

# Characteristics of Healthcare Workers Infected by COVID-19 in General Hospital Dr. Soetomo Surabaya

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## Abstract

The COVID-19 outbreak has affected the community in many aspects, especially healthcare workers as the frontline in COVID-19 treatment. The general objective of this research is to find out the characteristics of healthcare workers infected by COVID-19 in General Hospital Dr. Soetomo, by looking at the relation of healthcare workers' age, sex, occupation, and underlying medical condition with COVID-19 incidence. The collected data from 102 samples is taken using a questionnaire filled out by the healthcare workers of General Hospital Dr. Soetomo until July 2023. The collected data is processed, descriptively analyzed, and categorized based on the research variables as tables and graphics. The results of the study showed that the characteristics of healthcare workers with the most COVID-19 cases are 31–45 years old, female, the occupations at higher risk are doctor and nurse, medical disciplines in higher risk are anesthesiology and obstetrics & gynecology, and 26.5% of the infected respondents experienced reoccurrence. The number of COVID-19 cases among healthcare workers increased in 2021 despite the vaccination program by the government starting in 2021 but then decreased in 2022 and no cases in 2023. The number of cases among healthcare workers each year depends on the appearance of a new variant of the virus and the long-term effect of national vaccination coverage.

*Keywords: COVID-19; healthcare worker; hospital; good health and well-being*

## 1. Introduction

The coronavirus disease 2019 named COVID-19 outbreak has rapidly spread globally within a short period since first emerged in Wuhan, China in 2019. The Government of the Republic of Indonesia has reported a total of 6,812,670 confirmed COVID-19 cases and 161,895 deaths (KPCPEN, 2023).

The COVID-19 outbreak has affected the community in many aspects, especially healthcare workers as the frontline in COVID-19 management with a higher risk of exposure to the virus in their workplace. *Lapor Covid-19* in 2021 has recorded 1569 deaths due to COVID-19 among healthcare workers in Indonesia, with significantly high mortality occurring in East Java is 493 deaths in total (*Lapor Covid-19*, 2021). It is necessary for healthcare workers to be aware of their risks and to be more careful in carrying out their duties so that the increasing number of victims among healthcare workers can be suppressed.

This research aims to identify the characteristics of healthcare workers infected by COVID-19 in General Hospital Dr. Soetomo from March 2020 until July 2023. Of the 102 healthcare workers respondents in General Hospital Dr. Soetomo were involved in the study through a cross-sectional design. The main variables required are the age, sex, occupation and medical discipline, underlying medical disease, and the time they were infected by COVID-19 based on year.

## 2. Methods

This study is a retrospective descriptive study and was conducted in Dr. Soetomo General Academic Hospital in Surabaya, Indonesia from December 2021 to July 2023 and was approved by the local ethics committee (No. 1133/111/4/XII/2021). We conducted a retrospective survey of COVID-19 cases among healthcare workers who worked in Dr. Soetomo General Academic Hospital in Surabaya during the pandemic that started in March 2020 until this research was finished in July 2023. The criterion for inclusion is based on the age above 19 years old and those healthcare workers who actively worked during the pandemic in Dr. Soetomo General Academic Hospital in Surabaya. The sampling technique used is random sampling.

We observed several variables in this study. The data from both offline questionnaire papers and online questionnaire forms were gathered, analyzed, and presented in tables and graphics. The variable data included the age, sex, occupation and medical discipline, underlying medical condition during the infection, and the time the healthcare workers received their vaccination against COVID-19. Data categorization was performed using Google Sheets. Data visualization was performed using Microsoft Excel as tables and graphics.

### 3. Results

Upon data extraction of a total of 102 healthcare workers in General Hospital Dr. Soetomo, 83 (81.37%) have experienced COVID-19 infection and 19 (18.62%) have never been infected by COVID-19 since March 2020 until July 2023. The detailed information about the age and sex demography of the health workers will be explained below.

