

Apakah Penerapan Kebijakan Mempengaruhi Penularan dan Kematian akibat COVID-19? Pembelajaran dari Kabupaten Nganjuk

Does the Implementation of Regulation Affect COVID-19 Transmissibility and Mortality? Lessons Learned from Nganjuk Regency

Danik Iga Prasiska¹✉, Sangchul Yoon²

¹ Health Promotion Section, Public Health Department of Nganjuk District Health Office, Dr Soetomo Street No 77 Nganjuk, 64411, Indonesia

² Graduate School of Public Health, Yonsei University, 50-1 Yonsei-ro, Seodaemun-gu, Seoul 03722, Korea

Corresponding directed to e-mail: digaprasiska@gmail.com

ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) as a global pandemic is ineluctable, transmission that originated from a foreign country became the local transmission in Indonesia. As several regional authorities implemented a large-scale social restriction policy to reduce the transmission of COVID-19, the Nganjuk Regency government chose to implement a different strategy with the implementation of Regent Regulation number 28 of 2020 about novel practice in the COVID-19 pandemic situation. **Objective:** This study aimed to analyze the impact of the implementation of the regulation on COVID-19 transmissibility and mortality at the Nganjuk Regency. **Methods:** Data were collected from the daily confirmed cases and death of COVID-19 made accessible for the public by the Nganjuk Regency Task Force for COVID-19 and Nganjuk Regency Health Office starting from March 30th to September 20th. Interrupted time series analysis was performed to estimate the impact of the implementation of regent regulation on COVID-19 transmission and mortality parameters. **Result:** The trend of new confirmed cases and deaths of COVID-19 in the Nganjuk Regency continued to fluctuate before and even after the implementation of regent regulation. It was found that there were reductions in case of fatality rates by -0.002 ± 0.003 (p 0.002) on CFR and -0.008 ± 0.008 (p 0.007) on eCFR after the regent regulation was implemented but there was no significant reduction on COVID-19 transmissibility parameter. **Conclusion:** Implementation of regent regulation in Nganjuk Regency significantly affected the reduction of case fatality rate but failed to slow down the COVID-19 transmissibility. Intensive community engagement to comply with the health preventive measures should be considered as an effective preventive strategy to reduce the transmission of COVID-19.

Keywords: coronavirus, impact, mortality, regulation, transmission

ABSTRAK

Latar Belakang: Coronavirus disease 2019 (COVID-19) sebagai pandemi global tidak dapat dihindari, penularan yang berasal dari luar negeri menjadi penularan lokal di Indonesia. Seiring beberapa pemerintah daerah menerapkan kebijakan pembatasan sosial berskala besar untuk menekan penularan COVID-19, Pemerintah Kabupaten Nganjuk memilih menerapkan strategi berbeda dengan pemberlakuan Peraturan Bupati nomor 28 Tahun 2020 tentang pedoman persiapan tatanan kebiasaan baru pada kondisi pandemi corona virus disease 2019 (COVID-19). **Tujuan:** Penelitian ini bertujuan menganalisis dampak penerapan peraturan tersebut terhadap penularan dan kematian akibat COVID-19 di Kabupaten Nganjuk. **Metode:** Data dikumpulkan dari kasus harian terkonfirmasi dan kasus kematian akibat COVID-19 yang dapat diakses publik oleh Gugus Tugas Percepatan Penanganan Covid-19 Kabupaten Nganjuk dan Dinas Kesehatan Kabupaten Nganjuk mulai tanggal 30 Maret hingga 20 September. Analisis dilakukan dengan interrupted time series untuk memperkirakan dampak pemberlakuan peraturan bupati terhadap parameter penularan dan kematian akibat COVID-19. **Hasil:** Tren kasus baru terkonfirmasi dan kasus

kematian akibat COVID-19 di Kabupaten Nganjuk terus mengalami fluktuasi sebelum dan bahkan setelah pemberlakuan peraturan bupati. Ditemukan penurunan tingkat kasus kasus kematian sebesar $-0,002 \pm 0,003$ (p 0,002) pada CFR dan $-0,008 \pm 0,008$ (p 0,007) pada eCFR setelah peraturan bupati diterapkan, tetapi tidak ada penurunan signifikan pada parameter penularan COVID-19. **Kesimpulan:** Implementasi peraturan bupati di Kabupaten Nganjuk berpengaruh signifikan terhadap penurunan angka kematian namun tidak dapat mengurangi angka penularan COVID-19. Keterlibatan masyarakat secara intensif untuk mematuhi langkah-langkah pencegahan kesehatan harus dipertimbangkan sebagai strategi pencegahan yang efektif untuk mengurangi penularan COVID-19.

