Risk Factors and Survival Analysis of COVID-19 Among Health Care Workers in West Jakarta Hospital

Virmandiani[1,2], Asri C. Adisasmita[2], Febby Elvanesa Sandra Dewi[1]*

[1]Harapan Kita Hospital, Jakarta, Indonesia.
[2]Department of Epidemiology, Universitas Indonesia, Jakarta, Indonesia.

Corresponding Author:
Virmandiani, MD. Harapan Kita Hospital. Jl. Letjen S.Parman Kav 87, Slipi, Jakarta 11420, Indonesia. Email: drvirmandiani@gmail.com.

ABSTRACT

Background: *The first two cases of Coronavirus Disease 2019 (COVID-19) were identified in Indonesia on March 2nd, 2020. Health Care workers (HCWs) are at risk of contracting COVID-19 infection. This study analyzed the risk factors, compared the prevalence rate of COVID-19 between HCWs and non-HCWs, and investigated survival analysis describing the time risk of COVID-19.* ***Methods:*** *This prospective cohort study retrieved data from the Hospital Surveillance Team (one of the largest hospitals in West Jakarta) which were analyzed using descriptive, bivariate analysis, Survival Analysis through the Kaplan-Meier method, and multivariate Cox analysis.* ***Results:*** *Observations were conducted on 1,080 employees from March 2021 to March 2022. There were 192 employees (17.78%) of 40±11 years tested positive for COVID-18, of which 126 cases (16.84%) were HCWs of ≤ 40 years of age, with females dominating. There was no difference between HCW and Non-HCW; ARR=1.08; [95% IK, 0.83-1.43]; p=0.591. Workers on shift work (> 38 hours in a week) were likely to be affected by COVID-19 with RR=1.37; [95% IK, 1.06-1.78]; p=0.018. Kaplan–Meier method and the log-rank test showed the difference between Shift and Non-shift groups HR=1.43; [95% IK 1.06-1.94]; p=0.019. Asthma or Chronic Obstructive Pulmonary Disease appeared as the independent factor of COVID-19 infection with RR=1.82; [95% IK, 1.10-3.02]; p=0.031.* ***Conclusion:*** *The probability of contracting COVID-19 was found equal to HCW and Non-HCW. Employees who are on shifts have a greater probability of contracting COVID-19. Survival analysis showed a statistically different Hazard Ratio between shifts with Non-shift workers.*

Keywords*: COVID-19; Health Care Workers*

INTRODUCTION

COVID-19 was first identified in China in December 2019 due to coronavirus SARS-CoV-2 infection that is believed to have originated from bats and was transmitted to humans before spreading among humans it is a global endemic, a public health emergency and a national disaster in Indonesia.[1] Indonesia reported its first COVID-19 cases on March 2nd, 2020 which number then rapidly increased. By December 31st, 2020,[2] there were 743,196 cases, requiring optimizing health resources to support COVID-19 patient care. Health workers played important roles in maintaining and improving community health. The number of COVID-19-positive health workers has increased tenfold since the initial report, highlighting the need to protect the health and safety of this workforce.

Health workers were grouped into: medical personnel (general practitioners, dentists, specialists, and dentist specialists), clinical psychology personnel, nursing staff, midwifery staff, pharmaceutical personnel, public health personnel, environmental health personnel,

nutritionists, physical therapy personnel, medical technicians, biomedical engineering personnel, traditional health workers and other health workers.[3] In April 2020, the Centers for Disease Control and Prevention (CDC) reported that health workers made up 3% of all COVID-19 cases in the US, but only 16% of these cases were reported through standard forms.[4] The number of health workers infected by COVID-19 increased tenfold. This condition shows the high transmission rate among health workers, thereby their health and safety need to be further protected.[5]

COVID-19 mortality rate among health worker was one of the highest in Asia and top three worldwide based on testing and population statistics and based on the data released by Indonesian Doctors Association (PB-IDI) Mitigation Team, the Indonesian Dentist Association (PDGI), the Indonesian National Nurses Association (PPNI), the Indonesian Midwives Association (IBI), the Association of Indonesian Medical Laboratory Technologists (PATELKI), and the Indonesian Pharmacists Association (IAI) In January 2021, 647 health workers confirmed positive for COVID-19, including 289 doctors, 27 dentists, 221 nurses, 84 midwives, 11 pharmacists, and 15 medical lab staff from 26 provinces and 116 cities/districts.[6]

