

RESEARCH ARTICLE

 OPEN ACCESS

Received: 27-07-2022

Accepted: 06-09-2022

Published: 31-10-2022

Citation: Moogaambiga S, Pranay C, Kirubhakaran K, Rangabashyam SR, Parajiya L (2022) A Comparative Study of Severity of Covid-19 Infection & their Radiological Findings in Vaccinated and Unvaccinated Individuals. Indian Journal of Science and Technology 15(40): 2103-2108. <https://doi.org/10.17485/IJST/v15i40.899>

* **Corresponding author.**chittimallapranay15@gmail.com**Funding:** None**Competing Interests:** None

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Published By Indian Society for Education and Environment ([iSee](https://www.isee.org/))

ISSN

Print: 0974-6846

Electronic: 0974-5645

A Comparative Study of Severity of Covid-19 Infection & their Radiological Findings in Vaccinated and Unvaccinated Individuals

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Abstract

Objectives: To compare the severity of COVID-19 infection and their radiological findings between vaccinated and unvaccinated individuals. Also, to investigate if any difference of severity of infection exists between patients with blood group 'A' and with blood group 'O'. **Methods:** This study has 302 patients which include both vaccinated and unvaccinated individuals. Both the group of patients were subjected to Computed tomography-Chest imaging and the severity of COVID-19 infection was analyzed between both the groups using CT-Severity score (CT-SS). **Findings:** In 302 study population, 91% of patients are unvaccinated and remaining 9% are vaccinated. Among these patients, 273 were having CORADS-5 which constitute 90% of population. Mortality among unvaccinated people was 17.2% compared to vaccinated people having mortality rate of 3.4% which was significant. Individuals with Blood group 'A' were highly infected and individuals with group 'O' were least affected compared to individuals with other blood groups among unvaccinated individuals. **Novelty:** Increased mortality was seen among unvaccinated individuals(17.2%)compared to vaccinated patients(3.4%). CT-Severity score was lower among vaccinated patients compared to unvaccinated patients. This study also compared the severity of the infection in individuals with various ABO blood groups among unvaccinated patients which showed that there was a significant effect on blood groups on severity of infection.