The range of age of this research's subjects are grouped into five groups from a total of 102 healthcare workers, the groups are 19–30 years old, 31–45 years old, 46–60 years old, and above 60 years old. Combining the result of Age and Sex Characteristics, it can be seen that the most common age group of healthcare workers infected by COVID-19 is 31–45 years old ( $n=49$ ; 59.03%) and female workers are the group with the greatest number of COVID-19 case ( $n=50$ ; 60.24%).

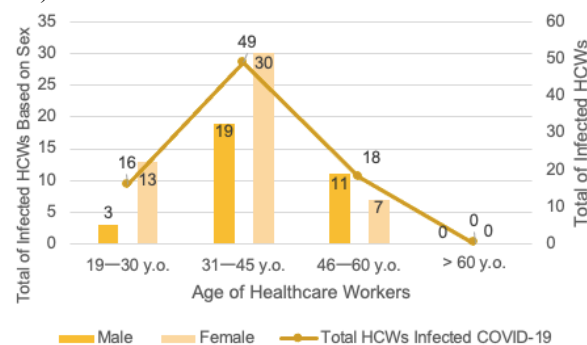


Fig. 1. Age and Sex Characteristics of Healthcare Workers Infected by COVID-19

Among 102 healthcare workers, 33 (32.35%) are doctors, 28 (27.45%) nurses, and 23 (22.55%) public health officers. The highest number of healthcare occupations infected by COVID-19 are doctor ( $n=25$ ; 30.12%), nurse ( $n=23$ ; 27.71%), and public health officer ( $n=18$ ; 21.69%).

Table 1. Occupation Categorization of Healthcare Workers Infected by COVID-19 in General Hospital Dr. Soetomo

Occupation	Infected by COVID-19	Percentage Infected (%)	Total	Percentage (%)
Doctor	25	30.12	33	32.35
Nurse	23	27.71	28	27.45
Public Health Officer	18	21.69	23	22.55
Biomedical Technician	6	7.23	7	6.86
Pharmacist	4	4.82	4	3.92
Physical Therapist	4	4.82	4	3.92
Medical Technician	2	2.41	2	1.96
Nutritionist	1	1.20	1	0.98
Midwife	0	0.00	0	0.00
Clinical psychologist	0	0.00	0	0.00
Traditional health worker	0	0.00	0	0.00
Environmental health officer	0	0.00	0	0.00
Total	83	100.00	102	100.00

For doctors, the medical discipline with the greatest number of COVID-19 incidences are Anaesthesiologist (n=5; 20.0%) and Obstetrics and Gynaecology (n=4; 16.0%), while no one from the total of 3 General Practitioners respondents is infected (n=0; 0.0%)

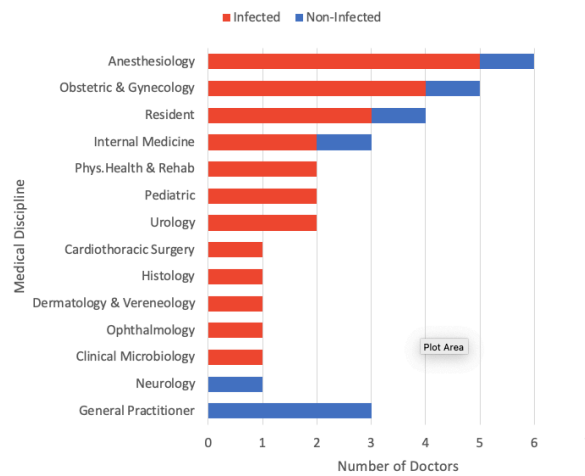


Fig. 2. Medical Discipline of Doctors Infected by COVID-19 in General Hospital Dr. Soetomo

As for the nurse, the medical discipline with the most number of COVID-19 incidents is a general nurse who doesn't belong to a specific department unit (n=6; 26.09%), the second is the nurse who works in the Anaesthesiology department (n=4; 17.39%).