With a higher risk of exposure to infectious diseases due to high exposure to pathogens, the death rate of health workers in Indonesia is among the highest in Asia and the top three worldwide. The death rate of health workers in Indonesia is the third highest worldwide and one of the highest in Asia. The literature about health workers and COVID-19 which highlights the importance of examining the risk of exposure between those on shifts versus those off shifts at health facilities is limited. This study aims to analyze the risk factors and survival outcomes for the workers in a hospital in the West Jakarta area as an evaluation to improve their survival rate for the next pandemic and its management, especially in the national referral hospital.

METHODS

Design Study

This is a prospective cohort study on health workers and non-health workers in a maternal and children national referral hospital, in Jakarta, Indonesia from March 2nd, 2020 to March 2nd, 2021.

Population and Sampling

The population of this study is hospital workers (health workers and non-health workers). A sample size of 1.080 was involved in the study. Employees at this hospital were regarded as Health Workers (according to Law of the Republic of Indonesia No. 36 of 2014, concerning Health Workers). They need to interact and touch the patients. Among health workers in this hospital, managerial staff were included in Non-Health Employees. Non-health employees are those not included in the operational definition of health workers. Employees who work in shifts have longer working hours (>38 hours a week).

Statistical Analysis

The baseline data (age, sex, comorbidities, and job) was obtained. The continuous data was expressed as mean $\pm$ SD and the categorical data as frequency (percentage [%]). A confidence interval (CI) of 95% was used in this study. Cox Regression analyzed the estimated risk of COVID-19 infection. It will be expressed as a Hazard ratio, a *p*-value of under 0.05 is indicated as statistically significant.

To obtain HR with Cox Regression, when a violation of the PH assumption occurred, an approach would be taken to evaluate the Proportional Hazard (PH) assumption of the Cox model, using a graphical procedure (both with log-log survival curves and expected-observed graphs). Goodness-of-fit (GOF) approach was also used to see the test results and p-values to assess PH assumptions, therefore researchers will be able to make more objective decisions.[7]

RESULTS

The study analyzed the risk factors and survival for COVID-19 between health workers and non-health workers in a hospital in West Jakarta. The results show that out of 1080 hospital

workers, 671 (62.13%) were health workers and 126 (18.78%) of them were confirmed positive for COVID-19. Meanwhile, 409 (37.87%) were non-health workers and 66 (16.83%) of them were confirmed positive for COVID-19 cases. No significant correlation was found between being a health worker or non-health worker and COVID-19 incidence (RR=1.16, 95% CI 0.88-1.53, p=0.270). The study also found that working as a shift worker was significantly correlated with COVID-19 incidence (RR=1.37, 95% CI 1.06-1.78, p=0.018). However, after stratification analysis for the shift variable, there was no significant correlation between health workers and COVID-19 incidence (RR=1.08, 95% CI 0.83-1.43, p=0.591). The presence of comorbidities was present in 40 workers (22.60%) and was not significantly correlated with COVID-19 incidence (RR=1.34, 95% CI 0.99-1.82, p=0.066).

However, employees with comorbid respiratory system disorders such as asthma or obstructive pulmonary disease (COPD) are at greater risk of getting infected with RR=1.82; [95% CI, 1.10-3.02]; p=0.031. Employees with hematological disorders also risk being affected by COVID-19 with RR = 2.84; [95%; IK 1.26-6.39]; p=0.038.

Employees with comorbid hypertension showed RR=1.43; [95% CI, 1.00-2.00]; p=0.063 and comorbid Diabetes Mellitus (DM) with RR=1.34; [95% CI, 0.99-1.82]; p=0.06; showing a statistically insignificant correlation with the COVID-19 prevalence.

Employees in outpatient and inpatient settings seem to be at greater risk of being exposed to COVID-19, with RR=1.52; [95% CI, 1.08-2.14]; p=0.01. After controlling for the health worker variable, we obtain ARR=1.64; [95% CI, 1.07-2.53]; p=0.204.