Keywords: COVID19; Vaccination; CTSeverity score; ABO Blood grouping; Mortality

1 Introduction

COVID-19 was emerged in Wuhan city of China in December 2019. Since 2 years after the first described SARS-CoV-2 patient, the pandemic of COVID-19 is still being continued in many countries with new infection waves⁽¹⁾. Initially, it was caused by Beta variant of SARS-Cov2 virus. Later it was also caused by other variants like Alpha, Omicron. Initial days it was confined only to China which later spread to other countries. Corona virus spreads rapidly through the droplets from mouth & nose of COVID-infected individual when the person coughs or sneezes. In the people who are infected with corona virus the severity of infection varied from mild infection I.e, asymptomatic to severe infection which also led to mortality. Depending on several factors the case fatality rates for SARS-CoV-2 varies, but the most important factor that prevents is vaccination⁽²⁾. COVID-19 pandemic caused very high mortality and morbidity, with new variants rapidly spreading. At the same time vaccines were also developed to prevent coronavirus disease with unprecedented speed⁽³⁾. After 1year of pandemic, various types of vaccines were invented against the infection and protected the people against the viral infection and prevented the severity of disease. Various types of COVID-19 vaccines include mRNA vaccine, Non-replicating viral vector vaccine and subunit vaccine. mRNA vaccine uses genetically engineered mRNA to make s-protein found on surface of COVID-19 vaccine by cell. This S-protein makes our body produce antibodies against it and these antibodies act against the COVID-19 Virus when person gets infected & prevent severity of infection. Pfizer and Moderna use mRNA. Similarly in vector vaccine type, the genetic material from COVID-19 virus is used in different viruses that acts like vector. The immune system recognizes the s-Protein and produces antibodies against it and these antibodies also act against the COVID-Virus when person gets infected and prevent severity of infection. JOHNSON & JOHNSON, AstraZeneca are viral vector vaccines. Protein subunit vaccines are under development. Covaxin which is an Indian based vaccine is a whole virion inactivated COVID-19 vaccine which was granted for emergency use by WHO in 2021, showing efficacy of 93% against severe disease 14 or more days post 2nd dose. Almost all vaccines are effective against all variants of COVID-19 & prevent severity of infection. CT-Scan had played a major role in making a diagnosis of COVID-19 and was also emphasized as being a problem-solving modality in patients with complications related to infection, diagnostic dilemmas, and poor response of patient to therapy⁽⁴⁾. After a mean interval of 5 days CT-chest has sensitivity of 97% in the diagnosis of COVID-19 pneumonia. CT-chest findings that are classically seen in COVID-19 pneumonia include ground glass opacities with bilateral, peripheral, and basal predominance with or without consolidation⁽⁵⁾. It was also noted that blood group of individual plays a role in immunopathogenesis of COVID 19 infection, individuals with blood group 'A' were higher susceptibility to infection and propensity to severe disease compared to group 'O' individuals less likely⁽⁶⁾. Viral entry in to host is facilitated by interaction of two subunits of spike protein, S1 and S2. S1B, corresponding to the receptor-binding domain, which binds to Angiotensin-Convertor Enzyme 2 (ACE2). ACE2 is the central entry route for several corona viruses into host cells⁽⁷⁻⁹⁾. People who have Anti-A antibodies prevent the attachment of SARS-COV 2 virus spike protein to ACE-2 receptors and have decreased the entry of virus into body. Hence people with 'O' blood group who have Anti-A antibodies are more protective and people with 'A' blood group who do not have Anti-A antibodies are more susceptible to infectivity of SARS-COV 2 virus. COVID-19 vaccines are effective and considered as critical tools for controlling the pandemic. However, there was no 100% effectiveness of vaccines in preventing the viral infection. There are cases of breakthrough infections that are defined as detection of SARS-CoV-2 viral RNA or antigen in a specimen collected from the person at least 14 days after receiving the recommended doses of COVID-19 vaccines⁽¹⁰⁾. Where as the risk of SARS-CoV-2 reinfection among unvaccinated people with prior COVID-19 is a subject of debate on which various studies were being done⁽¹¹⁾.

2 Methodology

2.1 Material & Methods

My studies were conducted at COVID ward with co-operation of General medicine Department and Department of Radiodiagnosis, VMKV medical College &Hospitals, Salem.

2.1.1 Inclusion Criteria

1. All patients who are diagnosed as COVID with RT-PCR positive.
2. All patients aged between 18 years to 60 years

2.1.2 Exclusion Criteria

1. Patients with symptoms of COVID but RT-PCR Negative.
2. Patients aged below 18years and above 60 years.
3. Patients who are having other infections simultaneously

4. Pregnant and lactating females.

Demographic data like age, sex, address and information regarding vaccination status which include type of vaccine, date of vaccination, number of doses of vaccination taken and other information like previous COVID-infection, comorbidities of patient were collected at the time of admission. Patients aged above 60 years are not included in study as they do not respond to immune challenge as robustly as the young. They are by no means immunodeficient, they often do not respond efficiently to novel or previously encountered antigens. This is illustrated by increased vulnerability of old age people to influenza, a situation that is exacerbated by their poor response to vaccination⁽¹²⁾. After admission all patients were subjected to blood investigations which included Blood Count, Blood grouping, RFT, LFT, Blood sugars, serum inflammatory markers like LDH, Ferritin, D-Dimer and radiological investigation HRCT-chest. In our study we analyzed the severity of infection using CT-severity score which indicates the percentage of lung involvement. Based on findings of CT-chest, patients were categorized into 6 categories CORADS 1 to CORADS 6.

- CORADS 1 – Normal or Non-infectious abnormalities
- CORADS 2 – Abnormalities consistent with infection other than covid
- CORADS 3 – Unclear whether COVID-19 is present
- CORADS 4 –Abnormalities suspicious of COVID-19
- CORADS 5 –Typical COVID-19
- CORADS 6- PCR Positive for COVID 19.

Among patients with CORADS-5, percentage of lung involvement was analyzed using score between 1-25. Higher the score higher is the percentage of lung involvement and more is the severity of Infection. For the convenience of study, data was entered into Microsoft excel sheets and data was analyzed using SPSS software.

