The Impact of Vaccination on COVID-19 Transmission in Indonesia from March to June 2021

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*Abstract— **Introduction**: Coronavirus disease (COVID-19) is an illness induced by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The mortality rate of COVID-19 is relatively significant, with the incidence of daily cases rising consistently. A primary objective to mitigate an increase in COVID-19 infections is the vaccinations initiative, particularly for healthcare professionals in Indonesia. This study aims to examine the impact of vaccination on daily cases, recoveries, and deaths related to COVID-19 in Indonesia. **Methods**: This is an observational study. The dataset was derived from secondary data obtained from the COVID-19 data repository of the Indonesian Innovative Research Agency (BRIN), encompassing daily dosage information, daily case counts, recoveries, and deaths from March to June 2021. **Results**: The findings from simple linear regression indicated that double-dose vaccination influenced new cases and recovered cases (11.5% vs 10.4%; p = 0.0001 vs p = 0.0001), but did not affect mortality rates (2.2%; p = 0.053). **Conclusion**: double-dose vaccination could reduce the incidence of new cases and daily cases among the Indonesian population.*

Keywords— Coronavirus disease; vaccinations; daily case; recoveries; deaths

I. INTRODUCTION

Coronavirus disease (COVID-19) is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The coronavirus emerged from a conventional market in Wuhan City, China (1). As of December 30, 2020, the global amount of confirmed COVID-19 cases was 80,783,035, with 1,784,109 mortality (CFR 2.2%) among 221 affected nations and 180 countries experiencing local transmission (2). The transmission of this virus occurs by droplets exhaled during coughing, sneezing, and close contact to individuals infected with the virus (3). The clinical manifestations of COVID-19 included fever, cough, dyspnoea, anosmia, and fatigue (4). Additional symptoms observed in COVID-19 patients include severe dyspnoea and chest pain. To mitigate the transmission of the virus, numerous nations, including Indonesia, have instituted health standards that emphasise enhanced personal hygiene, frequent hand washing with soap and water, mask use, and social distancing. To mitigate ongoing viral spread, numerous nations have instituted lockdown measures both internationally and domestically (3).

As of December 30, 2020, Indonesia reported 735,124 confirmed COVID-19 cases and 21,944 deaths, resulting in a case mortality rate of 3%. East Java had the highest COVID-19 mortality rate, totaling 5,762 deaths, followed by Central Java with 3,501 deaths and DKI Jakarta with 3,249 deaths. The elevated mortality rate is accompanied by an increase in daily COVID-19 infection cases. As of December 30, 2020, DKI Jakarta reported the highest number of daily cases at 181,713, followed by East Java with 83,217 cases and West Java with 82,555 cases (5). The increase in COVID-19 infections caused the Indonesian Government to reinstate a lockdown to mitigate the surge in cases. Alongside the lockdown initiative, the Indonesian Government has started a vaccination program across Indonesia since January 2021. The aim of the COVID-19 vaccination program is to protect a minimum of 70% of the Indonesian population in order to reach public immunity, commonly referred to as herd immunity. Indonesia is projected to reach this state in March 2022 (6).

Over 200 vaccine candidates for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have been created (7). Multiple candidates have started phase 2 clinical trials (8-10). ChAdOx1 nCoV-19, BNT162b2 mRNA, and mRNA 1273 have progressed to phase 3 clinical trials and have been considered acceptable for clinical application (8, 11-14). Nonetheless, although several studies indicate an expected decrease in SARS-CoV-2 transmission post-vaccination (14, 15), neither clinical trials nor post-marketing investigations have assessed infection rates among close contacts of vaccinated versus unvaccinated individuals. The extent of vaccination's impact on transmission, essential for preventing pandemics and guiding mass-vaccination programs (16), remains uncertain. Prior observational studies in real-world settings have revealed the impact of vaccination on infection and hospitalisation rates associated with COVID-19, independent of clinical trial environments (17-19). Indonesia lacks official data regarding the impact of vaccination on COVID-19 transmission. Consequently, researchers intend to examine the impact of vaccination on COVID-19 transmission in Indonesia.

II. METHOD

This study is an observational study. The data set was collected from secondary data from the COVID-19 data source of the Indonesian Innovative Research Agency (BRIN) for daily dosage data, daily cases, recovered cases, and deaths from March to June 2021. The study cohort consists Indonesian individuals who have received the complete double-dose COVID-19 vaccination. The variables employed in this study consist of one independent variable (X) and three dependent variables (Y). The independent variable (X) in

this study is the daily dose, while the dependent variable (Y) in this study is daily cases, recovered cases, and deaths.