Table 1. Respondents' characteristics, risk factors, and the transmission risk of COVID-19.

Variables	Total N = 1080	COVID-19 n = 192	Non-COVID19 n = 888
Age (year), Mean (±SD)	39.5 ±11 years	40 ± 11 years	39 ± 10 years
≤ 40 years	665 (61.57)	112 (16.84)	553 (83.16)
>40 years	415 (38.43)	80 (19.28)	335 (80.72)
Sex, n (%)			
Male	276 (25.56)	48 (17.39)	228 (82.61)
Female	804 (74.44)	144 (17.91)	660 (82.09)
Type of Work, n (%)			
Shift			
Shift	564 (52.22)	115 (20.39)	449 (79.61)
Non-Shift	516 (47.78)	77 (14.92)	439 (85.08)
Profession, n (%)			
Health Worker	671 (62.13)	126 (18.78)	545 (81.22)
Non-Health Worker	409 (37.87)	66 (16.14)	343 (83.86)
Comorbid, n (%)			
Comorbid	177 (16.39)	40 (22.60)	137 (77.40)
Non-Comorbid	903 (83.61)	152 (16.83)	751 (83.17)
Asthma/PPOK, n (%)			
Yes	35 (3.24)	11 (31.43)	24 (68.57)
No	1045 (96.76)	864 (82.68)	181 (17.32)
Hematological Disorder, n (%)			
Yes	6 (0.56)	3(50)	3 (50)
No	1074 (99.44)	189(17.60)	885 (82.40)
Hypertension, n (%)			
Yes	107 (9.91)	26 (24.30)	81 (75.70)
No	973 (90.09)	166 (17.06)	807 (82.94)
Diabetes Mellitus (DM), n (%)			
Yes	26 (2.41)	2 (7.69)	24 (92.31)
No	1054 (97.59)	190 (18.03)	864 (81.97)

*adjusted for shift worker variable; **adjusted for health worker variable.

Table 2 presents that health workers and non-health workers have a similar average age of (40 ± 10 years) and (41 ± 12 years), respectively. They also have similar positive duration (from positive PCR to negative PCR duration) of a mean of 23 ± 20 days for health workers and 21 ± 23 days for non-health workers. However, health workers were more likely to require hospital treatment (73.85% of confirmed cases) compared to non-health workers (26.15% of confirmed cases). None of the subjects died and only one required intensive care. Health workers had symptoms such as fever 23 (76.67%), respiratory system disorders 37 (69.81%), and anosmia 30 (81.08%) at higher rates compared to non-health workers. The results of multivariate analysis showed shift work was the only factor affecting COVID-19 transmission among health workers with RR=1.45 [95% CI, 1.06-1.99].

The study analyzed the survival rate of 1080 hospital workers from March 2nd, 2020 to March 2nd, 2021 as shown in **Table 3**. The study found that 192 workers were diagnosed with COVID-19 with an incident rate of 0.0005149 per day. The incidence rate was higher for health workers (0.0005471) than for non-health workers (0.0004629). The study observed the workers for 365 days; the average observation time was 345.2593 days. No median survival rate was found because the number of COVID-19 cases did not reach 25% of the total employees at the end of the observation period. 192 subjects tested positive, with a Prevalence Rate of 0.0005149 per day, or 5 cases per 10,000 person-days. If 10,000 people were observed in 1 year there would be 5 workers who tested COVID-19 positive. Health workers have a 0.0005471 higher incidence rate compared to non-health workers 0.0004629. There was no median survival rate in this study because, until the end of observation, the number of subjects with an event (COVID-19) from all employees (observation subjects) did not reach 25%.

The survival probability of the non-shift workers until the end of the observation results was higher, namely 84.93% [95% CI, 0.81-0.87] compared to Shift Workers at 79.61% [95% CI, 0.76-0.82] was regarded as statistically significant (p=0.023). Employees' profession variable (Health Worker or Non-Health Worker) shows cumulative survival probability of non-health workers until the end of the observation results was higher i.e.: 83.86% [95% CI, 0.79-0.87] compared to Health Workers at 81.22% [95% CI, 0.78-0.83], with p=0.240, indicating no statistical difference. For the age group variable, employees aged up to 40 years until the end of the observation showed slightly higher i.e.: 83.16% [95% CI, 0.80-0.85]; compared to employees aged over 40 years 80.72% [95%

Table 2. Data by profession of respondents.

