



A Study on Clinicopathological Features of Covid-19 Among Vaccinated and Non-vaccinated People

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Abstract

Introduction: The World Health Organisation declared Covid-19 outbreak by SARS-CoV-2 as a global Public Health Emergency of International Concern under the International Health Regulations on 30 January 2020 and was then further characterized as a pandemic on 11 March 2020. The pandemic has since then swept the globe as an unprecedented event causing widespread disruption and mayhem in terms of economic upheaval and health care ruin, dredging up the fragility of health services and public health systems worldwide. The Government of India (GoI) introduced new vaccines for mass vaccination against SARS-CoV-2 with the intent to keep the menace of the virus pandemic at bay and included Covishield (the name employed in India for the Oxford-AstraZeneca vaccine), a non-replicating, adenovirus vector vaccine carrying a recombinant spike protein of SARS-CoV-2. The situation in India in the April and May months of 2021 mandated a unified and comprehensive response by everyone at the helm when the country was struck by the second wave of Covid-19. An observational study was carried out to assess the course and the effects of SARS-CoV2 on the biochemical and haematological profile of Covid-19 patients and to draw comparisons between the vaccinated and non-vaccinated groups of people.

Method: The study was carried out at two different locations in India for two different groups of population, one vaccinated against Covid-19 by two doses of Covishield vaccine while the other group which was not being vaccinated against Covid-19. The non-vaccinated group comprised entirely of civilian population at Bihta, state of Bihar in India who were referred by the government medical hospital to a Covid hospital established by the Indian Army. The vaccinated group comprised of those vaccinated against Covid-19 with two doses, atleast 28 days apart, of Covishield vaccine. A total of 138 Covid-19 patients, 78 covid-19 patients of non-vaccinated group and 60 Covid-19 patients of vaccinated group were studied between 01 May 2021 and 31 July 2021. The patients were evaluated in terms of clinical presentation, haematological and biochemical laboratory parameters including inflammatory markers and mortality rates.

Result: The study reveals that the vaccinated cohort with breakthrough infections following Covid-19 vaccination with two doses of Covishield Vaccine had only mild symptoms and no deaths being reported while the non-vaccinated cohort presented with moderate to severe Covid-19, deranged laboratory parameters and increased mortality rate.

Conclusion: The study clearly demonstrates that Covid-19 vaccination with two doses of Covishield vaccine, offers significant protection against severe infections and death from Covid-19. While the study highlights the importance of Covid-19 vaccination particularly amongst the high risk groups such as those with co-morbid conditions including obesity, diabetes mellitus, hypertension, etc., it also emphasizes the need for observing Covid appropriate behaviour such as social distancing, frequent hand hygiene and wearing of face mask as breakthrough infections were noted amongst the vaccinated cohort in this study for want of such measures in the milieu.

Keywords: SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2); Covid-19 Vaccination; Covishield Vaccine; Breakthrough Infections; Neutrophil Lymphocyte Ratio; Delta Variant; Inflammatory Markers

Introduction

On 30 January 2020, the World Health organization declared Covid-19 outbreak, caused by SARS-CoV-2, to be a global Public Health Emergency of International Concern under the International Health Regulations and was then characterized as a pandemic on 11 March 2020 [1]. The Covid-19 pandemic has since then swept the globe as an unprecedented event causing widespread disruption and mayhem in terms of economic upheaval and health care ruin. During the initial part of the pandemic, efforts were concentrated largely on preventing and slowing down the disease transmission. Various mechanisms were adopted by way of Quarantine, isolation, contact tracing, containment and testing strategies employing molecular tests and rapid test kits [2,3]. The pandemic has dredged up the fragility of health services and public health systems worldwide and has emphasized the need for robust medical infrastructure and health systems to counter any future outbreaks.

The Government of India (GoI) introduced new vaccines for mass vaccination of against SARS-CoV-2 with the intent to keep the menace of the virus pandemic at bay. Free Covid-19 vaccination commenced in India on 16 January 2021. Out of the eight COVID-19 vaccines that were under various stages of clinical trials in India then, four were developed in the country. The drug regulator of India had approved restricted emergency use of Covishield (the name employed in India for the Oxford-AstraZeneca vaccine) and Covaxin, the home-grown vaccine produced by Bharat Biotech [4,5]. The country carried out the vaccination programme in a systematic manner by prioritizing the various sections of the society based on the age, vulnerable people with medical conditions and occupations with the Health Care Workers (HCW) and Frontline Workers (FLW) being categorized as high priority. Despite the advent of the vaccines, the world is still reeling under the devastation caused by the virus by way of mutant variants which inexplicably appear to be more virulent than the original parent virus.

The Covishield (ChAdOx1 nCoV-19) vaccine is a non-replicating, adenovirus vector vaccine carrying a recombinant spike protein of SARS-CoV-2. The vaccine has been found to be safe, tolerant and immunogenic in phase I/II trials with an efficacy of 74% in preventing infections in interim analysis of phase III trials [6-9].

The situation in India in the April and May months of 2021 mandated a unified and comprehensive response by everyone at the helm when the country was struck by the second wave. Augmentation and earmarking of medical facilities were an integral part of

the overall response mechanism. The Indian Armed Forces Medical Services committed to the management of Covid-19 patients, ensured optimal utilization of medical resources and manpower with setting up of various Covid hospitals across the country. One such Covid hospital was established in Bihta, state of Bihar, India, in order to support the local state medical authorities who were overwhelmed by the sudden surge in Covid-19 cases in the April and May months of 2021.

We carried out a study to assess the course and the effects of SARS-CoV2 on the biochemical and haematological profile of Covid-19 patients and to draw comparisons between the vaccinated and non-vaccinated groups of people. The vaccinated group included those vaccinated against Covid-19 by two doses, atleast 28 days apart, of Covishield vaccine and atleast 2 weeks following the second dose while the vaccinated group included those who had not received even a single dose of any vaccine against Covid-19.

Materials and Methods

Population

An observational study was carried out at two different locations in India for two different groups of population, one vaccinated against Covid-19 by two doses of Covishield vaccine while the other group which was not being vaccinated against Covid-19. The non-vaccinated group comprised entirely of civilian population at Bihta, state of Bihar in India who were referred by the government medical hospital to a Covid hospital established by the Indian Army. The vaccinated group comprised of those vaccinated against Covid-19 with two doses, atleast 28 days apart, of Covishield vaccine and who either reported sick to the respiratory clinic of the military hospital or were screened for Covid-19 as part of the contact tracing.

Sample size

A total of 138 patients of which 78 covid-19 patients of non-vaccinated group and 60 Covid-19 patients of Vaccinated group were studied between 01 May 2021 and 31 July 2021.