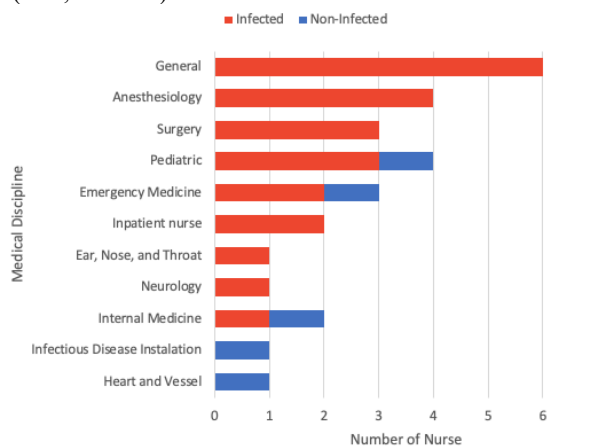


Fig. 3. Medical Discipline of Nurses Infected by COVID-19 in General Hospital Dr. Soetomo

It was discovered that the most common underlying medical conditions are Obesity (n=17; 20.5%), Pregnancy (n=7; 8.4%), Hypertension (n=6; 7.2%), Lung & Respiratory disorder (n=4; 4.8%), and Diabetes Mellitus (n=3; 3.6%).

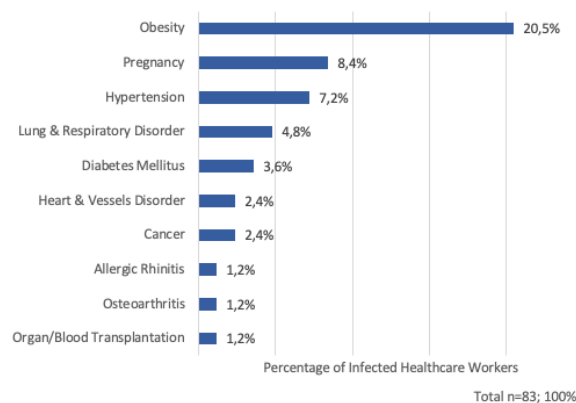


Fig. 4. Underlying Medical Conditions of Healthcare Workers Infected by COVID-19

The healthcare workers infected by COVID-19 are Passive Smoker (n=18; 21.7%), Former Smoker (n=2; 2%), and Active Smoker (n=3; 3.6%).

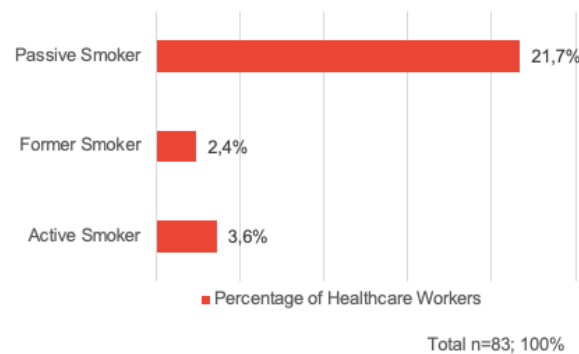


Fig. 5. Smoking History of Healthcare Workers Infected by COVID-19

Out of 83 healthcare workers who were infected by COVID-19, 61 (73.49%) were infected only once, 19 (22.89%) experienced reoccurrences once or were infected twice in total, 2 (2.41%) were infected three times, and 1 (1.2%) were infected four times. The same chart also shows the number of vaccination status based on infection occurrence.

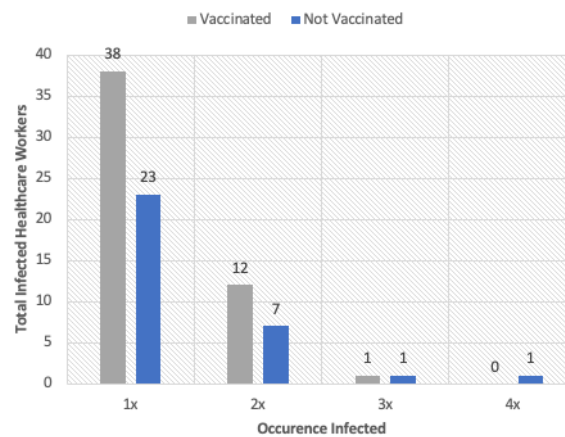


Fig. 6. The Occurrence of COVID-19 Among Healthcare Workers Divided by Vaccination Status

It is reported that 30 (36.1%) of the healthcare workers were infected in 2020 or before the vaccination program started. After the vaccination program started in January 2021, 33 (39.8%) of the healthcare workers were infected in 2021 and 20 (24.1%) were infected in 2022. No one (0%) of the healthcare workers in this research were infected by COVID-19 in 2023.