Kata Kunci: coronavirus, dampak, kematian, regulasi, transmisi

INTRODUCTION

Public Health Emergency of International Concern (PHEIC) of Corona Virus Disease (COVID-19) has been announced by The World Health Organization (WHO) on January 30th, 2020 followed by an announcement of the situation as a pandemic (VERTIC, 2020). COVID-19 that initially occurred in Wuhan, China, is currently outspread to other countries including Indonesia (World Health Organization, 2020a). The Indonesian government confirmed the initial case of COVID-19 on March 2nd, 2021, the Indonesian citizen with a contact history with the Japanese, who has been confirmed positive with COVID-19 (Ratcliffe, 2020). As of March 3rd, 2021, confirmed cases of COVID-19 hit 1.353.834 people with 36.271 deaths. The highest confirmed cases were in DKI Jakarta province and East Java Province including Nganjuk Regency with 3100 confirmed cases and 271 deaths, making it one of the highest regencies with confirmed cases and deaths in East Java Province (Kementerian Kesehatan Republik Indonesia, 2021).

Transmission of COVID-19 that was originally from foreign citizens has now become the local transmission (World Health Organization Indonesia, 2020). Health Ministry of Indonesia, working collaboratively with WHO, has provided recommendations to regional authorities to help controlling measures for further transmission of COVID-19 such as; training and education to the asymptomatic patient, collaborating with animal laboratories to expand test capacity, cross-collaboration and community empowerment, and social gathering activity restriction regulation (World Health Organization Indonesia, 2020).

Yet, the government's decisions to restrict the citizen movements to reduce virus transmission have been divergent. Ranging from closing down the educational institutions, offices, to restricting public gathering activities (Suraya *et al.*, 2020).

As the COVID-19 cases were rapidly increasing, on March 31st, 2020, the Indonesian government declared the situation as a national public health emergency but was declined to implement total lockdown due to economic considerations (Pasley, 2020). Later on, the Indonesian government chose to enforce large-scale social restriction as one of the main policies directed to restrict citizen movement and reduces the potential transmission of COVID-19 (Kementerian Kesehatan Republik Indonesia, 2020). On May 11th, 2020, four provinces and twenty-two cities were reported to be enforcing large-scale social restrictions (*Pembatasan Sosial Berskala Besar* (PSBB)). However, it was reported that the policy failed to reduce the incidence of COVID-19 in Indonesia. The average number of confirmed cases in East Java and West Java continued to spike before and during the large-scale social restrictions. In Banten, confirmed cases before and during the first period of the large-scale social restrictions decreased but escalated in the second period. In Jakarta, the average number of cases during the first period of the large-scale social restrictions experienced an escalation from the average but later experienced a reduction in the second period. The result of the study has confirmed if the large-social scale restrictions were ineffective to contain

the transmission of COVID-19 in Indonesia (Suraya *et al.*, 2020).

Nganjuk Regency as one of the highest COVID-19 confirmed cases in East Java province chose a different strategy from the central government recommendations with the issuance of a Regent Regulation number 28 of 2020 about the guidelines for the preparation of novel practice in the condition of coronavirus disease (COVID-19) pandemic in Nganjuk Regency (*Peraturan Bupati Nomor 28 Tahun 2020 Tentang Pedoman Persiapan Tatatan Kebiasaan Baru Pada Kondisi Pandemi Corona Virus Disease (COVID-19) di Kabupaten Nganjuk*) on July 15th, 2020. The implementation of the regulation was intended to avoid the heavy socio-economic cost burden due to the COVID-19 pandemic. However, in an article, nine of the regulations stated that several activities, public gatherings, religious activities, schools, and social-cultural activities could be done as long as there was permission from Nganjuk Regency Taskforce, it was following health protocol, and was held in the village or sub-regency among the green zone (Pemerintah Daerah Kabupaten Nganjuk, 2020). This article was in contrast with the scope of the large-scale social restrictions recommended by the central government which indicated ease in restrictions during the pandemic situation in Nganjuk Regency.

The measurement of transmissibility and mortality during an epidemic are crucial parameters in epidemiological modeling (Binny *et al.*, 2020). As both parameters are commonly used to evaluate the effectiveness of the control measure implemented during the epidemic. Appraisal of the effective reproduction number $R(t)$ is the most common method used to measure disease transmissibility. Effective reproduction number $R(t)$ is defined as the average number of people that will be infected by a single infectious person in a certain population after an intervention over time (Shim *et al.*, 2020). Another important characteristic of infectious disease is mortality. The disease mortality rate is measured by case fatality rate (CFR), defined as the proportion of deaths to the number of confirmed cases (Sipahutar and Eryando, 2020; World Health Organization, 2020b). Reliable CFRs are capable to assess the fatality of an

outbreak and evaluate the effectiveness of implemented control measures. CFR is generally obtained at the end of an outbreak and may not be held in an ongoing epidemic. Therefore to mitigate the bias due to delays to case resolution during an ongoing outbreak, restriction on the analysis to resolved confirmed cases is a proper measurement of the CFR during the epidemic (World Health Organization, 2020b).

