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**Original Research Article**

# COVID-19 infection and vaccine status in patients with chronic kidney diseases

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## ABSTRACT

**Background:** The COVID-19 virus has had a great effect globally, changing many commonalities. The incidence of COVID-19 had weakened the immune system, leading to more severe outcomes of various common diseases. Since its early development, the vaccination of COVID-19 has also had mixed responses. The aim of the study was to observe the incidence rate of COVID-19 infection and vaccination status among chronic kidney disease patients.
**Methods:** In this study 50 (27 male and 23 female) adult skulls were investigated to determine the type of asterion, its distance from important bony landmarks and also the nearby venous sinuses were measured.
**Results:** Majority (41.61%) of the participants had been between the ages of 41-55 years old, and 64.84% male prevalence was observed. 60.65% of the participants had been from rural areas. A large portion of the participants (38.06%) did not have any comorbidities, while multiple comorbidities were present among many of the remaining participants. Hypertension was the most common comorbidity, observed in 56.45% of the participants. 72.26% of the present study participants had been asymptomatic, while 13.23% had a fever as their symptom of COVID-19. COVID-19 test was done on 81 patients, among whom 64 had tested positive. Among the total 310 participants, 29.03% had not received any vaccinations, while 14.19% had received only 1st dose of vaccination, 47.2% had received up to their 2nd dose, and 9.35% had received their booster dose.
**Conclusions:** The present study observed a low incidence rate of COVID-19 positive patients among those affected by chronic kidney disease. However, the study also observed a significant positive relation between COVID-19 positive patients and the need for additional medical support, leading to the conclusion that COVID-19 can significantly affect the severity of CKD.

**Keywords:** Kidney, Infection, COVID-19, CKD, Vaccination

## INTRODUCTION

Since December 2019, when the first verified case was announced in Wuhan, China, the COVID-19 pandemic has been impacting the global population.[1] Since then, the virus has spread around the world, impacting nearly every segment of society. Due to its strong homology (80%) to SARS-CoV, which caused acute respiratory distress syndrome (ARDS) and high mortality during 2002-2003, the novel coronavirus was called the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2, 2019-nCoV).[2] The SARS-CoV-2 virus typically affects the respiratory system, while it also affects other organ systems. The original case series from Wuhan, China, indicated lower respiratory tract infection-related symptoms such as fever, dry cough, and dyspnea.[3] It is

now commonly acknowledged that COVID-19 respiratory symptoms are quite varied, ranging from mild symptoms to severe hypoxia with ARDS. Although COVID-19 incidence rates have lately declined dramatically, there have been many waves of extraordinarily high COVID-19 incidence rates, with over 15,000 cases recorded daily in Bangladesh alone.[4] And many recent studies have been finding lasting effects of COVID-19 among surviving patients.[5-8]

Even though the number of COVID-19 cases has decreased, many new variations of the virus have been discovered in various parts of the world.[9] Epidemiological data revealed that the severe disease rate of COVID-19 infection is as high as 25%, and while the lungs are the most impacted, the kidney is also one of the most afflicted organs in severe illness.[10]

Acute kidney damage (AKI) was observed in 5-15 percent of SARS-CoV and MERS-CoV infections, with a death rate of 60-90 percent.[11] COVID-19 infection produces AKI and is a separate risk factor for death.[12,13] It also affects people with chronic kidney disease (CKD), those on chronic replacement therapy, and those who have received a kidney transplant. In contrast, several studies have found that people with kidney illness are more likely to have a severe COVID-19 infection.[14-16] As patients with kidney disease commonly have compromised immune systems, they are more likely to be infected by the COVID-19 virus. The Global Burden of Disease (GBD) collaboration, which provides information on the health of populations worldwide annually, recently addressed the prevalence of risk factors for severe COVID-19 worldwide.[17,18]

According to the GBD, chronic kidney disease is the most prevalent risk factor for COVID-19 among the global population.[17] The present study was conducted with only CKD-affected patients, to observe the incidence rate of COVID-19 infection among such patients, as well as their vaccination rate.

### *Objective*

The objectives of the study was to observe the incidence rate of (a) COVID-19 Infection among patients with chronic kidney disease; (b) rate of vaccination among patients with chronic kidney disease

## METHODS

This cross-sectional observational study was conducted at the Department of Nephrology, Chattogram Medical College Hospital, Chattogram, Bangladesh. The study duration was 10 Months, from February 2021 to November 2021. During this period, a total of 310 cases of chronic kidney disease (CKD) patients visiting or admitted to the study hospital were admitted in this study following inclusion and exclusion criteria. The patients were selected through purposive sampling, and the data was collected based on a pre-made questionnaire by attending doctors.

Informed written consent was obtained from each of the participants before starting data collection, and ethical approval regarding the study was also obtained from the ethical review committee of the study hospital. All collected data were digitally recorded in a database and analyzed using the SPSS software.

### *Inclusion criteria*

Patients of all ages and gender; with chronic kidney disease; and who had given consent to participate in the study were included.

