COVID-19 pandemic and its recovery time of patients in India: A pilot study

Manash Pratim Barman [a], Tousifur Rahman [a, *], Krishnarjun Bora [a], Chandan Borgohain [b]

[a] Department of Statistics, Dibrugarh University, Assam, India
[b] Sibsagar College, Joysagar, Assam, India

ABSTRACT

Background and aims: Covid-19 virus started from Wuhan, China and has brought the world down to its knees. It has catapulted as a venomous global phenomenon. This study focuses on the Covid-19 situation in India and its recovery time.
Method: The study period is from March 1, 2020 to April 25, 2020. A random sample of 221 individuals found positive with Covid-19 from March 1, 2020 to 31st March is included in the study which is followed up April 25, 2020. There is a male preponderance in the sample with 66% of the Covid-19 patients being male and about 34% being female. Kaplan-Meier Product limit estimator, Kaplan-Meier survival curve and Log-rank test are used to analyze the recovery time of Covid-19 patients.
Result: From the results of the study, it is found that the average recovery time of Covid-19 patients in India is 25 days (95% C.I. 16 days to 34 days). Only 4% of the patients get cured after 10 days of treatment. The recovery time of male and female patients is not statistically different. Recovery time of patients belonging to different age groups is also not statistically significant.
Conclusion: This information on recovery time of Covid-19 patients will help planners to chalk out effective strategies.

1. Introduction

Mankind has, more often than not, been at the receiving end of certain unprecedented events that have hogged the limelight and become history [1]. Diseases which were never there in the past have gained currency and become a part of the popular parlance. Plagues, flu etc. have battered humanity from time to time and the casualties have been of no small dimension. As of now, it is Covid-19 caused by SARS-CoV-2 which is doing the rounds and have brought the world to a deadening standstill [2]. Regarded as a family of viruses, the Corona Viruses cause cold, cough, and respiratory problems [2]. Known as the SARS-CoV-2, this virus is life threatening and can take a heavy toll in terms of morbidity and fatalities [2]. The global headcount as of on May 31st, 2020, is about 6.2 million which presents a staggering picture indeed [3]. In India, with reports of the first case reported way back in January 30, 2020, the headcount as of May 31st, 2020, stands about 190,648 which is

likely to increase exponentially [4].

The beginnings of which are to be located in fateful Wuhan in China [5], the disease gradually spread across the globe with the initial hotspots being Italy, France, Germany, England et al. and of course, the United States of America and India. It finally turned its ugly head to become a global phenomenon which the world is now trying to grapple with and thereby eke out a solution in the form of a Vaccine. Even as the efforts towards finding a vaccine are underway, there have been simultaneous efforts to reach out to those huge groups of people which have been by now affected. The process being undertaken by Governments is to trace, test, isolate and quarantine. The mechanism currently in place to contain or rather to flatten the curve is hard and fast social distancing, using of masks and frequent hand washing [6]. By now, a few countries have endorsed and ramped up rapid testing to contain the spike and spiraling of Covid-19.

Meanwhile, various studies have been undertaken to understand the nitty-gritty of this venomous disease. These studies have been of variegated nature. Instead of creating health burden, this pandemic has a great impact on the economic downturn which has seriously affected people from the lower socio-economic stratum

* Corresponding author. Department of Statistics Dibrugarh University, Dibrugarh, 786004, Assam, India.
  E-mail address: rs_tousifurrahman@dibru.ac.in (T. Rahman).

Sl No.	States/UT	Total Cases
1	Maharashtra	67655
2	Tamil Nadu	22333
3	Delhi	19844
4	Gujarat	16794
5	Rajasthan	8831
6	Madhya Pradesh	8089
7	Uttar Pradesh	8075
8	West Bengal	5501
9	Bihar	3807
10	Andhra Pradesh	3571
11	Karnataka	3221
12	Telengana	2698
13	Jammu and Kashmir	2446
14	Punjab	2263
15	Haryana	2091
16	Odissa	1948

Sl No.	States/UT	Total Cases
17	Assam	1340
18	Kerala	1270
19	Uttarakhand	907
20	Jharkhand	635
21	Chhattisgarh	498
22	Himachal Pradesh	331
23	Tripura	316
24	Chandigarh	293
25	Ladakh	77
26	Manipur	71
27	Goa	71
28	Puducherry	70
29	Nagaland	43
30	Andaman & Nicobar	33
31	Meghalaya	27
32	Arunachal Pradesh	4
33	Daman and Diu	2
34	Mizoram	1
35	Sikkim	1
36	Lakshadweep	0
37	Unassigned	5491
	Total	**190648**