Inclusion criteria

All patients who reported sick to the respiratory clinic of the military hospital in case of vaccinated individuals and those who were referred for further management to the Covid hospital established by the Armed Forces Medical Services of Indian Army were included in the study. The patient categories were as under:

- All symptomatic individuals who reported sick to the respiratory clinic of the military hospital and were detected Covid-19 positive by RT-PCR testing or Rapid Antigen Test (RAT).
- All symptomatic and asymptomatic individuals who were screened as high risk contacts of Covid-19 case as part of the contact tracing in the military hospital and were found Covid-19 positive by RT-PCR testing or Rapid Antigen Test (RAT).
- All symptomatic individuals who were diagnosed as Covid-19 either by molecular tests or Rapid Antigen Tests (RAT) and referred to the Covid hospital established by the Indian Army at Bihta, in the state of Bihar, India.

Exclusion criteria

All symptomatic suspect Covid-19 patients and asymptomatic high risk contacts of Covid-19 case who were diagnosed negative for Covid-19 either by molecular tests or Rapid Antigen Tests.

Methodology

A total of 138 Covid-19 patients were evaluated and treated at two different locations in India during the second Covid-19 peak between May and June months of 2021. The Covid-19 positive patients were categorised into two groups. One group comprising of a total of 60 Covid-19 patients who are serving defence personnel, being completely vaccinated against Covid-19 with two doses of Covishield vaccine while the other group comprising of 78 Covid-19 patients who were not vaccinated or yet to be vaccinated against Covid-19. The list of patients of both these groups with their symptomatology is as per table 1 and 2.

S NO	Sex	Age (yrs)	SpO ₂ on arrival at room air	Type of Oxygen Support provided (NIV, IV, NRBM, RA, Nasal prongs)*	Co-morbidities if any
1	Male	25	94%	NRBM	-
2	Male	80	92%	NRBM	-
3	Female	44	88%	NRBM	Anemia
4	Male	55	69%	NRBM	Obesity
5	Male	65	70%	NRBM	-
6	Male	56	96%	NRBM	-
7	Female	50	84 %	NRBM	Anemia
8	Female	67	75 %	NRBM	CAD, COPD, Bronchial Asthma, Anemia, Obesity
9	Female	55	90%	NRBM	-
10	Male	38	90%	NRBM	-
11	Male	51	96%	NRBM	-
12	Female	47	97%	Nasal prongs	-
13	Female	66	80%	NRBM	-
14	Male	32	92%	NRBM	-
15	Male	56	94%	Nasal prongs	-
16	Male	52	36%	NIV	Anemia
17	Male	69	76%	NRBM	Anemia
18	Male	47	95%	FM	DM-II
19	Male	58	96%	Nasal prongs	-

20	Male	75	90%	FM	-
21	Female	72	60%	NRBM	HTN, DM-II
22	Male	63	93%	Nasal prongs	HTN,DM-II
23	Female	55	88%	FM	Anemia, DM-II, Obesity
24	Male	56	88%	FM	HTN
25	Male	27	96%	FM	Bronchial Asthma, Obesity
26	Female	53	99%	FM	Anemia, HTN, DM-II, CAD
27	Male	26	92%	FM	-
28	Male	53	96%	FM	Anemia
29	Female	55	99%	FM	-
30	Male	38	96 %	FM	Obesity
31	Female	35	81%	RA	DM-II
32	Male	76	82%	RA	DM-II
33	Male	55	35%	NRBM	-
34	Female	60	91%	Nasal prongs	-
35	Male	66	89%	NRBM	-
36	Female	75	87%	FM	-
37	Male	52	62%	FM	Anemia, DM-II
38	Male	50	62%	Nasal prongs	HTN
39	Male	32	80%	Nasal prongs	Obesity
40	Female	60	94%	Nasal prongs	DM-II
41	Male	55	90%	Nasal prongs	Anemia
42	Female	55	84%	FM	
43	Male	40	46%	NRBM	Anemia
44	Male	51	84%	NRBM	DM-II, HTIN
45	Male	62	40%	NRBM	DM-II
46	Male	71	80%	FM	HTN, DM-II
47	Male	55	76%	NRBM	
48	Male	68	50%	NRBM	DM-II
49	Male	60	52%	IV	DM-II
50	Male	61	80%	IV	DM-II
51	Female	47	40%	NIV	Anemia, DM-II
52	Male	64	80%	NRBM	HTN, Obesity
53	Male	64	80%	FM	DM-II
54	Male	35	82%	FM	DM-II
55	Female	55	84%	NIV	
56	Male	24	92%	Nasal prongs	
57	Male	62	76%	NIV	DM-II

58	Female	51	94%	NRBM	DM-II
59	Male	54	87%	NRBM	Anemia
60	Female	75	93%	NRBM	HTN
61	Female	51	92%	FM	
62	Female	75	86%	FM	DM-II
63	Male	70	70%	FM	
64	Male	41	88%	IV	Obesity
65	Male	72	80%	FM	HTN, DM-II, Hypothyroid- ism, BPH
66	Male	70	82%	FM	
67	Female	70	72%	FM	
68	Male	70	82%	FM	
69	Male	70	88%	FM	
70	Male	15	70%	FM	
71	Male	55	80%	FM	DM-II
72	Male	41	52%	IV	
73	Male	69	80%	FM	HTN, DM-II
74	Female	63	88%	NRBM	DM-II
75	Male	40	90%	Nasal prongs	
76	Male	58	84%	Nasal prongs	Obesity
77	Male	75	90%	Nasal prongs	Anemia, DM-II
78	Male	41	85%	FM	Obesity

Table 1: List of Covid-19 patients admitted in Covid Hospital established in Bhita in the state of Bihar by the Indian Army.

*NIV: Non-Invasive Ventilation, IV: Invasive Ventilation, NRBM: Non-Rebreather Mask, RA: Room Air, DM-II: Diabetes Mellitus Type 2, HTN: Hypertension, CAD: Coronary Artery Disease, COPD: Chronic Obstructive Pulmonary Disease. FM: Face Mask

S No	Sex	Age (yrs)	Date Of First Dose of Covishield	Date of Second Dose of Covishield	Clinical Features
1	Male	41	25-Feb-21	25-Mar-21	Symptomatic with fever of 05 days duration.
2	Male	29	27-Mar-21	30-Apr-21	Symptomatic with chest discomfort
3	Male	37	23-Feb-21	23-Mar-21	Asymptomatic high risk contact.
4	Male	25	22-Jan-21	22-Feb-21	Asymptomatic high risk contact.
5	Male	30	16-Feb-21	16-Mar-21	Symptomatic with complains of malaise, generalised body ache of 3 days duration.
6	Male	26	20-Feb-21	15-Mar-21	Asymptomatic high risk contact.
7	Male	25	04-Mar-21	08-Apr-21	Asymptomatic high risk contact
8	Male	35	01-Mar-21	01-Apr-21	Symptomatic with bodyache, fatigue and cough, and was quarantined for 9 days.
9	Male	38	01-Mar-21	30-Mar-21	Symptomatic with fever, sore throat and myalgia.

