $\sigma2 = 3.09$ and the number of villages was indicated by $\sigma2 = 281.65$.

Table 1. Mean and Disparity of Demographic Variables, Mobility, Health Related Conditions, Health Workers, and Health Services in Indonesia

	Mean	Variance	Range	Minimum	Maximum
Variables					
Sociodemographic conditions					
Population number	7,884.83	125,485,653.70	48,574.50	742.20	49,316.70
Annual population growth rate	1.72	0.42	3.22	0.62	3.84
Population density	742.03	7,337,404.09	15,891.00	9	15,900
Percentage of older population	5.12	3.09	7.90	1.90	9.80
Percentage of poor people	10.24	30.47	23.13	3.42	26.55
Percentage of rural area	85.51	281.65	100	0	100
People mobility					
Retail and recreation	-27.44	74,860	40	-48	-8
Grocery and pharmacy	-10.26	65,413	35	-32	3
Parks	-29.12	277,440	85	-90	-5
Transit stations	-51.71	87,971	44	-77	33
Workplaces	-12.65	56,720	39	-34	5
Residential	11.12	6,046	11	5	16
Health-related conditions					
Basic immunization coverage	47.13	114.01	44.61	20.18	64.79
Percentage of smoker	27.89	10.15	14.11	19.75	33.86
Percentage of asthma	2.49	0.59	3.50	1	4.50
Percentage of CHD	1.42	0.16	2.13	0.07	2.20
Percentage of hypertension	31.07	22.64	21.91	22.22	44.13
Percentage of stroke	10.08	7.34	10.60	4.10	14.70
Percentage of diabetes	1.39	0.25	2	0.60	2.60
Health workers distributions					
Physician number	362.62	159,917.09	1,642	14	1,656
Medical specialist number	335.56	196,310.86	1,655	22	1,677
Nurse number	4230.79	30,319,902.90	21,957	161	22,118
Health facilities distributions					
PHC ratio per district	1.54	1.11	6.57	0.73	7.30
PHC with complete health workers	45.12	295.28	79.32	12.87	92.19
Number of COVID-19 Hospital	22.21	575	104	1	105
Bed ratio per 1000 people	1.46	0.26	2.38	0.78	3.16

Based on the population mobility on June 6, 2020, there was a diversity of changes in population mobility. Having compared to mobility on the baseline (April 25, 2020), all provinces had decreased mobility to workplaces, wholesalers, recreation, parks, and transit stations. However, mobility to shopping, staples and medicines, stations and workplaces in several provinces experienced an increase compared to the baseline. The opposite condition occurred with the mobility towards residential areas, where all provinces experienced an increase in the movement towards housing on 6 June 2020 with a range of change from 6% to 16%.

Table 1 also showed variations in the proportion of behavior related to health problems in Indonesia. The table shows that basic immunization coverage in Indonesia was uneven ($\sigma2$ = 114, 01), with some areas showing basic immunization coverage of 20.18%, while other regions reached 64.79%. The percentage of smokers in each province was diverse, ranging from 19.75% - 33.86% ($\sigma2$ = 10.15). Heterogeneity was also seen in the prevalence of hypertension ($\sigma2$ = 22.64) and stroke ($\sigma2$ = 7.34), while a more homogeneous value was seen in the prevalence of asthma ($\sigma2$ = 0.59), CHD ($\sigma2$ = 0.16), and diabetes ($\sigma2$ = 0.25).

In addition, there was inequality in the distribution of health workers for handling COVID-19. With a variance value ($\sigma2$) of = 30,319,902.89, there was one province that only had 161 nurses working in specialized COVID-19 hospitals, while other provinces had 22,118 nurses. The gap in the number of general practitioners was also wide, amounting to 1,642 (with a value of $\sigma2$ = 159,917.09), while that of specialist doctors was 1,655 (with $\sigma2$ = 196,310.86). The existence of special health facilities for handling COVID-19 in each province also varied. Even though the ratio of beds to 1000 population was homogeneous, the number of specialized COVID-19 hospitals was very heterogeneous, with some provinces having only 1 hospital while other provinces had 105 hospitals ($\sigma2$ = 575. 26).