Legend:
- 1-5,000
- 5,000-10,000
- 10,000-15,000
- 15,000-20,000
- 20,000-25,000
- 25,000 & above

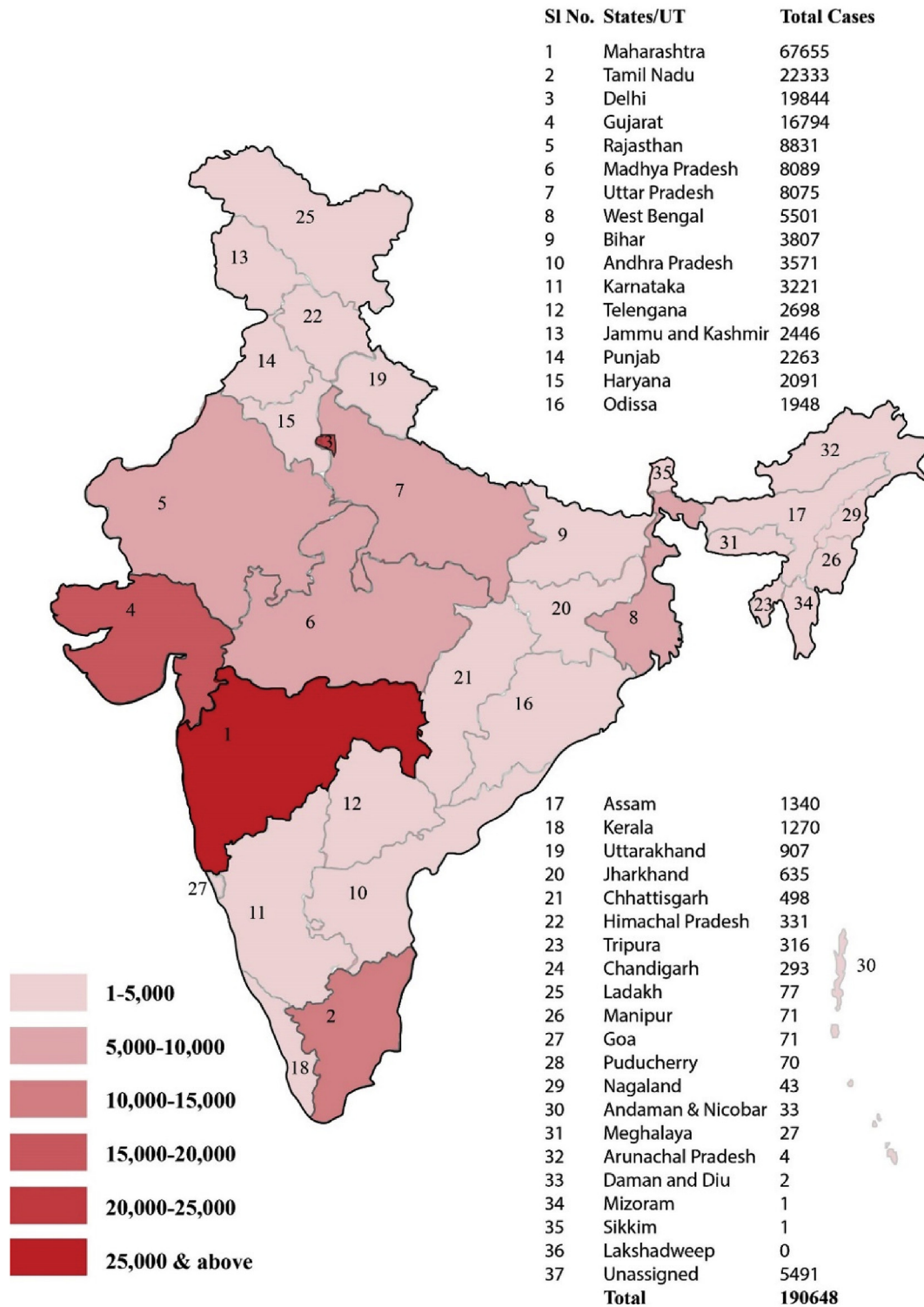**Fig. 1.** Total covid-19 cases in India on 31st May 2020
(Data Source: www.covid19india.org, Map not for scale).