3 Results & Discussion

This study constitutes 302 Patients among which 273 Patients were unvaccinated i.e. 91% and 29 Patents were vaccinated i,e 9%. Among these vaccinated Patients 19 were taken single dose vaccine and remaining 10 were double dose vaccinated. When CT-Severity is compared in both the groups, among 273 unvaccinated patients the CT-SS of (0-5), (6-10), (11-15), (16-20), (21-25) are 21,43,89,68,27 respectively. Similarly among 17 vaccinated patients the CT-SS of (0-5), (6-10), (11-15), (16-20),(21-25) are 13,6,3,2,1 respectively. Highest percentage(34.4%) of unvaccinated patients comes under category of CT-SS (11-15) where as highest percentage(44.8%) of vaccinated patients comes under category of CT-SS (0-5) which indicates that the severity of infection is higher in unvaccinated patients compared to vaccinated patients. Total mortalities in my study are 48 which include 47 patients who are unvaccinated & 1 patient who is vaccinated. These 47 patients constitutes 17.2% among unvaccinated & 1 patient who is vaccinated constitutes 3.2% which indicates significant decrease in mortality among vaccinated patients compared to unvaccinated. When the severity of infection was compared among various Blood groups among unvaccinated individuals, it was noted that the mean CT-Severity Score(CT-SS) of patients with blood group ‘A’ was 14.3 which was highest and mean CT-Severity Score of patients with blood group ‘O’ was 6.7 which was least compared to other blood groups which was 8.3 and 9.5 in blood groups ‘B’ & ‘AB’ respectively.

Table 1. Number of patients with respective CT-Severity Score

CT-Severity score	Unvaccinated	Partially vaccinated	Completely Vaccinated
0-5	21	9	4
6-10	43	4	2
11-15	89	2	1
16 -20	68	1	1
21-25	27	1	0
TOTAL	248	17	8

Table 2. Mean CT-SS of different category of patients

Category	Mean CT-SS
Unvaccinated	18.7
Partially vaccinated	7.9
Completely vaccinated	4.6

Table 3. Number of patients with various Blood groups and Mean CT-SS of them

Blood Group	Participants	Mean CT-SS (Out of 25)
A	77	14.3
B	68	8.3
AB	15	9.5
O	113	6.7

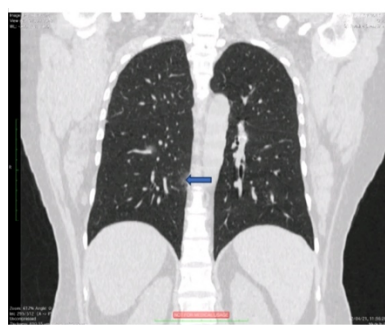
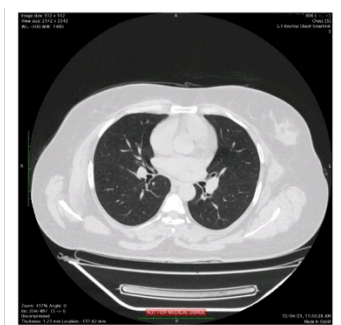


Fig 1. A. Transverse section of CT-Chest

B. Coronal section of CT-Chest

Fig 1. Images showing CT-Image of Unvaccinated individual

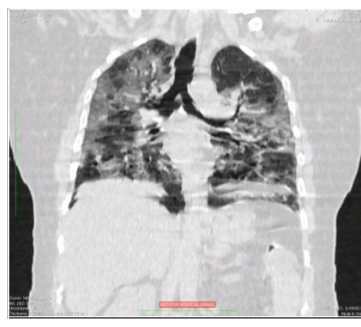
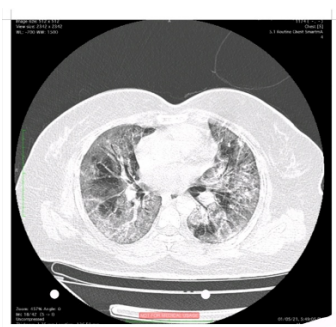


