

A Prospective Study to Explore the Impact of the Vaccination Status on Disease Severity and Mortality in COVID-19

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Abstract

Introduction: Vaccination is considered the tipping point that will contribute to curtail the ongoing SARS-CoV-2 outbreak. In this prospective cohort study, we explored the impact of the vaccination status on the disease severity and mortality in COVID-19 infection.

Objective: To assess the impact of vaccination status on disease severity and mortality in COVID-19

Methodology: The study was conducted over a 3-month period in District Base Hospital Theldeniya, which is a level III and the third major COVID-19 treatment center in Sri Lanka. A total of 179 COVID-19 positive patients were purposively selected. Data analysis was done by R and ER studio.

Results: Of all participants, 87 patients had taken only a single dose, 47 were fully vaccinated (2 doses) while 45 were not vaccinated at all (69 Sinopharm, 37 Covishield, 15 sputnik, 12 Moderna, 1 Pfizer). Out of all, 10.06% became critically ill requiring ICU care and 7.26% needed ventilator support. More than half (59.22%, 106 patients) fully recovered, about a quarter (24.58%) recovered, but required further follow up after discharge. Unfortunately, 29 patients (16.2%) died of COVID-19. Most, i.e.; 16 of the total 29 mortalities were from the group vaccinated with Sinopharm.

Discussion: COVID-19 infection has a clinical spectrum of disease from asymptomatic to critically ill, however, the greatest proportion presented with mild infection. Vaccination status i.e.; fully or partially vaccinated or not vaccinated, and the type of the vaccine showed a significant influence on the disease severity and outcome including mortality.

Conclusions and Recommendations: Vaccination effectively lowers the disease severity as well as mortality. However, the vaccine type and the presence of co-morbid conditions can greatly alter the disease outcome. Our findings strengthen the fact that the vaccination is the sustainer in COVID-19 pandemic control, further gives an insight to the future vaccination schedules.

Keywords: COVID-19 Vaccination, Disease severity, mortality

Introduction

The COVID-19 pandemic, caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2), is the defining global health crisis and the biggest challenge the world is struggling today.

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The novel virus spread around the world within months. On 30th January 2020, The World Health Organization (WHO) declared a Public Health Emergency of International Concern, and on 11th March 2020, a pandemic was declared¹. Since 2021, variants of the virus have emerged and become dominant in many countries, with the new variant being more and more virulent than the former. As of 19th September 2021, it was affecting 221 countries and territories, more than 229 million cases and



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4.7 million deaths have been confirmed, making it one of the deadliest pandemics in history. COVID-19 symptoms range from unnoticeable to life-threatening. Severe illness is seen more in elderly and in patients with certain underlying medical conditions. The pandemic has resulted in severe global social and economic disruption, including the largest global recession since the Great Depression of the 1930s³. Not to mention, the pandemic has raised issues of geographic discrimination, health equity as well as public health imperatives and individual rights.

Preventive measures such as social distancing, wearing masks, hand washing, disinfecting surfaces, and quarantining people are recommended. Authorities have implemented travel restrictions, lockdowns, systems for tracing contacts etc. Though current treatments focus on addressing symptoms, work is underway to develop medications that inhibit the virus.

Yet, the safe and effective vaccination is considered the tipping point that will contribute to curtail this outbreak. Since December 2020 several vaccines have been distributed in many countries.

From the very few of vaccines available globally, six vaccines, namely Sinopharm, Astra Zeneca, Pfizer-BioNTech, Moderna and Sputnik V are approved by WHO and authorized in Sri Lanka. Further, Vaccines were distributed District wise. Moreover, by mid-September, Sri Lanka has vaccinated more than 50% of the targeted population, covering over 10million with both vaccines⁴.