(SES) [7]. Research also shows that the different meteorological factors particularly daily temperature and relative humidity are also important in the spread of the disease [8].

Further, the efforts of the academia cutting across multiple disciplines have been working tirelessly to have a better understanding of the prevailing situation. It is in continuation of the same vein that there can be a feasible approach towards understanding the recovery time of the disease. The rationale behind making an effort to approximate the recovery time vis-à-vis the incidence of the pandemic is something that has a bearing on the overall preparations and the mechanism that needs to be put into place at the earliest convenience. In the event of any possibility to
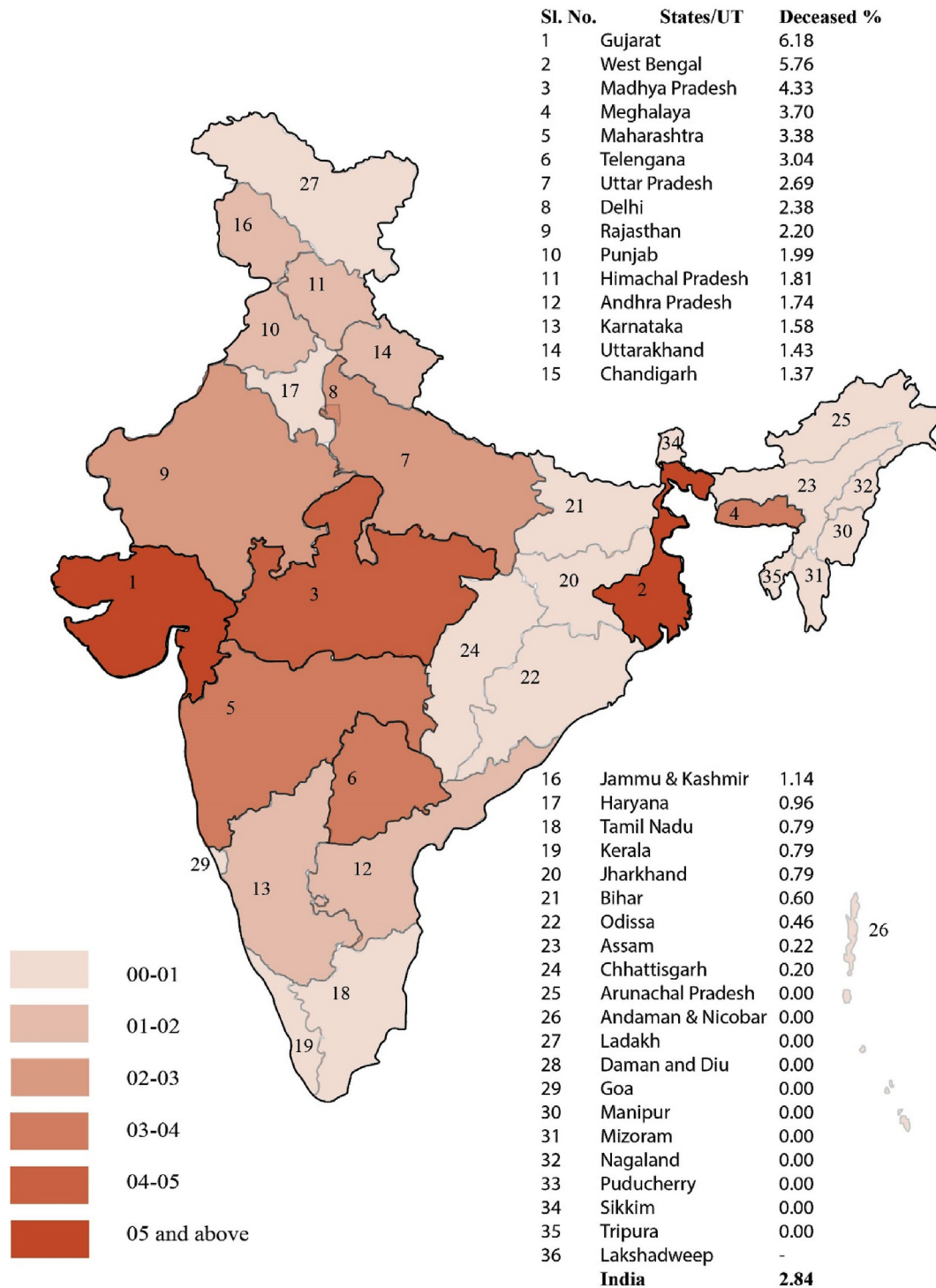
Sl. No.	States/UT	Deceased %
1	Gujarat	6.18
2	West Bengal	5.76
3	Madhya Pradesh	4.33
4	Meghalaya	3.70
5	Maharashtra	3.38
6	Telengana	3.04
7	Uttar Pradesh	2.69
8	Delhi	2.38
9	Rajasthan	2.20
10	Punjab	1.99
11	Himachal Pradesh	1.81
12	Andhra Pradesh	1.74
13	Karnataka	1.58
14	Uttarakhand	1.43
15	Chandigarh	1.37