Fig 1. A. Transverse section of CT-Chest

B. Coronal section of CT-Chest

Fig 2. Images showing CT-Image of Vaccinated individual

4 Discussion

This study included 302 patients in which 273 are unvaccinated & 29 are vaccinated. Study showed that mortality was significantly high in unvaccinated people i.e, 17.2% compared to mortality in vaccinated people i.e 3.4%.Till date 66.5% of the world population has received at least one dose of a COVID-19 vaccine. Among which people in UAE country are 100% vaccinated & least vaccinated in Nigeria i.e 13%. Significant differences were observed, with respect to severity of COVID-19 pulmonary involvement, between unvaccinated patients and vaccinated patients affected by Alpha variant, and same was observed between unvaccinated patients and vaccinated patients with Delta variant⁽¹⁾. Pneumonia due to COVID-19 was present in 78% of unvaccinated patients, but only 41% of fully vaccinated patients (P = .003 for the difference between groups)

which indicates pneumonia was roughly twice as frequent for unvaccinated compared to fully vaccinated patients⁽²⁾. In a study done in US by MW-Tenforde showed that hospitalization & disease progression among patients with COVID-19 was less likely in vaccination with mRNA type vaccine⁽¹³⁾. People who received 3 vaccine doses had better neutralization of the wild type virus & 3 variants than people who received 2 vaccine doses⁽¹⁴⁾. Chest CT severity score index can be considered as an efficient tool in predicting prognosis and monitoring disease in patients with COVID-19 in India⁽³⁾. CT severity scores in individuals receiving both doses of vaccination were less severe compared to those receiving a single dose of vaccine or no vaccine at all⁽⁴⁾. COVID-19 was mild in the vaccinated group compared to unvaccinated group. Covishield vaccine administration reduces the severity of COVID-19 pneumonia as compared to the nonvaccinated group, with a marked reduction in mortality⁽⁵⁾. Prior COVID-19 was associated with protection against any recurrent COVID-19 infection, against hospitalization and also against COVID-19 not requiring hospitalization⁽⁸⁾. Patients with COVID-19 breakthrough infections had a significantly higher proportion of CT scans without pneumonia compared with unvaccinated patients. Vaccinated patients with breakthrough infections had a lower likelihood of requiring supplemental oxygen and intensive care unit admission⁽⁷⁾. Many studies also suggest that people with blood group 'A' are more susceptible to infection with COVID-19 while people with blood group 'O' are less susceptible to infection with COVID-19⁽⁶⁾.

5 Limitation of the Study

The severity of disease was accessed only by considering HRCT findings. Many other Inflammatory markers also can be used to access the severity of infection. Other confounding factors like smoking and comorbidities were also not considered for the study.

6 Conclusion

Mortality among unvaccinated group is higher compared to vaccinated group. Mortality among unvaccinated group is 17.2% compared to mortality among vaccinated group is 3.2% which is significantly higher. This tells that vaccination should be made compulsory to decrease the mortality & severity of infection. COVID vaccines not only protects against a particular variant but also protects against all variants. All people irrespective of their ages should be vaccinated with atleast 2 doses of vaccine if possible add booster dose. Break though infection is still possible in some people even after second dose of vaccination. Blood group of an individual also plays a major role in severity of COVID-19 infection. The mean CT-SS among people with blood group 'A' is 14.3 compared to mean CT-SS among people with blood group 'O' is 6.7 which is significantly higher.

7 Acknowledgement

The authors thank Department of General Medicine and Department of Radiodiagnosis, VMKV Medical college and Hospital, Salem.