Bivariate Analysis

The results of the Spearman correlation between the independent variables and the COVID-19 confirmed cases are shown in Table 2. There are 14 out of 26 independent variables that showed a significant relationship. On the sociodemographic dimension, the provinces with high population density tended to have high COVID 19 confirmed cases (ρ = 0.717; *p*-value = 0.000) (Figure 3). The growth rate variable showed the opposite, with provinces that had low growth rates tending to have high confirmed cases (ρ = -0.467; *p*-value = 0.003). Provinces that had increased mobility towards residential areas on June 6, 2020 tended to have high confirmed cases (ρ = 0.701; *p*-value = 0.000) (Figure 4). However, provinces that had decreased mobility outside the home also tended to have high confirmed cases.
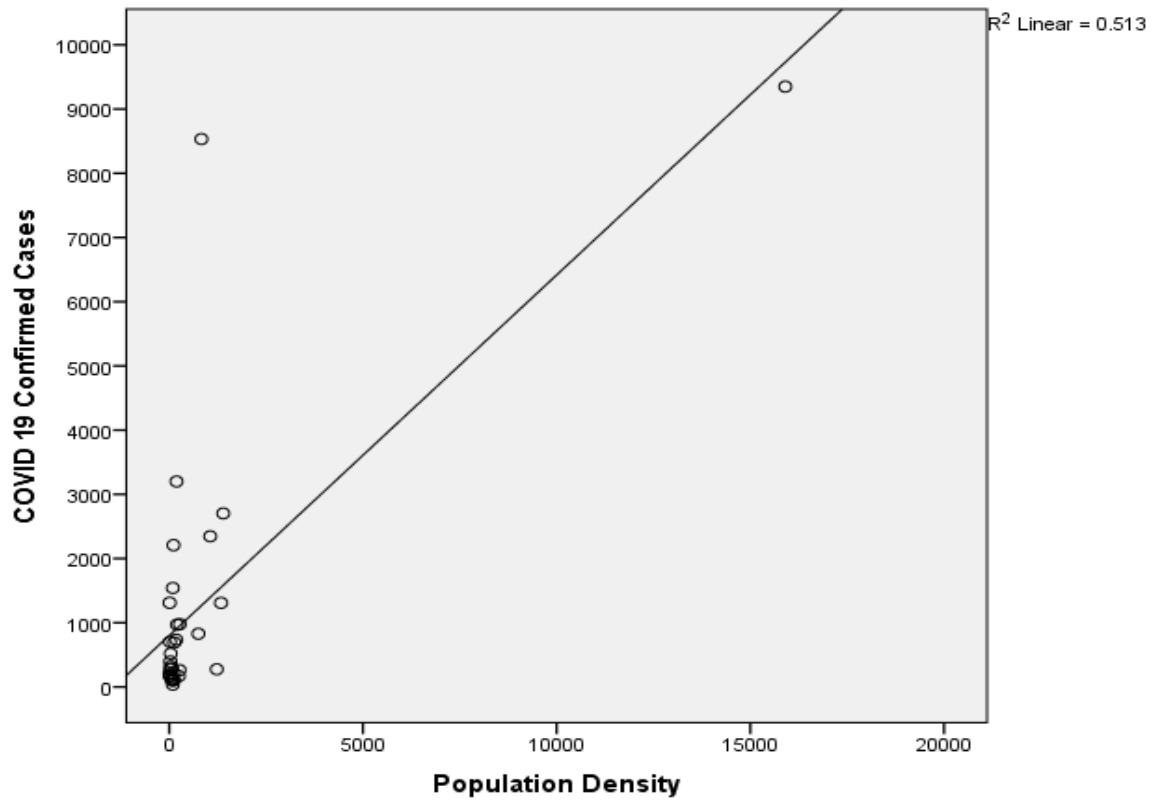
Figure 3. Scatter plot and Spearman correlation coefficient (r) of Population Density and COVID-19 Confirmed Cases
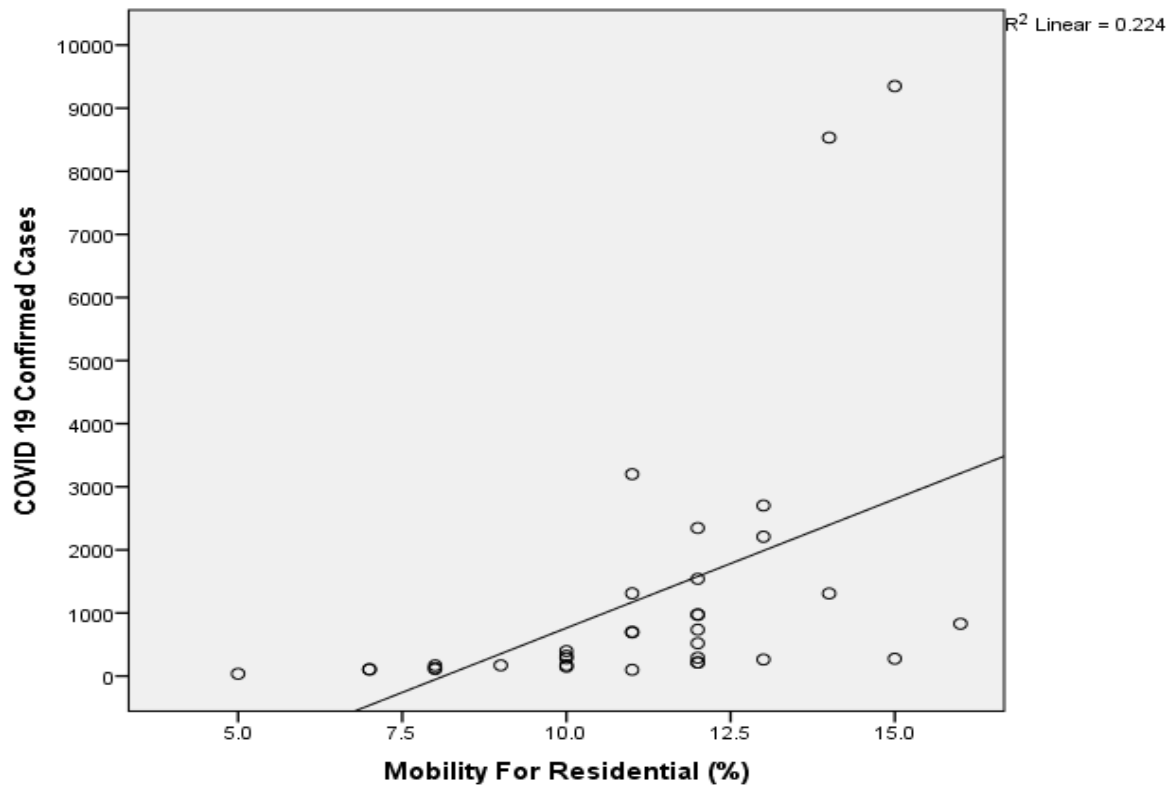