Medical treatment in COVID-19 patients in Sri Lanka took place in three tiers⁵;

- Level 1 – Intermediate care centers where only asymptomatic and mildly symptomatic patients were admitted
- Level 2 – Selected COVID-19 hospitals (Divisional and Base hospitals) with consultant cover
- Level 3 – COVID-19 designated specialized/Tertiary care hospitals

District Base hospital- Theldeniya, being a third major Level 3 COVID treatment center in Sri Lanka, has been providing medical care since the first wave of the Pandemic in Sri Lanka. As a Tertiary level treatment Center, having two male and female COVID HDUs (High dependency units) and COVID ICU (Intensive care unit) and separate COVID wards for maternal and paediatric groups; We received patients, from almost all districts of the country, of different severity levels, different medical backgrounds and different levels of vaccination statuses.

Accordingly, this study was designed to explore the impact of the vaccination status on disease severity and mortality in COVID-19.

Methodology

Study Design

A prospective descriptive cross sectional study conducted over 3 months period in COVID treatment unit (in Male and female wards, HDUs and ICU) in District Base Hospital Theldeniya. Quantitatively 179 cases were selected prospectively following getting informed written consent to participate in the study

Selection of Participants

All consented COVID-19 positive patients at COVID treatment Unit, District Base hospital – Theldeniya were taken as participants, excluding who were unaware or unable to provide correct details about their vaccination. Purposive sampling technique was adopted for data collection.

Data collection and Analysis

Vaccination and other clinical data were analyzed by Chi square test of independence variables with 95% confidentiality using R and ER studio.

Level of severity was assessed using the clinical parameters and the mode of oxygenation with their escalation pattern. E.g. oxygenation started from 2L nasal prongs, 5L

oxygen masks, Non Re breathing masks and recorded by using a Likert's scale.

Disease severity was categorized as below6;

- Asymptomatic
- Mild Illness – Individuals who have any of the signs and symptoms of COVID-19 (e.g., fever, cough, sore throat, malaise, headache, muscle pain) without shortness of breath, dyspnea
- Moderate Illness - Individuals who have evidence of lower respiratory disease by clinical assessment or imaging, , and saturation of oxygen (SpO2) =<94% on room air
- Severe Illness - Individuals who have respiratory frequency >30 breaths per minute with excessive use of accessory muscles, and thoraco-abdominal dis synchrony, SpO2) <94% on Oxygen (or for patient with chronic hypoxemia, a decrease from baseline of >3%), ratio of arterial partial pressure of oxygen to fraction of inspired oxygen (PaO2/FiO2) <300 mmHg, or lung infiltrates >50%
- Critical Illness - Individuals who have respiratory failure, septic shock, and/or multiple organ dysfunction

Ethical clearance

Ethical clearance was issued by the Ethical Review Committee, Kandy Society of Medicine, National Hospital – Kandy on 6th January 2022 (Ref No : NHK/ERC/67/2021)

Results

During the 3-month study period, a total of 179 COVID-19 positive patients participated in the research. Among them, 83 (46.37%) were female and 96 (53.63%) were male, and their ages ranged from 15 – 90 years.

Out of the subjects, 110 (61.45%) participants had one or more co-morbidities such as Diabetes mellitus, cardiovascular disease, lung disease, liver disease, Malignancy/ immune-compromised (that included patients on long

term immunosuppressant and special cases like COVID-19 with DHF); and 69 (38.55%) were free from any chronic diseases.

Of the co-morbid patients, 20 (11.17%) had Diabetes Mellitus, 17 (9.5%) had cardiovascular diseases as hypertension, dyslipidemia, ischemic heart disease etc., 7 (3.91%) had lung diseases as Bronchial Asthma, COPD, pulmonary tuberculosis etc., 2(1.12%) had malignancy/Immune-compromised, 1 (0.56%) had renal disease and 3 (1.68%) had other illnesses including liver diseases alone; whereas 45 (25.13%) had two of the above and 14 (7.82%) had combination of 3 or more of the above conditions.