The strategy to closely monitor COVID-19 transmissibility and mortality has been implemented in several respective countries such as Hongkong, Japan, South Korea, England, Germany, and Norway (Han *et al.*, 2020). The transmissibility and mortality that are closely monitored are used to adjusting the COVID-19 alert system and public health response. The respective countries have set the same goals to reduce the growth of $R(t)$ and CFR as a strategy to contain the transmission of COVID-19 (Han *et al.*, 2020). As the response to intervention is initiated, the pathogen transmissibility changes (Thompson *et al.*, 2019). It is necessary to understand the transmission and mortality of COVID-19 on the initial control measure to evaluate the effectiveness of the implemented control measure. This study aimed to evaluate the effectiveness of the implementation of Nganjuk Regency Regent Regulation number 28 of 2020 in reducing the transmissibility and mortality of COVID-19.

METHOD

Data were collected from the daily confirmed cases report of COVID-19, made available for the public on <https://covid19.nganjukkab.go.id> by Nganjuk Regency Taskforce for COVID-19 (*Satuan Tugas Penanganan COVID-19*) and requesting onset data series from Nganjuk Regency Health Office. For this analysis, data were obtained from March 30th to September 20th, 2020, with 420 total confirmed cases and 49 deaths. The transmissibility of COVID-19 was measured through the estimation of the effective reproduction number ($R(t)$) using the Microsoft Excel Spreadsheet EpiEstim program, available for the public at <http://tools.epidemiology.net/EpiEstim.xls>.

COVID-19 Serial Interval (SI) and Coefficient of Variation (CV) are needed to produce Effective Reproduction Number ($R(t)$). The serial interval was defined as the time period between the onset symptoms of the primary case and the onset of the secondary case, obtained from the literature that used Singaporean COVID-19 serial interval 4.56 days (Tindale *et al.*, 2020) and 5.20 days (Ganyani *et al.*, 2020). Singaporean was chosen under the assumption that it was similar to Indonesian as the serial interval for Indonesian was not available. The Coefficient of Variation (CV) was set by default into 0.3 as recommended by the EpiEstim program. Confidence interval (CI), the range of true value for $R(t)$ analysis was set into 95% and the time step of $R(t)$ production was set into 14 days with the estimation of $R(t)$ performed every 7 days (Taljaard and Hemming, 2020). Effective reproduction number was reported periodically every 14 days and the next period of $R(t)$ estimation was started 7 days after the start date of the previous period. The estimation of $R(t)$ was produced from April 7th to September 14th. The respective analysis result of $R(t)$ was defined as the average number of people that could be infected by a single contagious person in the Nganjuk Regency for 14 days. $R(t) > 1$ indicated a sustained COVID-19 transmission while $R(t) < 1$ indicated otherwise, and the number of new cases was expected to follow the declining trend (Shim *et al.*, 2020).

The mortality of COVID-19 was measured with the Estimation of Case Fatality Rate (CFR). This study used two approaches to calculate CFRs. Naïve case fatality rate (nCFR) was calculated as the number of cumulative deaths among COVID-19 patients from the number of cumulative confirmed cases of COVID-19 at times, while ongoing epidemic case fatality rate (eCFR) was calculated as the number of cumulative deaths among COVID-19 patients from the cumulative deaths of COVID-19 combined with the number of recovered cases of COVID-19 (World Health Organization, 2020b). The

analysis was done every seven days starting from the first death case on May 24th until September 20th. The results of CFRs were used to determine the fatality of COVID-19 that caused deaths (mortality) among confirmed cases in the population of Nganjuk Regency.

Statistical software was used to evaluate the effectiveness of the implementation of regent regulation on reducing transmissibility and mortality of COVID-19. Interrupted time series analysis was performed to estimate the effect of the implementation of regent regulation on several parameters of transmissibility and mortality, newly confirmed cases, the number of deaths, effective reproduction number ($R(t)$), and case fatality rate (CFR).

RESULTS AND DISCUSSION

COVID-19 Mortality in Nganjuk Regency

Mortality parameters of COVID-19 are presented by the number of the death, naïve case fatality rate (nCFR), and ongoing epidemic case fatality rate (eCFR). New confirmed cases of COVID-19 and the number of death are presented periodically in figure 1, starting from the first discovered case of COVID-19 in Nganjuk Regency on March 30th, 2020 to September 20th, 2020. It is shown that new confirmed cases of COVID-19 were really fluctuating with an increasing tendency. The first death of a COVID-19 patient was reported on May 18th, 2020.

