EVALUATION OF COVID-19 VACCINE EFFECTIVENESS AMONG HEALTHCARE WORKERS USING CASCADE ANALYSIS

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ABSTRACT

Background: *Healthcare workers in Indonesia have been prioritized for vaccination. Nevertheless, fully vaccinated healthcare workers are still at risk of being infected with COVID-19, but will be less likely to develop severe symptoms, be hospitalized or be at risk for death as compared to those who have not been vaccinated.* ***Objectives****: This study aims to analyze the incidence of COVID-19 in fully vaccinated healthcare workers.* ***Methods****: This cross-sectional study was conducted in 2021. All healthcare workers who have been fully vaccinated, have recovered from COVID-19 (2-4 weeks after vaccination) and able to complete a questionnaire were the participants. The collected data was then analyzed using the cascade method.* ***Results****: Based on the 529 collected questionnaires, by using the cascade analysis conclude that the percentage of healthcare workers who have been fully vaccinated was 99%, healthcare workers who have been fully vaccinated and then infected with COVID-19 was 14%, healthcare workers who have been fully vaccinated, infected with COVID-19 and hospitalized was 4%, healthcare workers who have been fully vaccinated, exposed to COVID-19, hospitalized and experienced the long-haul effect of COVID-19 was 0%.* ***Discussion****: Health workers are still at risk of being confirmed by COVID-19, because have high risk of being exposed in the workplace. The risk of being confirmed and severity are also influenced by age, gender and comorbidities.* ***Conclusions****: Complete vaccinations of healthcare workers did not reduce their risk of being infected with COVID-19, however, it can reduce the severity and the risk of the long-haul effects.*

ARTICLE INFO

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EVALUASI EFEKTIVITAS VAKSIN COVID-19 PADA TENAGA KESEHATAN MENGGUNAKAN ANALISIS CASCADE

ABSTRAK

Latar belakang: Tenaga kesehatan di Indonesia mendapatkan prioritas untuk vaksinasi. Tenaga kesehatan dengan status vaksinasi lengkap masih beresiko terinfeksi COVID-19 dengan lebih kecil kemungkinan untuk resiko keparahan, rawat inap dan kematian dibandingkan dengan yang belum vaksin. **Tujuan**: Penelitian ini bertujuan untuk menganalisis kejadian COVID-19 pada tenaga kesehatan dengan vaksinasi lengkap. **Metode**: Penelitian dilakukan pada Agustus 2021 menggunakan desain cross sectional. Partisipan adalah seluruh tenaga kesehatan yang telah di vaksinasi lengkap, sembuh dari COVID-19 (2-4 minggu setelah vaksinasi) dan telah mengisi kuesioner. Data yang terkumpul kemudian dianalisis menggunakan metode kaskade. **Hasil**: Berdasarkan 529 data kuisioner yang terkumpul, persentase tenaga kesehatan yang sudah vaksin lengkap sebanyak 99%, tenaga kesehatan yang sudah vaksin lengkap dan terpapar Covid-19 setelahnya sebanyak 14%, tenaga kesehatan

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yang sudah vaksin lengkap, terpapar Covid-19 dan dirawat di Rumah Sakit sebanyak 4% dan tenaga kesehatan yang sudah vaksin lengkap, terpapar Covid-19, dirawat di Rumah Sakit dan yang mengalami efek long haul Covid-19 sebanyak 0%. **Diskusi**: Tenaga kesehatan masih berisiko terkonfirmasi COVID-19 meskipun telah divaksinasi lengkap, karena memiliki risiko tinggi terpapar di tempat kerja. Risiko terpapar dan keparahan juga dipengaruhi oleh usia, jenis kelamin dan penyakit penyerta. **Kesimpulan**: Pemberian vaksinasi lengkap pada tenaga kesehatan tidak mengurangi resiko terkonfirmasi Covid-19 disebabkan karena resiko tertular yang sangat tinggi pada saat bekerja namun dapat mengurangi keparahan dan long haul covid.