10	Male	35	01-Mar-21	30-Mar-21	Symptomatic with fever, cough, cold, anosmia and dysgeusia of 01 day duration.
11	Male	35	27-Feb-21	27-Mar-21	Symptomatic with anosmia for 01 days.
12	Male	30	01-Mar-21	30-Mar-21	Symptomatic with fever, myalgia, headache, nasal congestion and pain in left lumbar region for 01 day duration.
13	Male	40	22-Jan-21	06-Mar-21	Health Care Worker symptomatic with headache, malaise and sore throat for 01 day duration.
14	Male	37	05-Mar-21	23-Apr-21	Asymptomatic high-risk contact.
15	Male	33	28-Feb-21	29-Mar-21	Symptomatic with cough and fatigue.
16	Male	31	03-Apr-21	12-May-21	Symptomatic with fever, cough, myalgia and fatigue.
17	Female	25	16-Feb-21	18-Mar-21	Symptomatic with throat irritation of 02 days duration.
18	Male	32	19-Jan-21	17-Feb-21	Health Care Worker, symptomatic with complaints of myalgia and cold of 01 day duration.
19	Male	37	16-Feb-21	17-Mar-21	Symptomatic with complaints of fever with chills and dry cough associated with chest pain of 01 day duration.
20	Male	28	25-Apr-21	28-Jun-21	Symptomatic with complains of weakness, fever, anosmia of 1 day duration.
21	Male	58	02-Mar-21	05-Apr-21	Symptomatic with complaints of malaise, loss of appetite, bloating of abdomen.
22	Male	40	11-May-21	28-Jun-21	Symptomatic high risk contact with complaints of fever of 01 day duration.
23	Male	29	23-Feb-21	25-Mar-21	Symptomatic high risk contact with complaints of body ache, headache, dizziness, fever of 1 day duration.
24	Male	46	12-Mar-21	11-Jun-21	Symptomatic with complaints of fever, loose motion, loss of appetite of 1 day duration.
25	Male	30	25-Feb-21	03-Apr-21	Symptomatic with myalgia, malaise of 1 day duration.
26	Male	33	26-Feb-21	26-Mar-21	Symptomatic with complaints of fever, cold and dry cough of 1 day duration.
27	Male	41	06-Feb-21	03-Apr-21	Symptomatic with fever, headache, anosmia, dysguesia, cold, dry cough of 2 days duration.
28	Male	28	02-Mar-21	31-Mar-21	Symptomatic with complaints of fever, cold, headache, myalgia of 3 days duration.
29	Male	31	27-Feb-21	28-Mar-21	Symptomatic high risk contact with fever, cold, headache, dysguesia and anosmia of 2 days duration.
30	Male	36	26-Feb-21	26-Mar-21	Symptomatic with complaints of dysguesia, throat pain of 1 day duration.
31	Male	29	20-Mar-21	24-Apr-21	Symptomatic with complaints of fever, dry cough, cold, myalgia, malaise, anosmia, dysguesia, headache, dyspnea of 2 days duration.
32	Male	27	03-Mar-21	03-Apr-21	Symptomatic with complaints of dry cough and low back ache of 1 day duration.
33	Male	29	23-Mar-21	27-Apr-21	Symptomatic with complaints of malaise, myalgia and dysguesia since 1 day duration.
34	Female	25	26-Feb-21	30-Mar-21	Symptomatic with complaints of fever, cold, dry cough, myalgia, malaise of 2 days duration.

35	Male	26	02-Mar-21	25-Apr-21	Symptomatic with complaints of fever, cold and headache of 1 day duration.
36	Male	28	05-Mar-21	06-Apr-21	Symptomatic with complaints of bilateral eye pain and redness of 1 day duration.
37	Male	45	28-Feb-21	01-Apr-21	Symptomatic with complaints of fever, cold, throat irritation, myalgia of 1 day duration.
38	Male	44	11-Mar-21	09-Apr-21	Symptomatic with complaints of dry cough, fever, blocked nose with mild breathlessness, myalgia, malaise, anosmia, dysgeusia of 2 days duration.
39	Male	36	20-Mar-21	22-Apr-21	Symptomatic with complaints of dry cough of 3 days duration.
40	Male	41	13-Mar-21	03-Apr-21	Symptomatic with complaints of cold and myalgia of 1 day duration.
41	Male	42	02-Mar-21	01-Apr-21	Symptomatic with complaints of dry cough, fever, myalgia, malaise, dysgeusia, anosmia, loose stools of 1 day duration.
42	Male	44	20-Mar-21	21-Apr-21	Symptomatic with complaints of cough with expectoration, myalgia, malaise of 4-5 days duration.
43	Male	22	03-Mar-21	04-Apr-21	Symptomatic with complaints of fever, dry cough, cold and myalgia of 01 day duration.
44	Male	45	22-Feb-21	22-Mar-21	Symptomatic high risk contact with complaints of body aches.
45	Male	42	06-Mar-21	06-Apr-21	Symptomatic high risk contact with complaints of cough.
46	Male	47	06-Mar-21	06-Apr-21	Symptomatic with complaints of generalised weakness.
47	Male	30	03-Mar-21	25-Apr-21	Symptomatic with complaints of dry cough of 1 day duration.
48	Male	38	04-Mar-21	05-Apr-21	Symptomatic with fever and anosmia of 1 day duration.
49	Male	51	02-Mar-21	03-Apr-21	Symptomatic with complaints of fever of 04 days duration.
50	Male	32	22-Mar-21	22-Apr-21	Symptomatic with complaints of fever, myalgia, dry cough and dysgeusia of 2 days duration.
51	Male	41	26-Feb-21	26-Mar-21	Symptomatic with complaints of fever, myalgia, dry cough and headache of 2 days duration.
52	Male	30	19-Jan-21	19-Feb-21	Symptomatic with complaints of fever, headache, dry cough and malaise of 01 day duration.
53	Male	41	26-Feb-21	26-Mar-21	Asymptomatic
54	Male	39	11-Mar-21	20-Apr-21	Symptomatic with complaints of running nose.
55	Male	47	05-Mar-21	03-Apr-21	Asymptomatic.
56	Male	23	26-Feb-21	26-Mar-21	Symptomatic with complaints of fever and throat pain.
57	Male	29	07-Mar-21	04-Jun-21	Symptomatic with complaints of dry cough and cold.
58	Male	40	11-Feb-21	21-Mar-21	Asymptomatic
59	Male	55	10-Apr-21	15-Jun-21	Symptomatic with complaints of fever, myalgia and dry cough of 01 day duration.
60	Male	31	26-Feb-21	30-Mar-21	Asymptomatic

Table 2: List of Covid-19 patients at Military Hospital in the state of Assam.