Since then, the number of death continues to increase but the number was fluctuating following the trend of new confirmed cases. The case fatality rate of the Nganjuk Regency was reported to be much higher than the national case fatality rate. The trend of national nCFR was decreasing with the highest number of death in the early epidemic then slowed down to 4.0% on September 20th, 2020. However, the trend of Nganjuk Regency nCFR gradually increased from 9.1% on May 18th, 2020 to 15,1% on September 20th, 2020.

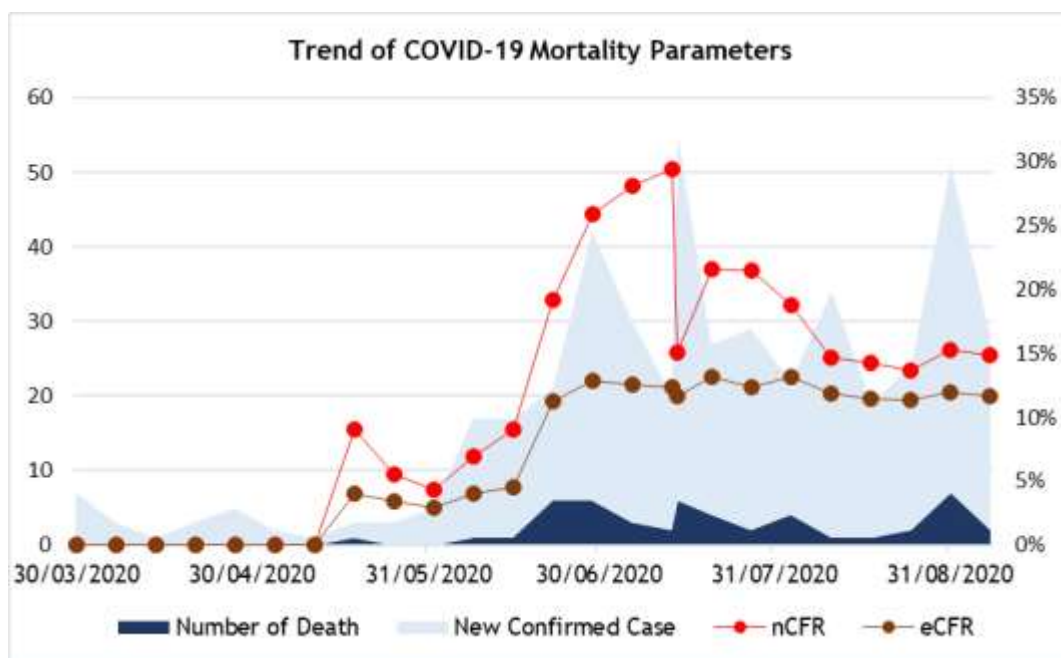


Figure 1. Trend of COVID-19 Mortality Parameters in Nganjuk Regency

COVID-19 Transmissibility in Nganjuk Regency

Table 1 showed the estimation result of the effective reproduction number (R(t)) using the Microsoft Excel Spreadsheet EpiEstim package. The estimation was started to be produced from April 7th and ended on September 14th. Using a serial interval of 4.56 days, the peak of reproduction number was in the first time series, starting from April 7th and ending on April 20th (14 days) with the corresponding R(t) of 2.50 (95% CI 0.52 - 6.02). Estimation using a serial interval of 5.20, the peak was also in the first time series with the corresponding mean R(t) (95% CI 0.52 - 6.05). However, it should be noted that the range on the first time series was really wide between the lower level and upper level, indicating that the reported R(t) has a low power that was relatively less precise. The second strike was noticed on the eighth time series between 26th May and 8th June, 2020 with the corresponding effective reproduction number (R(t)) of 2.04 using 4.56 days serial interval and 2.06 using 5.20 days serial interval, indicating that a single contagious COVID-

19 case could transmit the disease to two until three other people in the population. The production of effective reproduction numbers was found to be volatile with a tendency to decrease in each time series.

Impacts of Implementation of Regent Regulation

Table 2 presented the result analysis of transmissibility and mortality parameter estimation before and after the implementation of regent regulation. Before the implementation, it was estimated that nCFR increased periodically by 0.013 ± 0.001 (P-value <0.001) and eCFR was estimated to increase periodically by 0.028 ± 0.012 (P-value 0.001). Nevertheless, after the regent regulation was implemented, it was noticed that there was a significant reduction of nCFR and eCFR estimation by -0.002 ± 0.003 (P-value 0.002) on nCFR and by -0.008 ± 0.008 (P-value 0.007) on eCFR. However, the implementation of regent regulation did not show any significant effect on the transmissibility parameters.