Figure 4. Scatter plot and Spearman correlation coefficient (r) of Mobility for Residential and COVID-19 Confirmed Cases

Izza Suraya, Mochamad Iqbal Nurmansyah, Nia Musniati, Elia Nur Ayunin,
Catur Rosidati, and Ibrahim Isa Koire

Table 2. Correlation between Demographic Variables, Mobility, Health-related Conditions, Health Workers, and Health Services with COVID Confirmed Case and Case Fatality Rate 19 in Indonesia

| Variables | Coeffition Corelation (ρ) | | | |
	Confirmed cases		CFR	
Sociodemographic conditions	Coeff.	pvalue	Coeff.	Pvalue
Population number	0.001	0.498	**0.447**	**0.004**
Annual population growth rate	**-0.467**	**0.003**	**-0.325**	**0.030**
Population density	**0.717**	**0.000**	**0.516**	**0.001**
Percentage of older population	0.292	0.050	0.105	0.280
Percentage of poor people	-0.209	0.117	-0.203	0.125
Percentage of rural area	0.091	0.307	0.051	0.388
People mobility				
Retail and recreation	**-0.486**	**0.002**	0.139	0.217
Grocery and pharmacy	**-0.344**	**0.023**	0.158	0.186
Parks	**-0.388**	**0.012**	-0.133	0.226
Transit stations	-0.254	0.073	0.274	0.059
Workplaces	**-0.520**	**0.001**	**-0.313**	**0.036**
Residential	**0.701**	**0.000**	0.271	0.060
Health-related conditions				
Basic immunization coverage	0.268	0.062	-0.069	0.350
Percentage of smoker	-0.201	0.127	**0.385**	**0.012**
Percentage of asthma	0.025	0.444	-0.160	0.183
Percentage of CHD	0.175	0.162	0.097	0.293
Percentage of hypertension	**0.340**	**0.025**	0.140	0.216
Percentage of stroke	0.267	0.063	0.257	0.071
Percentage of diabetes	**0.437**	**0.005**	0.200	0.129
Health workers distributions				
Physician number	**0.645**	**0.000**	0.251	0.076
Medical specialist number	**0.635**	**0.000**	**0.447**	**0.004**
Nurse number	**0.657**	**0.000**	**0.338**	**0.025**
Health facilities distributions				
PHC ratio per district	**0.691**	**0.000**	0.087	0.313
PHC with complete health workers	-0.219	0107	-0.131	0.231
Number of COVID-19 Hospital	**0.448**	**0.004**	0.183	0.150
Bed ratio per 1000 people	0.165	0.175	-0.008	0.483

The health conditions variable was noted, with provinces that had high prevalence of diabetes and high hypertension having high COVID-19 confirmed cases. In addition, the number of health workers such as doctors, specialists and nurses also showed a strong positive correlation with COVID-19 case number (with $\rho > 0.6$). This meant that provinces that had many health workers tended to detect more confirmed cases. In addition, provinces with high ratio of government primary healthcare in sub-districts had high confirmed cases ($\rho = 0.691$; p-value = 0.000). This was also observed with the number of COVID-19 specialized hospitals ($\rho = 0.448$; p value = 0.004).