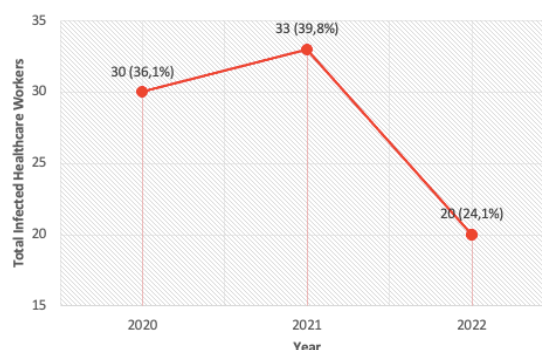


Fig. 7. COVID-19 Incidence Among Healthcare Workers Based on Year

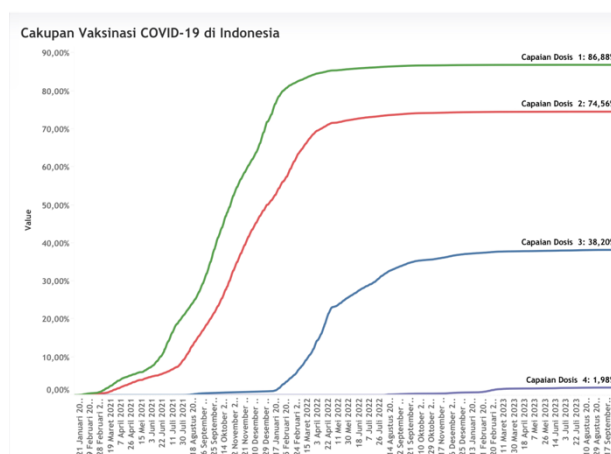


Fig. 8. COVID-19 Vaccination Coverage In Indonesia (KPCPEN, 2023)

## 4. Discussion

### 4.1. Demography of Healthcare Workers Infected by COVID-19

The total number of respondents in this research is 102 active healthcare workers in General Hospital Dr. Soetomo Surabaya from March 2020 until July 2023 who filled out the questionnaires. In this research, the most common age group is 31–45 years old (56.86%). This data indicates the work setting in hospitals wherein young adults or 19–30 years old (19.6%) are the busiest age group and therefore inhibited from participating in this research. For the age group above 60 years old, the percentages are unable to be determined due to the lack of respondents that belong to those groups that filled out the questionnaires due to most of the older adults more than 60 years old working from home or have already retired.

This research focused more on active healthcare workers during the pandemic until the time this research was conducted. Of the healthcare workers infected by COVID-19 ( $n=83$ ), 49 (59.03%) belong to 31–45 years old thus making them the most infected age group in this research. This age group consisted of active adults working in the health sector who mostly have reached stability in their jobs and thus have more spare time to be the respondents of this research. The age 31–45 years old group is also the group with the most COVID-19 cases in Province Jambi (Faridah et al., 2022). Although the incidence among older adults above 60 was not able to be obtained in this research, it is important to note that COVID-19 mortality and patients who required ICU care belong to this age group (Wang, D, 2020)

Based on sex grouping, there are more female (62.74%) than male healthcare workers (37.25%) in this research. It is possibly because most of the respondents' occupations are doctors and nurses with slight differences, and traditionally in this present day, there is still a tendency for more female nurses compared to male nurses in Indonesia which impacts the result of this research. The incidence rate of COVID-19 infection is higher in females (60.24%) than in male workers (39.75%). This number matches with the data provided by the government that stated there are more female COVID-19 patients compared to males (KPCPEN, 2023).