References

- 1) Granata V, Fusco R, Villanacci A, Magliocchetti S, Urraro F, Tetaj N, et al. Imaging Severity COVID-19 Assessment in Vaccinated and Unvaccinated Patients: Comparison of the Different Variants in a High Volume Italian Reference Center. *Journal of Personalized Medicine*. 2022;12(6):955–955. Available from: <https://doi.org/10.3390/jpm12060955>.
- 2) Schiebler M, Bluemke D. Seeing Is Believing: COVID-19 Vaccination Leads to Less Pneumonia at Chest CT. *Radiology*. 2022;303:693–695. Available from: <https://doi.org/10.1148/radiol.220129>.
- 3) Naik BR, Kumar SA, Rachegowda N, Ullas LY, Revanth RB, Ullas Y, et al. Severity of COVID-19 Infection Using Chest Computed Tomography Severity Score Index Among Vaccinated and Unvaccinated COVID-19-Positive Healthcare Workers: An Analytical Cross-Sectional Study. *Cureus*. 2022;14(2):22087–22087. Available from: <https://doi.org/10.7759/cureus.22087>.
- 4) Verma A, Kumar I, Singh PK, Ansari MS, Singh HA, Sonkar S, et al. Initial comparative analysis of pulmonary involvement on HRCT between vaccinated and non-vaccinated subjects of COVID-19. *Eur Radiol*. 2022;32(6):4275–4283. Available from: <https://doi.org/10.1007/s00330-021-08475-8>.
- 5) Mahajan M, Gupta V, Ilyas M, Gupta K, Singh P. Comparative evaluation of severity of COVID-19 pneumonia on computed tomography of the chest in vaccinated and non-vaccinated individuals: an observational study. *Polish Journal of Radiology*. 2022;87(1):257–262. Available from: <https://doi.org/10.5114/pjr.2022.116192>.
- 6) Goel R, Bloch EM, Pirenne F, Al-riyami AZ, Crowe E, Dau L, et al. ABO blood group and COVID-19: a review on behalf of the ISBT COVID-19 Working Group. *Vox Sanguinis*. 2021;116(8):849–861. Available from: <https://doi.org/10.1111/vox.13076>.
- 7) Zhang Y, Garner R, Salehi S, Rocca ML, Duncan D. Association between ABO blood types and coronavirus disease 2019 (COVID-19), genetic associations, and underlying molecular mechanisms: a literature review of 23 studies. *Annals of Hematology*. 2021;100(5):1123–1132. Available from: <https://doi.org/10.1007/s00277-021-04489-w>.
- 8) Fan Q, Zhang W, Li B, Li DJ, Zhang J, Zhao F. Association Between ABO Blood Group System and COVID-19 Susceptibility in Wuhan. *Frontiers in Cellular and Infection Microbiology*. 2020;10:404–404. Available from: <https://doi.org/10.3389/fcimb.2020.00404>.

- 9) Zhao J, Yang Y, Huang H, Li D, Gu D, Lu X, et al. Relationship Between the ABO Blood Group and the Coronavirus Disease 2019 (COVID-19) Susceptibility. *Clinical Infectious Diseases*. 2021;73(2):328–331. Available from: <https://doi.org/10.1093/cid/ciaa1150>.
- 10) Lee JE, Hwang M, Kim YH, Chung MJ, Sim BH, Chae KJ, et al. Imaging and Clinical Features of COVID-19 Breakthrough Infections: A Multicenter Study. *Radiology*. 2022;303(3):682–692. Available from: <https://doi.org/10.1148/radiol.213072>.
- 11) Wu BB, Gu DZ, Yu JN, Yang J, Shen WQ. Association between ABO blood groups and COVID-19 infection, severity and demise: A systematic review and meta-analysis. *Infect Genet Evol*. 2020;84:32739464–32739464. Available from: <https://doi.org/10.1016/j.meegid.2020.104485>.
- 12) Montecino-Rodriguez E, Berent-Maoz B, Dorshkind K. Causes, consequences, and reversal of immune system aging. *J Clin Invest*. 2013;123(3):3582124–3582124. Available from: <https://doi.org/10.1172/JCI64096>.
- 13) Tenforde MW, Patel MM, Ginde AA, Douin DJ, Talbot HK, Casey JD, et al. Self WH; Influenza and Other Viruses in the Acutely Ill (IVY) Network. Effectiveness of SARS-CoV-2 mRNA Vaccines for Preventing Covid-19 Hospitalizations in the United States. *Clin Infect Dis*. 2021. Available from: <https://doi.org/10.1172/JCI64096>.
- 14) Nemet I, Kliker L, Lustig Y, Zuckerman N, Erster O, Cohen C, et al. Third BNT162b2 Vaccination Neutralization of SARS-CoV-2 Omicron Infection. *N Engl J Med*. 2021;386(5):492–494. Available from: <https://doi.org/10.1056/NEJMc2119358>.