Table 2 also shows the relationship between the independent variables with COVID-19 fatality rate. There was 7 out of 26 variables showing a significant correlation.

Sociodemographic variables showed provinces with large numbers and population density to have high mortality rates, while the growth rate variable had a negative correlation with CFR COVID 19 ($\rho = -0.325$; p-value = 0.03). Provinces that had low mobility to workplaces compared to baseline data have high COVID-19 mortality rates ($\rho = -0.335$; p-value = 0.036).

Based on health-related variables, the proportion of smokers in a province had positive correlation with mortality due to COVID-19 ($\rho = 0.385$; p-value = 0.012) (Figure 5). In addition, the number of specialized doctors and nurses in a province also influenced the death rate due to COVID-19 ($\rho = 0.447$; p-value = 0.004 & $\rho = 0.338$; p-value = 0.025) (Table 2).
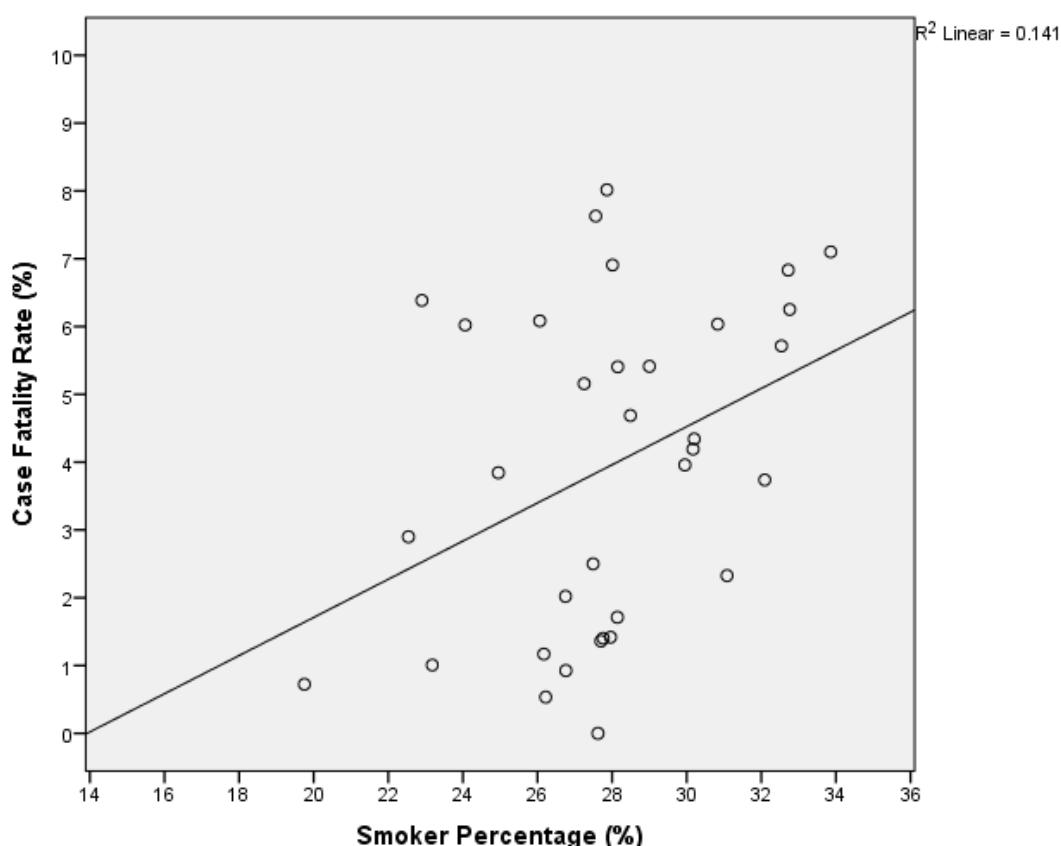

Figure 5. Scatter plot and Spearman correlation coefficient (r) of Smoker Prevalence and COVID-19 Case Fatality Rate

Discussion

This study found a correlation between several sociodemographic and health-related factors with the increasing number of COVID-19 cases in Indonesia. It found out that provinces with high population density tended to have high COVID 19 confirmation cases. A different study showed that high population densities play a role in accelerating the spread of COVID-19 (Rocklöv & Sjödin, 2020), while another study found population density to have a role in the increase of number, proportion and distribution of infectious diseases (Tarwater & Martin, 2001). People who live in high-density areas may find it more difficult to practice physical distancing which is one of prevention measures in COVID-19 fight (Center for Diseases Control and Prevention, 2020).