Kata kunci:
COVID-19; Tenaga kesehatan; Vaksinasi

Introduction

In December 2019, a Chinese patient from Wuhan, Hubei province, China suffered from severe respiratory tract illness and was hospitalized. This was followed by an influx of 1975 cases with the same symptoms (fever, dry cough, fatigue, and sore throat). Through metagenomic RNA sequencing, it was discovered that the cause was a new RNA virus belonging to the Coronavirdae family, which was named 2019-nCOV and later became SARS-COV-2(Guo et al., 2020). COVID-19 infection then spread rapidly throughout the world and there is no specific effective treatment and optimal supportive care for this infection. One of the main strategies to deal with COVID-19 is through vaccination. Efforts have been made towards the development of vaccines against COVID-19 and most of the vaccine candidates under development use the S protein of SARS-CoV-2(Kaur & Gupta, 2020).

On January 11, 2021, the CoronaVac (Sinovac Biotech, Beijing, China) was approved for emergency use by the Indonesian Food and Drug Administration and this was followed by other types of vaccines (Pfizer, Moderna, Biofarma, AstraZeneca). The Indonesian Ministry of Health prioritized healthcare workers for vaccination in the initial COVID-19 vaccination program in Indonesia due to their greater risk of contracting COVID-19 compared to the general population(Cucunawangsih et al., 2021). The COVID-19 vaccine offers strong protection, but time is required for antibodies to form against the SARS-CoV-2 virus. In addition, complete vaccination (two doses) is required to obtain full immunity. In the first dose, the vaccine provides only partial protection, which then increases after the second dose. Maximum protection is only obtained 2-4 weeks after the second dose(Wei et al., 2021).

Methods

Data collection was conducted through a questionnaire with Indonesian people as the population. The questionnaire was distributed in August 2021. Furthermore, from the questionnaire obtained, a sample of healthcare workers was selected with the inclusion criteria used, namely fully vaccinated healthcare workers, healthcare workers who have been fully vaccinated and had COVID-19 (2-4 weeks post-vaccination), and fully vaccinated healthcare workers who had COVID-19 then experience the long-haul effects of COVID-19. The exclusion criteria are non-healthcare workers who have not been fully vaccinated.

The cascade analysis was then used to analyze the data and determine the problems at each stage of the COVID-19 vaccine effect in healthcare workers. This is so that the data obtained can be used to evaluate the achievements at each stage and provide results for the effectiveness of the COVID-19 vaccine for healthcare workers. The cascade analysis was done by designing the chart based on the inclusion criteria used in data collection with percentages on each and then analyzing the factors that affect the percentage gain from each compartment. This research has been approved by the Ethical Committee of Public Health Faculty, Airlangga University No: 50/EA/KEPK/2021.

Results

After processing the data, 525 respondents out of 529 respondents met the inclusion criteria. The characteristics of the respondents are presented in Table 1. The collected data was then made into cascade analysis chart in Figure 1

Table 1. Respondents Baseline Characteristics

Variable	Number of fully vaccinated respondent (n=525)
Gender	
Men	62 (11,8%)
Women	463 (88,2%)
Age	
17-30	252 (48%)
31-45	255 (48,6%)
>45	18 (3,4%)
Covid-19 History	
Ever Infected	69 (13,1%)
Never Infected	456 (86,9%)

