

A Study on the CT scoring and Demographic profile of the Covid Breakthrough Infection in a Tertiary Care Centre in South India

¹Tabitha Merium Sabu, ²Chakravarthi Alapati, ³Vaithaiyanathan Malathi, ⁴Amir Mohamed,

¹(Consultant, Department of Internal Medicine), ²(HOD, Department of Critical care), (Consultant, Department of Radiology), ⁴(Resident, Department of Emergency Medicine), Billroth Hospitals, Shenoy Nagar, Chennai

Abstract:

Back ground: The development of the Covid vaccine was the hope for normality for a world which was in a standstill. Ever since the introduction of the vaccines against covid, their effectiveness, efficacy and side effects were systematically studied by researchers all over the world. Computed tomography (CT) is a crucial tool for the diagnosis and prognosis of the covid pneumonia. Hence, the study of the CT characteristics of breakthrough infections is important to assess the role of the vaccination.

Materials and Method: This was retrospective observational study conducted on admitted patients in a tertiary care centre in South India over a period of one year. Patients above 18 years, who had received at least one dose of the vaccine, with a positive RT PCR were included in the study. The total CT scores of the patients were noted. The mean total CT score, correlation of the total CT score with age, gender, comorbidities and vaccination were seen .

Results: A total of 108 patients formed the study group. The mean age was 57.47 ± 14.7 years. There were 68 (62.96%) males and 40(37.04%) females. 75% of patients received 2 doses of vaccination. The mean Total CT score of the study population was 6.22 ± 4.57 . There was a worsening in the total CT severity score with increasing age of the patients. There was a worsening in the CT score in the diabetic patients compared to non diabetic patients. Total CT scoring was comparable between male and female patients. On performing univariate linear regression, age was a significant risk factor for worsening of chest CT scoring.

Conclusion: 50% patients had a total CT severity score of less than 5 and 83.33% had a total CT severity score of less than 10. We concluded that vaccinated patients had a less severe covid pneumonia. We identified diabetes and increasing age as risk factors for severe infection.

Key word: Covid pneumonia, Computed Tomography (CT), Vaccination

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I. Introduction:

The Covid pandemic had crippled every aspect of life including the global health care system, economy and social life.⁽¹⁾ As rightly recorded, 2021 was ‘a new year of new beginnings’ which began with a ray of hope with the introduction of vaccines against covid infection. The Oxford- AstraZeneca vaccine was approved by the Drug Controller General of India (DCGI) on January 1st 2021, followed by the approval of the BBV152. India began its vaccination drive against covid infection on 16th January 2021. The nation witnessed its most intense vaccination drive.⁽²⁾ Though the vaccines could not guarantee a ‘mask free’ life, it has been acknowledged as the saviour of lives and livelihood . Ever since the introduction of vaccination, its impact has been studied. Vaccines are claimed to decrease the severity of infection with subsequent decrease of hospital stay and mortality.⁽³⁾ CT scoring is used as an important diagnostic and prognostication tool for the covid pneumonia. Total lung severity score, where the involvement of each lobe of the lung is estimated and added to give a score out of 25 is one of the common CT scoring systems used. The CT scoring systems has been validated to correlate with clinical and biochemical profile and mortality of the covid infection.⁽⁴⁾ Hence, the evaluation of CT characteristics of the breakthrough infection is an important tool to study the impact of vaccination.

II. Materials and Method

This was a retrospective observational study conducted on 108 patients admitted with covid from June 2021 to May 2022 in a tertiary care centre in South India. Patients meeting the inclusion criteria were randomly

selected. Vaccination status of the patients were noted. The CT grade, length of hospital stay, comorbidities, oxygen requirements, during the hospital stay, were also noted.

Inclusion Criteria:

- In-patients with positive RT PCR
- Patients who have received at least one dose of vaccination
- Age >18 years

Exclusion criteria:

- Negative RT-PCR
- Non vaccinated patient

Statistical analysis:

Categorical variables were recorded as number and percentage. Quantitative data with normal distribution were presented as the mean \pm SD and the data with non-normal distribution as median with 25th and 75th percentiles (interquartile range). The data normality was checked by using Kolmogorov-Smirnov test. Parametric tests were used for data which was not normal. The association of the variables which were quantitative and not normally distributed in nature were analysed using Mann-Whitney Test (for two groups) and Kruskal Wallis test (for more than two groups). Spearman rank correlation coefficient was used for correlation of CT chest score with age and length of stay and for correlation of length of stay with age. Univariate linear regression was used to find out significant factors affecting CT chest scoring. p value of less than 0.05 was considered statistically significant.