### 4.2. The Proportion of COVID-19 Incidence Between Each Occupation And Medical Discipline of Healthcare Workers

In hospitals, healthcare workers are at high risk of infection because they are likely to be in contact with patients and colleagues. This research shows that there are more infected doctor respondents in total 25 (30.12%), 23 infected nurses (27.71%), and 18 infected public health officers (21.69%). Doctors and Nurses are health professionals who have direct contact with patients longer than other health professionals, especially nurses (Ridlo, 2021), while public health officers such as receptionists have a high risk of contact with a greater number of undiagnosed patients on their first visit. This result matches a scooping review in multiple countries that stated that doctor and nurse are the two occupations with the most COVID-19 cases and deaths (Bandyopadhyay et al., 2020).

Breaking down on the medical discipline or working place of infected doctors, 5 (20.0%) doctors worked as anesthesiologists, 4 (14.0%) doctors are obstetric & gynecologist, while no one from the total of 3 General Practitioners respondents is infected ( $n=0$ ; 0.0%). General Hospital Dr. Soetomo is known as the biggest referral hospital in East Java, so most of the patients are referred from other hospitals or public health centers and seeking advanced medical services, which is why the number of infected healthcare workers is low for general

practitioners and high in specialized doctors. For the infected nurses, 6 (26.09%) nurses worked in general wards, 4 (17.39%) worked in the anesthesiology department, 3 (13.04%) nurses worked in the surgical department, and 3 (13.04%) nurses worked in the pediatric ward. Doctors and nurses who work in the anesthesiology sector have the highest number compared to other medical disciplines, most likely because COVID-19 patients who manifest severe symptoms need to be treated in the ICU or observation unit where the anesthesiologists and nurses work. The second medical discipline where the infection most occurred is obstetrics and gynecology because obstetricians must treat patients with COVID-19 and cannot delay the treatment because of the urgency. The risk of infection in maternal health service is still considered high even though the maternal health management in General Hospital Dr. Soetomo including protection for health workers has been taken care of carefully with the use of PPE level 3 in childbirth assistance (Laksana, M.A.C., et al, 2020)

The case number of lung and pulmonary specialized doctors was expected to be high due to them being on the frontline in the COVID-19 pandemic. Since this research used the random sampling method, it caused a limitation in the respondent distribution, including respondents from lung and pulmonology departments. Furthermore, the low number of infections among lung and pulmonary specialized doctors could be because they are used to treat airborne or droplet-transmitted patients, and it has been always part of the procedure to wear the proper PPE on a daily basis thus making them more prepared to face this pandemic.

To ensure optimal service to COVID-19 patients while maintaining the protection and safety of the healthcare workers, it is not only the government or health ministry, but the role of hospital managers is also certainly essential. It is also necessary to consider the high workload on health workers during the pandemic which caused mental health problems among health workers. (Ridlo, 2021)

#### 4.3. Underlying Medical Condition

It was discovered that the most common underlying medical conditions are (20.5%) Obesity, (8.4%) Pregnancy, (7.2%) Hypertension, (4.8%) Lung and Respiratory disorder, and (3.6%) Diabetes Mellitus.

Obesity is the most common comorbid disease accompanying COVID-19 in this research. It was found that 2 respondents answered that they were obese, but after calculating the BMI based on their height and weight, there are 17 people in total with BMI score of more than 30 points which can be categorized as obese by WHO. It was unknown whether 15 healthcare workers were unaware of their obesity, or they refused to fill it out. Several studies have stated how obesity and overweight can increase the risk of severe illness from COVID-19 due to some factors such as a significant correlation between obesity, disease severity, and mortality has been reported in the H1N1 influenza virus pandemic in 2009. Obesity has been associated with the decrease of T-cell receptors, the inhibition of the number of T-cells in the lymph nodes, and a decrease in the ability of the immune system to effectively recognize foreign antigens (Budi et al., 2021) or impaired immune function (Tanaka et al, 2001) (Alwarawrah et al, 2018) and Obesity decreases lung capacity and reserve and can make ventilation more difficult (Simonnet et al., 2020). Obesity is a risk factor for difficulty in intubation and oxygen mask ventilation therapy.

