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REVIEW ARTICLE

Exposure to Empowerment in COVID-19: Healthcare workers' resilience for future Pandemics

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Abstract

Background: The COVID Health Care Workers (HCWs) were committed to the treatment of COVID patients during the pandemic. In this process, there was a high chance of acquiring and/or carrying the deadly infection to themselves as well as to their family members. Hence it was imperative to take all the necessary steps to provide protection to the HCWs, confining the spread of the virus. Using the WHO (World Health Organization) risk assessment tool, many researchers had evaluated the probability of spreading of COVID infection. In this paper, we tried to assess the risk of HCWs exposed to COVID-19 patients during the pandemic. **Methods:** A prospective cross-sectional study was carried out from August 2020 to August 2021 using WHO (World Health Organization) risk assessment tool. A total of 1600 HCWs, who worked in the COVID hospital were included in the study. The HCWs were divided into two groups high-risk group and a low-risk group. The HCWs who got confirmed exposure to COVID patients or their infected material were included in the high-risk group and others were included in low-risk group. The chi-square test and binary logistic regression analysis were done by using the SPSS 24 statistics application. **Results:** Females were more prone to the risk of infection than their male counterparts [OR 1.9 (1.13-3.28), p=0.015]. HCWs with confirmed exposure to COVID-19 patients were more prone to the risk of infection [OR 196.9 (19.78-1960.7), p=0.001]. The HCWs who were exposed to the biological secretory materials of the COVID-patients were more prone to COVID-19 infection, including the needle stick injury [OR 0.229 (0.056-0.931), p=0.039]. **Conclusions:** The study revealed that HCWs in the high-risk group were less infected than the low-risk group, which contradicts the common perception of HCWs that they will get an infection after the COVID duty.

Keywords: COVID-19, Risk of infection, Healthcare Workers, PPE, IPC practices, Risk ratio

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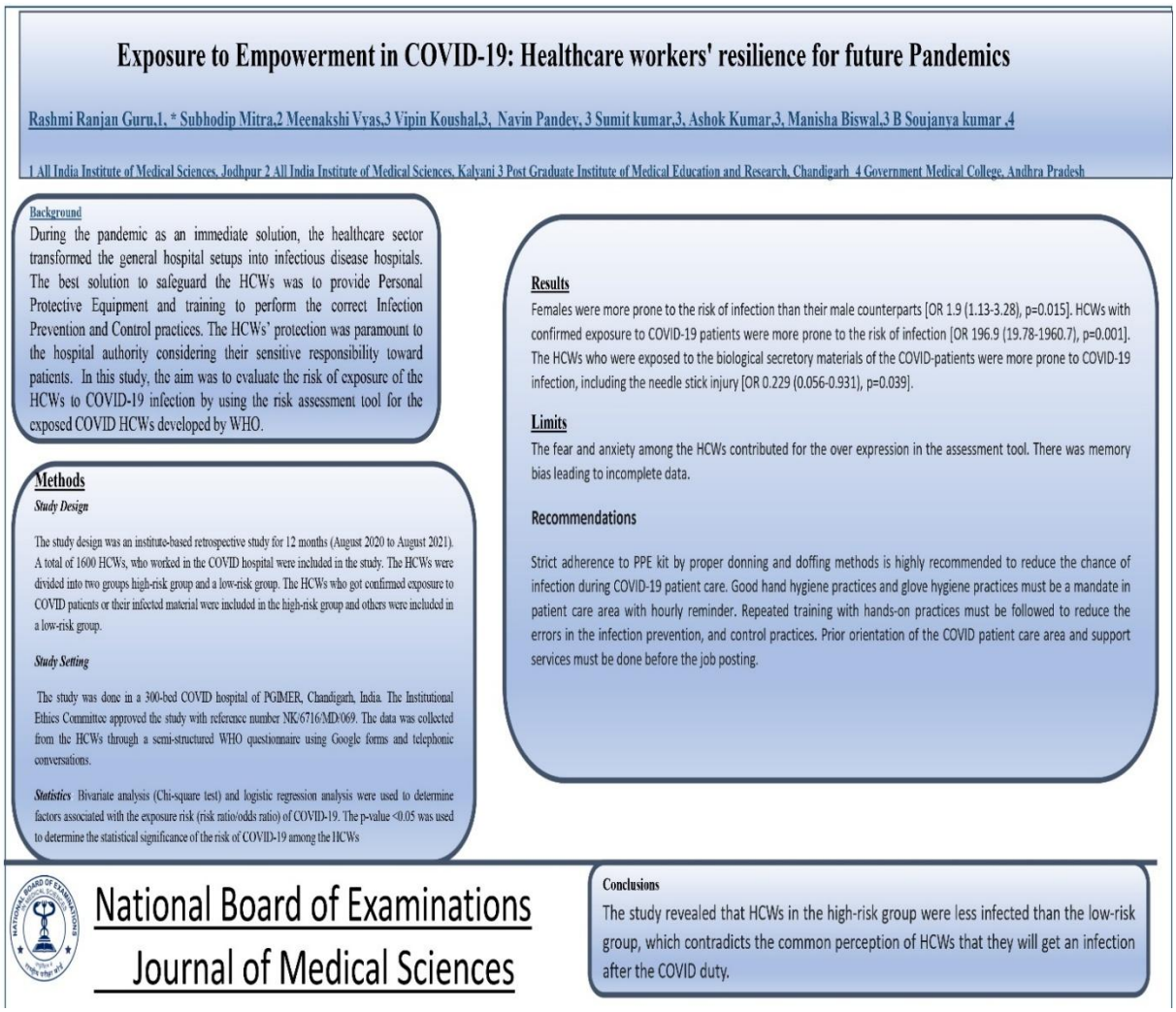
Graphical Abstract