III. Results

There were 108 patients in the study. The mean age was 57.47 ± 14.7 years. There were 68 (62.96%) males and 40(37.04%) females. Majority ,i.e 81(75.00%) of the 108 patients had received 2 doses of vaccination. 61(56.48%)of patients, vaccine brand was covishield and the remaining were vaccinated with Covaxin. Oxygen was required in 21 out of 108 patients (19.44%). Amongst the study population, 59(54.63%) patients were diabetic.

Table 1: Distribution of CT chest score of study subjects.

CT chest score	Frequency	Percentage
1 to 5	54	50.00%
6 to 10	36	33.33%
11 to 20	17	15.74%
21 to 25	1	0.93%
Mean \pm SD		6.22 \pm 4.57
Median(25th-75th percentile)		5.5(3-7)
Range		1-22

Figure 1: Distribution of CT chest score of study subjects.

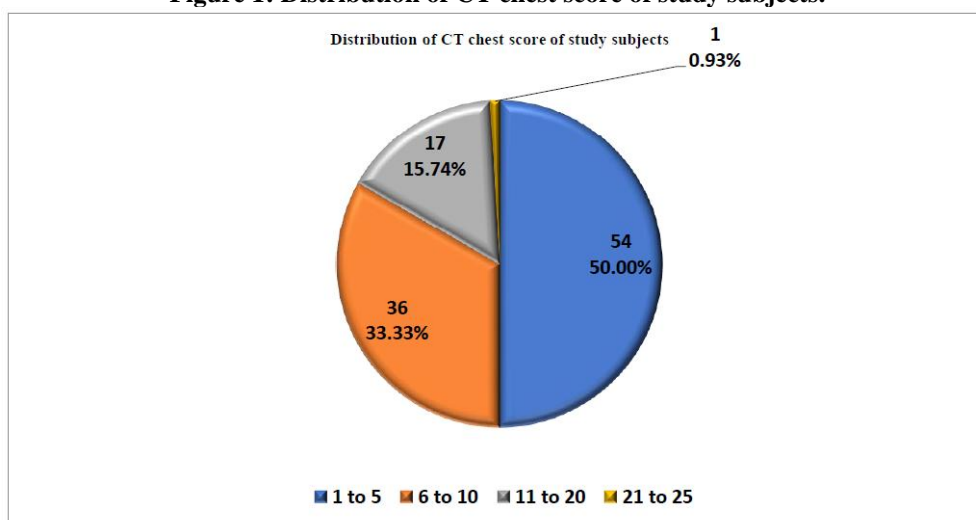


Figure 2: Correlation of age with CT chest score

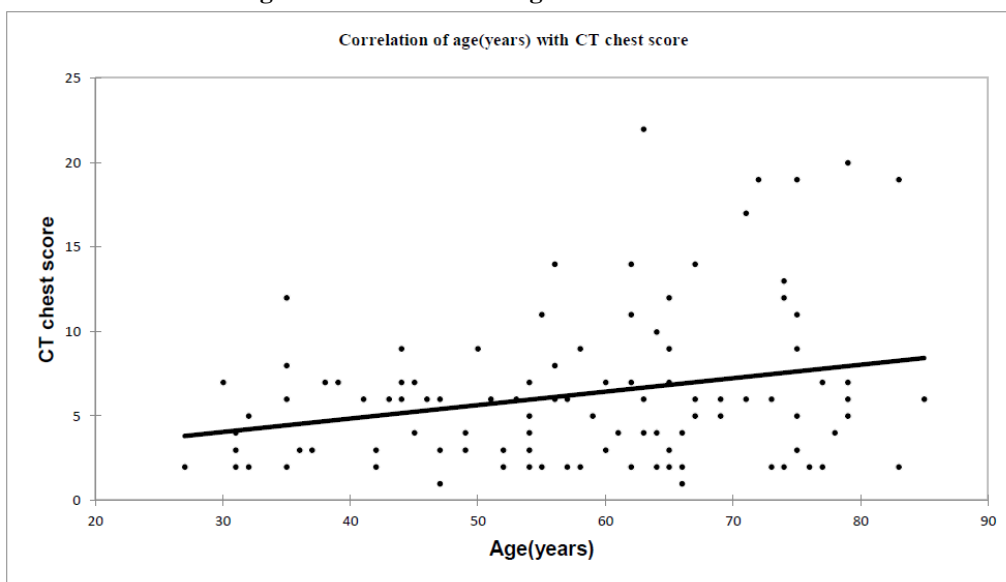
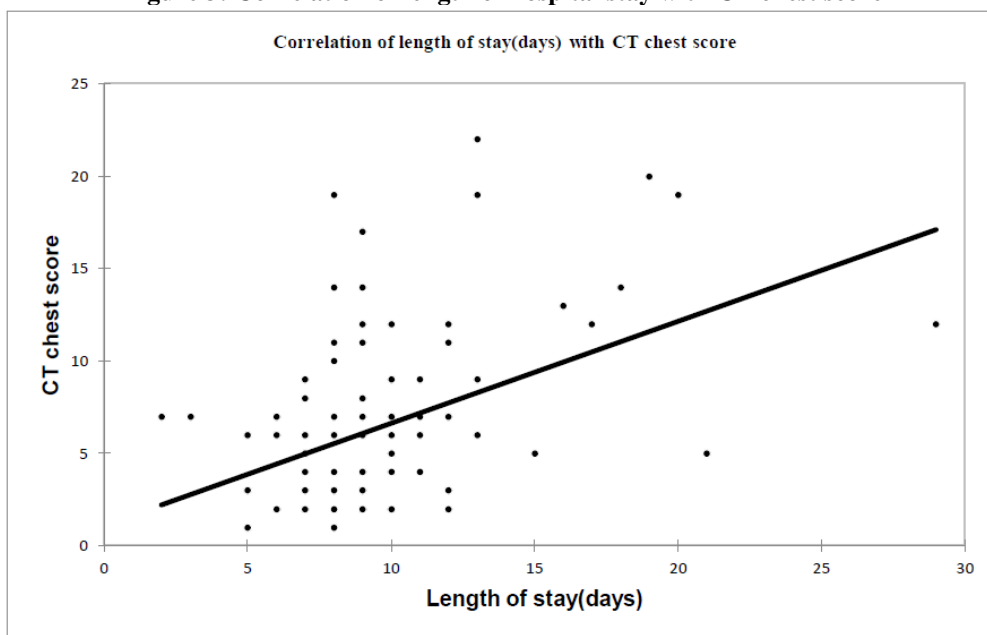


Figure 3: Correlation of length of hospital stay with CT chest score



Significant positive correlation was seen between CT chest score with length of stay with correlation coefficient of 0.345

Table 2: Association of CT chest score with diabetic/non diabetic.

CT chest score	Diabetic(n=59)	Non diabetic(n=49)	Total	P value
1 to 5	28 (47.46%)	26 (53.06%)	54 (50%)	
6 to 10	16 (27.12%)	20 (40.82%)	36 (33.33%)	0.006 [†]
11 to 20	15 (25.42%)	2 (4.08%)	17 (15.74%)	
21 to 25	0 (0%)	1 (2.04%)	1 (0.93%)	
Median(25th-75th percentile)	6 (3-10)	5 (2-7)	5.5 (3-7)	0.043 [‡]