The patients were admitted upon confirmation of Covid-19 diagnosis either by RT-PCR test or Rapid antigen test. On admission, blood samples were drawn by observing standard universal pre-

cautions for assessment of haematological and biochemical parameters including inflammatory markers. The laboratory assessment of patients of both groups is depicted in table 3 and 4.

S NO	Sex	Age (yrs)	Hb {g/dl}	NLR	TLC	Platelet	Urea/ Creatinine	NA/K	Bilirubin (mg/dl)	AST/ALT	ALP (U/L)	CRP (mg/dl)	Procal (ng/ml)	D-DIMER (ng/ml)	Ferritin (ng/ml)	IL-6 (pg/ml)	LDH
1	Male	25	14.4	84/08	9,800	1,93,000	45.2/0.89	137.6/4.29	0.92	71.5/202.4	94	58	0.36	1045	547	3.4	800
2	Male	80	13.6	82/08	15,800	2,80,000	25.6/0.67	132.3/4.67	0.36	46/95	119	109	0.62	750.9	288	4.2	560
3	Female	44	10.3	88/06	22,100	1,98,000	21.1/0.69	134.1/3.9	0.75	82/113.7	189	115.1	0.85	2083	659.7		481
4	Male	55	12.3	91/05	19,500	1,60,000	73.1/1.73	136.2/3.22	1.48	59/67.5	112	81.22	0.41	856	214	9.3	991
5	Male	65	13.2	85/08	12,400	2,24,000	30.7/0.92	139/4.2	0.88	36/42	109	66.7	0.33	310	920	6.36	1012
6	Male	56	14.3	87/09	11,900	3,47,000	34.1/0.78	140/4.7	0.82	102/223	97	101	0.39	337	810	6.25	1014
7	Female	50	10.7	58/30	26,500	2,80,000	32/0.64	131.2/4.26	0.37	29.7/26.6	84	81.84	1.2	1588	131	7.56	2398
8	Female	67	9.6	89/05	10,800	4,45,000	38.5/0.66	130.8/4.48	0.22	88/103	68	47.5	0.90	1810	512	2.16	1555
9	Female	55	12.6	86/08	16,800	4,31,000	26.7/0.65	140.2/3.5	0.49	79/134	90		0.89	1297	718	3.48	845
10	Male	38	15.2	81/14	14,300	2,16,000	41/0.85	137.5/4.9	0.91	29/35	102	84	0.27	783	494	6.1	912
11	Male	51	14.2	84/09	13,700	1,86,000	39/0.72	136.7/3.8	0.62	107/216.4	59	73	0.42	679	528	5.7	963
12	Female	47	12.8	87/07	15,900	3,12,000	41/0.94	139.7/3.9	0.95	31/40	115	68.2	0.29	407	197	4.1	1031
13	Female	66	14.2	83/09	15,600	2,70,000	45.6/0.69	133.5/4.28	0.34	32.2/42.7	93	38.27		1106	220		592
14	Male	32	13.1	85/09	9,300	2,04,000	26.7/0.67	140.2/3.5	0.38	36/48	90	51.89	0.76	306	710	3.6	410
15	Male	56	13	88/05	14,100	2,10,000	31.3/0.71	134.1/4.22	0.27	150.9/181.6	167	36.79	0.4	955	382		952
16	Male	52	11.7	84/07	11,500	1,67,000	73.8/1.35	137/4.6	0.74	36/145	141	78.32	0.23	2815.6	839	12.6	3753
17	Male	69	11.1	88/07	12,100	3,34,000	53.2/0.76	136.8/4.07	0.46	88/143	121	51		1851	192	1.6	1093
18	Male	47	14.6	89/07	18,200	4,10,000	124/46.5	133/4.86	0.30	182/201	110	53.29	0.95	1844	397.5	5.9	916
19	Male	58	12	87/06	8,000	1,17,000	43.4/0.89	130.2/4.03	0.93	71.8/111.8	132	26.9	1.9	767	81.5		655
20	Male	75	14.1	90/05	12,400	3,86,000	31.6/0.83	141/3.97	0.81	38/66	94	70.2	0.41	318	227	3.8	784
21	Female	72	12.5	91/07	34,800	2,02,000	84.6/1.49	144.3/4.66	0.99	722/817	277	4.87	0.15	800	42.8	14.1	2018
22	Male	63	15.1	81/11	17,100	1,68,000	38.4/0.97	139/4.7	0.67	84/120	166	101		927	342	2.8	715
23	Female	55	10.5	95/02	28,000	2,88,000	30.1/0.93	142/4.06	1.29	65/100	97	54	0.23	862	784	11.6	1176
24	Male	56	14.7	82/10	14,900	2,67,000	65.4/0.88	135/4.2	0.56	176/322	283	5.8	0.30	471	297	2.9	753
25	Male	27	13.5	84/10	10,600	3,13,000	39.7/1.26	139/4.12	0.33	62/106.3	107	36.58		1236	379.6	5	927
26	Female	53	10.0	81/09	18,100	3,60,000	114/2.45	134/4.33	1.79	340/566	192	72.63	0.36	1872	1503		1562
27	Male	26	14.4	72/13	10,200	2,10,100	35.6/0.81	140.2/3.92	0.87	162.1/79.7	208	27.08	0.27	1206	373	3.4	778
28	Male	53	11.4	68/23	14,200	3,20,000	36.7/0.71	146/4.41	0.94	124/217	178	68	0.19	230	211	4.1	620
29	Female	55	12.4	88/07	13,700	1,50,000	38/0.92	138/3.97	0.78	78/184	102	55.21	0.37	416	182		740
30	Male	38	14	86/08	14,000	1,92,000	20/0.87	138.2/4.98	0.64	188/256	210	88.48	1.2	3014	510.2	5.86	1208
31	Female	35	12.8	85/10	13,500	2,28,000	32/1.02	140/3.86	0.54	50/62	86	62.17	0.4	237	144		416
32	Male	76	15.6	83/08	9,000	1,32,000	48.1/0.71	125.1/4.2	0.71	176/322	283	5.8		114		6	753
33	Male	55	14	94/03	30800	1,58,000	53/1.06	139/4.08	0.99	70/57	164	81.5	2.86	3019	816.4	28.14	3428
34	Female	60	13.2	90/05	34,300	86,000	75.4/1.49	138/4.12	0.61	144/70	158	83.76		2618.2	488.2		1394
35	Male	66	13.3	89/07	18,300	1,75,000	49/1.2	128/4.9	0.59	120/203	187	114.30	0.24	1602	958	12.3	2179
36	Female	75	11.3	88/05	12,200	3,12,000	56.4/0.6	133.2/4.26	0.43	54/26	35	80.07	0.35	372	753	2.4	567
37	Male	52	12.1	89/04	16,500	1,41,000	85.7/0.86	134/4.68	0.62	70/153	386	68.19	0.29	5580	616.3	16.19	1833
38	Male	50	16	87/10	16,800	1,60,000	58/0.60	134.2/4.48	0.45	78.3/131.7	67	62.44	0.15	1688	569	17.4	1810
39	Male	32	14.4	92/06	20,800	3,54,000	31.5/0.69	136.2/4.3	0.49	37/49	76	5.19		870	706	2.49	956
40	Female	60	12.8	80/15	6,600	1,81,000	24/0.69	135/3.96	0.41	98/20	301	48.03	0.36	142.3	257	3.91	704
41	Male	55	9.4	95/03	29,300	1,31,000	112/1.26	134/4.88	0.5	64/92	165	51.2	1.2	910	637.9		661
42	Female	55	12	84/11	18,300	2,70,000	32/0.94	139.2/4.17	0.74	41/53	92	33.41	0.41	1042	574	1.86	1019
43	Male	40	11.2	86/10	15,900	1,51,000	132.9/6.86	137/4.36	0.53	168.2/117.8	175	115.3	14.9	3800	468	4.96	1126
44	Male	51	13.9	94/03	24,500	1,68,000	132.9/1.29	126.9/6.45	1.56	85.8/63	144	40.5	0.36	1142	800	9.28	1377
45	Male	62	14.9	92/03	19,200	1,59,000	49.6/0.67	137.9/4.05	0.96	31/18	131	113.7	2	4600	672	4.16	2057