Sl. No.	States/UT	Deceased %
16	Jammu & Kashmir	1.14
17	Haryana	0.96
18	Tamil Nadu	0.79
19	Kerala	0.79
20	Jharkhand	0.79
21	Bihar	0.60
22	Odissa	0.46
23	Assam	0.22
24	Chhattisgarh	0.20
25	Arunachal Pradesh	0.00
26	Andaman & Nicobar	0.00
27	Ladakh	0.00
28	Daman and Diu	0.00
29	Goa	0.00
30	Manipur	0.00
31	Mizoram	0.00
32	Nagaland	0.00
33	Puducherry	0.00
34	Sikkim	0.00
35	Tripura	0.00
36	Lakshadweep	-
	India	**2.84**

Fig. 2. Percentage of deaths of different states in India till 31st May 2020 (Data Source: www.covid19india.org, Map not for scale).

determine the recovery time, then the governments will be better placed to make arrangements accordingly and in accordance with the likely number of patients that are to be affected by the disease in the near future.

2. Covid-19 situation in India

Considering the world scenario regarding the spread of covid-19, India is also not an exception. The Government of India has been working round the clock to make a holistic assessment of the situation. On 31st May 2020, the total number of covid-19 cases in India is 190,648 with a total deaths of 5414. The number of recovered patients in the country on the same day is 91,862 i.e. 48.18% of the total cases. The total number of covid-19 cases of the various states in India on 31st May 2020 is shown in the map in Fig.1.

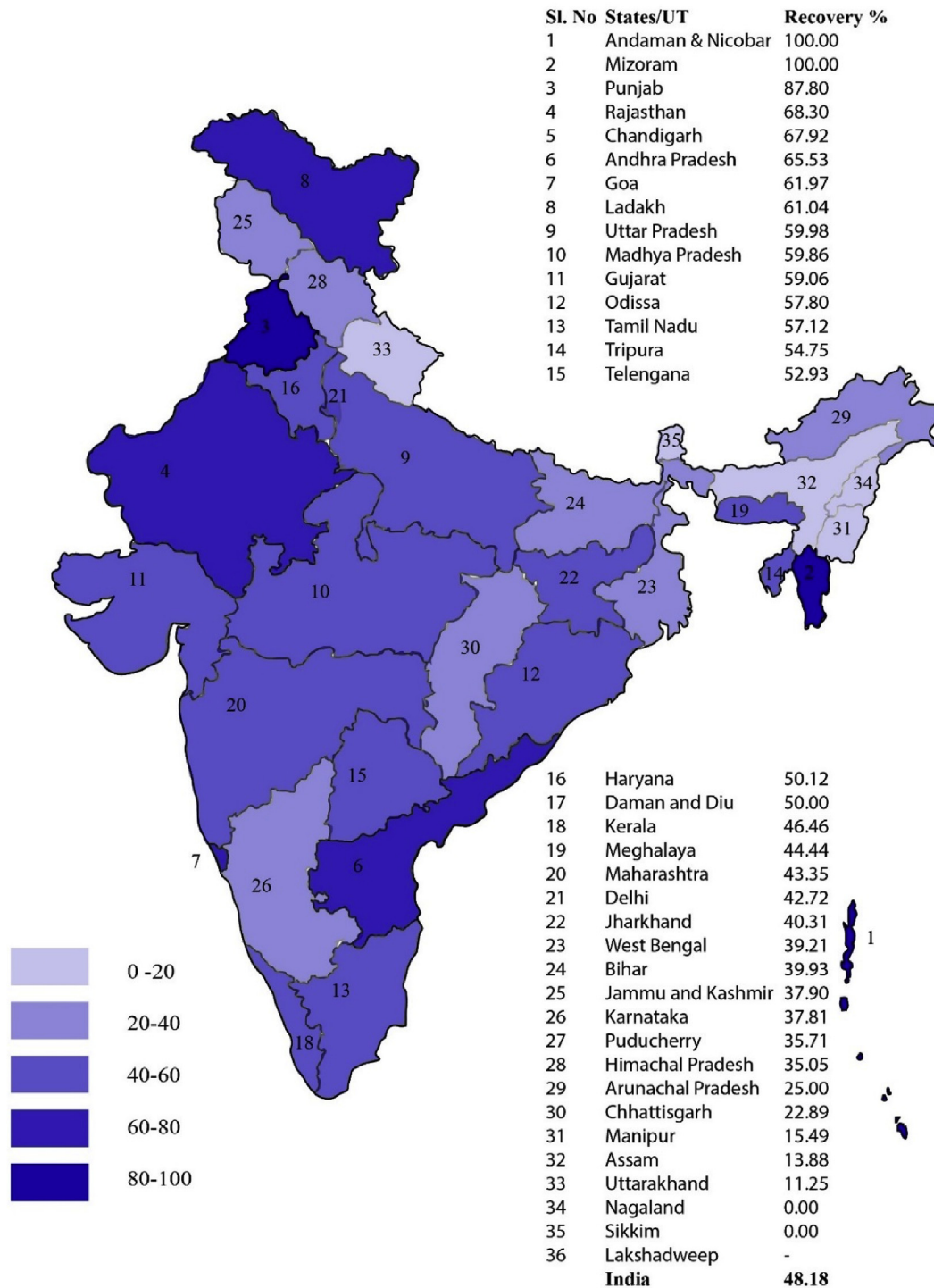Among the states of India, Maharashtra topped the list in terms