‡ Mann Whitney test, † Fisher's exact test

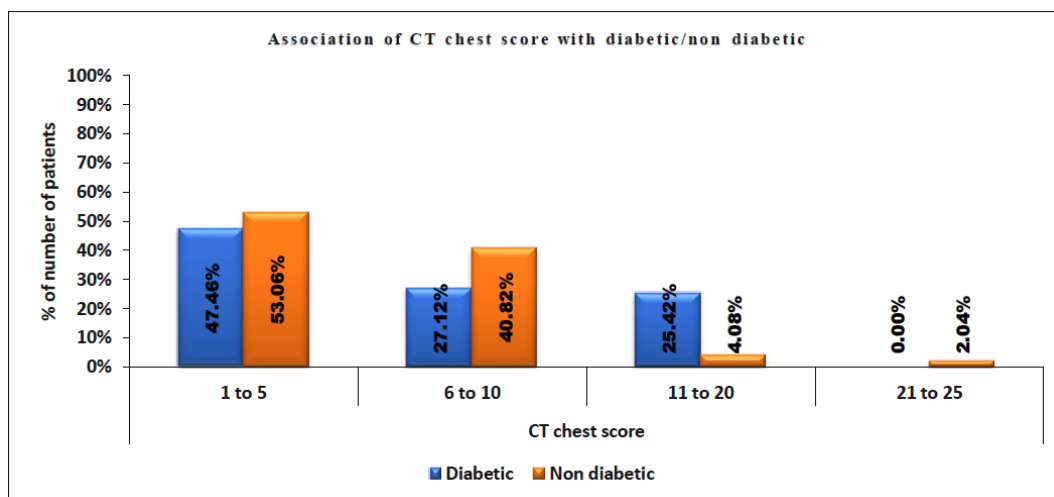


Figure 4: Association of CT chest score with diabetic/non diabetic.

Proportion of patients with CT chest score:- 11 to 20 was significantly higher in diabetic as compared to non diabetic. (11 to 20:- 25.42% vs 4.08% respectively). Proportion of patients with CT chest score:- 1 to 5, 6 to 10 was significantly lower in diabetic as compared to non diabetic. (1 to 5:- 47.46% vs 53.06% respectively, 6 to 10:- 27.12% vs 40.82% respectively). (p value=0.006)

Median(25th-75th percentile) of CT chest score in diabetic was 6(3-10) which was significantly higher as compared to non diabetic (5(2-7)). (p value=0.043)

Table 3: Association of CT chest score with vaccination status.

Total CT chest score Out of 25	Received 1 dose(n=27)	Received 2 doses(n=81)	Total	P value
1 to 5	11 (40.74%)	43 (53.09%)	54 (50%)	0.586 [†]
6 to 10	10 (37.04%)	26 (32.10%)	36 (33.33%)	
11 to 20	6 (22.22%)	11 (13.58%)	17 (15.74%)	
21 to 25	0 (0%)	1 (1.23%)	1 (0.93%)	
Median(25th-75th percentile)	6 (3-8.5)	5 (3-7)	5.5 (3-7)	0.494 [‡]

‡ Mann Whitney test, † Fisher's exact test

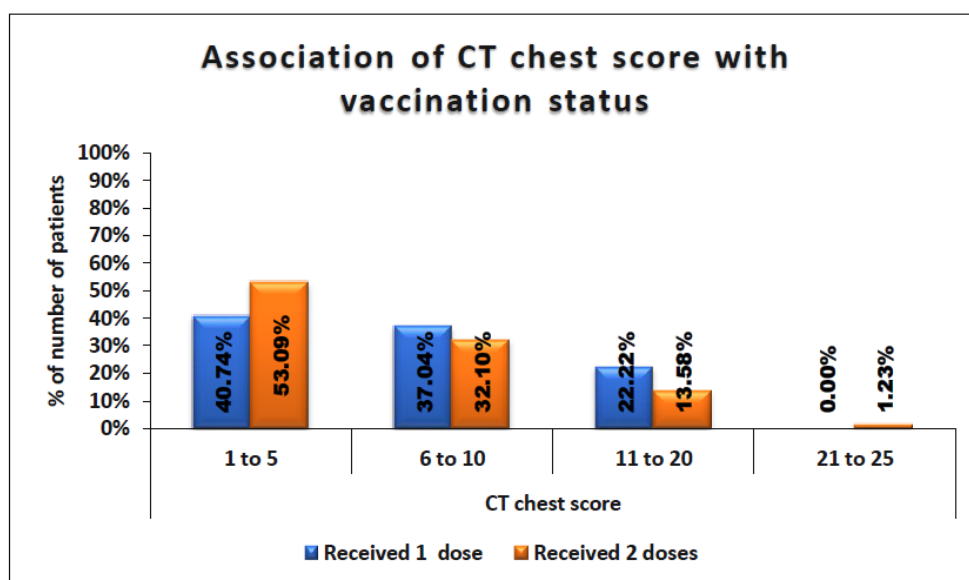


Figure 5: Association of CT chest score with vaccination status.

Distribution of CT chest score was comparable between patients who had received 1 dose and 2 doses of vaccination. (1 to 5:- 40.74% vs 53.09% respectively, 6 to 10:- 37.04% vs 32.10% respectively, 11 to 20:- 22.22% vs 13.58% respectively, 21 to 25:- 0% vs 1.23% respectively) (p value=0.586).