This study used correlation analysis and simple linear regression for its analysis. Correlation analysis is carried out to see the correlation coefficient used to identify the degree or intensity and direction of the association between two variables. Simple linear regression analysis is used to determine the direction of the relationship between the independent variable and the dependent variable whether it is positive or negative.

III. RESULT

The findings of the study applying correlation tests and simple linear regression are presented in the table below:

TABLE 1. The Correlation and Linear Regression Tests of Daily Dose Variables with Daily Cases, recovered cases and death cases

Independent Variable	Dependent Variables	r	p value	R square
Daily doses	Daily Cases	-0,339	0,0001	0,115
	Recovered	-0,323	0,0001	0,104
	Deaths	-0,148	0,053	0,022

Based on Table 1 above, it can be concluded that there is a relationship between daily dose and daily cases and recovered cases (p = 0.0001) at a 95% confidence level. In Table 1 above, the coefficient of determination is 11.5% for daily cases and 10.4% for recovered cases. Based on this, it can be concluded that the daily dose variable influences on the daily case variable of 11.5%, while the remaining 88.5% is influenced by other factors that were not studied. In addition, the daily dose variable influences on the recovered case variable of 10.4%, while the remaining 89.6% is influenced by other factors that were not studied. Other factors that were not studied have a greater influence on the occurrence of daily cases than the daily dose factor.

In Table 1 above, This study showed that there is no correlation between the daily dose and mortality (p value = 0.053) at a 95% confidence level. Further statistical analysis revealed a coefficient of determination value of 2.2%. Based on this, it can be concluded that the daily dose variable influences on the mortality of 2.2%, while the remaining 97.8% is influenced by other factors that were not explored. Other factors that were not analysed have a bigger influence on the occurrence of Covid mortality than the daily dose factor.

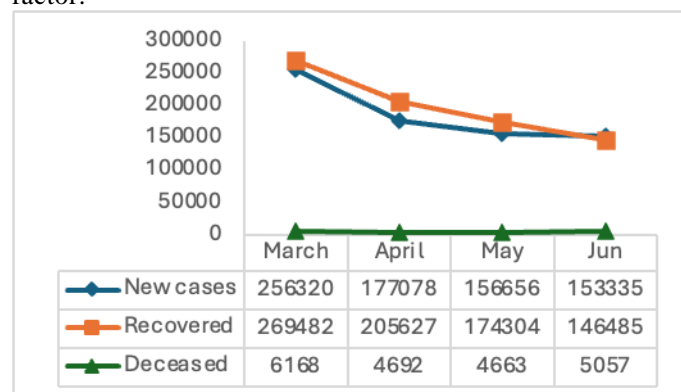|	March	April	May	Jun
New cases	256320	177078	156656	153335
Recovered	269482	205627	174304	146485
Deceased	6168	4692	4663	5057

Fig. 1. COVID-19 transmission during March to June, 2021

Overall, the number of daily COVID-19 cases, recoveries and deaths from March to June 2021 reduced from 34% to 21% for daily cases and 34% to 18% for recoveries. Meanwhile, deaths reduced from 30% to 25% from March to June 2021. There was a slight increase of approximately 2 percent between May and June 2021 for deaths.

IV. DISCUSSION

This study investigated the effects of a national vaccination program on the incidence of COVID-19 in Indonesia. Vaccination seemed to reduce the transmission of Covid-19. The findings indicated that a double-dose COVID-19 vaccine can substantially influence the daily case rate (p=0.0001; p<0.05). The findings of this study align with a worldwide meta-analysis conducted across 187 countries, indicating that an increase of 10,000 fully vaccinated individuals per day can decrease daily COVID-19 cases by 24.43% (95% CI: 18.89–29.59%) (20). In Seoul, South Korea, regression analysis results indicated that the first to third doses of the COVID-19 vaccination significantly reduced daily cases, however the fourth dose exhibited no significant effect (21). An observational analysis conducted in the United States involving 2,558 counties indicated that each 10% rise in vaccination coverage correlated with a 7% reduction in the incidence of COVID-19 cases (22). This indicates that double-dose vaccination is adequate to diminish the daily incidence of COVID-19 patients.

The findings of this study demonstrate that there is no correlation between two doses of COVID-19 vaccination and mortality rates (p=0.053; p>0.05). Nonetheless, the findings of this study indicate a trend towards a reduction in mortality attributed to the vaccination program. This outcome contradicts global research indicating that each increment of 10,000 individuals fully vaccinated daily can decrease daily COVID-19 mortality by 13.32% (95% CI: 3.81–21.89%) (20). In Iran, although hospitalizations rose during the prevalence of the Delta variation, the mortality rate considerably declined following the mass vaccination initiative, with a relative risk of death of 0.61 (95% CI: 0.60–0.62) (23).