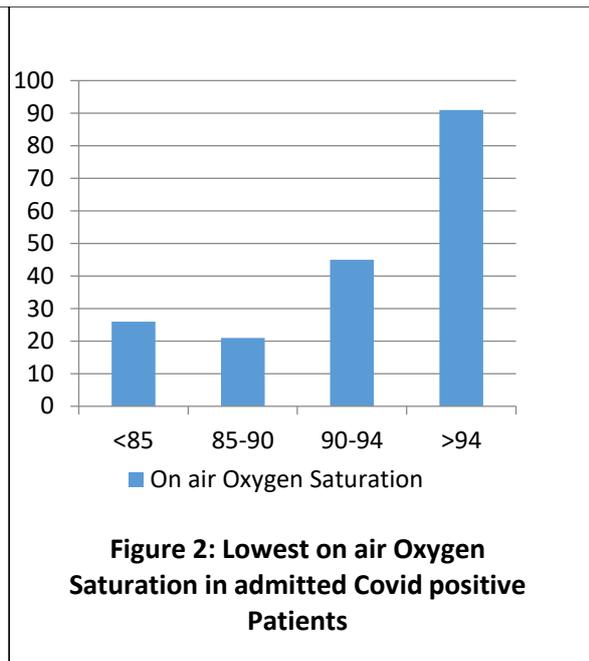
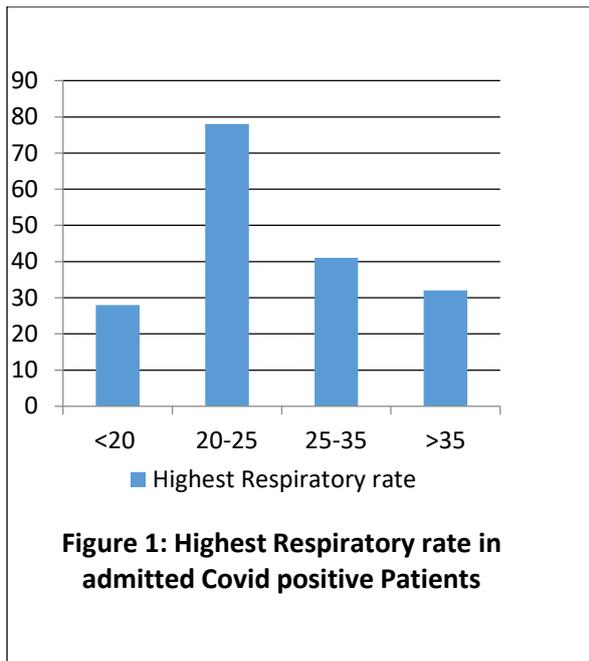
On admission to the COVID-19 treatment unit, 134 patients were vaccinated; 87 (48.60%) patients had taken only a single dose, 47 (26.26%) were vaccinated with two doses while 45 (25.14%) were not vaccinated at all.

From the vaccinated group of (134) patients, most, that is 69 (51.49%) had taken Sinopharm, whereas 37 (27.62%) Covishield, 15 (11.19%) Sputnik V, 12 (8.95%) Moderna and 1 (0.75%) Pfizer/BioNTech.

Total sample considered, 5.59% (10) were asymptomatic, 37.43% (67) patients had mild disease, 26.26% (47) had moderate disease, 20.67% (37) were severely diseased and 10.06% (18) became critically ill requiring ICU care.

In majority, 43.58 % (78 patients) noted highest respiratory rate was in between 20-25 breaths/min. There were 22.91% (41) and 17.88 % (32) with respiratory rates between 25-35/min and > 35 breaths/min respectively. Only 15.65% (28) had normal respiratory rate which is less than 20. (Figure 1)

On the contrary, roughly a half of the patients, 50.84% (91 patients) could maintain oxygen saturation more than 94% on air, about a quarter, 25.14% (45 patients) had on air SpO2 between 90-94%, 11.73% (21) had saturation between 85-90% and in 12.29% (22) saturation dropped below 85. (Figure 2)