Jakarta, which has the highest COVID-19 cases, has a population density that is much higher than the population density of Indonesia; with the population density of Jakarta reaching 16,704 inhabitants km² while Indonesia's population density is 141 inhabitants/km² (Akbar, 2020). Related to density, one of the conditions that can be a cluster of transmission of COVID-19 in Indonesia are the traditional markets (Girsang et al., 2020). In addition to the increased population density in traditional markets, where it is difficult to maintain physical distance, lack of community compliance in implementing COVID-19 prevention protocols such as regular hand washing and wearing masks, increases the likelihood of traditional markets to act as clusters of COVID-19 transmission.

The percentage of older population had no significant correlation with the increase in COVID-19 cases; since COVID-19 cases in Indonesia were dominated by the productive age (31-45 years) (Hidayati, 2020). However, due to the changes in the physiological functions of the respiratory system and decreased immunity made older people with COVID-19 had worse clinical manifestations, greater severity and longer disease courses (Liu et al., 2020).

Due to the government's policy of implementation of large-scale social restrictions, it has had an impact on reducing the mobility of the population to various places such as workplaces, recreation, grocery, and transit stations. The increase in mobility in the residential areas had a significant effect on the increase in COVID-19 cases, as observed in a previous study that showed that the family was among the COVID-19 transmission routes (Xiong et al., 2020). However, we assumed that although there has been a decline in mobility compared to the baseline mobility, population mobility to various places (such as workplaces and other places) is still quite high. A study performed in Jakarta, Indonesia showed that movement of

people from Jakarta-Bekasi (West Java) and Jakarta-Banten during the implementation of large-scale social restriction policy had not changed much compared to the period before the policy was enacted (Suryahudaya, 2020). Jakarta being the centre of Indonesia's economy, attracts people's mobility from the neighboring provinces towards it for work or school. A report from the Statistics Indonesian showed that 29.3 million people in Jakarta, Bogor, Depok, Tangerang, Bekasi (these 4 cities are cities that border directly with Jakarta) were commuters, with south Jakarta being the biggest commuter destination (Subdirektorat Statistik Mobilitas Penduduk dan Tenaga Kerja, 2019).

A report from the Department of Transportation in the Jakarta Province also showed that the number of vehicles entering Jakarta from West Java and Banten during the second period of the large-scale social restriction was still high (Rahmawati, 2020). Despite the implementation of a large-scale social restriction policy, community compliance with these regulations in the policy was inadequate. This is indicated by the fact that there were many people leaving their houses without wearing masks, with non-essential workplaces still operating. In Jakarta, the government found from 1 to 14 September 2020, there were more than 6000 violation of the large-scale social restrictions (Saidah, 2020). For information, during the large-scale social restriction, schools and workplaces (exempting central government offices, businesses and transportation companies that serve public essential needs) were closed, religious activities that involve mass gatherings, modes of transportation, activities in public places or facilities were limited and everyone who goes out of the house was required to use a mask. A previous study showed that timely implementation with high compliance from the community could be a factor in the successful implementation of non-pharmaceutical interventions (Fong et al., 2020). Therefore, the ineffectiveness of

the PSBB in reducing COVID-19 cases was not derived from misconceptions and rules issued, but rather to the lack of community compliance with regulations such as wearing masks and maintaining physical distance. The underlying conditions to describe the people's lack of implementation of the PSBB protocol were complicated. Restrictive social and business processes carried short and possibly medium-term financial burdens (Anderson et al., 2020). The people, particularly those working in the informal sector should continue to work or open their business to get income. A previous study showed some of the reasons why people did not practice the social distance, including work requirements for non-essential industries, engagement in social, physical or routine activities and the belief that social distancing was not needed if other preventive measures had been performed (Moore et al., 2020).

