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Research Article

Incidence and the Factors Associated with Severe COVID-19 among Healthcare Workers in Kannur District of Kerala: A Longitudinal Study

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A B S T R A C T

Background: COVID-19 remains a challenge to healthcare workers (HCWs) all over the world since its emergence in the form of a pandemic. Keeping in view the vulnerability of HCWs to multiple exposures because of the nature of the service they are providing, the Government of India launched COVID-19 vaccination initially for the HCWs. The study intended to estimate the incidence of severe COVID-19, the factors associated with as well as the predictors of severe COVID-19 among the HCWs declared positive for Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2) in Kannur, a northern district of Kerala.

Methods: The study design used was a prospective observational, where the study population was HCWs declared positive for SARS-CoV-2 from January to July 2021 in Kannur district. Out of the total declared, 3014 HCWs were followed up for two months from their date of declaring positive for COVID-19, over the telephone as part of the district-level monitoring process under COVID-19 surveillance.

Results: Out of the total 3014 HCWs, 2604 (86%) reported at least one kind of symptom. Twenty cases belonged to severe COVID-19 and the severity of COVID-19 was found associated with factors like place of isolation, transmission of COVID-19 infection to the family members, history of COVID-19 vaccination, presence of more than one co-morbidity, having diabetes mellitus, having hypertension, presence of symptoms such as fatigue, vomiting and dyspnoea. 65 cases were COVID-19 re-infections and none of them were having severe COVID-19. On regression, the significant predictors obtained were the presence of vomiting, dyspnoea, diabetes mellitus, and a history of transmission of COVID-19 infection to the family members.

Conclusion: The disease severity can be predicted by the presence of co-morbidities, disease transmission, and certain clinical features.

Keywords: Healthcare Workers, Kerala, Severe COVID-19

Introduction

COVID-19 has remained a challenge to healthcare workers (HCWs) all over the world since its emergence,[1] and the pandemic was declared a public health emergency of international concern (PHEIC) on January 30, 2020.[2] Kannur, a northern district in Kerala reported its first case in March 2020[3] and in May 2020 COVID-19 started to peek out among HCWs. Though the risk of severe disease and death is higher among senior citizens and those with chronic diseases,[4] HCWs are more prone to getting infected because of their increased workplace exposure which contributes to a significant proportion of COVID-19 cases.[5] The severity of symptoms among patients infected with COVID-19 varies considerably from being asymptomatic to fatal[6] which depends mainly on the presence of co-morbidities.[7] Severe COVID-19 infections also lead to multiple long-term sequelae which in turn can affect the work productivity of HCWs.[8]

Keeping in view of protecting the vulnerable HCWs, the Government of India placed them as a priority group while launching COVID-19 vaccination on 16th January 2021.[9] Vaccination is the main strategy that helped not only to reduce the disease severity[10] but also to contain the pandemic. This study intended to estimate the incidence of severe COVID-19, to determine the factors associated with severe COVID-19 among the HCWs declared positive for Severe Acute Respiratory Syndrome Corona Virus-2 (SARS CoV-2) in the Kannur district of Kerala.

Methods

The study design used was a prospective observational study, where the study population was HCWs declared positive for SARS CoV-2 from January to July 2021 in Kannur district. Out of the total declared, 3014 HCWs were followed up for two months from their date of declaring positive for COVID-19, over the telephone as part of the district-level monitoring process under COVID-19 surveillance. The details were collected either directly from the HCWs or from their caretakers using a semi-structured questionnaire. The study variables included demographic details, occupational and disease-related factors andCOVID-19 vaccination. The COVID-19 positive HCWs were first contacted on a possible date soon after the date of the declaration of COVID-19 positive test result. Those who reported minor symptoms were followed up for a two-month period and those who were hospitalised and reported sick were more frequently followed up for the two-month period. The outcome variable studied during the two-month period was 'severe COVID-19', which was defined as those COVID-19 positive HCWs who died or required oxygen support, or intensive care unit (ICU) admission, or ventilator support during the monitoring period.

Confidentiality and privacy were maintained at every step of the investigation. The present study was the result of HCW surveillance done as instructed by the district medical officer (DMO), Kannur. Hence it was exempted from obtaining clearance from the institutional ethics committee. Data were entered into Microsoft Excel and analysed using the SPSS trial version. Quantitative variables were summarised using measures of central tendencies and qualitative variables were expressed as proportions. The chi-square test was used to compare differences observed in the two groups and binary logistic regression was done to pick out the significant predictors of severe COVID-19.