46	Male	71	12.1	83/07	16,800	2,39,000	59.2/0.91	137.6/3.70	0.58	22/17	78	69.4	0.94	972	434	1.6	761
47	Male	55	13.4	92/06	15,600	3,13,000	32.2/0.97	139/4.16	0.6	49.5/168.1	102			1018	818	1.0	936
48	Male	68	13.4	76/10	16,600	1,95,000	52.9/0.70	135.8/4.69	0.3	28/40	109	52.70	0.28	471	532	45.70	1166
49	Male	60	12.1	93/02	22,300	3,09,000	24.6/0.67	126/4.22	0.33	268/291	239	87.77	119.3	1700	516	4.68	2270
50	Male	61	16.8	84/11	4,000	3,90,000	92/1.34	138.7/4.51	0.72	65/36	137	80.37		4097	718	44.18	1865
51	Female	47	6.9	92/06	23,400	2,39,000	210.1/5.1	133.7/7.42	0.32	77/58	520	34.56		1088	670	24.6	1121
52	Male	64	13.5	90/05	20,800	2,57,000	79/1.87	136/3.98	0.91	201/326	169	102.76	0.38	952	705	10.3	2146
53	Male	64	12.7	66/23	8,300	2,38,000	31.7/0.74	136.2/5.4	0.51	38/145	121	4.38	0.22	760	277	3.55	458
54	Male	35	14.7	89/09	9,400	1,90,000	16.9/0.55	134.1/4.2	0.69	44/142	116	34.32	0.23	930	670	21	588
55	Female	55	15.4	94/03	19,600	2,25,000	80.1/0.70	134/4.88	0.49	62/104.8	89	45.06	0.33	720	527.1	18.74	3745
56	Male	24	14.5	50/20	6,600	1,63,000	24.7/0.69	136.1/4.2	0.62	40/71	87	29.47		1210	907	5.82	631
57	M	62	13.9	95/04	15,100	1,56,000	75.2/0.96	137/4.56	0.5	29/42.5	65	44.6		1095	730	6.34	1826
58	Female	51	12.6	88/09	17,200	1,93,000	33.4/0.83	139/3.94	0.77	116/204	163	37.2	0.29	412	279	4.61	657
59	Male	54	10.6	89/03	30,800	1,56,000	48.2/0.69	133.5/4.5	0.84	115/383	145	124	1.40	940	419	3.97	723
60	Female	75	14.7	93/02	16,900	2,55,000	61/0.89	145.6/3.81	0.73	63/72	118	84.4	0.32	5040	458	2.85	1501
61	Female	51	10.9	69/25	11,300	4,01,000	40/0.89	136/4	0.3	24/18	136	58.3		340	270	2.46	381
62	Female	75	14.8	86/04	11,900	1,21,000	63.8/1.10	145/3.5	0.61	89.9/133.4	182	89.3	0.41	210.4	393	3.58	694
63	Male	70	10.2	90/08	10,600	1,56,000	70/0.87	133/4.56	0.84	58.6/86	141	127	0.3	5018	522.4	0.79	1081
64	Male	41	16.4	90/08	21,700	2,09,000	63.5/0.81	138/4.22	0.80	109/205	351	97.2	0.15	1098	917.2	13.2	1596
65	Male	72	14.4	77/20	10,300	2,11,000	81.3/1.39	136/4.22	0.75	23.2/35	112	86.4	0.42	1045	538.7	3.92	616
66	Male	70	14.7	95/04	14,400	3,80,000	57.4/0.94	142/4.33	0.32	41.6/49.2	96	86.8	0.32	3081	449.8	6.15	1580
67	Female	70	14.8	85/12	11,800	1,89,000	28.2/1.26	132/4.22	0.68	59.1/90.8	135	22.8	0.28	4013	561.6	3.86	627
68	Male	70	16.7	95/04	25,700	3,10,000	36/0.83	139/4.09	0.92	22.9/42	84	66.5	0.25	300	518	4.71	712
69	Male	70	13.8	89/07	14,300	3,70,000	41/1.02	138.2/3.66	0.74	184/251	193	47	0.4	678	862	5.89	1047
70	Male	15	12.4	91/04	18,700	4,50,000	28.4/0.89	125/4.2	0.39	104/24	84	98.4	1.30	447	118	0.96	881
71	Male	55	14.6	95/03	13,800	1,12,000	63.9/0.70	135/4.32	0.59	57.1/73.3	377	128.2	0.46	4088	718.6	12.8	2968
72	Male	41	13.2	90/08	15,900	1,35,000	32.9/0.72	140/4.12	0.83	111.2/223.4	64	107	0.39	332	800	6.63	1114
73	Male	69	11.9	90/04	17,800	1,90,000	105/1.18	144.1/4.34	0.57	46/49	166	136.4	0.23	300	435	5.1	835
74	Female	63	13.1	86/10	9,400	1,60,000	41.5/0.87	137/3.62	0.43	24/83	175	22.35	0.39	280	372	4.87	803
75	Male	40	14.5	85/09	13,800	3,05,000	40.3/0.67	135.1/4.42	0.40	85.5/137.6	220	18.67	0.24	809.4	116.2		498
76	Male	58	14.3	87/11	10,500	2,54,000	41.9/0.69	137.4/4.98	0.54	84/174	118	2.86		599.4	203	1.27	354
77	Male	75	11.1	93/04	8,000	4,30,000	38/0.84	140.2/3.67	0.81	42/63	79	52	0.33	372	517	5.3	741
78	Male	41	11.3	95/04	23,300	1,66,000	53.7/0.81	145.1/5.57	0.3	92.6/455.6	111	88.6	0.81	667	382	4.68	577

Table 3: Haematological and biochemical profile of Covid-19 patients admitted in Covid hospital established by Indian Army in Bhita, Bihar.