Median(25th-75th percentile) of CT chest score in 1 dose was 6(3-8.5) and 2 doses was 5(3-7) with no significant association between them. (p value=0.494)

Table 4:Association of CT chest score with gender.

CT chest score out of 25	Female(n=40)	Male(n=68)	Total	P value
1 to 5	24 (60%)	30 (44.12%)	54 (50%)	0.312 [‡]
6 to 10	12 (30%)	24 (35.29%)	36 (33.33%)	
11 to 20	4 (10%)	13 (19.12%)	17 (15.74%)	
21 to 25	0 (0%)	1 (1.47%)	1 (0.93%)	
Mean ± SD	5.35 ± 3.65	6.74 ± 4.98	6.22 ± 4.57	0.239 [‡]
Median(25th-75th percentile)	4.5 (2.75-7)	6 (3-9)	5.5 (3-7)	
Range	2-19	1-22	1-22	

[‡] Mann Whitney test, [†] Fisher's exact test

Distribution of CT chest score was comparable in female and male. (1 to 5:- 60% vs 44.12% respectively, 6 to 10:- 30% vs 35.29% respectively, 11 to 20:- 10% vs 19.12% respectively, 21 to 25:- 0% vs 1.47% respectively) (p value=0.312).

Median(25th-75th percentile) of CT chest score in female was 4.5(2.75-7) and male was 6(3-9) with no significant association between them. (p value=0.239)

Table 5:Univariate linear regression to find out significant factors affecting CT chest scoring.

Variable	Beta coefficient	Standard error	P value	Lower bound (95%)	Upper bound (95%)
Age(years)	0.080	0.029	0.008	0.022	0.138
Gender					
Male					
Female	-1.385	0.904	0.128	-3.178	0.407
Vaccination second dose					
Received 1 dose					
Received 2 doses	-0.494	1.018	0.629	-2.513	1.525
Diabetic/non diabetic					
Non diabetic					
Diabetic	1.677	0.872	0.057	-0.051	3.405

On performing univariate linear regression, age(years) was significant risk factor of chest CT scoring. With the increase in age by 1 year, chest CT scoring significantly increased by 0.08.

IV. Discussion

CT has played an important role in the diagnosis and prognostication of the covid pneumonia. Hence, characteristics on the CT and CT severity scoring is an important facet to be evaluated, to study the impact of vaccination. In this study on 108 cases of breakthrough infection, 50% of the study population had a total CT severity score of 1 to 6 and 33.33% had a total CT score of 6 to 10. It is worth mentioning that majority (83.33%) of the patients had a total severity score below 10. This is in accordance with the previous studies. The study in India by Lakhia RT et al, found less severe pneumonia features or no pneumonia features in the breakthrough infection⁽⁵⁾ This had reflected in the clinical profile of the patients. Majority of the patients could be managed on room air. Significant positive correlation was seen between CT chest score with length of stay

with correlation coefficient of 0.345. A positive correlation co-efficient of 0.175 was seen between CT chest score with age. Age was identified as a risk factor on univariate analysis. The possibility of a severe infection in the vaccinated elderly may be due to 'immunosenescence'. This is explained as a diminished immune response to the vaccination in the elderly as compared to the young population. The increased susceptibility can also be explained by the increased comorbidities in the elderly. The worsening on CT scoring with increasing age was noticed on the breakthrough infections in previous studies.^{(5),(6)} We found that CT features were comparable between patients who received 1 or 2 doses of vaccinations. The study by Gurmurthy B et al in India on vaccinated patients did not find a major difference in CT features of patients who received 1 dose and 2 doses of vaccine, though, the study mentioned significant worsening in the unvaccinated patients compared to the vaccinated patients.⁽⁴⁾ We could not find any correlation between the CT severity score and gender of the study population. Studies evaluating the gender preponderance had showed mixed results, as there are a few reports where males were identified to have an increased susceptibility for severe infection.⁽⁷⁾ Median (25th-75th percentile) of CT chest score in diabetic was 6 which was significantly higher as compared to non diabetics. Diabetes was identified as a risk factor for severe infection with a significant p value of 0.043, which was in agreement with the previous studies.⁽⁸⁾

V. Conclusion

The mean Total CT score of the study population was 6.22 ± 4.57 . We conclude that the Total CT score of the break through infection is low. Vaccines assures a less severe infection. Increasing age and diabetes are associated with a worsening of the CT severity score in the study.

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