Results

Descriptive Analysis

A total of 3016 HCWs were declared positive during the study period. Because of the unavailability of full data, two HCWs were excluded while doing analysis. Among the 3014 HCWs followed for two months, 20 had severe COVID-19 and one of them died after 3 weeks of testing positive for COVID-19. Of the total, the majority were females (n = 2361; 78.3%), and the rest were males (n = 653; 21.7%). Among the female HCWs, 42 (1.7%) were pregnant. After being declared SARS CoV-2 positive, most of them were isolated at home (n = 2406; 79.8%), and some were isolated in a hospital (n = 608; 20.2%). The remaining study variables are described as given in Tables 1 to 4.

Bronchial asthma was the most commonly reported co-morbidity among the 3014 HCWs (n=143, 4.7%), and 90 HCWs had multiple co-morbidities. 86 percent (n=2604) of the HCWs reported exhibiting at least one symptom. The most common symptom reported was fever and the least common was rash. Figures 1 and 2, respectively, demonstrate the frequency distribution of co-morbidities and clinical characteristics among HCWs.

Table 1.Descriptive Analysis of Job-related Variables

Variables	Categories	Frequency	Percentage
Type of workplace	Government	1369	45.4
	Cooperative	389	12.9
	Private	1256	41.7

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Staff placement	Hospital	2914	96.7
	Field	100	3.3
Native district	Kannur	2699	89.5
	Other districts of Kerala	313	10.4
	Outside Kerala	2	0.1
Type of duty	COVID Duty	461	15.3
	Non-COVID duty	2553	84.7

Table 2.Descriptive Analysis of Health-related Variables

Variables	Categories	Frequency	Percentage
Co-morbidity	Yes	184	6.1%
	No	2830	93.9%
Multiple co-morbidities*	Yes	90	3%
	No	2924	97%

*Multiple co-morbidities referred to having more than one chronic illness, such as diabetes mellitus, hypertension, coronary artery disease, bronchial asthma, and thyroid disorders.

Table 3.Descriptive Analysis of Epidemiological Variables

Variables	Categories	Frequency	Percentage
Type of exposure	Workplace	1837	60.9
	Community	1177	39.1
Possible source of infection	From an identified source while taking COVID duty	107	3.6
	From an unidentified source while taking COVID duty	313	10.4
	From an identified source while taking non-COVID duty	818	27.1
	From an unidentified source while taking non-COVID duty	558	18.5
	From community (source other than hospital)	1165	38.7
	From a non-COVID setting while taking COVID duty	41	1.4
	Interstate travellers/ flight travelling	12	0.4
Disease transmission	Transmitted to family members	592	19.6
	Not transmitted to family members	2422	80.4
Family transmission	Transmitted from family members	551	18.3
	Not transmitted from family members	2463	81.7
Re-infection*	Yes	65	2.2
	No	2949	97.8
Vaccination status	Vaccinated with two doses	1518	50.4
	Vaccinated with a single dose	412	13.7
	Unvaccinated	1084	36.0

*Re-infection was defined as a case of COVID-19 infection that was previously diagnosed with COVID-19 no less than three months prior to the current episode.

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Table 4.Descriptive Analysis of Disease-related Variables

Variables	Categories	Frequency	Percentage
Death	Yes	1	0.03%
	No	3013	99.9%
ICU admission	Needed	10	0.3%
	Not needed	3004	99.7%
Oxygen support	Needed	16	0.5%
	Not needed	2998	99.5%
Clinical features	Symptomatic	2604	86.4%
	Asymptomatic	410	13.6%
COVID-19 outcome	Severe	20	0.66%
	Mild	2994	99.3%

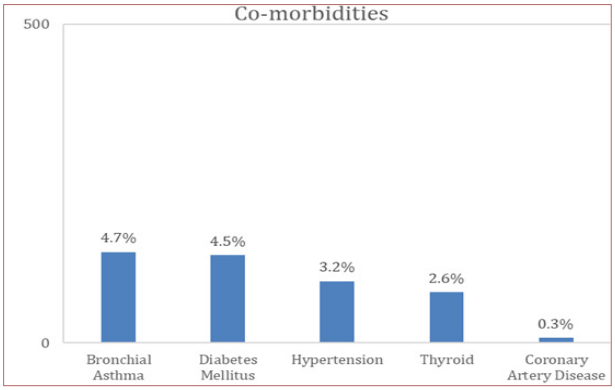

Figure 1.Frequency Distribution of HCWs with Co-morbidities (N = 3014)