Hb: Haemoglobin, TLC: Total Leukocyte Count, NLR: Neutrophil Lymphocyte Ratio, NA/K: Serum Sodium/Potassium, AST/ALT: Serum Aspartate Transaminase/Alanine Transaminase, ALP: Serum Alkaline Phosphatase, CRP: C-Reactive Protein, Procal: Serum Procalcitonin, IL-6: Serum Interleukin-6.

Reference range:

Hb: 13.5- 18 g/dl in males and 12-17.5 g/dl in females

TLC: 4000-11000/cmm; NLR: 40-80/20-40

Serum Bilirubin: 0.3-1.2 mg/dl

AST/ALT: <45/<45 (in IU/L)

Serum Alkaline Phosphatase: 30-120 U/L

Serum Urea/Creatinine: 17-43/0.65-1.14 (in mg/dl)

Serum Sodium/Serum Potassium: 1335-145/3.5-5.5 (in mmol/L)

CRP: <6 mg/dl

D-Dimer: <500 ng/ml

Serum Ferritin: 22-350 ng/ml in males and 10-291 ng/ml in females

Serum IL-6: 0-7 pg/ml

LDH: 230-460 U/L

Serum Procalcitonin: <0.5 ng/ml.

S No.	Sex	Age (yrs)	Hb (g/dl)	TLC	NLR	Platelet	Urea/ Creatinine	Bilirubin (mg/dl)	AST/ ALT	ALP (U/L)	LDH (U/L)	CRP (mg/dl)	Procal (ng/ml)	D-DIMER (ng/ml)	Ferritin (ng/ml)	IL-6 (pg/ml)
1	Male	41	12.9	6700	46/44	150000	28/0.9	0.8	29/32	45	305	2	0.2	225	80.5	2.1
2	Male	29	15.5	6500	63/58	286000	29/1.1	0.7	27/29	62	690	3.2	0.1	132	91.2	4.53
3	Male	37	11.7	8300	66/20	200000	22/0.6	0.6	37/26	98	376	3.6	0.15	182.5	109.6	
4	Male	25	15	6100	52/44	150000	24/0.9	0.5	37/50	87	226	4	0.03	313	75.6	
5	Male	30	14.5	13300	76/13	426000	36/1.2	0.8	60/90	114	410	2.7	0.12	105	55	2.38
6	Male	26	14.7	14400	80/17	118000	24/0.7	0.7	33/36	101	337	5.2	0.07	412	37.2	3.64
7	Male	25	13.9	6300	71/25	472000	27/0.8	0.8	18/22	55	288	4.78		102	255	
8	Male	35	13	6600	70/23	264000	24/0.6	0.5	36/32	76	316	2.8		241	117.8	4.1
9	Male	38	15.6	6400	65/28	129000	21/0.9	0.6	28/16	49	266	3.96	0.08		38.5	
10	Male	35	16.4	5200	62/26	171000	27/0.8	0.7	38/28	104	397	2.1		155	184	
11	Male	35	10.4	5800	52/44	162000	27/0.7	0.6	24/28	51	380	1.89		286	21.4	3.9
12	Male	30	15.7	6300	55/31	199000	31/0.8	0.7	36/38	113	387	2.66		127	63.2	4.89
13	Male	40	15.3	4600	60/30	184000	27/0.8	0.8	64/50	94	325	1.56	0.08	188		5.2
14	Male	37	13.5	7700	64/31	332000	25/0.5	0.9	21/24	102	255	2.34		117	207	
15	Male	33	18.4	5800	50/39	220000	27/0.8	0.5	27/29	63	558	4.2	0.06	264	114	3.5
16	Male	31	13.5	6200	77/16	276000	27/0.8	0.8	38/28	81	217		0.22	137	212	5.6
17	Female	25	14.1	4100	60/30	229000	20/0.8	0.7	40/36	67	326	3.39		104	81.2	2.73
18	Male	32	14.1	8100	79/15	138000	31/0.9	0.5	26/31	103	396	2.58	0.17	323	93.6	
19	Male	37	15.8	4100	54/34	186000	36/1.0	0.8	36/24	85	285	1.51	0.3	245	67.4	3.5
20	Male	28	15.2	5300	59/28	242000	28/1.0	0.7	29/34	110	229	2.67	0.14	114	242	
21	Male	58	13.1	9200	60/30	337000	35/1.2	0.5	26/29	79	200		0.2	351	195	
22	Male	40	14.9	7400	80/17	150000	45/1.4	0.9	27/30	69	232	4.1	0.11	243	105	2.62
23	Male	29	14.6	4900	60/30	150000	22/0.9	0.5	24/16	93	324	3.28	0.28	361	207	
24	Male	46	17	6600	50/40	254000	22/0.5	0.8	27/20	107	290	7.4	0.07	305	51.2	1.56
25	Male	30	14.4	8000	70/20	150000	27/0.9	0.6	36/42	72	256	2.84	0.09	329	79.3	
26	Male	33	14.3	5900	52/32	180000	26/0.9	0.6	29/25	86	290	2.4	0.21	282	102.5	
27	Male	41	18.3	5200	51/40	129000	27/0.7	0.8	82/74	92	528	4.5	0.17	306	185	3.12
28	Male	28	15.4	5800	66/22	219000	28/0.9	0.8	29/32	58	290	2.28	0.29	215		
29	Male	31	12.3	6100	50/39	176000	26/0.7	0.5	36/40	64	317	3.1	0.19	114	42.5	2.65
30	Male	36	16.4	9000	70/17	136000	32/1.3	0.5	31/35	81	276	4.17	0.08	201	117	3.69
31	Male	29	13.6	7900	61/30	237000	32/0.9	0.7	31/32	89	272	3.94	0.24	153	94	4.52
32	Male	27	14.9	7900	61/32	264000	30/1.1	0.9	33/38	110	410	3.57	0.16	185	227	
33	Male	29	16.9	5300	55/33	155000	29/0.9	0.5	29/34	103	319	2.1	0.3	271	114	3.37
34	Female	25	12.1	3200	64/30	172000	26/0.7	0.7	30/18	78	302	2.19	0.14	304	186	2.54
35	Male	26	16.4	9000	72/17	165000	32/1.3	0.5	31/35	96	276	4.21	0.26	328	247	4.8
36	Male	28	14	5500	48/45	184000	28/1.0	0.5	25/31	68	231	3.25	0.06	127	209	3.81
37	Male	45	14.7	4000	56/34	206000	30/1.0	0.6	21/31	87	302		0.2	238	114.2	
38	Male	44	13.3	10000	76/16	168000	32/1.0	0.6	30/21	113	263	3.62	0.37	367	192	
39	Male	36	17.5	8000	54/38	228000	22/0.8	0.6	21/25	102	245	3.1		128	216	
40	Male	41	14.5	5200	66/27	220000	32/1.1	0.5	32/39	78	235	2.69	0.07	210	195	3.77
41	Male	42	15.8	6300	71/20	158000	40/1.3	0.8	30/35	67	368	3.58	0.12	174		
42	Male	44	13.3	5700	67/24	168000	32/1.0	0.5	34/34	93	333	2.28	0.18	346	184	2.96
43	Male	22	14.1	6000	65/28	150000	24/0.7	0.7	30/32	80	370	2.1		183	72.4	3.2
44	Male	45	14.3	5000	60/30	283000	24/0.8	0.6	54/48	82	240	3	0.24	176	88	4.1
45	Male	42	16.5	5100	61/28	175000	31/0.9	0.7	50/24	64	346	2.8	0.3	231	139	