After obesity, the data collected shows the comorbidity accompanying COVID-19. There are Hypertension (7.2%), Lung & Respiratory Disorder (4.8%), Diabetes Mellitus (3.6%), Cancer (2.4%), and Cardiovascular disease (1.8%). COVID-19 patients with hypertension, chronic obstructive pulmonary disease (COPD), diabetes, malignancies, cardiovascular diseases, HIV, and other comorbidities could develop a life-threatening situation (Ejaz et al., 2020), this list of diseases is shown as the most common comorbidities in this research shown in Figure 4. Regarding hypertension, a case report stated that hypertension as a comorbid has not always been proven to be burdensome to the degree of COVID-19 as long as the hypertension sufferer is taking medication regularly, however, anyone with comorbidities should always be well anticipated if COVID-19 attacks them (Rosyid et al., 2021)

Regarding the pregnancy status during the time the healthcare workers were infected by COVID-19, among the 64 (62.74%) female workers, 7 people were pregnant. As for organ or blood transplantation before infection, only 1 out of 83 infected HCWs (1.2%) received transplantation while the rest didn't receive it.

Associated with underlying medical condition, the smoking history of healthcare workers infected by COVID-19 are shown in Figure 5. Although most of the infected healthcare workers are non-smokers (93.9% never smoke and 2.4% are former smokers who stopped smoking long before the infection), the number of passive smokers reached 21.7%. As concluded by an analysis by Patanavanich et al, smokers have 1.91 times the odds of progression in COVID-19 severity than never-smokers (Patanavanich et al, 2020). According to a literature review by WHO, there is no evidence to quantify the risk to smokers of infection by SARS-CoV-2 found in the peer-reviewed literature, but smoking is associated with increased severity of disease and death in hospitalized COVID-19 patients (WHO, 2020). The low number of active smokers in this research indicated the higher awareness of healthcare workers about the risk factors of many diseases including COVID-19 caused by smoking, but the relatively high number of passive smokers is worth taking note of.

#### 4.4. Occurrence And Vaccination Status



We tracked down that among 83 healthcare workers who were infected by COVID-19, 19 (22.89%) of them experienced reoccurrence once or were infected twice in total, 2 (2.41%) were infected three times, and 1 (1.2%) were infected four times. According to the infected healthcare workers, 51 (61.4%) of them have received vaccinations provided by the Indonesian government before, but they still get infected by COVID-19. Twelve out of 51 of the vaccinated healthcare workers had reoccurrence once and 1 had reoccurrences twice. The reoccurrence could be caused by the vaccination coverage by the government that has not covered everyone yet, and even if one has strong immunity against COVID-19, healthcare workers still have a high risk of re-infection because they are constantly exposed to infectious patients.

#### 4.5. Difference Between COVID-19 Incidence Among Healthcare Workers Before And After The Vaccination Program Started in January 2021

As of January 2021, the government of the Republic of Indonesia has provided COVID-19 vaccination to more than a million healthcare workers in Indonesia (KPCPEN, 2021). In this research, we determine the time period when the healthcare workers were infected by COVID-19 based on years, whether they were infected before the vaccination program started in 2020, or after the vaccination program started in early 2021 until this research was conducted in 2023. Healthcare workers were one of the prioritized groups that received the vaccination, hence the number of infected healthcare workers was expected to decrease after the vaccination program started.

In 2020, there were 30 (36.1%) healthcare workers who were infected by COVID-19. All of them were only infected once, which could mean that after the infection, they developed natural immunity against SARS-CoV2 and never had reoccurrence since most of them had not received vaccination, as the vaccination program by the government had not been started. Out of the 30 healthcare workers, 27 have no comorbidity, 2 have cancer, and 1 has lung & respiratory disease.

In 2021, there are 33 (39.8%) of the healthcare workers infected by COVID-19. As described earlier, the vaccination program started in January 2021 and healthcare workers are the prioritized group to receive it, so the number of cases was expected to decrease. However, as shown in Figure 7, there are more COVID-19 infections among healthcare workers in 2021 than in 2020. This could be caused by another factor such as the Delta variant outbreak in 2021 which is said to be more transmissible than the previously dominant Alpha variant and the original strain (Lamb, 2021). Another factor is the duration needed for vaccine distribution to healthcare workers. So, looking in wider view, the effect of the vaccine needs a year-long duration to be seen by looking at the number of infected people by year.