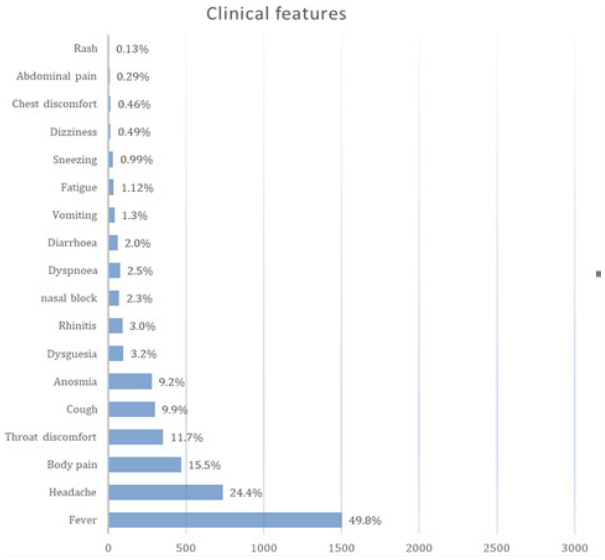

Figure 2.Frequency Distribution of Symptoms as Reported by HCWs (N = 3014)

Bivariable Analysis

Asymptomatic or minor symptoms that do not necessitate hospital admissions or death were defined as mild COVID-19 cases, whereas those who required ICU admissions, ventilator support, or oxygen support during the follow-up period were considered severe COVID-19 cases, including fatal COVID-19. None of the health care workers needed ventilator support during the follow-up period. Among the total, 20 HCWs (<1%) were classified into severe COVID-19 cases, including one COVID-19 death. A nested case control analysis was done where severe COVID-19 cases were grouped as cases and mild COVID-19 cases as the control group. Then, bivariable analysis was done to find out the factors associated with COVID-19, which are given in Table 5.

Among the job-related factors, none of the factors showed an association with COVID-19 severity, including the placement of staff either at the hospital or in the field. Similarly, the type of duty taken, and the kind of exposure were also not associated with the severity of the disease. The gender of HCW had no association with the severity of the disease. The severity of COVID-19 was found to be mildly associated (OR-1.03) with the place of isolation. The places of isolation were classified as hospitals and homes. All severe COVID-19 cases were isolated in hospitals.

Among the epidemiological factors, the only factor that showed an association was the transmission of disease to the family members. Those who had not transmitted COVID-19 infection to family members were found as a protective factor (OR-0.29) of severe COVID-19 whereas those who got infected from family members were found to have no association with the severity. The severity was strongly associated with multiple co-morbidities which was defined as the presence of having more than one co-morbidity (OR-8.4). It was found that no association was found with the presence of a single co-morbidity. Among the co-morbidities, the presence of diabetes mellitus (OR-7.17) and hypertension (OR-5.4) were strongly associated with the disease severity.

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The presence of any one of the clinical features was not associated with the disease severity while the presence of fatigue (OR-10.2), vomiting (OR-14.1), and dyspnoea (OR-35.7) were strongly associated with the disease severity.

Table 5.Bivariable Analysis

Variables	Category	Severe (%) N=20	Mild (%) N=2994	OR(95%CI)	p Value#
Staff placement	Hospital	20 (100%)	2894 (96.7%)	0.99 (0.990-0.996)	1.00
	Field	0	100 (3.3%)		
Place of Isolation	Hospital	20 (100%)	588 (19.6%)	1.03 (1.01-1.04)	**<0.001***
	Home	0	2406 (80.4%)		
Type of duty taken	COVID duty	3 (15%)	458 (15.3%)	0.977 (0.28-3.3)	1.000
	Non-COVID duty	17 (85%)	2536 (84.7%)		
Gender	Male	7 (35%)	646 (21.6%)	1.9 (0.77-4.9)	0.170
	Female	13 (65%)	2348 (78.4)		
Source of Exposure	Hospital	16 (80%)	1821 (60.8%)	2.5 (0.85-7.7)	0.106
	Community	4 (20%)	1173 (39.2%)		
Transmitted to family	No	11 (55%)	2411 (80.5%)	0.29 (0.12-0.17)	**0.009***
	Yes	9 (45.01%)	583 (19.5%)		
Transmitted from family	No	18 (90%)	2445 (81.7%)	2.02 (0.46-8.7)	0.56
	Yes	2 (10%)	549 (18.3%)		
Multiple co-morbidities	Yes	4 (20%)	86 (2.9%)	8.4 (2.7-25.8)	**0.002***
	No	16 (80%)	2908 (97.1%)		
Co-morbidity	Yes	3 (15%)	181 (6%)	2.7 (0.79-9.4)	0.119
	No	17 (85%)	2813 (94%)		
Diabetes Mellitus	Yes	5 (25%)	133 (4.4%)	7.17 (2.5-20.02)	**0.002***
	No	15 (75%)	2861 (95.6%)		
Thyroid disorders	Yes	1 (5%)	79 (2.6%)	1.9 (0.25-14.6)	0.417
	No	19 (95%)	2915 (97.4%)		
Hypertension	Yes	3 (15%)	94 (3.1%)	5.4 (1.5-18.9)	**0.025***
	No	17 (85%)	2900 (96.9%)		
Bronchial Asthma	Yes	2 (10%)	141 (4.7%)	2.2 (0.517-9.7)	0.245
	No	18 (90%)	2853 (95.3%)		
Coronary Artery Disease	Yes	0	8 (0.3%)	1.007 (1.004-1.01)	1.000
	No	20 (100%)	2986 (99.7%)		
Fever	Yes	12 (60%)	1490 (49.7%)	1.5 (0.61-3.7)	0.380
	No	8 (40%)	1504 (50.2%)		
Body pain	Yes	2 (10%)	466 (15.6%)	0.603 (0.139-2.6)	0.757
	No	18 (90%)	2528 (84.4%)		
Headache	Yes	5 (25%)	731 (24.4%)	1.03 (0.374-2.8)	1.000
	No	15(75%)	2263 (75.6%)		

