

IMPACT OF COVID-19 ON BREAST CANCER SCREENING PROGRAM (BCSP) IN INDIA

Sashikanta Prusty*

Department of Computer Science and Engineering, Siksha 'O' Anusandhan (Deemed to be University),
Bhubaneswar, Odisha-751030, India
sashi.prusty79@gmail.com

Sujit Kumar Dash

Department of Electrical and Electronics Engineering, Siksha 'O' Anusandhan (Deemed to be University),
Bhubaneswar, Odisha-751030, India
sujitdash@soa.ac.in

Srikanta Patnaik

Director of Interscience Institute of Management & Technology,
Kantabada, Bhubaneswar, Odisha-752054, India
srikantapatnaik@iimt.ac.in

Sushree Gayatri Priyadarsini Prusty

Department of Computer Science and Engineering, Siksha 'O' Anusandhan (Deemed to be University),
Bhubaneswar, Odisha-751030, India
liza.sushree19@gmail.com

Abstract

In the past three years, covid-19 viruses have spread rapidly worldwide, while low and middle-income countries were affected mostly so far. Emergency limits were imposed due to the rapid infection and significant mortality rates. Only emergency medical treatments are available during these shutdowns and lockdowns in India. All non-emergency treatments, such as Breast Cancer Screening Program (BCSP), have been temporarily halted due to the huge number of deaths caused by coronavirus. However, the ability of BC screening programs to improve survival rates while lowering mortality rates has been well demonstrated. Suspension may result in poorer outcomes for patients with BC. In this regard, early detection and treatment are critical for increased survival and long-term quality of life. Thus, we have taken breast cancer patients' data for the last six years i.e. from 2016 to 2021 in India to properly evaluate and analyze for our research. Assessing recent results for various features from, modeled evaluations can aid pandemic responses. Besides that, we proposed a novel method that implements the EDA technique to graphically represent BC patients' data. This experiment was done using Python programming language on Jupyter 6.4.3 platform. We found the sudden rise of BC patients from lakhs to millions in 2019. This signifies the deadly coronavirus has greatly affected people during the pandemic days when people are more serious about this virus rather than screening their breasts.

Keywords: Breast cancer screening; Covid-19; Breast cancer statistic report; Comparative analysis.

1. Introduction

According to the World Health Organization (WHO), the COVID-19 pandemic has overwhelmed 222 countries and territories as of June 20, 2022, with over 535 million confirmed cases and over 6 million deaths [covid19]. Although, this virus has affected India with over 43 million confirmed cases and over 5 lakh deaths [covid19 country wise (2020)]. The ongoing COVID-19 epidemic has caused significant mortality and exposed flaws in healthcare systems around the world. Regional reactions have differed from region to region, with differing levels of constraints or lockdowns undertaken to tackle the pandemic, with varying results. There are suspicions that the pandemic may have harmed numerous aspects of health care, including baby and maternal health, immunization, and also in screening for cancer. Hospital visits were also limited to reduce COVID-19 exposure and cross-infection. Once having entered the health center, forced to wait in a queue to measure the temperature of each individual and also to gather details about their travel, employment, and contacts during these pandemic days. Meanwhile, the COVID-19 pandemic received widespread media attention around the world. In 2004, Taiwan became the first country to introduce universal, population-based biennial mammography screening, which serviced approximately 1 million women in 2019 [Yen *et al.* (2016)]. COVID-19, on the other hand, in the Netherlands would have a significant impact on cancer detection and treatment [Sharpless (2020)]. The American College of Radiology in the United States endorsed the deferral and rearrangement of non-urgent care, such as screening mammography [Prabhakar *et al.* (2020)]. The cancer screening programs as well were temporarily halted in the Netherlands to relieve the strain on healthcare services caused by an influx of coronavirus, to prevent it from spreading [Dinmohamed *et al.* (2020)]. In contrast, cancer death cases are continuing to be prone since the 1900 century in worldwide, where the majority of cases are found in the Asia continent, e.g. Fig. 1.