Variables	Health Worker n = 126 (65.62%)	Non Health Worker n = 66 (34.38%)
Age, Mean ± SD	40±10 years	41±12 years
≤ 40 years	73 (65.18%)	39 (34.82%)
>40 years	53 (66.25%)	27 (33.75%)
Positive mean duration	23±20 days	21±23 days
Needed hospital care, n (%)	48 (73.85)	17 (26.15)
Complaints, n (%)		
Fever	23 (76.67)	7 (23.33)
Respiratory disorder	37 (69.81)	16 (30.19)
Anosmia	30 (81.08)	7 (18.92)
Myalgia	9 (75)	3 (25)
Comorbid, n (%)	25 (19.84)	15 (22.73)
Hypertension	15 (42.31)	11 (57.69)
DM	2 (100)	0 (0)
Asthma/PPOK/Allergy	8 (72.73)	3 (27.27)
Hematological disorder	1 (33.33)	2 (66.67)
Reason for PCR, n (%)	66 (61.68)	41 (38.32)
Close contact at the hospital	13 (61.9)	8 (38.1)
Close contact with the family Suspect	42 (75)	14 (25)
Hospital routine screening	5 (62.5)	3 (37.5)

CI, 0.76-0.84]. However, the difference was not statistically significant (p=0.296). Analysis was not carried out for the gender variable since most of them were female. The Cox Regression risk analysis resulted in HR = 1.43 [95% CI, 1.06-1.94] p=0.019 for the Work Shift variable, implying the presence of a statistically significant difference in risk between the Shift Workers group and non-Shift workers. For employee profession variables (health workers vs. non-health workers), HR=1.11; [95% CI, 0.82-1.51]; p = 0.476 shows that there is no statistically significant difference in the risk of COVID-19 transmission rate between the groups.

In the age group variable, HR = 1.26 [95% CI, 0.94-1.70] p = 0.112 indicates that there is no statistically significant difference in the risk of COVID-19 infection among employees aged below and older than 40 years. The Goodness-of-Fit (GOF) results as shown in Table 3 conform to the proportional hazards (PH) assumption with p>0.05 proportional hazards (PH) values: Shift variable p=0.079 (p-value>0.05), health worker variable p=0.101 (p-value>0.05), age group variable p-value=0.947 (p-value>0.05).

The survival plot graph above shows that the cumulative probability of survival for the Non-Shift Workers and non-health workers groups was higher than for the Shift Workers and health workers.

The Log-log Survival curve and the expected-observed graph of three variables are parallel, thereby PH assumption is fulfilled based on the shift variable, health worker variable, and the age group variable.

Similar to the results of the Kaplan-Meier (KM) approach, the Log-log Survival curve of the Shift variable (shift code) and age group variable (usage) is parallel (consistent), showing that the assumptions based on the results of the Goodness-of-fit graph (**Figure 3**) are fulfilled. Whilst the health worker variable may not meet the PH assumption, Extended Cox analysis was used.

The Extended Cox model found that the health worker variable did not meet the Proportional Hazard (PH) assumption with a function of time or ln(t) based on the 210th day time cut point (t=210) determined from Kaplan Meier Log-log Survival Curves. A double Heaviside analysis was performed and followed by exponential calculations. The hazard ratio (HR) for Health Workers (1) versus Non-Health Workers (0) of <210 days g1(t) = 1, while g2(t) = 0

HR =exp[0.036*g1(t)+ 0.128*g2(t)]

HR = exp[0.036] = 1.03, that employees in the Healthcare group have a risk of 1.03 times higher [95%CI; 0.58-1.88] than the Non-Health Workers group on less than 210 days of observation.