Sl. No	States/UT	Recovery %
1	Andaman & Nicobar	100.00
2	Mizoram	100.00
3	Punjab	87.80
4	Rajasthan	68.30
5	Chandigarh	67.92
6	Andhra Pradesh	65.53
7	Goa	61.97
8	Ladakh	61.04
9	Uttar Pradesh	59.98
10	Madhya Pradesh	59.86
11	Gujarat	59.06
12	Odissa	57.80
13	Tamil Nadu	57.12
14	Tripura	54.75
15	Telengana	52.93

16	Haryana	50.12
17	Daman and Diu	50.00
18	Kerala	46.46
19	Meghalaya	44.44
20	Maharashtra	43.35
21	Delhi	42.72
22	Jharkhand	40.31
23	West Bengal	39.21
24	Bihar	39.93
25	Jammu and Kashmir	37.90
26	Karnataka	37.81
27	Puducherry	35.71
28	Himachal Pradesh	35.05
29	Arunachal Pradesh	25.00
30	Chhattisgarh	22.89
31	Manipur	15.49
32	Assam	13.88
33	Uttarakhand	11.25
34	Nagaland	0.00
35	Sikkim	0.00
36	Lakshadweep	-
	India	**48.18**

Legend:
- 0 -20
- 20-40
- 40-60
- 60-80
- 80-100

Fig. 3. Recovery Percentage of different states in India till 31st May 2020 (Data Source: www.covid19india.org, Map not for scale).

of fatality with 2286 numbers of deaths till 31st May 2020. The geographical distributions of deaths (in percentage) in the country till 31st May 2020 is shown in the map in Fig. 2.

Maharashtra is the state with the maximum number of recovered patients which is 29,329 (43.35% of the total cases) followed by Tamil Nadu with 12,757 (57.12% of the total cases). The proportion of recovery across India is found to be 48.18% which is greater than the world's proportion of recovery. In case of Andaman &

Nicobar Islands and Mizoram, though the recovery percentage is 100, yet it is noticeable that the total numbers of covid-19 cases in these states are also very low. The percentage of recovery of different states in India till 31st May 2020 is shown in the map in Fig. 3.

Understanding the recovery time of disease is very useful information in the fight against the disease. If the incidence of a disease is very high and the recovery time of the disease is also high

Table 1
Demographic profile of the Covid-19 patients.

Characteristics		Frequency	Percentage
Sex	Male	146	66.1
	Female	75	33.9
Age	Less than 60 years	147	66.5
	60 years & above	74	33.5
Total		221	

then the prevalence of the disease in the country is likely to increase which in turn puts extra health, economic and social burden on the country. Understanding the recovery time of the disease will help the Government to plan proper strategies to counter the disease. With the information on recovery time of a disease in pandemic situation like Covid-19, the government will be able to plan strategies like requirement of hospitals, doctors, medical staffs, medical equipment's etc. It will also help to make different social and economic policies which will help to fight with the disease. Thus in this study, an attempt would be made to study the recovery times of Covid-19 patients of India.