This study found that a proportion of smokers in a province had a positive correlation with mortality due to COVID-19, whereas a previous study showed that smokers were 1.4 times more likely (95% CI: 0.98–2.00) to have severe conditions and approximately 2.4 times more likely to be admitted to an ICU, needed mechanical ventilation or died compared to non-smokers (RR=2.4, 95% CI: 1.43–4.04) (Vardavas & Nikitara, 2020). As showed in this study, the proportion of +15 age years old who smoked cigarette in each province was quite diverse in the range of 19.75% - 33.86%since not all provinces had a smoke free area policy, since the 2018 data from Ministry of Home Affairs of the Republic of Indonesia showed that 22 out of 34 Provinces had local regulations about free area smoke policy (Nainggolan, 2018). Although the central government has already issued smoke free policy since 2009, due to a decentralized system in the Indonesian government, the realization of these regulations at the city level requires passage of laws by local governments.

Later, Provinces that had high prevalence of diabetes and hypertension tended to have high COVID-19 confirmed cases. A study that examined around 5,000 COVID-19 patients in New York City and the nearby areas showed that high blood pressure, obesity and diabetes were the most common commonalities (Richardson et al., 2020). Based on the Indonesian Basic Health Survey, prevalence of diabetes and hypertension increased in 2018 compared to 2013 (Badan Penelitian dan Pengembangan Kesehatan, 2019). The number of health workers such as doctors, specialists, and nurses in one province also showed a strong positive correlation with COVID-19 case number. This could mean that provinces with many health workers tended to detect more confirmed cases. Data showed that Indonesia had only conducted SARS-CoV-2 tests on 25 people per one million people; the lowest compared to other Asian countries (Katadata.co.id, 2020). Besides the lack of health infrastructure, the existence of negative stigma towards people infected with COVID-19 discourages them, since they get afraid to be shunned or treated badly could avoid testing or treatment.

The results of this study suggested that government should put in heavy efforts on policies related to population development; like developing regional growth centers especially in eastern Indonesia and outside Java, so that population growth in each subnational region in Indonesia can be distributed evenly. This in turn will have an impact on the distribution of population density. During pandemic, the government needed to take various efforts to increase community compliance in implementing large-scale social restrictions to reduce community mobility and thereby encouraging communities to be more compliant in implementing preventive behavior, which in turn could reduce the number of COVID-19 cases. In addition, there is need to involve various community groups to carry out

different initiatives to increase community compliance in implementing COVID-19 prevention protocols at individual, family, and community levels.

This study used aggregate data so that it does not describe correlations at the individual level. However, this study could be a baseline for further research about a similar topic. The people mobility data was taken from a single date and not the average mobility that occurred during a pandemic. However, this study assumes that the mobility of people at that date had reflected the daily mobility during the pandemic.

Conclusion

Demographic conditions, people mobility, health-related states, number of health workers number, and number of health services in a province had a role in the number of confirmed cases and mortality due to COVID-19. The number of COVID-19 confirmed cases occurred more in provinces with dense population, small population growth rates, high residential mobility, high prevalence of hypertension and diabetes, as well as high number of health workers and hospitals. Whereas the magnitude of the COVID-19 mortality rate in a province correlated with a dense population, number of smokers, and number of health workers. This study suggested that COVID-19 preventive measures can be further intensified, particularly in areas with high population density, population growth, mobility, and high rates of hypertension and diabetes. In addition, the equal distribution of health personnel and services needs to be improved so that the effort of testing, tracing, and treatment of COVID-19 could be equitably carried out in all areas of Indonesia.

References

Akbar, A. 2020. *Berapa Kepadatan Penduduk DKI Jakarta saat ini?* Unit Pengelola Statistik Dinas Komunikasi, Informatika Dan Statistik. http://statistik.jakarta.go.id/berapa-kepadatan-penduduk-dki-jakarta-saat-ini/.

Anderson, R. M., Heesterbeek, H., Klinkenberg, D., & Hollingsworth, T. D. 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic? *The Lancet*, *395*(10228), 931–934. https://doi.org/10.1016/S0140-6736(20)30567-5.

Ariawan, I. 2020. *Pelaksanaan PSBB dan Dampaknya Terhadap Pandemi COVID-19 di Indonesia*.

Badan Penelitian dan Pengembangan Kesehatan. 2019. *Laporan Nasional Riskesdas 2018*. Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan.

Balbo, N., Kashnitsky, I., Melegaro, A., Mesle, F., Mills, M. C., Valk, H. de, & Vilhenna, D. V. de. 2020. *Demography and the Coronavirus Pandemic* (No. 25; May 2020).

Board of Development and Empowerment Human Resources of Health. 2020. *Tenaga Kesehatan dan COVID-19 di Indonesia*. http://bppsdmk.kemkes.go.id/web/.