46	Male	47	14.1	2500	47/43	184000	29/0.7	0.7	120/242	91	414	3.4	0.17	266	217	
47	Male	30	16.8	7500	72/20	168000	27/1.0	0.6	114/220	86	286	2.4	0.36	314	94	2.38
48	Male	38	14	5900	52/41	150000	20/0.6	0.6	60/46	101	261	1.8	0.19	183	106	4
49	Male	51	14.8	5500	71/25	204000	58/1.4	0.5	36/22	105	252	4	0.2	215	155	3.6
50	Male	32	15.9	6900	60/31	164000	27/0.6	0.5	36/18	83	271	8.56	0.08	169	147	2.7
51	Male	41	15.5	4600	50/34	182000	26/0.9	0.9	48/30	74	230	2.5	0.06	116	211	
52	Male	30	15.5	4000	50/38	210000	34/1.2	0.5	34/39	85	244	2.2	0.13	73	182	2.49
53	Male	41	13.8	3400	52/30	160000	22/0.8	0.4	26/18	69	191	3.7	0.07	104	220	
54	Male	39	16.1	5400	68/24	200000	26/0.9	0.5	29/36	107	231	3	0.14	202	162	
55	Male	47	11.6	8900	76/14	204000	25/0.8	1.2	49/53	119	309	2.1	0.08	114	236	2.56
56	Male	23	14	5100	60/30	172000	31/1.0	0.6	18/21	110	281	3.2	0.12	97	174	
57	Male	29	16.2	8500	80/15	181000	27/1.0	0.5	18/36	76	256	4.1	0.23	274	195	4
58	Male	40	16.4	5100	50/40	170000	34/1.0	1.0	51/76	94	250	2.2	0.2	84	110	3.4
59	Male	55	16.4	5300	65/30	198000	30/1.0	0.7	29/32	88	306	3.1		378	209	
60	Male	31	13.2	11900	69/20	219000	18/0.6	0.4	18/21	106	210	3.8	0.08	302	292	3.3

Table 4: Haematological and biochemical profile of Covid-19 patients at Military hospital, Assam.

Hb: Haemoglobin, TLC: Total Leukocyte Count, NLR: Neutrophil Lymphocyte Ratio, NA/K: Serum Sodium/Potassium, AST/ALT: Serum Aspartate Transaminase/Alanine Transaminase, ALP: Serum Alkaline Phosphatase, CRP: C-Reactive Protein, Procal: Serum Procalcitonin, IL-6: Serum Interleukin-6.

Reference range:

Hb: 13.5- 18 g/dl in males and 12-17.5 g/dl in females

TLC: 4000-11000/cmm; NLR: 40-80/20-40

Serum Bilirubin: 0.3-1.2 mg/dl

AST/ALT: <45/<45 (in IU/L)

Serum Alkaline Phosphatase: 30-120 U/L

Serum Urea/Creatinine: 17-43/0.65-1.14 (in mg/dl)

Serum Sodium/Serum Potassium: 1335-145/3.5-5.5 (in mmol/L)

CRP: <6 mg/dl

D-Dimer: <500 ng/ml

Serum Ferritin: 22-350 ng/ml in males and 10-291 ng/ml in females

Serum IL-6: 0-7 pg/ml

LDH: 230-460 U/L

Serum Procalcitonin: <0.5 ng/ml.

The patients were categorised into mild, moderate and severe cases as per the symptoms presented by and clinical signs elicited in the patients. Mild cases were those presenting with low grade fever, cough, malaise, body ache, rhinorrhea, sore throat without any shortness of breath. The moderate cases were those presenting with respiratory distress, hypoxemia or shock with respiratory rate more than 24/min and/or SpO₂ less than 94% in room air. The patients were classified as severe if any two of the following were pres-

ent: severe respiratory distress, respiratory rate more than 30/min, SpO₂ less than 90% in room air, altered sensorium, blood pressure less than 90/60 mm Hg and new onset or worsening organ dysfunction. All treatment modalities were instituted as per the clinical management protocol for Covid-19 promulgated by the Ministry of Health and Family Welfare, GoI.

Results

It is apparent from the tables 1 and 2 that much of the severe Covid-19 cases were observed in the unvaccinated group while the breakthrough infections in the vaccinated lot were mostly mild infections and a few even being asymptomatic. There were a total of 20 deaths reported amongst the 78 unvaccinated people while no deaths were reported amongst the vaccinated cohort. The clinical presentation correlated with the laboratory parameters as depicted in the tables 3 and 4. There was marked derangement in the haematological and biochemical parameters with significant elevation of inflammatory markers amongst the unvaccinated group.

The clinical presentation varied between the vaccinated and the non-vaccinated groups. The vaccinated cohort presented with mild symptoms including malaise, fatigue, body ache, headache, dysgeusia, anosmia, fever, cough, sore throat, nasal stuffiness, running nose, abdominal discomfort and retro-orbital pain. About 13.33% of patients were asymptomatic and were detected to have Covid-19 during contact tracing of Covid-19 positive cases. In contrast to the vaccinated cohort, the unvaccinated group presented with moderate to severe symptoms, majority of them requiring oxygen therapy in addition to the steroids and other medications. The management of the Covid-19 patients were as per the clinical management protocol for Covid-19 promulgated by Ministry of Health and Family Welfare, GoI.