HR Health Workers (1) vs Non-Healthcare Workers (0) at <210 days at >=210 days g1(t)=0, while g2(t)=1

HR = exp[0.036*g1(t)+ 0.128*g2(t)]

HR = exp [0.128] = 1.13 shows that employees in the health care group are at

Table 3. Survival probability based on patients' characteristics.

Variables	Survival Cumulative	LogRank	PH Assumption	Hazard ratio
Type of worker				
Shift Worker	79.61% [95% CI; 0,76 – 0,82]	p=0.023	0.079	HR=1.43; [95% IK 1.06-1.94]; p=0.019
Non-Shift Worker	84.93%, [95%IK; 0.81-0.87]			
Profession				
Health Worker	81.22%, [95%IK; 0.78-0.83]	p=0.240	0.101	HR=1.11; [95%IK 0.82-1.51]; p=0.476
Non-Health Worker	83.86%, [95%IK; 0.79-0.87]			
Age				
≤ 40 years	83.16%, [95%IK; 0.80-0.85]	p=0.296	0.947	HR=1.26; [95%IK 0.94-1.70]; p=0.112]
>40 years	80.72%, [95%IK; 0.76-0.84]			

1.13 times higher risk [95%CI; 0.81-1.62] of contracting COVID-19 compared to the Non-Health Workers group for more than 210 days of observation and so on.

Even though the GOF graph indicates a non-parallel figure, after calculating double Heaviside, it turns out that the risk before and after 210 days was not significantly different. It can be understood that the exposure to COVID-19 based on the health worker variable remained constant during the 1 year observation period.

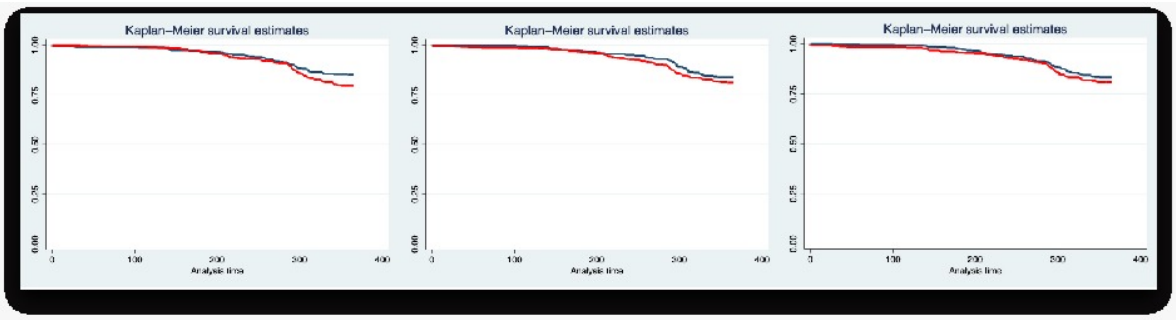

Figure 1. Graph of the cumulative probability for the incidence of COVID-19 survival on the shift variable (figure 1a), profession variable or health worker vs. non-health worker (figure 1b), and age group up to 40 years and over 40 years old

Description of images from left to right,
Figure 1a shift variable, the blue line Non-Shift worker, the red line Shift worker Figure 1b profession variable, the blue line Non-HCWs, the red line HCWs
Figure 1c age group variable