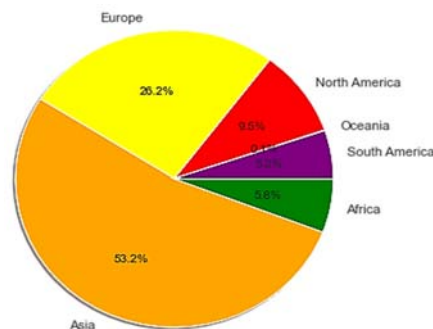
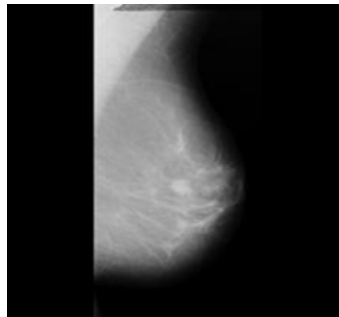
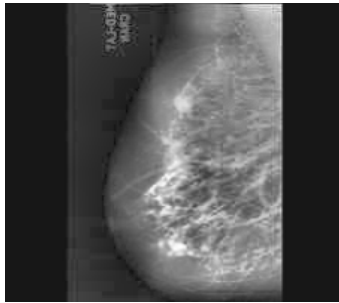


Fig. 1. Cancer death rates in all continents since the 1900 century

Nevertheless, in Asia, a country like India is the second largest population after China and has faced a huge number of cancer deaths like other developed countries such as the Netherlands and the United States these days. Therefore, we plan to focus on cancer death rates especially breast cancer occurred in India since 2016. However, an estimated new breast cancer cases in 2018 has been designed over here, and the screened female breast images of both benign and malignant tissues have been shown in Fig. 2. As reported by World Health Organization (WHO), BC is the top disease caused in Indian women, resulting in approximately 1.5 lakh new cases. Breast cancer seems to be the most often diagnosed cancer worldwide, with 2.3 million people diagnosed each year, and has become a significant public health burden [Sung *et al.* (2021) and IARC (2021)]. Thus, early detection of BC can lower mortality rates and reduce the amount of treatment needed [Alkatout *et al.* (2021)]. To ascertain the effect on BC incidence, a study has been performed by the India Cancer Registry on the preliminary cancer diagnoses for 2018.



Benign



Malignant

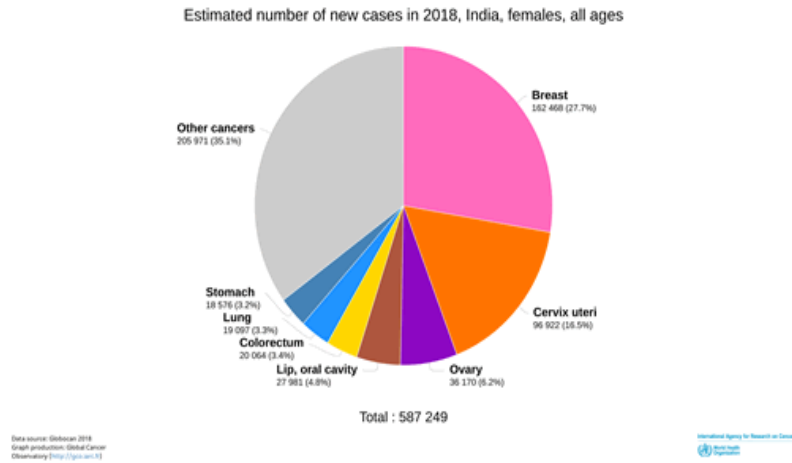


Fig. 2. Human breast screening images of (a) benign, (b) malignant masses and Breast Cancer Statistic Report for 2018 in India [Image link: <https://www.breastcancerindia.net/images/main-stat.png>]

In this regard, a breast cancer screening program will be more effective to better analyze breast images in this crucial period continuing in India. In this article, we offer BC patients for 28 states and 8 union territories in India from 2016 to 2021 to identify the effects of COVID-19 on BCSP results in the coming section to provide a basis for this research. For this experiment, we have implemented Exploratory Data Analysis (EDA) techniques using Python programming language on Jupyter Notebook 6.4.3. These findings will show how the pandemic has greatly affected breast screening programs in India since 2019. However, the rest of the paper follows as: Section 2, indicates the material and method; Section 3, shows the result analysis; Section 4, describes the author's contribution; Section 5 concludes with a conclusion and references.

2. Materials and Methods

2.1. Material

The BC dataset of India Statewise (2016-2021) was collected from the Kaggle repository. This report says BC diagnostics have increased 10 times in the past 3 years. Fig. 3, shows the number of BC patients from 2016 to 2021 using a line graph.