Introduction

The Novel Coronavirus was first detected in Wuhan, China, in December 2019 [1]. World Health Organization declared COVID-19 as a pandemic after the spread of the infection in China in January 2020 [2]. HCWs were the direct targets of infection while attending the COVID struck patients. Protecting the HCWs from this deadly disease was an essential responsibility of society [3]. During the pandemic as an immediate solution, the healthcare sector transformed the general hospital setups into infectious disease hospitals [4]. The best solution to safeguard the HCWs was to provide Personal Protective Equipment and training to perform the correct Infection Prevention and Control practices [5]. The HCWs' protection was of utmost importance to the hospital authority considering their sensitive responsibility toward patients [6,7]. In this study, the aim was to evaluate the risk of exposure of the HCWs to COVID-19 infection by using the risk assessment tool for the exposed COVID HCWs developed by WHO [8].

Methods

Study design

The study design was an institute-based retrospective study for 12 months

(August 2020 to August 2021). A total of 1600 HCWs, who worked in the COVID hospital were included in the study. The HCWs were divided into two groups high-risk group and a low-risk group. The HCWs who got confirmed exposure to COVID patients or their infected material were included in the high-risk group and others were included in a low-risk group.

Study Setting

The study was done in a 300 bedded COVID hospital of PGIMER, Chandigarh, India. The Institutional Ethics Committee approved the study with reference number NK/6716/MD/069.

Data collection

The data was collected from the HCWs through a semi-structured WHO questionnaire using Google forms and telephonic conversations [8].

The questionnaire has three parts:
Part 1 - HCWs' socio-demographic information
Part 2 - Assessment of exposure to the COVID-19 virus
Part 3 - Adherence to infection prevention and control practices and use of PPE during healthcare interactions and procedures.

Statistics

Bivariate analysis (Chi-square test) and logistic regression analysis were used to determine factors associated with the exposure risk (risk ratio/odds ratio) of COVID-19. The p-value <0.05 was used to determine the statistical significance of the risk of COVID-19 among the HCWs.

Results

Part 1*: Socio-demographic data of HCWs*

Among the 1600 HCWs, 639 HCWs voluntarily replied to the questionnaire in the study. Among the participants, 123 became COVID-positive during patient care, and 516 successfully averted infection (COVID-negative). Of the study participants, 70 (56.91%) were male and 53 (43.09%) were female. Table 1 summarizes the socio-demographic characteristics of the participants.

Table 1. Socio-demographic Characteristics of participants

Variables	**% COVID +ve (N= 123)**	**% COVID -ve (N= 516)**	**Odds Ratio (CI=95%)**	**p-Value**
Sex				
Male	56.91	61.0	1.0(0.02-50.3)	*<0.001
Female	43.09	39.0	1	-
Age Group (Yrs.)				
18-24	10.57	26.0	1	-
25-34	59.35	58.7	2.4 (1.33-4.63)	*<0.003
35-44	22.76	13.0	4.3 (2.0-8.8)	*<0.001
45-54	7.32	2.3	7.7 (2.74-21.76)	*<0.001

Patient care Areas of the COVID Hospital				
WARD (HDU)	43.90	24.0	1	-
ICU (Intensive Care Unit)	26.82	37.0	1.80 (1.1-3.0)	*0.008
OT (Operation Theatre)	25.20	8.0	0.40 (0.2-0.7)	*0.003
Other Areas ****	4.06	31.0	8.15 (3.16-20.98)	*<0.001
Professional Status				
(Doctors)**	26.82	33.2	1	-
Nurses	36.58	26.2	1.73 (1.0-2.8)	*0.030
Technicians	7.31	3.8	2.34 (0.98-5.60)	*0.050
Others ***	29.26	36.8	0.9 (0.53-1.5)	0.725
Educational Status				
MD / MBBS / PhD	26.83	33.2	1	-
MSc. / BSc.	43.90	30.2	0.55 (0.33-0.89)	*0.015
Diploma / H.S.C /10+2	29.27	36.6	0.9 (0.53-1.5)	0.725
Experience				
<1 year	10.56	20.4	1	-
1-5yrs	59.34	54.3	2.0 (1.11-3.9)	*0.019
5-10yrs	22.76	17.8	2.4 (1.2-5.0)	*0.012
>10yrs	7.31	7.5	1.9 (0.75-4.83)	0.165