3. Methodology

The necessary data for the study are collected from a secondary source. Information on confirmed Covid-19 individual cases in India is collected from the web portal https://www.kaggle.com/. The duration of the study was from March 1, 2020 to April 25, 2020. All the cases hospitalized with positive Covid-19 in India through March 1, 2020 to March 31, 2020 are included in the study. The follow-up of the included cases is done up to April 25, 2020 during which no inclusion of patients is made. Up to March 31, 2020, a total number of 1635 Covid-19 positive patients is diagnosed which are admitted in different hospitals of India. With the help of the sample size determination formula for finite population [9], the sample size for the study stands at 221 samples of Covid-19 positive patients where the population size is 1635. Simple random sampling is used to select 221 covid-19 patients from the population using MS-Excel. The information about sex and age of the patients are also collected from https://www.kaggle.com/. The recovery time (in days) is evaluated from the day of hospitalization until recovery. The patients were pondered as censored if he/she died or remain hospitalization after April 25, 2020.

To evaluate the probability of recovery at different time points Kaplan-Meier product limit estimator [10] is used. The average (median) recovery time of Covid-19 patients is estimated by using Kaplan-Meier survival curve. Average recovery time with respect to sex and age of Covid-19 patients are also estimated by using the same method. Log-rank [11,12] test is used to compare the average recovery time of Covid-19 patients with respect to sex and age.

4. Results and analysis

A random sample of 221 covid-19 patients is included in the study and status of the patients is studied after 25th April 2020. The age and sex distribution of the Covid-19 patients are presented in Table 1. Kaplan-Meier product limit estimator is used to study the survival time of the Covid-19 patients. The results of which are presented in Tables 2 and 3.

Table 2, shows the chances of recovery of covid-19 patients at different time points (in days). The probability of recovery from covid-19 virus in 10 days is very small. Only 4% of the patients recovered in 10 days. About 40% of the patients recovered in 20 days. In 25 days of treatment about 50% of the patient were discharged from the hospital i.e., got cured from covid-19.

The Kaplan-Meier product limit estimator estimated that the average recovery time of covid-19 patients is 25 days (95% confidence interval 16.14 days to 33.86 days). Thus from the results it is observed that a covid-19 patient needs on the average 25 days to recover. Log-rank test is used to study the recovery time of Covid-19 patients with respect to sex and age and the results are presented in Table 3. From Table 3, it can be observed that the average recovery time of male patients is 23 days (95% C.I. 12.71 days to 33.29 days). On the other hand, the average recovery time of female is little higher which is 25 days (95% C.I. 14.65 days to 37.34 days). The results of the Log-rank test shows that there is no significant difference (p-value > 0.397) in the recovery time of covid-19 patients with respect to sex i.e., the recovery time of male and female patients is more or less same. The average recovery time of patients of age less than 60 years is estimated to be 21 days (95% C.I. 12.82 days to 29.32 days) while the average recovery time of Covid-19 patients of age 60 years and above is found to be little bit higher i.e., 25 days (95% C.I. 17.22 days to 32.78 days). But this difference in recovery time of Covid-19 patients of age less than 60 years and more than 60 years is not significantly different. Kaplan-Meier survival curve representing the recovery time of the covid-19 patients is presented in Fig. 4. The Kaplan-Meier survival curve representing the recovery time of covid-19 patients with respect to sex and age is also constructed which are presented in Fig. 5 and Fig. 6.

5. Conclusion

SARS-CoV-2 is a new virus of the family of coronavirus, recognized in 2019. SARS-CoV-2 began in the month of December 2019 in

Table 2
Probability of recovery from Covid-19 at different time points.

Time (In days)	Probability of recovery	Standard deviation
10	0.046512	0.014362
15	0.293023	0.031041
18	0.395349	0.033344
20	0.437209	0.033830
21	0.465116	0.034017
23	0.474419	0.034055
25	0.534884	0.034017
27	0.539939	0.034020
37	0.557634	0.037029

Table 3
Average recovery time of covid-19 with respect to sex and age.