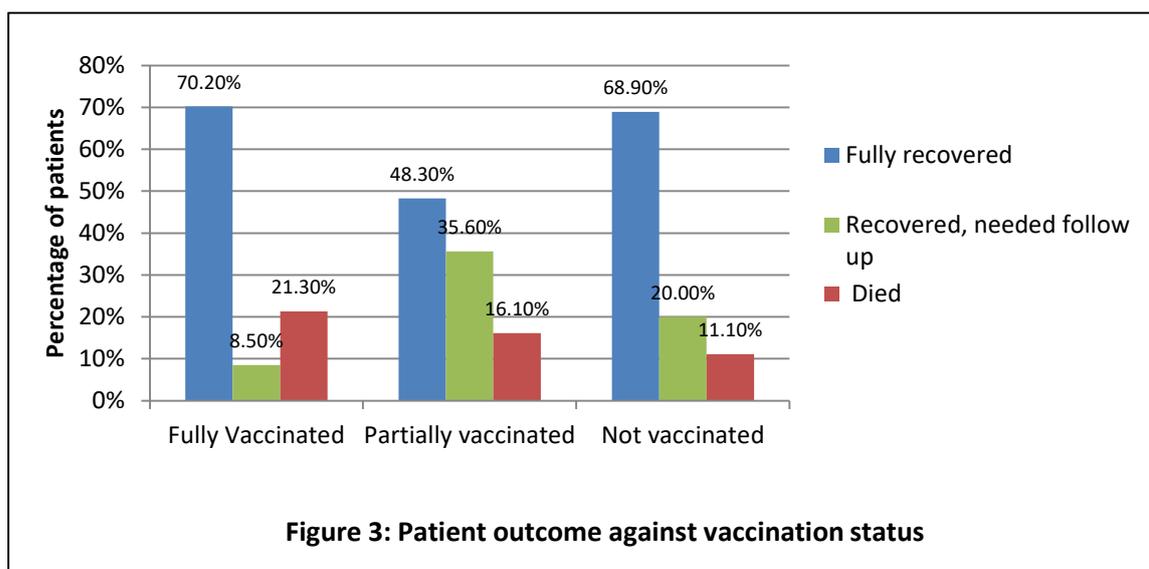


Further, most of the patients, i.e., 85 (47.48%) did not require supplementary oxygen. 28 (15.64%) were given nasal prong oxygen (up to 4l), 18 (10.06%) were given 4-6l of via face masks, 16 (8.94%) required Non- rebreathing mask (NRBM) with inspired oxygen fraction of about 90%, 4 (2.23%) were given High flow nasal oxygen (HFNO) and 15 (8.38%) needed CPAP (Continuous Positive airway pressure). Among others, 13 (7.26%) ended up being intubated and ventilated.

Of all, 59.22% (106 patients) was fully recovered, 24.58% (44) recovered, but required

further follow up after discharge whilst 16.20% (29) died of COVID-19.

There was a statistically significant correlation between vaccination status of the patients and their clinical outcome (chi-square statistic- 14.5414, p-value- .005753, significant at $p < .05$). In fully vaccinated group 21.3% (10) died, 70.2% (33) fully recovered, 8.5% (4) needed follow up after discharge; the values for the partially vaccinated and not vaccinated groups were 16.1% (14), 48.3% (42), 35.6% (31) and 11.1% (5), 68.9% (31), 20.0% (9) respectively ($p = 0.0039$). (Figure 3)



Most, i.e.; 16 of the total 29 deaths were the patients vaccinated with Sinopharm. Out of the subjects who had Covishield vaccine, 10.8% (4) died, 67.6% (25) fully recovered and 21.6% (8) recovered but needing further follow up. In comparison, from the patients who were after Sinopharm vaccine 23.2% (16) died, 44.4% (31) fully recovered and 31.9% (22) required further follow up at ILD clinic. In the Sputnik and

Moderna vaccinated groups; died, fully recovered and recovered needing follow-up were 6.6% (1), 66.7% (10), 26.7% (4) and 25% (3), 66.7% (8), 8.3% (1) respectively. One subject who was vaccinated with Pfizer fully recovered. In not vaccinated group of patients, 11.1% (5) died, 20% (9) needed follow up and 68.9% (31) gained full recovery. (Figure 4)