### *Exclusion criteria*

Patients who were mentally ill; without chronic kidney disease; those who were unable to answer the criteria question; and those affected with other chronic diseases etc were excluded.

## RESULTS

Among the total 310 participants, the majority (41.61%) had been between the ages of 41-55 years old. 28.39% had been between the ages of 26-40 years, and only about 4.4% of the participants had been from the youngest age group of 12-25 years.

Male predominance was observed, with 64.84% male prevalence. 60.65% of the participants had been from rural areas, while 39.35% had been from urban areas. About 14.19% of the participants had been illiterate, while the majority (41.94%) had been educated up to primary levels. Among the participants, less than 1% (3) did not have hemodialysis, while 307 had hemodialysis done.

A large portion of the participants (38.06%) did not have any comorbidities, while multiple comorbidities were present among many of the remaining participants. Hypertension was the most common comorbidity, observed in 56.45% of the participants. 35.16% had type 2 diabetes, while 13.23% had ischemic heart disease. Chronic liver disease, stroke, and immunosuppression were observed in 1 patient each. 72.26% of the present study participants had been asymptomatic, while 13.23% had a fever, 10.32% had a cough, another 10.32% had shortness of breath, 5.16% had malaise, and 3.23% had a history of contact with COVID-19 patients.

COVID-19 test was done for 26.13% of the total study population, among which, 79.01% had tested positive, and 20.99% had tested negative. Among the total 310 participants, 29.03% had not received any vaccinations, while 14.19% had received only 1st dose of vaccination, 47.2% had received up to their 2nd dose, and 9.35% had received their booster dose. Among the 220 participants who had received the vaccination, 16.36% had a history of

infection before their vaccination, while 10.45% had an infection after their vaccination. The remaining 73.18% did not have a history of infection.

Among the total 310 participants, 15.16% had needed to be hospitalized, while 13.87% had needed additional oxygen support.

Among the 246 COVID-19 negative patients, only 1.63% required hospitalization, while 68.75% of the 64 COVID-19 positive patients required hospitalization. This difference was highly significant.

Among the 246 COVID-19 negative patients, only 1.63% required additional oxygen supplementation, while 62.50% of the 64 COVID-19 positive patients required additional oxygen support. This difference was highly significant.

**Table 1: Distribution of the study population based on characteristics (N=310).**

| Characteristics | N | % |
|---|---|---|
| **Age (years)** | | |
| 12-25 | 15 | 4.84 |
| 26-40 | 88 | 28.39 |
| 41-55 | 129 | 41.61 |
| 56-70 | 62 | 20.00 |
| 71-85 | 16 | 5.16 |
| **Sex** | | |
| Male | 201 | 64.84 |
| Female | 109 | 35.16 |
| **Area** | | |
| Rural | 188 | 60.65 |
| Urban | 122 | 39.35 |
| **Education** | | |
| Illiterate | 44 | 14.19 |
| Primary | 130 | 41.94 |
| Secondary | 93 | 30.00 |
| Higher secondary | 33 | 10.65 |
| Above | 10 | 3.23 |

**Table 2: Distribution of the study population based on co-morbidities (N=310).**

| Co-morbidity | N | % |
|---|---|---|
| **Type 2 diabetes mellitus** | 109 | 35.16 |
| **Hypertension** | 175 | 56.45 |
| **Ischemic heart disease** | 41 | 13.23 |
| **Chronic liver disease** | 1 | 0.32 |
| **Chronic obstructive pulmonary disease** | 10 | 3.23 |
| **Malignancy** | 2 | 0.65 |
| **Heart failure** | 6 | 1.94 |
| **Stroke** | 1 | 0.32 |
| **Immunosuppressed** | 1 | 0.32 |
| **No co-morbidities** | 118 | 38.06 |

**Table 3: Distribution of the study population based on H/O COVID-19 symptoms (N=310).**

| Symptoms | N | % |
|---|---|---|
| **Fever** | 41 | 13.23 |
| **Malaise** | 16 | 5.16 |
| **Cough** | 32 | 10.32 |
| **Shortness of breath** | 32 | 10.32 |
| **H/O contact with COVID-19 patients** | 10 | 3.23 |
| **Asymptomatic** | 224 | 72.26 |

**Table 4: Distribution of the study population based on COVID-19 test outcome (n=310)**

| Variables | N | % |
|---|---|---|
| **COVID-19 test (N=310)** | | |
| Yes | 81 | 26.13 |
| No | 229 | 73.87 |
| **COVID-19 test outcome (N=81)** | | |
| Positive | 64 | 79.01 |
| Negative | 17 | 20.99 |
| **Vaccination status** | | |
| No vaccination | 90 | 29.03 |
| 1st dose | 44 | 14.19 |
| 2nd dose | 147 | 47.42 |
| Booster | 29 | 9.35 |