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Anosmia	Yes	2 (10%)	278 (9.3%)	1.08 (0.25-4.7)	0.708
	No	18(90%)	2716 (90.7%)		
Fatigue	Yes	2 (10%)	32 (1.1%)	10.2 (2.2-46.17)	**0.02***
	No	18 (90%)	2962 (98.9%)		
Diarrhoea	Yes	0	61 (2%)	1 (1.004-1.010)	1.000
	No	20 (100%)	2933 (98%)		
Cough	Yes	2 (10%)	299 (10%)	1.001 (0.23-4.3)	1.000
	No	18 (90%)	2695 (90%)		
Rhinitis	Yes	2 (10%)	90 (3%)	3.5 (0.82-15.6)	0.123
	No	18 (90%)	2904 (97%)		
Throat discomfort	Yes	0	353 (11.7%)	1.008 (1.004-1.011)	0.158
	No	20 (100%)	2641 (88.3%)		
Dyspnoea	Yes	9 (45.1%)	67 (2.2%)	35.7 (14.3-89.1)	**<0.001***
	No	11 (55%)	2927 (97.8%)		
Dysgeusia	Yes	0	97 (3.2%)	1 (1.004-1.010)	1.000
	No	20 (100%)	2897 (96.8%)		
Vomiting	Yes	3 (15%)	37 (1.2%)	14.1 (3.9-50.1)	**0.002***
	No	17 (85%)	2957 (98.8%)		
Dizziness	Yes	0	15 (0.5%)	1.007 (1.004-1.010)	1.000
	No	20 (100%)	2979(99.5%)		
Abdominal pain	Yes	0	9 (0.3%)	1.007 (1.004-1.010)	1.000
	No	20 (100%)	2985 (99.7%)		
Sneezing	Yes	0	30 (1%)	1.007 (1.004-1.010)	1.000
	No	20 (100%)	2964 (99%)		
Nasal block	Yes	0	70 (2.3%)	1.007 (1.004-1.010)	1.000
	No	20 (100%)	2924 (97.7%)		
Rash	Yes	0	4 (0.1%)	1.007 (1.004-1.010)	1.000
	No	20 (100%)	2990 (99.9%)		
Chest discomfort	Yes	0	14 (0.5%)	1.007 (1.004-1.010)	1.000
	No	20 (100%)	2980 (99.5%)		
Clinical feature	No	0	410 (13.7%)	1.007 (1.004-1.010)	1.000
	Yes	20 (100%)	2584 (86.3%)		
Vaccination status	Vaccinated	7 (35%)	1923 (64.2%)	0.3 (0.11-0.75)	**0.009***
	Unvaccinated	13 (65%)	107 (35.8%)		
Re-infection	Yes	0	65 (2.2%)	1.007 (1.004-1.010)	1.000
	No	20 (100%)	2929 (97.8%)		

*p value < 0.05 is considered significant; # chi-square test

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Among the 3014 cases, 65 cases were re-infections and none of them had severe COVID-19 though no significant statistical association was obtained. Those who took at least one dose of the vaccine were found 70% more protective (OR-0.3) against severe COVID-19 disease.