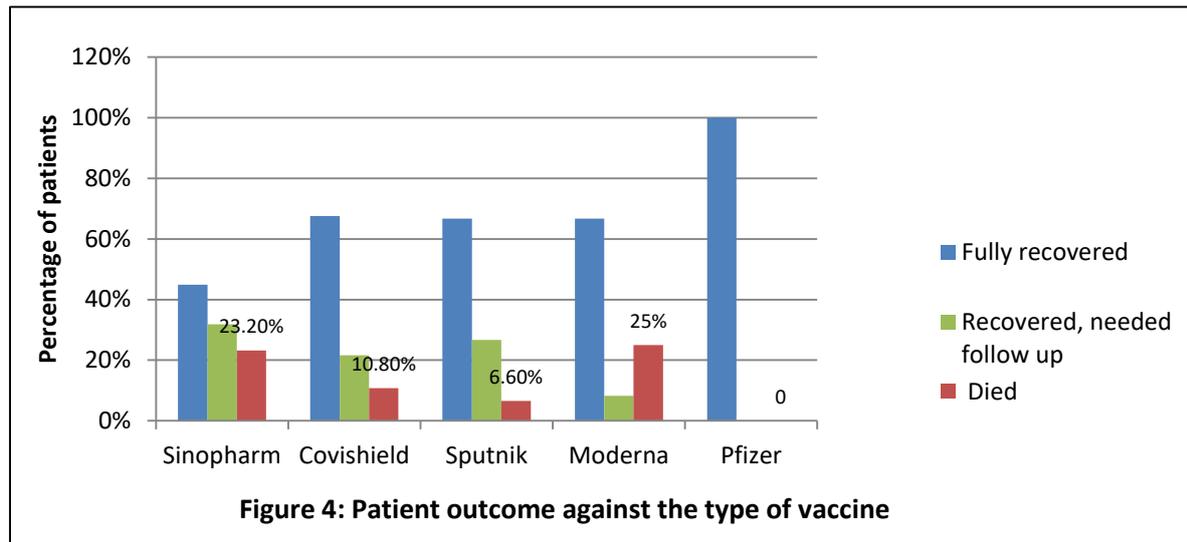


Figure 4: Patient outcome against the type of vaccine

When mortality and outcome were cross tabulated against the presence of co-morbidities, most of the deaths 75.9% (22) were from co-morbid group, in compared to 24.1% (7) deaths, of which there were no other chronic

illnesses. Similarly, none co-morbid group showed 89.9% (62) recoveries, compared to the 80% (88) recoveries when associated with other illnesses. (Figure 5)