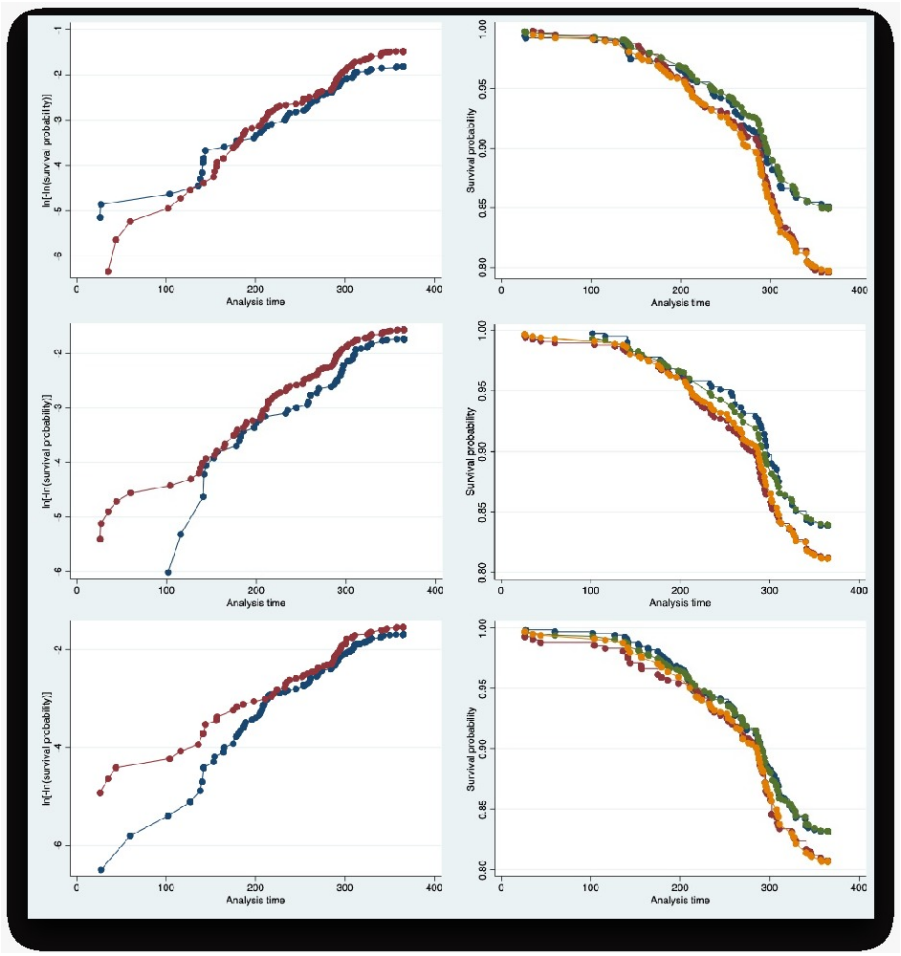

Figure 2. Log-log graph and The Expected-Observed graph.

Description of images from left to right, top to bottom
Figure 2(a) The Log-log Survival curve (aii) The Expected-Observed graph of shift variable, the blue line Non-Shift worker, the red line Shift worker
Figure 2(bi) The Log-log Survival curve (bii) The Expected-Observed graph of profession variable, the blue line Non-HCWs, the red line HCWs
The Log-log Survival curve and the Expected-Observed graph of three variables are parallel which shows that the PH assumption is fulfilled based on the Shift variable (figure 2a), profession or HCW variable (figure2b), and the age group variable (figure 2c)
Figure 2(ci) The Log-log Survival curve (cii) The Expected-Observed graph of age group variable, the blue line up to 40 years, the red line over 40 years old

DISCUSSION

Most of the confirmed COVID-19 cases were employees at the age of <40. This finding is similar to the one of Diana, et.al and the prevalence of COVID-19 cases in Indonesia where almost one-third are in the 31-45 years age group (29.3%).[8] Female health workers have a higher transmission rate.[4,9,10] CDC also reported the median age of health workers confirmed COVID-19 is 42 years (interquartile range [IQR] = 32-54 years), 6,603 (73%) of whom were female. The data also confirmed that most of the health workers (6,760, 90%) were not hospitalized and the course of the disease appears to be milder, where only 1 person required intensive care.[5] Results of our study showed that health workers and non-health workers have the same probability of contracting COVID-19. Moreover, health workers and non-health workers who work in shifts with longer working hours (>38 hours a week) have a greater risk of contracting COVID-19. Employees with comorbid respiratory system disorders such as asthma, and chronic obstructive pulmonary disease are also at higher risk.