Among the 3014 cases, 65 cases were re-infections and none of them had severe COVID-19 but no significant association was obtained. Those who took at least one dose of the vaccine were found protective (OR-0.3) against severe COVID-19 disease.

Multivariate Analysis

All the significant factors obtained in the bivariable analysis were considered for backward conditional logistic regression. The model significance obtained was very high (p value is <0.001) with Nagelkerke R square of 0.509. Hence, with a history of disease transmission to the family members, the presence of vomiting, dyspnoea, and diabetes mellitus, almost 50% of the occurrence of the disease severity can be predicted. The multivariate regression done is shown in Table 6.

Table 6.Multivariate Regression Analysis

Variables	Adjusted OR	95% CI	p Value*
Vomiting	14.7	2.5-83.4	0.002*
Dyspnoea	23	6.9-76.4	< 0.001*
Diabetes mellitus	4.4	1.2-15.8	0.021*
Transmitted to family members	8.3	2.5-27.3	< 0.001*

*p value < 0.05 is considered significant.

Discussion

The present study found 0.6% cases resulting in severe COVID-19 among HCWs whereas studies from Malaysia among HCWs during the same time period found 3% disease severity.[11] This might be due to the differences in coronavirus variants causing the disease and might be due to the different classifications used in assessing the severity of COVID-19. In one study if the disease condition necessitated hospital admission, it classified the disease as severe whereas the present study described severe as those COVID-19 cases who died or required ICU admission or oxygen or ventilator support.[12] The mortality rate among HCWs in the present study was .03% whereas one systematic review showed the mortality rate among HCWs from worldwide data as 0.9%. Thus, the outcomes obtained for COVID-19 infection among HCWs in Kannur were satisfying. Though females reported more cases the death rate was quite higher in males which was also the same obtained in the present study.[13] In our study, only one person died, and was a male HCW. Earlier studies in the same setting also showed a high caseload among females which might be due to the higher representation of the female gender in the health sector of Kerala.[14]

In one systematic review, 5% of the cases were asymptomatic compared to 13% of the present study which might be due to differences in the testing strategy and increased testing at the later setting for containing the spread of infection. Analysis of the same reference study on predictors of COVID-19 severity found fatigue and dizziness among the symptoms which are significant in the present study as well.[15] In one prospective study, the most common symptom reported was fever (78%) which is similar to the present study results. In one study, the male gender was found to have an association with severe COVID-19 whereas the presence of co-morbidities had no association.[16] A population-based cohort study, where the median follow-up period was 30 days, found a strong association with the presence of co-morbidities.[17] The presence of multiple co-morbidities showed higher disease severity which is also the same found in a retrospective study found among COVID-19 recovered cases[18] and the presence of non-communicable diseases especially diabetes mellitus and hypertension increases the disease severity and mortality.[19]

As the main mode of disease transmission is through droplet infection, the more severe the disease, the more shedding of the virus occurs, which will be amplified by the presence of symptoms such as cough.[20] The other mode is air-borne transmission, infection may occur in conditions like poor ventilation, overcrowding, and closed spaces.[21] These factors may contribute to the disease getting transmitted to family members in cases of severe COVID-19.

The history of COVID-19 vaccination was associated with a lower risk of disease severity which is similar to the results obtained from a community-based study.[22] Despite the results of a nationwide study conducted in the United Kingdom, the current study was unable to demonstrate the statistical relevance of any prior history of COVID-19 infection with protection against severe COVID-19.[23]

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Limitation

The results may not be comparable to the general population in terms of clinical features as obvious symptoms and re-infections get more self-reported and tested among HCWs.

Conclusion

The study found that factors like place of isolation, history of disease transmission to family members, presence of multiple co-morbidities, having diabetes mellitus, hypertension, presence of symptoms like fatigue, dyspnoea, and vomiting were strongly associated with severe COVID-19, and COVID-19 vaccination was protective against severe disease. These results can help in recognizing HCWs who may be at risk for severe COVID-19 disease. In view of potential COVID-19 waves or similar epidemics, the information is crucial for the formulation of occupational health policies and susceptibility risk assessments for HCWs.

Recommendation

More studies on the effect of prior COVID-19 infections and vaccinations are required to establish their benefits in the course of ongoing COVID-19 waves for policy-level decision-making.

Authors' Contribution

Dr Ameena Subair Raheela conceptualised the study, collected and analysed the data and wrote the report. Dr Preetha Muduvana supervised the process and reviewed the study report.

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