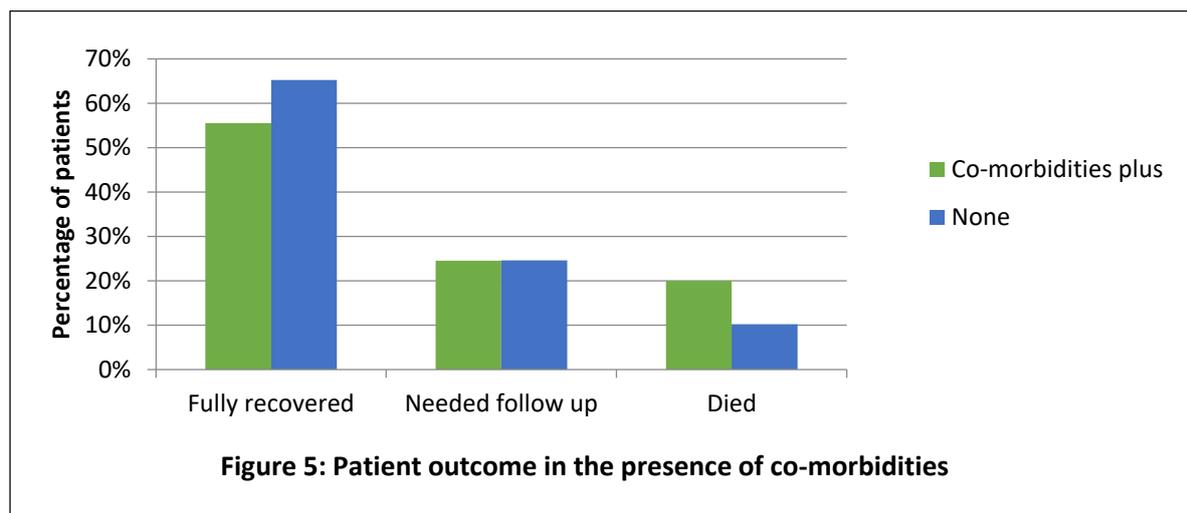


Figure 5: Patient outcome in the presence of co-morbidities

Disease severity showed a noteworthy variation with the vaccination status. When fully vaccinated, most (55.4%) were mildly symptomatic and when not vaccinated most (33.3%) were moderately symptomatic.

Partially vaccinated group showed highest proportions equally in both mild and moderate disease forms (32.2%)(Chi-squared 23.8693, p-value - .00241, significant at $p < .05$). (Figure 6)

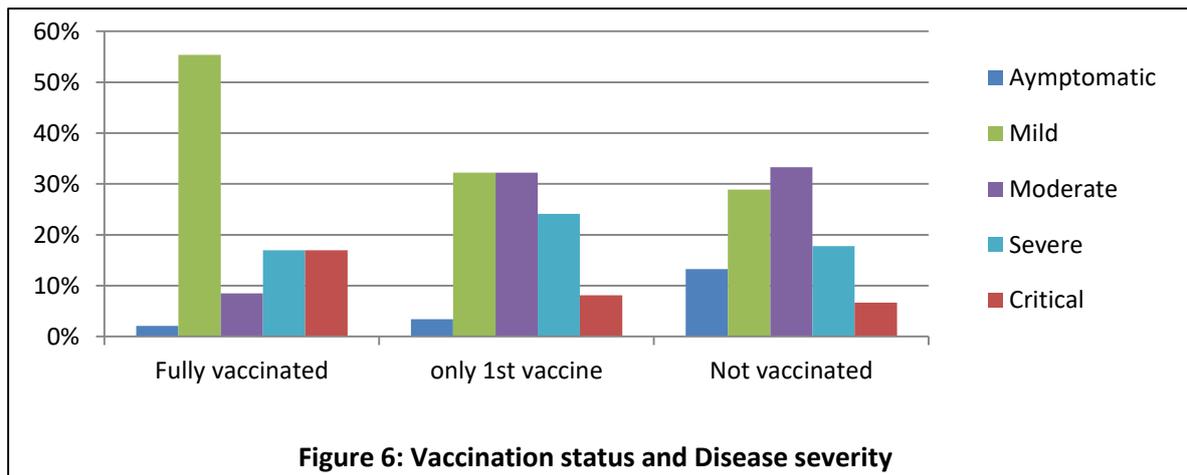


Figure 6: Vaccination status and Disease severity

Further, the severity of the disease exhibited a difference with the type of the vaccine received. Most of the critically ill have taken Sinopharm. Pfizer, Sputnik, Covishield and Moderna showed in decreasing order (100%, 66.7%, 54.2% and 41.7% respectively), more mild form

of the COVID illness. Plus, the disease severity did not show a significant difference with the Sinopharm vaccine; having 10.2% asymptomatic, 26.1% mild, 23.2% moderate, 24.6% severe and 15.9% critically ill patients. (Figure 7)