Bolin, B., & Kurtz, L. C. 2018. Race, Class, Ethnicity, and Disaster Vulnerability. In H. Rodríguez, W. Donner, & J. E. Trainor (Eds.), *Handbooks of Sociology and Social Research* (Handbook o, pp. 181–203). Springer. https://doi.org/10.1007/978-3-319-63254-4_10.

BPS Statistics Indonesia. 2020. *Statistical Yearboook of Indonesia 2020*. BPS-Statistics Indonesia.

Brake, S. J., Barnsley, K., Lu, W., McAlinden, K. D., Eapen, M. S., & Sohal, S. S. 2020. Smoking Upregulates Angiotensin-Converting Enzyme-2 Receptor: A

Potential Adhesion Site for Novel Coronavirus SARS-CoV-2 (Covid-19). *Journal of Clinical Medicine, 9*(3), 841. https://doi.org/10.3390/jcm9030841.

Center for Diseases Control and Prevention. 2020. *COVID-19 in Racial and Ethnic Minority Groups*. Center for Diseases Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/racial-ethnic-minorities.html.

Dezan Shira and Associates. 2020. *The Coronavirus in Asia and ASEAN – Live Updates by Country*. ASEAN Briefing. https://www.aseanbriefing.com/news/coronavirus-asia-asean-live-updates-by-country/.

Fong, M. W., Gao, H., Wong, J. Y., Xiao, J., Shiu, E. Y. C., Ryu, S., & Cowling, B. J. 2020. Nonpharmaceutical Measures for Pandemic Influenza in Nonhealthcare Settings-Social Distancing Measures. *Emerging Infectious Diseases, 26*(5). https://doi.org/10.3201/eid2605.190995.

Gibson, L. 2017. *Towards a more equal Indonesia*. Oxfam GB.

Girsang, V. I., Harianja, E. S., & Purba, I. E. 2020. Pencegahan Covid-19 Pada Pedagang Pasar Karya Wisata Kelurahan Gedung Johor. *Jurnal Abdimas Mutiara, 1*(2), 76–85.

Google. 2020. *COVID-19 Community Mobility Report*. www.google.com/covid19/mobility/.

Hidayati, D. 2020. Profil Penduduk Terkonfirmasi Positif Covid-19 dan Meninggal: Kasus Indonesia dan DKI Jakarta. *Jurnal Kependudukan Indonesia2, Special Issues*, 93–100.

Johar, M., Soewondo, P., Pujisubekti, R., Satrio, H. K., & Adji, A. 2018. Inequality in access to health care, health insurance and the role of supply factors. *Social Science and Medicine, 213*(September 2018), 134–145. https://doi.org/10.1016/j.socscimed.2018.07.044.

Katadata.co.id. 2020. *Rasio Tes Covid-19 Indonesia Baru 25 Orang per Satu Juta Penduduk*. Databoks.Katadata.Co.Id. https://databoks.katadata.co.id/datapublish/2020/04/02/rasio-tes-covid-19-indonesia-baru-25-orang-per-satu-juta-penduduk.

Kementerian Kesehatan. 2020. *Situasi Terkini Perkembangan Novel Coronavirus (COVID-19)*. https://covid19.kemkes.go.id/situasi-infeksi-emerging/info-corona-virus/situasi-terkini-perkembangan-coronavirus-disease-covid-19-17-juni-2020/#.XvBzx-e-nIV.

Liu, Y., Mao, B., Liang, S., Yang, J. W., Lu, H. W., Chai, Y. H., Wang, L., Zhang, L., Li, Q. H., Zhao, L., He, Y., Gu, X. L., Ji, X. Bin, Li, L., Jie, Z. J., Li, Q., Li, X. Y., Lu, H. Z., Zhang, W. H., … Xu, J. F. 2020. Association between age and clinical characteristics and outcomes of COVID-19. *The European Respiratory Journal, 55*(5), 2001112. https://doi.org/10.1183/13993003.01112-2020.

Mahendradhata, Y., Trisnantoro, L., Listyadewi, S., Soewondo, P., Marthias, T., Harimurti, P., & Prawira, J. 2017. *The Republic of Indonesia Health System Review* (K. Hort & W. Patcharanarumol (eds.); Vol. 7, Issue 1). World Health Organization Regional Office for South-East Asia.

Moore, R. C., Lee, A., Hancock, J. T., Halley, M., & Linos, E. 2020. Experience with Social Distancing Early in the COVID-19 Pandemic in the United States: Implications for Public Health Messaging. *MedRxiv, 04.08.2005*. https://doi.org/10.1101/2020.04.08.20057067.