The derangement in the haematological profile was very obvious amongst the patients in the unvaccinated group in the form of leucocytosis (78%), raised Neutrophils Lymphocyte Ratio (NLR) (94.87%) and even thrombocytopenia (7.69%). These derangements correlated well with raise in the inflammatory markers namely serum C-Reactive Protein (CRP) (94.3%), D-dimer levels (71.79%), Serum Ferritin (72.72%) and serum Lactate Dehydrogenase (LDH) (93.58%). Serum Interleukin 6 was also found elevated in 31.94% of patients in the non-vaccinated group with associated complicated clinical course and increased mortality rate (60%). The haematological profile of the patients in the vaccinated group were more or less within the normal limits with only 5% of the patients presenting with leucocytosis, 15% of patients presenting with elevated NLR and 5% with mild thrombocytopenia.

There was significant number of patients amongst the unvaccinated group presenting with severe liver injury. About 85.89% of patients of the unvaccinated cohort presented with significant elevation of serum aminotransferases, ALT more than AST, with a

resulting mortality rate of 85% amongst these patients. Patients with Mixed pattern of ALT/AST and Serum Alkaline phosphatase elevation had far more worse outcome than with a hepatocellular type. In contrast to the non-vaccinated cohort, majority of the patients of the vaccinated group presented with liver function tests being within normal limits with only 20% of the patients presenting with elevated serum aminotransferases.

About 51.28% of the patients in the non-vaccinated cohort presented with deranged renal function tests in the form of raised serum urea and serum creatinine levels. The deranged renal profile correlated with elevated inflammatory markers and worse prognosis. Significant proportion of these patients also presented with deranged serum electrolytes in the form of hyponatremia (30.76%) and hyperkalemia (3.84%). These derangements translated into impaired acid base balance leading to poor prognosis. All patients in the vaccinated group on the other hand presented with normal renal profile and normal serum electrolyte levels.

Discussion and Conclusion

Covid-19 is caused by the single stranded RNA virus, SARS-CoV2 (Severe Acute Respiratory Syndrome Coronavirus 2) which is a Betacoronavirus of the family Coronaviridae. The virus has taken the world by storm, hitting the world in waves and causing widespread devastation in terms of both lives lost and economic disruption. The circulating various mutant strains across the different regions of India in the second wave that hit the country in the initial months of the year 2021 were more transmissible and pathogenic compared to the first wave, indicating the evolution of the virus. The variant, B.1.617.2, also termed the Delta variant, is believed to be more transmissible and resistant to antibodies present in the sera of individuals, both those who had recovered from Covid-19 and those who had received both doses of Covid-19 vaccine [10]. Armed with improved immune escape mechanism and increased transmission capabilities, the Delta variant contributed to surge in Covid-19 cases in India and also across the globe in the early part of 2021 [11]. Studies have revealed that areas with large population density, like that in India, have higher chances of mutation, viral replication and evolution [12].

In the month of April 2021, India was reporting highest number of daily cases in the world with intensive viral transmission witnessed in the states of Assam, Bihar, Delhi and others [13]. The Indian SARS-CoV-2 Genomics Consortium (INSACOG), a network of ten laboratories established in December 2020 for continuously

monitoring the genomic changes of SARS-CoV-2 in India through Whole Genome Sequencing (WGS) acknowledged the fact the SARS-CoV-2 virus had been mutating and had advised the states of India to send the samples for genome sequencing to provide epidemiological insight into the link of the surge at various places in the country to the variants as well as enable INSACOG to discover other variants of concern, if present in the community [14]. Patients infected in the first wave in India were predominantly elderly individuals and those with co-morbid conditions were at increased risk of mortality. However, in the second wave, patients in the younger age group and even those without any co-morbidity were rendered susceptible.

Many laboratory parameters were found to be altered in Covid-19 patients and studies have revealed that significant variations in the haematological parameters such as NLR, Neutrophil count and biochemical parameters such as liver function tests and renal function tests and inflammatory markers do occur in Covid-19 [15-18]. Studies have found that the peripheral blood Total Leukocyte Count (TLC), Neutrophil Lymphocyte ratio (NLR) are the indicators of systematic inflammatory response in Covid-19 patients [19,20] and were similarly found elevated in the majority of the patients in the non-vaccinated group in stark contrast to the Vaccinated group where only 5% patients exhibited elevated TLC and 15% with raised NLR. Clinical studies on Covid-19 have revealed that severe Covid-19 present with hepatic injury in the form of elevated transaminases, elevated alkaline phosphatase levels and hypoproteinemia [21,22], and the same was found in our study as well. Further, our study has brought out that the patients with co-morbid conditions such as Type 2 Diabetes Mellitus, Hypertension and Obesity were found more susceptible to liver injury in the non-vaccinated cohort.

A systematic review and meta-analysis study carried out in pre-delta era has revealed that upto one-fourth of Covid-19 cases remained asymptomatic throughout the course of infection and that monitoring of such asymptomatic carriers was imperative to tackle the pandemic [23]. However, it has been clearly brought out by our study that the Covid-19 patients in the vaccinated group who were vaccinated with two doses of Covishield Vaccine presented only with mild symptoms and 13.33% of them being asymptomatic compared to moderate to severe symptoms noted amongst the non-vaccinated group who were hospitalized for management. The breakthrough infections were managed symptomatically with antipyretics, anti-tussives and vitamins while the patients in the non-vaccinated group required rigorous clinical monitoring and management with oxygen, steroids, anti-virals and at times mechanical ventilation. The results of a Cohort study have indicated a significant reduction in the Covid-19 breakthrough infections and

the resultant hospitalization with the Covishield vaccination [24]. The same has been demonstrated in our study which reveals mild symptoms with breakthrough Covid-19 infections and no deaths being reported amongst the Vaccinated group.

Epidemiological and clinical genomics study has revealed that Covid-19 vaccines help in thwarting the evolution of new coronavirus strains by limiting new mutations that allow immune escape [25]. As our study looked at the two cohorts of patients infected with Covid-19, one vaccinated while the other yet to be vaccinated, a stark contrast was drawn between the two groups in terms of the disease burden, clinical severity of the disease and the resources needed to tackle the same. Our study not only highlights the importance of Covid-19 vaccination particularly amongst the high risk groups such as those with co-morbid conditions including obesity, diabetes mellitus, hypertension, etc., but also emphasizes the need for observing Covid appropriate behaviour such as social distancing, frequent hand hygiene and wearing of face mask as breakthrough infections were noted amongst the vaccinated cohort in this study for want of such measures in the milieu. While the complete eradication of Covid-19 is aspirational, the complete removal of the SARS-CoV-2 from the world seems like a pipe dream. However, elimination of Covid-19 is potentially achievable by broad and deep cooperation within and across the nations by way of adequate and speedy mass vaccination against the contagion.

Ethical Approval

Informed consent of the patients involved in the study was obtained for publication of this paper. The study was approved by the ethical standing committee at the Military Hospital.

Conflict of Interest

The authors declare that they have no competing financial interests or personal relationship that could have influenced the work reported in this paper.

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