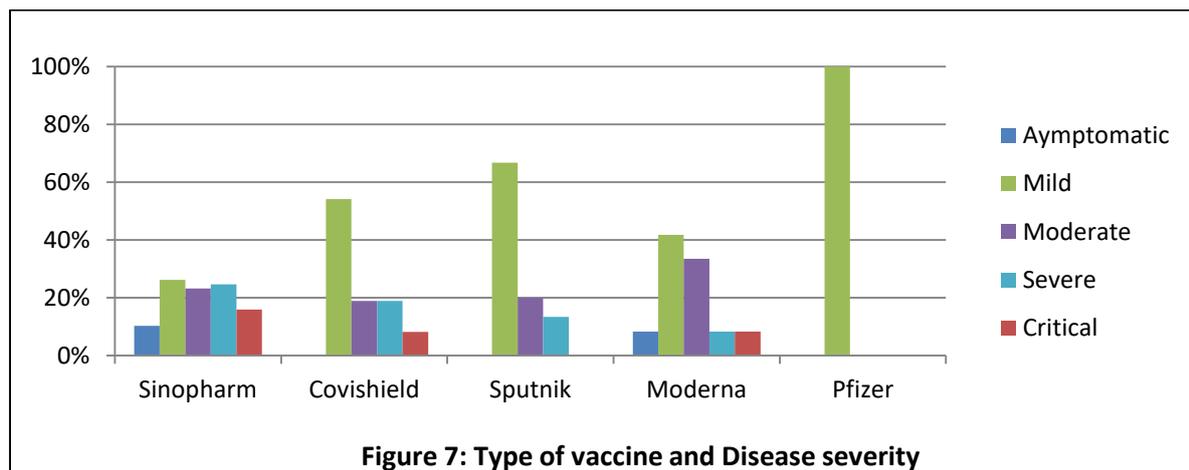


Figure 7: Type of vaccine and Disease severity

Discussion

During the research period, most of the admitted COVID-19 positive patients were vaccinated either two doses or a single dose, majority having given Sinopharm vaccine. COVID-19 infection has a clinical spectrum of disease from asymptomatic to critically ill, however, the greatest proportion presented with mild infection. In many, respiratory rate was slightly higher than normal (20-25/min), though, most could maintain normal oxygen saturation on air (more than 94%) without the need of oxygen therapy. More than half of patients fully recovered, about a fourth

recovered, but follows up after discharge was required, whilst 16.20% died of COVID-19.

Vaccination status i.e.; fully or partially vaccinated or not vaccinated, and the type of the vaccine showed a noteworthy influence on the disease severity and outcome. About 70% fully vaccinated patients recovered completely. Most fully vaccinated patients were mildly symptomatic when most of the not vaccinated group was moderately symptomatic. Of vaccinated group, highest number of deaths and critically ill were the patients who have taken Sinopharm. Moreover, complete recovery was seen in more than half of the patients with all (Covishield, Moderna, Sputnik and Pfizer)

except Sinopharm vaccine. Having notable variance in the outcome with different vaccines, study results raise the question behind the rationality of the expression 'the best vaccine is what one can get first' which was used when rolling out the vaccination program.

Our study further confirmed that the presence of co-morbidities augment the severity and mortality in COVID-19.

A major drawback of our study was the small sample size, given the limitations of planned study duration and the number of hospital admissions during the period; we could not reach the estimated sample size.

Many of the described apparent associations have yet to be repeated and validated using robust statistical methods. Now the vaccination has been extended further with booster doses. Undoubtedly the outcome can vary with this advancement. On that account, it is vital to address knowledge gaps in the field and identify factors that will be helpful in overcoming this health burden.

Conclusions and Recommendations

In COVID-19, the majority shows mild symptoms, but the number of deaths and critically ill cannot be simply neglected. Vaccination effectively lowers the disease severity as well as mortality. The results show that most of those who vaccinated with two doses recovered completely compared to the partially vaccinated and not vaccinated patients. We further observed a notable variance in the outcome with different types of vaccines. A significant reduction in mortality is seen with Pfizer, Covishield and sputnik vaccines. On the other hand, most of the deaths and critically ill among vaccinated groups are seen with Sinopharm vaccine. Furthermore, the study confirmed the prevailing finding that the presence of co-morbidities augments disease severity and mortality in COVID-19. Our findings strengthen the fact that the vaccination is the sustainer in COVID-19 pandemic control, also gives an insight to the future vaccination schedules.

There are still a great many uncertainties about COVID-19 disease and vaccination. As a case in point, the duration of protection of the vaccines is not yet known. On the other hand, clinical studies are still ongoing to answer these ambiguities such as the efficacy, effectiveness, side effects, impacts of vaccines, the necessity of booster doses etc. In furtherance of improving health outcomes, it is vital to identify and validate these untested areas.

Conflict of interest

None declared

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