Table 1. Result Analysis of Effective Reproduction Number (R(t)) Over Time

Period	Time series		SI 4.56 days			SI 5.20 days		
	Start Date	End date	R(t)	95% CI		R(t)	95% CI	
				Lower	Upper		Lower	Upper
Before implementation of regent regulation	07-04-2020	20-04-2020	2.50	0.52	6.02	2.51	0.52	6.05
	14-04-2020	27-04-2020	1.90	0.70	3.69	2.09	0.77	4.06
	21-04-2020	04-05-2020	1.73	0.92	2.79	1.87*	1.00	3.02
	28-04-2020	11-05-2020	0.98	0.49	1.64	0.98	0.49	1.64
	05-05-2020	18-05-2020	0.59	0.22	1.15	0.59	0.22	1.16
	12-05-2020	25-05-2020	0.87	0.28	1.79	0.85	0.28	1.74
	19-05-2020	01-06-2020	1.82	0.79	3.28	1.76	0.76	3.18
	26-05-2020	08-06-2020	2.04*	1.14	3.20	2.06*	1.15	3.23
	02-06-2020	15-06-2020	1.48	0.99	2.06	1.60*	1.07	2.23
	09-06-2020	22-06-2020	1.11	0.81	1.47	1.19	0.86	1.57
	16-06-2020	29-06-2020	0.95	0.67	1.27	0.93	0.66	1.25
	23-06-2020	06-07-2020	1.26	0.94	1.64	1.27	0.95	1.65
	30-06-2020	13-07-2020	1.19	0.91	1.51	1.21	0.93	1.53
	07-07-2020	20-07-2020	0.94	0.70	1.21	0.94	0.71	1.21
After implementation of regent regulation	14-07-2020	27-07-2020	1.03	0.78	1.31	1.04	0.79	1.33
	21-07-2020	03-08-2020	0.90	0.66	1.16	0.88	0.65	1.14
	28-07-2020	10-08-2020	1.03	0.78	1.32	1.05	0.79	1.35
	04-08-2020	17-08-2020	1.07	0.81	1.38	1.06	0.80	1.36
	11-08-2020	24-08-2020	1.09	0.81	1.42	1.04	0.77	1.36
	18-08-2020	31-08-2020	1.13	0.86	1.42	1.17	0.90	1.48
	25-08-2020	07-09-2020	0.88	0.66	1.12	0.89	0.67	1.13
	01-09-2020	14-09-2020	1.17	0.91	1.47	1.18	0.91	1.47

Note: *statistically significant

Table 2. The Estimation of COVID-19 Parameters Before and After Implementation of Regent Regulation

Parameter	Before Implementation		After Implementation	
	Estimation	P-value	Estimation	P-value
New Confirmed Cases	3.263 ± 0.424	<0.001*	2.311 ± 1.130	0.349
Number of Deaths	0.551 ± 0.203	0.500	0.833 ± 0.484	0.432
R(t) with SI 4.56 Days	-0.073 ± 0.028	0.070	1.816 ± 1.458	0.336
R(t) with SI 5.20 Days	-0.077 ± 0.030	0.067	1.999 ± 1.500	0.305
nCFR	0.013 ± 0.001	<0.001*	-0.002 ± 0.003	0.002*
eCFR	0.028 ± 0.012	0.001*	-0.008 ± 0.008	0.007*

Note: *statistically significant

The Nganjuk Regency government implemented Regent Regulation Number 28 of 2020 on 15th July, 2020 that regulated the activities that were allowed during the COVID-19 pandemic and the criteria that should be met by event organizers. The regulation was aiming to reduce the transmission rate and mortality rate due to the COVID-19 pandemic in the Nganjuk Regency. The rule-governed regarding public gatherings, religious activities, schools, and social-cultural activities which were permitted in Nganjuk Regency. The permit would be granted if the event organizer complied with the health protocols and the activity was held in the village and sub-regency within the green zone. The issuance of regent regulation has a few points that contradicted with the large-scale social restriction (PSBB) that was promoted by

the central government, indicating that Nganjuk Regency authorities enforced an easing restriction strategy.

Easing restriction strategies due to economic burdens was not a novel measure to contain COVID-19. Several respective countries such as Singapore, Norway, and Spain have implemented easing restriction strategies albeit the easing restriction criteria remain to be unclear, while other respective countries such as Japan, Germany, and South Korea put clear criteria based on epidemiological thresholds when easing restrictions and giving permission to held activities (Han *et al.*, 2020). Based on the result analysis, it is shown that the implementation of regent regulation in Nganjuk Regency was a non-significant control measure to reduce the transmissibility of COVID-19 as shown in

table 2. There was no significant reduction both in the effective reproduction number ($R(t)$) with SI 4.56 days and 5.20 days before and after the regulation was implemented (p -value > 0.05). However, there was a noticeable reduction in both naive case fatality rate (nCFR) and epidemic case fatality rate (eCFR) estimation after the implementation of regent regulation on July 15th, 2020. The result indicated that the implementation of the regulation gave a vital impact in reducing mortality of COVID-19 by -0.002 ± 0.003 (P -value 0.002) on nCFR and -0.008 ± 0.008 (P -value 0.007) on eCFR.