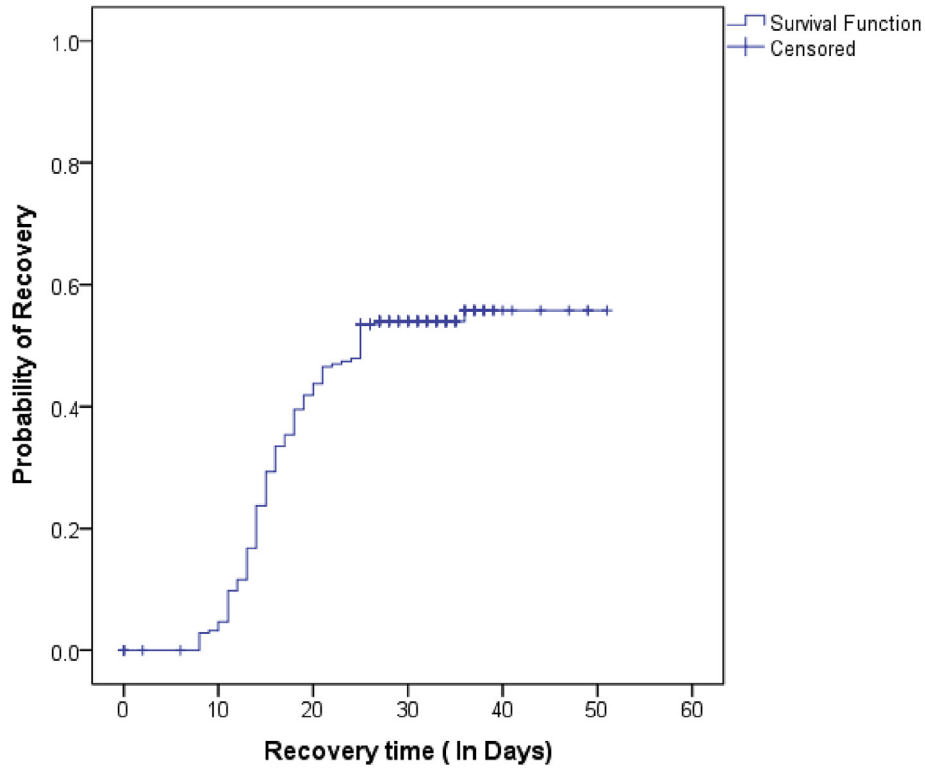|	Median (In days)	95% Confidence Interval		Log-rank
		Lowe	Upper	
Overall	25	16.14	33.86	
Sex				
Male	23	12.71	33.29	0.397
Female	25	14.65	37.34	
Age				
Less than 60 years	21	12.82	29.32	0.656
60 years and above	25	17.22	32.78	

Fig. 4. K-M curve for Covid-19 patients.

Wuhan, China. Research shows that, despite a large population and limited health infrastructure, the incidence as well as mortality of Covid-19 has been seen relatively lower in South Asian countries including India than many other developed country [13]. In India the first case of SARS-CoV-2 was identified in Kerala on January 30, 2020. The Covid-19 virus spread all over India and affected people
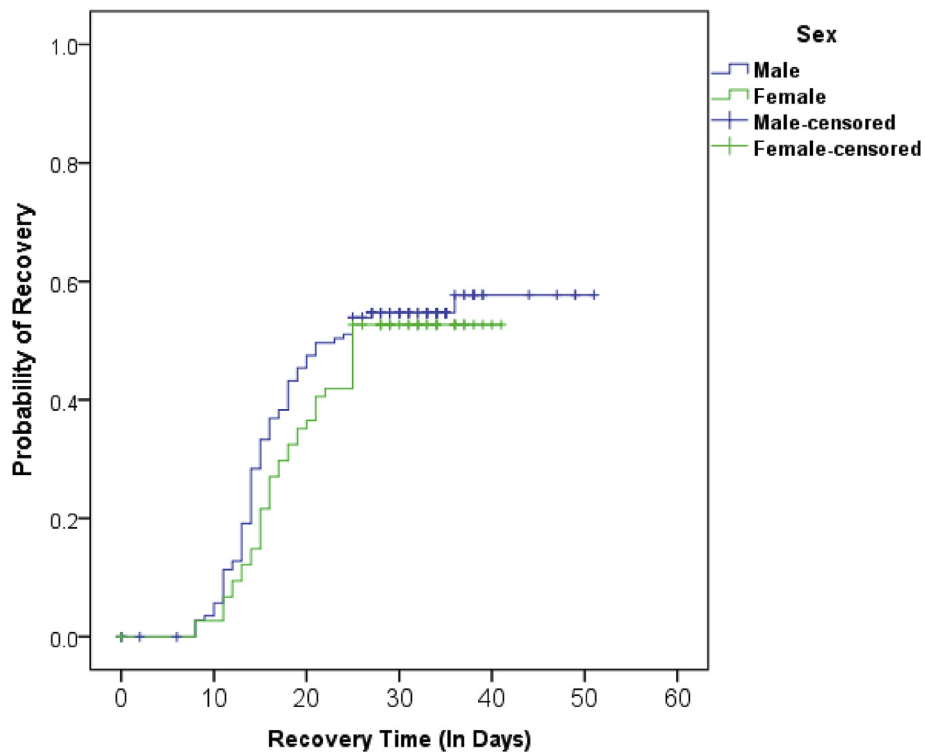