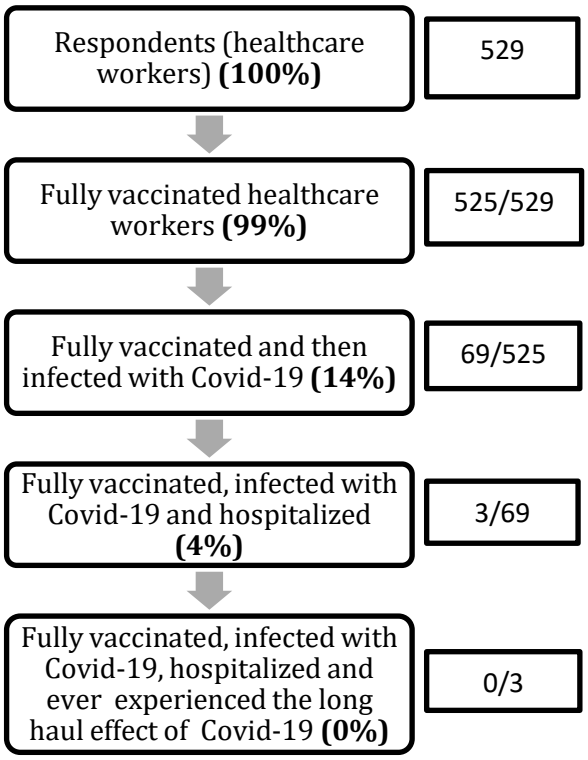

Figure 1 Cascade Analysis

Discussion

Based on the cascade analysis chart that was made, it is possible to analyze the effectiveness of the covid-19 vaccine on health workers, as follows:

1. Fully vaccinated healthcare workers

Indonesia reported a total of 4,198,678 COVID-19 cases as of September 22, with 2720 new cases and a total of 1,812,532 (123.41%) health workers who had been vaccinated (COVID, 2020). The difference in the percentage of health workers who have had the first vaccination but have not vaccinated the second is approximately 8.6%. Based on these data, it can be concluded that the vaccination process for health workers is going very well in Indonesia with achievements exceeding the target number of health workers in Indonesia. Sample of 529 health workers was obtained with 525 people from the sample having received complete vaccinations (vaccination 1 and 2). Thus, it can be seen that there are 99% of health workers from the entire sample who have had the second vaccination. The 1% difference may be caused by problematic vaccine distribution or the condition of health workers who cannot get the vaccine.

Based on studies on the ChAdOx1 nCoV-19 vaccine, it was found that a long interval between the first and second doses resulted in a higher antibody response compared to a shorter interval. This finding is also consistent with previous data showing that a longer interval between the first and second doses of ChAdOx1 nCoV-19 resulted in an increase in antibody titers, so for this type of vaccine provides further assurance that delaying the administration of the second dose will not compromise the level of protection achieved (Antonelli et al., 2021).

2. Fully vaccinated healthcare workers and then infected with Covid-19

Based on data obtained through questionnaires, from 525 health workers who have been fully vaccinated (vaccination 1 and 2) there are 69 (14%) people who are still infected even though they have been fully vaccinated. These results are in line with the results of a study conducted at a hospital in Indonesia, the results obtained from 1040 health workers who were fully vaccinated, there were 13 people (1.25%) who were infected with Covid-19(Cucunawangsih et al., 2021). Health workers who are vaccinated remain at risk of being infected, with the number of COVID-19 cases in Indonesia will increasing the risk of COVID-19 infection. Complete vaccination aims to develop immunity by forming post-vaccine antibodies within 2-4 weeks (Wei et al., 2021). Post-vaccination covid-19 infection can be influenced by several factors, there is an increased risk of being infected with COVID-19 in individuals aged >55 years compared to those age ≤55 years (Age >55 years tend to achieve low levels of antibody formation and slower formation compared to individuals younger)(Flaxman et al., 2021), in individuals with comorbidities and in individuals with a Body Mass Index 30 or more compared with < 30 (Menni et al., 2021).