*p- value < 0.05; **Doctors- JR / SR / Faculty; ***Others – Hospital Attendant / Sanitary Attendant / Kitchen Bearer / Engineering staff; **** Other Areas- Ambulance / Resuscitation area / Dialysis / Radiology

***Part 2**: Assessment of Exposure status of the health professionals for COVID-19*

Out of 123 COVID-positive HCWs, 76.42% got COVID infection in the high-risk group and 23.57% of the low-risk group during the patient care (Table 2). Table 2 showed the Bivariate analysis of the COVID-19 HCWs Confirmed Exposure to the COVID-19 virus.

Table 2. Bivariate analysis of the HCWs with Confirmed Exposure to the COVID-19 virus

Variables	**% COVID +ve** (N=123)	**% COVID -ve** (N=516)	**Odds Ratio (CI=95%)**	**p-Value**
High risk	76.42	93.7	4.66 (2.6-8.0)	*<0.001
Low risk	23.57	6.3	1	-

*p- value < 0.05

Part 3: Adherence to IPC procedures during healthcare interactions

(i) Adherence to PPE kit
(ii) Adherence to Hand Hygiene
(iii) Accidental exposure with biological fluid material (Including Needle Stick injury)

In the study among the HCWs those who got COVID-positive infection, 18.70% were categorized as high risk, and 81.30% were categorized as low risk, with respect to adherence to the PPE. In the analysis of adherence to hand hygiene practice, 41.4% HCWs got COVID infection in the high-risk group and 58.53% in the low-risk group. In the analysis of the PPE adherence to aerosol generation procedure, among the COVID-positive HCWs, 17.07% were positive in the high-risk group, and 71.54% were positive in the low-risk group. In the analysis of adherence to hand hygiene during aerosol generation procedure among the COVID-positive HCWs, 27.64% were positive in the high-risk group, and 60.97% were positive in the low-risk group. In the analysis of exposure to biological fluid material including needle stick injury among the COVID-positive HCWs, 8.9% were positive in the high-risk group, and 91.05% were positive in the low-risk group. Table 3 showed a Bivariate analysis of the COVID-19 HCWs adherence to IPC procedures during healthcare interactions.

Table 3. Bivariate analysis of the COVID-19 HCWs Adherence to IPC procedures during healthcare interactions

Variables	**% COVID +VE** N=123	**% COVID -VE** N=516	**Odds Ratio** (CI=95%)	**p-Value**
Adherence to PPE				
High risk	18.70	12.02	0.59 (0.35-1.0)	*0.05
Low risk	81.30	87.98	1	-
Adherence to Hand Hygiene				
High risk	41.46	4.9	0.07 (0.04-0.123)	*<0.001
Low risk	58.53	95.1	1	-
Adherence to PPE (Aerosol-generating procedures) (N=109 +ve & N=475 -ve)				
High risk	17.07	4.8	0.23 (0.12-0.43)	*<0.001
Low risk	71.54	87.2	1	-
Adherence to Hand Hygiene (Aerosol-generating procedures) (N=109 +ve & N=438 -ve)				
High risk	27.64	7.3	0.17 (0.10-0.29)	*<0.001
Low risk	60.97	92.7	1	-
Accidents with biological fluid material (Including Needle Stick injury)				
High risk	8.9	24.0	3.0 (1.6-5.9)	*<0.001
Low risk	91.05	76.0	1	-

*p- value < 0.05

A binary logistic regression was done by considering the COVID status of the HCWs along with other factors such as age group, sex, area posting, type of HCWs, confirmed exposure to positive patients, exposure to the biological fluid of the patient, hand hygiene practice and adherence to PPE kit during the patient care and during aerosol-generating procedures taking as covariates. The females were 1.9 times more prone to COVID infection than their counterparts. Table 4 showed a Binary logistic regression analysis of the COVID-19 HCWs and associated factors in COVID Hospital, North India, 2021 (N=639).