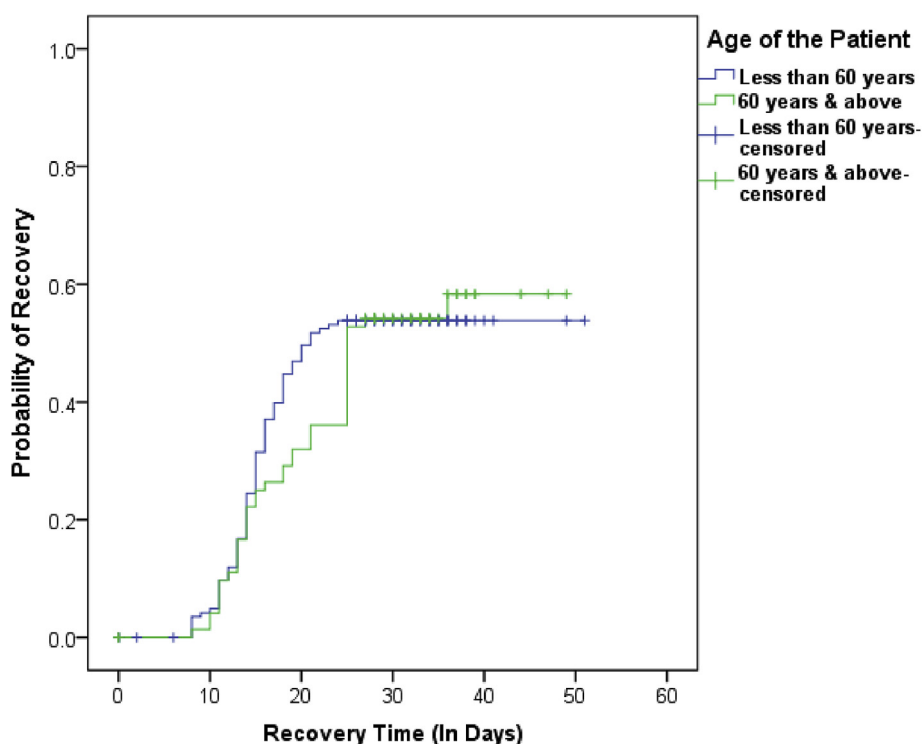**Fig. 5.** K-M curve for covid-19 patient w.r.t sex.

Fig. 6. K-M curve for covid-19 patient's w.r.t age.

irrespective of rank and status. Here, in the present study taking the positive Covid-19 cases of India from March 1, 2020 to March 31, 2020 with a follow up period of 25 days, it has been estimated that the average recovery time of covid-19 patients in India is 25 days (95% C.I. 16.14 to 33.86). Also the estimated average recovery time of male patients is 23 days (95% C.I. 12.71 to 33.29) and that of female patients is 25 days (95% C.I. 14.65 days to 37.34 days). The average recovery time of patients who are 60 years and above is estimated as 25 days (95% C.I. 17.22 to 32.78), on the other hand, recovery time of patients less than 60 years is estimated as 21 days (95% C.I. 12.82 to 29.32). The study also reveals that 50% of the patients got released in 25 days, about 40% in 20 days, while only 4% got released from the hospital in 10 days. Thus, the present study reflects that the positive Covid-19 patients of India have recovered on an average in 25 days. At present in India, around eight to nine thousand new cases of Covid-19 are diagnosed each day and if all of them have to stay on average 25 days then the situation in India with considerably limited hospitals, doctors and medical staff is going to be abysmal. It is also likely to consolidate to a certain extent the efforts for futuristic perusal of studies in such directions.

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Declaration of competing interest

The authors declare that there is no known competing interest, which could have influence in this paper.

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