Although several studies have shown that major comorbidities such as hypertension and DM have a greater risk of being affected by COVID-19.[8,11,12] The Systematic Review results showed 372 articles that described comorbidities of 161,271 confirmed COVID-19 patients, where asthma was reported as a premorbid condition in only 2,623 patients or 1.6% of all patients. From a global asthma prevalence of 4.4%, the article concluded that asthma is not a major premorbid that contributes to the rise in COVID-19 cases. It is also possible that researchers or clinicians may lack detail or description about the pre-morbidities in COVID-19 patients.[13]

Our study found that employees with comorbid hematological disorders such as Thalassemia Beta Minor (3 people) and Hypercoagulation (3 people) are at greater risk of being impacted by COVID-19. Three of the 6 employees were confirmed positive for COVID-19. COVID-19 patients with hematologic disease can experience substantial morbidity and mortality. The annual meeting of the American Society of Haematology (ASH) reported an overall mortality of 28% for the first 250 patients admitted to ASH. Research Collaborative COVID-19 Registry for Haematology that the mortality or morbidity of COVID-19 stated that patients with hematological disorders had worse prognosis and most often were in acute leukemia, non-Hodgkin's lymphoma, and myeloma or amyloidosis. Overall, these findings support the consensus that mortality and morbidity related to COVID-19 significantly indicate the presence of withhold intensive therapies in patients with hematological disorders, therefore further studies are needed following the change in the direction

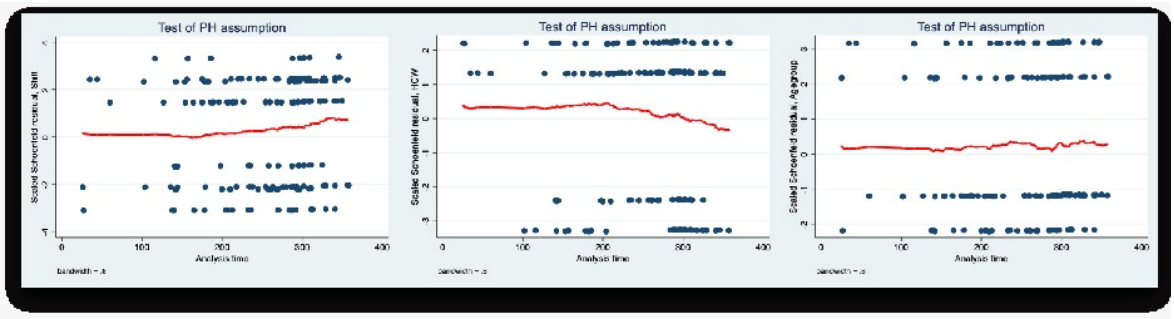

Figure 3. Goodness-of-fit graph.
Description of images from left to right, Figure 3a Goodness-of-fit graph of shift variable, Figure 3b, Goodness-of-fit graph of profession variable, Figure 3c Goodness-of-fit graph of age group variable

of treatment for underlying diseases. The findings of this registry are important to better understand how SARS-CoV-2 affects not only patients with hematological disease but also individuals who develop hematological complications related to COVID-19. However, it was also mentioned that the findings were limited due to the heterogeneity of the disease, symptoms, and treatments registered in the registry data. There is a need for research with more data to clarify these findings.[14]

Health workers confirmed with COVID-19 have different characteristics compared to the general population. A meta-analysis found that of 3,111,714 global COVID-19 cases, men have higher odds of being admitted to the ICU and of dying from COVID-19, even though the proportion of men and women confirmed with the disease was similar. Men have almost 3 times the odds compared to women and they need to be admitted to the Intensive Care Unit (ICU) with a higher risk of mortality. Gender differences will have important implications in clinical management and mitigation strategies. Since the location of this study is a maternity and children's hospital, male patients or male employees who tested positive for COVID-19 were referred to the COVID-19 Referral Hospital. In the United States, several pieces of literature show that the majority of confirmed health workers were female nurses and female nurse assistants.[4] Research shows that health workers have higher morbidity and mortality rates than non-health workers.[4] Yet, this finding should be confirmed in other studies involving more hospitals in Indonesia. All employees, both health workers and non-health workers must apply the appropriate Personal Protective Equipment (PPE) as they are often in close contact with COVID-19 patients. Health protocol adherence is crucial, especially when people are not at home. Health protocol compliance is a major factor that can help hold back the transmission of COVID-19.