The trend of new confirmed cases showed an increasing tendency even after the regent regulation was implemented. It indicated that the COVID-19 transmission was still ongoing. The results showed the same pattern with Hongkong as the ease of restrictions was put in place, several areas had spikes of new confirmed cases (Information Services Department and Region., 2020). Based on the results of the effective reproduction number ($R(t)$) that were mostly above 1 (one), indicating that the outbreak of COVID-19 cases was sustained in Nganjuk Regency. More stringent control measures and public health responses should be enforced to slow down the transmission of COVID-19.

A study in four provinces of Indonesia reported that the large scale-social restriction policy (PSBB) was ineffective in reducing the number of new confirmed cases because of the lack of compliance of the people to follow health protocols during activities such as not wearing masks and gloves. On the other hand, the number of human traffic from outside the PSBB region was still high (Suraya *et al.*, 2020). In contrast, a study reported that quarantining Hubei Province and the headquarters of Wuhan City, China was effective in reducing the growth of COVID-19 new confirmed cases as the human traffic is held (Yuan *et al.*, 2020). The finding of the previous studies indicated that the lack of compliance of the people in following health protocols during activities might be identified as the main reason for the ongoing transmission. Another vital factor that might contribute to the ongoing transmission in Nganjuk Regency was the attendance of event participants from

outside the green zone area as it was really challenging to manage.

Health promotion intervention may paradoxically be more important in this time of COVID-19 crisis than ever before. The health promotion profession plays a vital role in pandemics, and this has been abundantly evident in the responses to COVID-19. Messaging about health and hygiene is one of the roles that health promotion has played ultimately, drawing on our expertise in delivering health education, and implementing health-related mass media and social marketing campaigns (Smith and Judd, 2020). Nevertheless, changing people's transmission-related behaviors is a vital strategy to flatten the peak of the COVID-19 pandemic situation (van den Broucke, 2021). Several health promotion strategies suggested to reduce COVID-19 transmission in population included motivating people to adopt preventive behaviors, creating social norms that encourage preventive behaviors, creating the right level and type of emotion by coupling health warnings with concrete advice for preventive action, giving advice on how risk behaviors can be replaced by more effective ones, and making the behaviors easy (Michie *et al.*, 2020).

Health promoters can suggest authorities follow the behavioral change recommendations as the authorities have the obligation to decide accurate strategies and enforce sufficient control measures to elicit behavioral changes of the community to comply with the health protocols aimed to fight the COVID-19 pandemic (Guzek, Skolmowska and Głabska, 2020). Authorities also need to acknowledge that taking up health information is an active cognitive process. However, with the rapid availability of information sources that some may be contradictory and some false information may be taken as truth, coordination of key messaging between the health sector and other sectors is a necessity (Smith and Judd, 2020).

WHO promoted a key preparedness and response plan to reduce COVID-19 transmission, which included proper hand hygiene, personal protective equipment such as gloves, face masks, and face shields (World Health Organization, 2020c), isolation and quarantine for people who are ill, suspected, and/or

exposed, and physical distancing with people (Guzek, Skolmowska and Głabska, 2020). High transmission rates and threatening mortality rates have caused many countries and jurisdictions to introduce measures to block the transmission of COVID-19, and strongly encourage hand hygiene features (Alzyood *et al.*, 2020). Practicing hand hygiene effectively will assist in slowing down the transmission of COVID-19 and reduce the effect on people's health status (Aziz, 2021). Therefore, enhancing health promotion and education on changing personal behavior of the people to follow preventive action recommended by health experts should be prioritized as a vital strategy to slow down the transmission of COVID-19.

The implementation of the Regent Regulation showed that there was a significant reduction in Nganjuk Regency CFR, indicating that the fatality of COVID-19 was slowing down as the regulation was put in place. A study in Europe reported that enhancement testing and tracing capacity had a significant effect on reducing the COVID-19 case fatality rate (Pachetti *et al.*, 2020). This finding was in line with the reduction of CFR in Nganjuk Regency after the regent regulation was implemented as stated in the regulation article eleven, second section, that every Nganjuk citizen must follow the rapid test and PCR examination for Corona Virus Disease 2019 in epidemiological investigations (contact tracing) if has been determined by the health officer. This article emphasized the need to increase the number of testing and tracing done in the community thus confirmed cases of COVID-19 can be detected on early-stage before developing severe complications. For this reason, the vital factor that contributed to reducing the case fatality rate was the improvement of viral testing and tracing capability.