**Table 5: Distribution of vaccinated participants by the incidence of infection (N=220).**

| History of infection | N | % |
|---|---|---|
| **Before vaccination** | 36 | 16.36 |
| **After vaccination** | 23 | 10.45 |
| **No infection** | 161 | 73.18 |

**Table 6: Distribution of participants by the incidence of support (N=310).**

| Variables | N | % |
|---|---|---|
| **H/O hospitalization for COVID-19** | | |
| Yes | 47 | 15.16 |
| No | 263 | 84.84 |
| **Needed $O_2$** | | |
| Yes | 43 | 13.87 |
| No | 267 | 86.13 |

**Table 7: Correlation of COVID-19 test outcome and hospitalization status among participants (N=310).**

| COVID-19 test outcome | No hospitalization | | Hospitalization | | P value |
|---|---|---|---|---|---|
| | N | % | N | % | |
| **Negative (n=246)** | 242 | 98.37 | 4 | 1.63 | <0.001 |
| **Positive (n=64)** | 20 | 31.25 | 44 | 68.75 | |

**Table 8: Correlation of COVID-19 test outcome and oxygen supplementation status among participants (N=310).**

| COVID-19 test outcome | No hospitalization | | Hospitalization | | P value |
|---|---|---|---|---|---|
| | N | % | N | % | |
| **Negative (n=246)** | 242 | 98.37 | 4 | 1.63 | <0.001 |
| **Positive (n=64)** | 24 | 37.50 | 40 | 62.50 | |

## DISCUSSION

The present study was conducted with a total of 310 patients of all ages suffering from CKD. Among these patients, the incidence rate of COVID-19 and COVID-19 Vaccination was done. Among the participants, the majority had been from the age group of 41-55 years, but patients ranging from 12 years to 85 years were also present in the study. CKD is a disease of all ages, but generally occurs more among the older population, as observed in other studies.[19,20] However, CKD can have varying incidence range among the ages, and can even occur by birth.[21] High male prevalence was also observed in our study, with 64.84% male prevalence and 35.16% female prevalence. These findings were similar to other studies with higher male prevalence.[19,22] Education-wise, the majority had received primary levels of education, while 14.19% had been illiterate. This low illiteracy rate reflects the diminishing rate of illiteracy among the Bangladeshi population.

Hemodialysis was done for all but 3 of the patients. CKD patients often need hemodialysis to temporarily perform the function of the kidney. Among the existing comorbidities, hypertension was the most prevalent, with a 56.45% incidence rate. While 35.16% of patients had diabetes, 38.06% had no existing comorbidities. The majority of the patients had more than one type of comorbidity. The increased risk of hypertension among the CKD participants is not uncommon, as both hypertension and CKD are often recognized as interrelated diseases.[23] Diabetes is also of a similar category and can influence the severity and outcome of diabetes among participants.[24]

72.26% of the participants had shown no symptoms of COVID-19, while fever was observed in 13.23% of cases, and cough and shortness of breath were observed in 10.32% of cases each. Based on the presenting symptoms, 81 patients (26.13%) had been tested for COVID-19. Among those 81, 79.01% had tested positive for COVID-19, which was 20.65% of the total 310 sample size. Very few researches have been conducted on the incidence rate of COVID-19 positive patients among those suffering from CKD, which led to a lack of corresponding resources during our study. It was observed that among the admitted patients, only 29.03% had been unvaccinated, while the remaining patients had received at least 1 dose of COVID-19 vaccination. A majority (47.42%) of the participants had received both doses of the vaccination, while 9.35% had even received their booster shot. Among the 220 patients in total who had received a vaccination, 10.45% had been infected by COVID-19 after their vaccination, while 16.36% had been infected before being vaccinated. None of the patients had needed to be taken to the ICU, but 15.16% had been hospitalized, and 13.87% had needed additional oxygen supply support. Comparing the additional support cases of patients with their COVID-19 status, it was observed that 68.75% of the COVID-19 positive patients needed to be hospitalized, while only 1.63% of the COVID-19-negative patients needed to be hospitalized. In regards to an additional oxygen supply, it was observed that 62.50% of COVID-19-positive patients needed additional oxygen support, while only 1.63% of COVID-19 negative cases needed such support. Both these situations observed a highly significant relation between COVID-19 status and the need for additional medical support. This was in line with the findings of various other studies, that suggest that COVID-19 can significantly increase the severity of many diseases, including chronic kidney disease.[25-27]

### *Limitations*

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

## CONCLUSION

The present study observed a low incidence rate of COVID-19-positive patients among those affected by chronic kidney disease. The majority of the participants had 2 doses of their vaccination, while a few had received their booster shots. Only a very few patients had not received any vaccination. However, the study also observed a significant positive relation between COVID-19 positive patients and the need for additional medical support, leading to the conclusion that COVID-19 can significantly affect the severity of CKD.

### *Recommendations*

Further study with larger sample size needs to be done. Cross-referencing with number of vaccination dose received and patient outcome, need for medical assistance and support needs to be done to better understand the effect of COVID-19 vaccination in patient outcome.

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