Numerous factors affect the efficacy of vaccination in reducing daily cases and deaths, including vaccine uptake levels, social and demographic variables, accessibility and distribution of vaccines, cultural beliefs, and public awareness and education. The degree of vaccine uptake within the population significantly impacts the vaccine's efficacy in decreasing daily cases. Elements such as vaccine trust, perceived COVID-19 risk, and accessible information affect an individual's vaccination decision. A study by Smith et al. revealed that elevated education levels, proficiency in English, urban residency, possession of health insurance, and access to a healthcare practitioner were strongly correlated with improved vaccine acceptability within the Latino community in the United States (24). Social and demographic factors, including age, educational attainment, and economic status, affect vaccination rates. Research conducted by Al-Jayyousi et al. demonstrated that factors such as trust in health authorities and social norms affect public perceptions of COVID-19 vaccination (25). The accessibility and fair allocation of

vaccinations influence vaccination rates. Populations residing in distant regions or with restricted access to healthcare services may have challenges in obtaining vaccinations, thereby affecting the overall reduction in daily cases. A study conducted by Roghani shown that a vaccination strategy aimed at older persons substantially decreased hospitalisations and deaths in Tennessee, USA (26). Cultural conventions and personal convictions regarding vaccination affect the choice to receive immunisation. Al-Jayyousi et al. conducted a study employing a social-ecological modelling technique to examine how factors like religious membership and trust in government influence vaccine reluctance, consequently affecting daily case rates (25). The distribution of precise information and education regarding the advantages of vaccination might enhance vaccination rates. Insufficient information or the dissemination of disinformation can result in vaccine reluctance, hence undermining the efficacy of immunisation in decreasing daily case numbers. A study by Smith et al. highlighted the significance of good communication in enhancing vaccination intentions and acceptance within the Latino community in the United States (24)

The findings of this study indicated that double doses of the COVID-19 vaccination considerably decreased the number of recovered cases ($p=0.0001$; $p<0.05$). While concrete research on the correlation between vaccination and recovery rates is limited, vaccination is recognised to mitigate disease severity, hence enhancing recovery rates. A study conducted in Tennessee, USA, demonstrated that a vaccination strategy aimed at the elderly markedly decreased hospitalisations and deaths, while indirectly enhancing recovery rates (26). The findings of this study suggest that additional factors substantially influence the frequency of recovered cases beyond double-dose COVID-19 vaccination. Multiple categories of COVID-19 vaccines have been created, including mRNA vaccines (e.g., Pfizer-BioNTech and Moderna), viral vector vaccines (e.g., AstraZeneca and Johnson & Johnson), and inactivated virus vaccines (e.g., Sinovac and Sinopharm). The efficacy of each vaccination type in avoiding infection and enhancing recovery rates may differ. Research indicates that two doses of mRNA vaccines confer superior protection against infection and sequelae relative to a single dose (27). Research indicates that mRNA vaccines are exceptionally effective in preventing symptomatic infections and serious illnesses. The Pfizer-BioNTech vaccine demonstrated 94% efficacy in preventing symptomatic infection and 92% efficacy in preventing severe disease, according to a real-world research conducted in Israel. This strong efficacy resulted in a higher recovery rate among infected individuals relative to other vaccination types (28). The quantity of vaccination doses administered influences the immunological response and, consequently, the recovery rate. Research indicates that two doses of mRNA vaccines can diminish viral load and expedite viral clearance in individuals infected with the Delta strain. A single dosage of the vaccine failed to confer sufficient protective effectiveness (29). The efficacy of vaccinations in enhancing recovery rates may also be affected by the patient's health status, including the existence of comorbidities. A study conducted in Moscow

indicated that vaccination is the most efficacious approach to preventing COVID-19; nevertheless, evidence regarding its impact on individuals with multimorbidities remain limited. This indicates that it is important for additional research to comprehend the influence of vaccine kind and dosage on recovery rates in people with certain health disorders (30).

V.   CONCLUSION

The findings of the study indicate that double doses of the vaccination can decrease daily cases and deaths, but do not influence the recovery rate of COVID-19 patients in the Indonesian population. While concrete data on the impact of vaccination on recovery rates remains limited, vaccination enhances recovery by mitigating disease severity. Additional research is required to examine the parameters influencing the efficacy of the COVID-19 vaccine on daily case numbers, recovery rates, and mortality in the Indonesian population.

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