Nevertheless, Nganjuk Regency CFR was gradually growing higher than the national level naïve CFR (Kementerian Kesehatan Republik Indonesia, 2020). Local authorities should investigate the cause of the high CFR and adjust an appropriate public health response to lower and maintain low mortality. The lower rate of the CFR could be attributed to the limitation of laboratory confirmation or the lack of surveillance

reports related to the cause of deaths, leading to the underreporting of early epidemics. The high rate of CFR could be associated with the ongoing nature of the COVID-19 outbreak, the different age distribution of the population, and different control measures that are implemented. Other than that, the daily CFR can change according to the number of cumulative confirmed cases based on the laboratory case confirmation using real-time polymerase chain reaction (PCR). Several factors certainly affected the CFR such as the limitation of health worker availability, (Baud *et al.*, 2020) the number of personal protective equipment availability, (Kim and Goel, 2020) and PCR availability. Delayed test result information in the early epidemics led to the biased result of CFR calculation. With the situation of laboratory availability and capability of PCR test, CFR could be reported over-estimated and under-estimated. When the confirmation of the case slowed down, the denominator of CFR would be small which made the CFR over-estimated. However, if later when patients under surveillance died but the results of PCR were confirmed to be positive, then the previous reported CFR was under-estimated as it was not included in the numerator while calculating CFR (Kim and Goel, 2020; World Health Organization, 2020b).

Reliable CFR can be used to assess the severity and fatality of an outbreak and evaluate the impact of presented control measures. However, the calculation of naïve CFR may not be held in the epidemic situation as it is based on two assumptions which are the likelihood of detecting cases when death is consistent and all of the cases have been resolved (World Health Organization, 2020b). Estimating severity with eCFR could mitigate bias due to delays of case resolution but reports may delay (World Health Organization, 2020b). Despite a need to further clarify the reliability of CFR during an ongoing pandemic, the calculation of CFR is useful for informing the stakeholders, policymakers, and the general public about the potential severity of COVID-19. A particular strength of this study is the use of real-time data and provides novel analysis about the effectiveness related to the implementation of COVID-19 regulation

aside from large-scale social restrictions. Nevertheless, some limitations of this study should be addressed. First, estimation of the effective reproduction number ($R(t)$) was done using Singaporean series interval with the assumption that it is similar to Indonesia because there was no report related to the Indonesian series interval available. Second, for asymptomatic confirmed cases, the date of onset was reported using the same date of the first PCR test. Therefore, the results of the calculation might not be able to describe the actual conditions perfectly. Further study with a longer period should be done to ensure the long-term effectiveness of the implementation of regent regulation in reducing transmission and mortality of COVID-19.

CONCLUSION

This study reported that the implementation of regent regulation in the Nganjuk Regency significantly affected the reduction of case fatality rate but failed to slow down the COVID-19 transmissibility. Special attention needed to be paid to the growth of CFR as it would be beneficial to understand the appropriate measures to reduce and maintain CFR to the low mortality.

Controlling human traffic of the citizen in the specific zone and compliance in following health protocols during the activities remained to be challenging. Therefore, enhancing health education on changing personal behavior to follow health recommendations should be considered as a vital strategy to slow down the transmission of COVID-19.

ACKNOWLEDGEMENT

We thank Nganjuk Regency Health Office for providing the COVID-19 onset data series for the analysis. The data presented and the views expressed are solely the responsible of the author.

REFERENCES

- Alzyood, M. et al. (2020) 'COVID-19 reinforces the importance of handwashing', *Journal of Clinical Nursing*, 29(15-16), pp. 2760-2761. doi: 10.1111/jocn.15313.
- Aziz, A.-M. (2021) 'Hand hygiene and stopping the spread of COVID-19',

Journal of Paramedic Practice, pp. 1-7.

- Baud, D. et al. (2020) 'Real estimates of mortality following COVID-19 infection', *The Lancet*, 20(July), pp. 776-777. doi: [https://doi.org/10.1016/S1473-3099\(20\)30195-X](https://doi.org/10.1016/S1473-3099(20)30195-X).
- Binny, R. N. et al. (2020) 'Effect of alert level 4 on Reff: review of international COVID-19', *medRxiv*, (April), pp. 1-17.
- van den Broucke, S. (2021) 'Why health promotion matters to the COVID-19 pandemic, and vice versa', *Health Promotion International*, 35(2), pp. 181-186. doi: 10.1093/HEAPRO/DAAA042.
- Ganyani, T. et al. (2020) 'Estimating the generation interval for COVID-19 based on symptom onset data', *MedRxiv Preprint*. doi: 10.1101/2020.03.05.20031815.
- Guzek, D., Skolmowska, D. and Głabska, D. (2020) 'Analysis of gender-dependent personal protective behaviors in a national sample: Polish adolescents' covid-19 experience (place-19) study', *International Journal of Environmental Research and Public Health*, 17(16), pp. 1-22. doi: 10.3390/ijerph17165770.
- Han, E. et al. (2020) 'Lessons learnt from easing COVID-19 restrictions: an analysis of countries and regions in Asia Pacific and Europe', *The Lancet*, 396(10261), pp. 1525-1534. doi: 10.1016/S0140-6736(20)32007-9.
- Information Services Department, the G. of H. K. and Region., S. A. (2020) Some anti-epidemic measures eased, Some anti-epidemic measures eased.
- Kementerian Kesehatan Republik Indonesia (2020) Situasi Terkini Perkembangan Coronavirus Disease, Infeksi Emerging.
- Kementerian Kesehatan Republik Indonesia (2021) Situasi Terkini Perkembangan Coronavirus Disease (COVID-19) 04 Maret 2021, Infeksi Emerging.
- Kemntrian Kesehatan Republik Indonesia (2020) 'Peraturan Menteri Kesehatan Republik Indonesia Nomor 9 Tahun 2020 Tentang Pedoman Pembatasan Sosial Berskala Besar Dalam Rangka Percepatan Penanganan Corona Virus Disease 2019 (COVID-19)', Kementerian Kesehatan Republik Indonesia. Jakarta,