Our study identified some common characteristics between health workers and non-health workers who were confirmed positive for COVID-19. One characteristic was the duration of positivity, with an average of 23 days for health workers and 21 days for non-health workers, from the time they received a positive PCR result to a negative result. Although the number of health workers confirmed with COVID-19 in Indonesia is high due to their potential exposure, the data showed that the possibility of infection was similar for both groups. Employees who provide direct medical services had the highest proportion of COVID-19 impacts. This highlights the importance of proper use and disposal of Personal Protective Equipment (PPE) in hospitals, as all patients, visitors, and employees have the potential to become asymptomatic confirmed cases. The 5M protocol must be mandatory for all hospital employees and visitors to ensure their safety, which includes wearing masks, washing hands with soap and running water, maintaining distance, avoiding crowds, and limiting mobility and interaction. The study also found that most cases were detected through contact tracing or close contact at the workplace and that most employees were confirmed to be asymptomatic. The majority of symptomatic employees reported fever and respiratory system disorders, with a higher incidence among health workers compared to non-health workers, which is in line with research by Dionita et al. in the general population of Indonesia.[8] Comorbidities such as hypertension and diabetes mellitus were dominating, similar to results from other studies conducted in the general population and among health workers.[8–10,15]

A Cox proportional hazards regression model analysis was performed, indicating no significant difference in cumulative survival between health workers and non-health workers, or between employees aged 40 and under and those over 40. However, a difference was observed between shift and non-shift workers, where longer working hours related to a higher likelihood of contracting COVID-19. Social-behavioral and cultural factors may also affect this condition. The longer an individual stays outside their home, the higher their risk of contracting the virus. However, with a better understanding of COVID-19 transmission and the vaccination since February 2021, the number of infected health workers has reportedly decreased. Further

research is necessary to compare the number of infections before and after vaccination.

Most COVID-19 infection cases in health workers are severe and the scarcity of personal protective equipment (PPE) is the most infection-related factor. The other risk factors of COVID-19 infection in health workers are work overload, inadequate or non-usage of PPE and poor hand hygiene, close contact with potentially infected people, the risk of aerosol-generating procedures, and late diagnosis of COVID-19, and inadequate air renovation in the negative pressure room. Also, the overload of the health system is an important factor for COVID-19 infection. As an example, the occupational medicine department in Spain was overwhelmed due to the COVID-19 pandemic, therefore both physicians and nurses from the different departments had to manage the pandemic. The survival rate was affected by several factors. Another study stated that age, gender, body mass index, and three respiratory symptoms affect the speed of negativisation of the PCR result The presence of dry cough and dyspnea can decrease the negativitasion rate of positive PCR result. Therefore, it is important to make strategies for the usage of PPEs, adequate training, and reinforcement of PPE usage, eye protection, and the adoption of standard precautions.[15,16]

Our study has several limitations including a potential non-differential information bias due to insufficient information and the inability to distinguish between different types of work that may have direct patient contact, such as cleaning staff who are non-health workers but have close contact with patients. It is also not possible to specifically determine the impact of health workers who do not have direct contact with patients, such as doctors in supporting services. More detailed data on subgroups of health workers is needed, such as non-health workers who have daily direct patient contact. Additionally, this study is limited to maternity and children's hospitals that are located in the epicenter of the COVID-19 pandemic in Indonesia. Hence, the findings of this study may not be generalized to other healthcare facilities. Finally, this study also excluded outsourced employees who may also have direct contact with patients.

CONCLUSION

In summary, health workers and non-healthcare workers have the same probability of being infected by COVID-19. Employees who work in shifts (work duration 38 hours/ week) have a greater probability of contracting COVID-19.

The results of the 1-year survival analysis showed no significant difference in the hazard ratio between health workers and non-health workers. However, workers who worked in shifts with an average working hour of 38 hours per week, showed a statistically significant difference in hazard ratio compared to non-shift workers. It is therefore crucial that surveillance programs at all health facilities are strengthened with adequate and sustainable strategies, such as timely testing and close contact tracing to test pre-symptomatic or asymptomatic cases, especially for employees who work in high-risk areas or are vulnerable (e.g. elderly or those with comorbidities). Establishing a standard protocol of PPE and PPE and personal hygiene training is necessary to decrease the transmission rate and increase the survival rate of infectious diseases in the hospital.

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