Compared to 2021, the number of COVID-19 infection cases among healthcare workers in 2022 significantly decreased, there are 20 (24.1%) healthcare workers in total. Looking back at Figure 8 about the vaccination coverage in Indonesia, the vaccination coverage was still low in early 2021 which affects the high number of infected healthcare workers in this research. However, in early 2022, The first dosage reached more than 80% coverage, a rather high number compared to the first half of 2021. This data matches the number of infected healthcare workers in this research: a higher number of infection cases caused by the low vaccination coverage in 2021 and a lower number of infection cases caused by the high vaccination coverage in 2022 (KPCPEN, 2023).

In 2023, no one (0%) of the healthcare workers in this research was infected by COVID-19. The number decreased significantly compared to 2022 and 2021. As reported by KPCPEN, the first dosage vaccination coverage for only healthcare workers has reached 139.34% and the second dosage reached 137.01% (KPCPEN, 2023). This data means all of the healthcare workers in Indonesia have received vaccination in 2023 and the high vaccination coverage indicates the low number of infected people in 2023. In response to the improving situation, on June 9th, 2023, the Task Force for Handling COVID-19 issued a letter concerning Health Protocols During the Transition Period of Endemic Corona Virus Disease 2019 (COVID-19), which states "It is permissible not to use a mask if in good health and not at risk of contracting or transmitting COVID-19 and it is advisable to continue to use a mask that is properly covered if in an unwell condition or at risk of COVID-19, before and when traveling and activities in public facilities." (*Satgas COVID-19*, 2023). Although the COVID-19 situation in Indonesia has improved, it is still required for healthcare workers to be careful because their workplace still has the risk of another airborne-type disease transmission.

#### Strength and Limitations

Our study has several strengths and limitations. One strength is the fact that our study explores the COVID-19 incidence in each occupation of healthcare workers and the profile of age, sex, occupation, and underlying medical condition of health workers infected by COVID-19, so healthcare workers in their respective medical discipline can be informed about their risk of infection due to COVID-19 and be more careful in carrying their duty in the future possible airborne-transmitted disease pandemic. In addition, we could find the correlation between the vaccination coverage by the government for healthcare workers nationwide and its actual effect on

the number of COVID-19 cases among healthcare workers each year. The primary limitation of this descriptive research was the quantity of the data available to us. A wide range of data was needed to reach a more precise result, which made it difficult to achieve with limited human resources and budget. Furthermore, different occupations and medical disciplines have different availability to fill out the questionnaires which affects the result of the research. The mortality of COVID-19 among healthcare workers could not be assessed due to the questionnaire method which only allows living people to be the subject of this research.

## 5. Conclusion

The conclusion of this study is the healthcare workers group with a higher risk of COVID-19 infection are 31–40 age group, the female group, doctors and nurses who work in anesthesiology and obstetrics & gynecology field, passive smokers, and healthcare workers who have obesity, hypertension, and lung & respiratory disease. It is also observed that despite having been vaccinated, healthcare workers still have the risk of reinfection and the increase and decrease of COVID-19 case numbers among healthcare workers depends on the appearance of a new virus variant and the vaccination coverage by the government.

## Acknowledgments

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## Conflict of Interest

The author declared there is no conflict of interest.

## Funding

This study did not receive any funding.

## Ethical Clearance

The study was approved by KEPK (*Komite Etik Penelitian Kesehatan*) / Medical Research Ethics Committee of RSUD Dr. Soetomo Surabaya by the issuance of Letter of Exemption no. 0829/LOE/301.4.2/III/2022.

## Authors' Contributions

Designed the study and drafted the manuscript: YZE and AAF. Collected data and performed background literature review: YZE. Performed statistical analysis: YZE. Supervised results and discussion: YZE, AAF, AB, and ANR. All authors reviewed and approved the final version of the manuscript.

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