- Indonesia: Kementerian Kesehatan Republik Indonesia. doi: 10.4324/9781003060918-2.
- Kim, D. D. and Goel, A. (2020) 'Real Estimates of Mortality Following COVID-19 Infection', *The Lancet*, 20(July), pp. 773-774. doi: 10.1001/jama.2020.1585.WHO.
- Michie, S. et al. (2020) Slowing down the covid-19 outbreak: changing behaviour by understanding it, *The BMJ Opinion*.
- Pachetti, M. et al. (2020) 'Impact of lockdown on Covid-19 case fatality rate and viral mutations spread in 7 countries in Europe and North America', *Journal of Translational Medicine*, 18(1), pp. 1-7. doi: 10.1186/s12967-020-02501-x.
- 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, *INSIDER*.
- Pemerintah Daerah Kabupaten Nganjuk (2020) 'Peraturan Bupati Nomor 28 Tahun 2020 Tentang Pedoman Persiapan Tatatan Kebiasaan Baru Pada Kondisi Pandemi Corona Virus Disease (COVID-19) di Kabupaten Nganjuk'. Indonesia: Pemerintah Daerah Kabupaten Nganjuk.
- Ratcliffe, R. (2020) First coronavirus cases confirmed in Indonesia amid fears nation is ill-prepared for outbreak, *The Guardian*.
- Shim, E. et al. (2020) 'Transmission potential and severity of COVID-19 in South Korea', *International Journal of Infectious Diseases*, 93, pp. 339-344. doi: 10.1016/j.ijid.2020.03.031.
- Sipahutar, T. and Eryando, T. (2020) 'COVID-19 case fatality rate and detection ability in Indonesia', *Kesmas*, 15(2), pp. 14-17. doi: 10.21109/KESMAS.V15I2.3936.
- Smith, J. A. and Judd, J. (2020) 'COVID-19: Vulnerability and the power of privilege in a pandemic', *Health Promotion Journal of Australia*, 31(2), pp. 158-160. doi: 10.1002/hpja.333.
- Suraya, I. et al. (2020) 'The impact of large-scale social restrictions on the incidence of covid-19: A case study of four provinces in Indonesia', *Kesmas*, 15(2), pp. 49-53. doi: 10.21109/KESMAS.V15I2.3990.
- Taljaard, M. and Hemming, K. (2020) 'Why proper understanding of confidence intervals and statistical significance is important: Covid-19 randomised trials as a case in point', *The Medical Journal of Australia*, (July), pp. 1-11.
- Thompson, R. N. et al. (2019) 'Improved inference of time-varying reproduction numbers during infectious disease outbreaks', *Epidemics*, 29. doi: 10.1016/j.epidem.2019.100356.
- Tindale, L. et al. (2020) 'Transmission interval estimates suggest pre-symptomatic spread of COVID-19', *MedRxiv Preprint*. doi: 10.1101/2020.03.03.20029983.
- VERTIC (2020) Addendum to Fact Sheet 15 on National Implementation Measures for the International Health Regulations 2005 (IHR) COVID-19 as a Public Health Emergency of International Concern (PHEIC) under the IHR protect against , control an. London.
- World Health Organization (2020a) Covid-19 Situation Report, World Health Organization. Geneva.
- World Health Organization (2020b) Estimating mortality from COVID-19: Scientific brief.
- World Health Organization (2020c) Recommendation to Member States to improve hand hygiene practices widely to help prevent the transmission of the COVID-19, WHO Interim Report.
- World Health Organization Indonesia (2020) Coronavirus disease 2019 (COVID-19) Situation Report-66, WHO Situation Report. Geneva. doi: 10.1056/nejmc2004973.
- Yuan, J. et al. (2020) 'Monitoring transmissibility and mortality of COVID-19 in Europe', *International Journal of Infectious Diseases*, 95, pp. 311-315. doi: 10.1016/j.ijid.2020.03.050.