Nainggolan, A. T. 2018. *Perda Kawasan Tanpa Rokok Catatan Singkat tentang Surat Dirjen Bangda Kemendagri Pemda Penerapan Regulasi KTR di Daerah*. Fakta. http://www.fakta.or.id/no-reg-rilis-103rlsxii2018-perda-kawasan-tanpa-rokok-catatan-singkat-tentang-surat-dirjen-bangda-kemendagri-pemda-penerapan-regulasi-ktr-di-daerah/.

Pasley, J. 2020. *Here's how Indonesia — where "ghosts" representing trapped*

souls are scaring people into maintaining lockdown — went from no cases in early March to having the second highest death rate in Asia. https://www.insider.com/photo-indonesia-no-cases-to-second-most-deaths-in-asia-2020-4#on-march-14-the-president-admitted-the-government-had-been-holding-back-information-about-the-coronavirus-because-he-said-we-did-not-want-to-stir-panic-11.

Rahmawati, F. 2020. *PSBB, Kendaraan Masuk Jakarta Masih Tinggi*. Ayojakarta. Com. https://www.ayojakarta.com/read/2020/05/05/17005/psbb-kendaraan-masuk-jakarta-masih-tinggi%0A.

Richardson, S., Hirsch, J. S., Narasimhan, M., Crawford, J. M., McGinn, T., Davidson, K. W., Barnaby, D. P., Becker, L. B., Chelico, J. D., Cohen, S. L., Cookingham, J., Coppa, K., Diefenbach, M. A., Dominello, A. J., Duer-Hefele, J., Falzon, L., Gitlin, J., Hajizadeh, N., Harvin, T. G., … Zanos, T. P. 2020. Presenting Characteristics, Comorbidities, and Outcomes among 5700 Patients Hospitalized with COVID-19 in the New York City Area. *JAMA - Journal of the American Medical Association*, *323*(20), 2052–2059. https://doi.org/10.1001/jama.2020.6775.

Rocklöv, J., & Sjödin, H. 2020. High population densities catalyse the spread of COVID-19. *Journal of Travel Medicine*, *27*(3). https://doi.org/10.1093/jtm/taaa038.

Saidah, D. 2020. Analisis Pelaksanaan Kebijakan Penangan Wabah Covid 19 di DKI Jakarta. *Jurnal Ilmiah Administrasi Pemerintahan Daerah*, *12*(2), 20–30.

Slamet, S. 2018. *Kebijakan Kementerian Kesehatan dalam Pengaturan Dokter dan Dokter Gigi di Era Global*.

Subdirektorat Statistik Mobilitas Penduduk dan Tenaga Kerja. (2019). *Statistik Komuter Jabodetabek: Hasil Survei Komuter Jabodetabek*. Badan Pusat Statistik.

Suryahudaya, E. G. 2020. *Mobilitas, Migrasi dan Kebijakan PSBB COVID-19 : Gambaran Terkini Dari Data Facebook Disease Prevention Map* (Issue April). https://csis.or.id/publications/mobilitas-migrasi-dan-kebijakan-psbb-covid-19-gambaran-terkini-dari-data-facebook-disease-prevention-map.

Tarwater, P. M., & Martin, C. F. 2001. Effects of population density on the spread of disease. *Complexity*, *6*(6). https://doi.org/10.1002/cplx.10003.

Vardavas, C. I., & Nikitara, K. 2020. COVID-19 and smoking: A systematic review of the evidence. *Tobacco Induced Diseases*, *18*(20). https://doi.org/10.18332/tid/119324.

Wahyuni, N. C. 2020. *Indonesia Currently Has Highest Covid-19 Mortality Rate in Asia*. Jakarta Globe. https://jakartaglobe.id/news/indonesia-currently-has-highest-covid19-mortality-rate-in-asia.

WHO Indonesia. 2020. *Media Statement: Knowing the risks for COVID-19*. WHO Indonesia. https://www.who.int/indonesia/news/detail/08-03-2020-knowing-the-risk-for-covid-19.

Wilonoyudho, S., Rijanta, R., Keban, Y. T., & Setiawan, B. 2017. Urbanization and regional imbalances in Indonesia. *Indonesian Journal of Geography*, *49*(2), 125–132. https://doi.org/10.22146/ijg.13039.

World Health Organization. 2017. *State of health inequality: Indonesia*. World Health Organization.

Xiong, Y., Song, S., Ye, G., & Wang, X. 2020. Family cluster of three recovered cases of pneumonia due to severe acute respiratory syndrome coronavirus 2 infection. *BMJ Case Reports*, *13*(5). https://doi.org/10.1136/bcr-2020-235302.