In addition, post-vaccination covid-19 infection can also be affected by the history of COVID-19 infection. Individuals who have been infected with COVID-19 before, after the first vaccine will have antibody titers that are closer to the titers obtained after the second dose compared to the previously uninfected group, so the risk of re-infection after vaccination will be smaller. In addition, it is known that male gender also affects post-vaccination infections (Antonelli et al., 2021). Based on the data obtained, it can be seen that the majority of the participants were male and the majority were young and middle-aged adults, resulting in a low outcome of infected health workers after complete vaccination (14%). Several types of covid-19 vaccines have different results for the length of time for antibody formation so that they can affect the protection of health workers against COVID-19. In several previous studies, it was found that the highest post-vaccination antibody titers were seen in the 3 to 6 months post-vaccination period (Antonelli et al., 2021; Flaxman et al., 2021). To minimize the risk of health workers being infected with Covid-19, it is necessary to carry out routine laboratory checks such as PCR Swabs/antigens and antibody serology to reduce the risk of infection between health workers and transmission to the environment outside health services.

3. Fully vaccinated healthcare workers, infected with Covid-19 and hospitalized

Based on previous data, from the 69 health workers who are still infected with Covid-19, there are 3 health workers who experience severity and undergo treatment at the hospital. At the time of infection with Covid-19, individuals without vaccination were more likely to show severity compared to individuals who were fully vaccinated, either for the number of symptoms in the first week of infection or the need for hospitalization. From the data we have collected, it is known that health workers with complete vaccination status are still at risk of experiencing severity when infected with Covid-19, although only 3/69 (4%). Age and comorbidity are factors that cause severity (Petrilli et al., 2020). The percentage of individuals with severity (risk of hospitalization, use of mechanical ventilation and even death) increases with increasing number of comorbidities such as diabetes, hypertension, and cardiovascular disease. In addition, age also affects the severity of COVID-19, several studies clearly state that ages >50, >64 or >65 have a risk of experiencing the severity of COVID-19 (Hu et al., 2020; Shoaib et al., 2021; Wei et al., 2021). There is a positive correlation between severity and antibody response (Antonelli et al., 2021). Health workers with severe COVID-19 infection will have higher antibody titers compared to the group with mild disease. The antibody titer obtained in the moderate/severe disease group will be higher than in the mild disease group. So that health workers with a history of the severity of Covid-19 infection will reduce the risk of reinfection by 84% and reduce the risk of infection with severity by 93% (Flaxman et al., 2021).

4. Fully vaccinated healthcare workers, infected with Covid-19, hospitalized and ever experienced the long haul effect of Covid-19

Long haul COVID is condition with previous symptom that still exists or is new in Covid-19 survivor (Sudre et al., 2021). Some of the frequently reported symptoms are shortness of breath, headache, chest pain, abdominal symptoms, myalgia, fatigue, cognitive difficulties, as well as anxiety and depression. Based on data obtained from 3 health workers who experienced severity, none of the health workers experienced the long haul effect of COVID-19. The experience of long haul Covid-19 is affected with the severity of the condition when infected with COVID-19. After a long period of intensive care and mechanical ventilation, anesthesia and disease severity, it is not surprising that a long rehabilitation period is required due to the long haul effects of COVID-19(Carfì et al., 2020). Antibody titers will be higher in individuals with severe, but at risk of causing long-haul Covid due to the long-term effects of organ damage (Antonelli et al., 2021), also women have a greater risk of experiencing the long haul effects of COVID-19 (Nabavi, 2020) but in some studies found that several cases of long haul covid also occurred at a young age and individuals with mild symptoms of Covid-19 (Taquet et al., 2021). The 0% of healthcare worker who experienced the long haul covid-19 may be caused by the low severity in covid-19 history and only 3 from 69 healthcare workers who hospitalized also there are some possibility that the effect is not yet exist at the time of data collection. It is known that in some cases it shows a delayed effect of long haul covid (Taquet et al., 2021).

Conclusion

Health workers are still at risk of being confirmed by COVID-19 even though they have been fully vaccinated, especially because healthcare workers have a high risk of being exposed at work. Providing complete vaccination does not reduce the risk of being infected by COVID-19, but it can reduce the severity and minimize the rise for long-haul effect of COVID-19. Post-vaccination RT-PCR, antigen, and antibody examinations need to be conducted to ensure that the healthcare workers' COVID-19 vaccine protection are enough to protect them.

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