Table 4. Binary logistic regression analysis of the COVID-19 HCWs and associated factors in COVID Hospital, North India, 2021 (N=639)

Covariates		**Adjusted Odds Ratio (CI=95%)**	**p-value**
Gender	Female	1.9(1.13-3.28)	*0.015
	Male	1	
Confirmed Exposure to COVID Patient	Yes	196.9(19.78-1960.7)	*0.001
	No	1	
Exposure To Biological Material	No	0.229(0.056-0.931)	*0.039
	Yes	1	

Discussion

The COVID-19 pandemic is a super spreading disease, which had created a crisis in the healthcare setup [9,10]. The HCWs were more prone to the infection of the COVID-19 virus because of their workplace and job responsibility [11,12]. In this study, 7.6% of HCWs got positive after the RT PCR report from the study place [13]. Similar studies were done on the infection rate of the COVID-19 HCWs found to be 3% in Italy, 9%in the Netherlands, and 18% in the UK [14]. To the best of the author's knowledge, this was the first study in the institute in north India, where the risk ratio (Odds ratio) of COVID-19 infection among the HCWs was calculated whereas limited similar studies were published globally [15].

Among the 639 HCWs, 123 HCWs got COVID-19 infection after seven days of duty (6hrs per day). The health professionals in the USA did studies that showed that the mean age of infection among the HCWs was 42yrs and in China was 37yrs [5]; wherein this study, the mean age of the HCWs was found to be 32yrs. Another study was done in the USA, suggesting the male sex was more likely to be infected than the female sex. In contrast, this study result showed that female HCWs were more prone to infection than male HCWs [16]. Our study results suggested similar high infectivity among the age group of 25-34 years compared to the age group of 18-24 years of the HCWs in a previous study done by Nguyen et al [17]. The HCWs with experience of 1-5 years were two times more likely to be infected than those with experience of less than 1year, and HCWs with 5-10years of experience were 2.4 times more likely to get the infection than those with less than 1year of experience. This explains that

experience and understanding the importance of the training is a vital factor in COVID-19 disease among HCWs [18].

The confirmed exposure of HCWs to COVID-19 patients, environment, and high-touch surfaces created a greater chance of infection; the results were statistically significant in this study and similar to previous studies [19-21]. HCWs with good adherence to PPE kits were less likely to be infected, which was similar to a study done in Bangladesh on adherence to PPE kits showed a protective factor against COVID-19 infection among the HCWs [22]. According to WHO recommendations, the N-95 mask exhibited a protective factor against COVID-19 infection among HCWs [23]. A previous study on ENT procedures showed an essential role of the N-95 mask in COVID-positive and COVID-19 suspected patients [24]. As reported by other studies, the HCWs with a habit of always hand hygiene practice were less likely to be infected, including those present during the aerosol-generating procedures [25]. A previous study stated that the decontamination of the patient care area and the high-touch surfaces had a significant role in preventing COVID infection; neglecting hand hygiene practice and decontamination practice will lead to infection among the HCWs [26]. Similar studies showed that using a PPE kit during aerosol-generating procedures became an asset to remain free from COVID infection [27][28]. The study showed proper use of goggles and face shields and following carefulness during needle use will prevent exposure to biological fluid and hence COVID-19 infection [29,30].

The result of binary logistic regression analysis showed female sex was two times more prone to infection than their counterparts. Confirmed exposure to COVID-19 patients showed a maximum chance of infectivity [19], and exposure to biological secretion materials of the positive patient showed a definite association with COVID-19 infection same as the results of other studies [30].

Interestingly, this study revealed that HCWs in high-risk groups were less infected than the low-risk group, which contradicts the common perception of HCWs that they will get an infection if they will go for the COVID-19 patient care.

Limitation of the study

The fear and anxiety among the HCWs contributed for the over expression in the assessment tool. There was memory bias leading to incomplete data.

Recommendations

Strict adherence to PPE kit by proper donning and doffing methods is highly recommended to reduce the chance of infection during COVID-19 patient care. Good hand hygiene practices and glove hygiene practices must be a mandate in patient care area with hourly reminder. Repeated training with hands-on practices must be followed to reduce the errors in the infection prevention, and control practices. Prior orientation of the COVID patient care area and support services must be done before the job posting.

Conclusion

The COVID-19 pandemic created fear and anxiety, particularly among the HCWs working in large healthcare setups. In developing countries like India, fewer HCWs provide care to the population so safeguarding the HCWs was a challenge for the administrators working in healthcare

setups. To protect the HCWs from COVID infection, the good practice of IPC was the utmost priority. A significant rate of infection among the HCWs was observed in the study. Poor adherence to PPE kit, improper use of N-95 masks, poor Hand Hygiene practice, exposure to biological fluid were analyzed and found significant to be significant contributory factors for the spread of the COVID-19 virus.

Statements and Declarations

Ethical Approval

The ethical approval of the study was approved by the Institute Ethics Committee, PGIMER, Chandigarh with approval no. NK/6716/MD/069.

Conflict of Interest

The authors declare no competing interests.

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