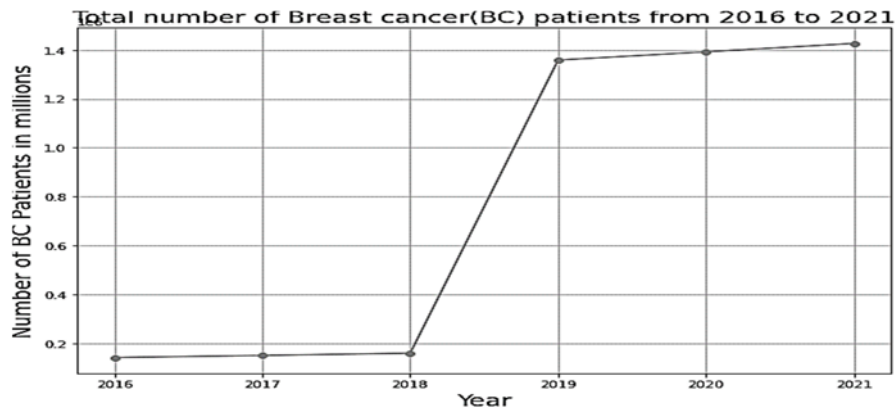


Fig. 3. BC patient report in India from 2016 to 2021

2.2. Methods

Evaluation of breast screening programs during these covid-19 pandemic days has been suspended by the government of India, due to the high volume of patients staying in line in the hospitals. In early 2021, the government of India started the analysis of BC patients in the pre-pandemic days and also during the pandemic days. This outcome shows the sudden rise of BC patients millions during the pandemic, e.g. Fig. 3. This result is based on the screening, diagnosing, and abnormal growth of breasts in women. This fluctuation in the graph includes the lack of screening programs and patient interaction with doctors due to the increase of covid-19 patients, priority given to these patients as compared to others, and unavailability of sufficient beds and equipment in medical and many more. These were caused by affecting a maximum number of cases and the result has been reported in the above figures. However, this BC patient's data can be properly analyzed and differentiated to identify the states that are mostly affected by covid-19 pandemic in India. That's why, we have designed a method to smoothly process and evaluate BCSP using EDA techniques as shown in Fig. 4.

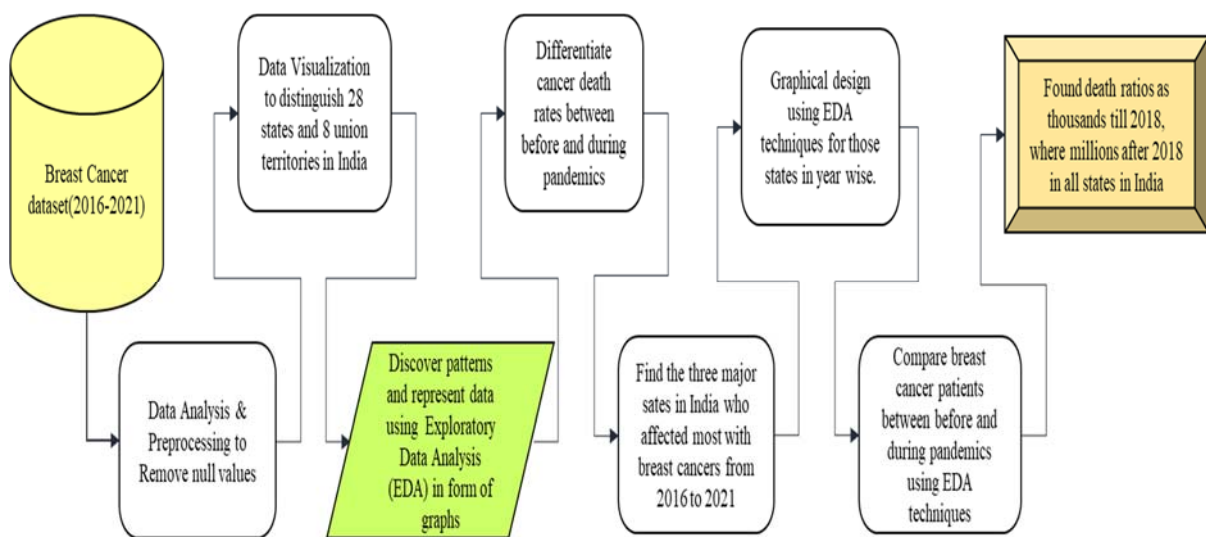


Fig. 4. Proposed method for analyzing breast cancer death rates in India from 2016 to 2021

Although, this diagram shows that the total number of BC patient from 2019 onwards were considerably high than in the previous three consecutive years. It has been shown that a sudden increase in the total number of BC patients from 2018 (i.e. 159924) to 2019 (i.e. 1,35,8417), indicates the most saturation points for an Indian Govt. at diagnosing this disease. Although the delay in cancer screening, the impact of the huge number of deaths due to multiple covid-19 variants, and the carelessness of people caused the rise of BC patients [Ranganathan *et al.* (2021), Kregting *et al.* (2021), Miller *et al.* (2021), and Lehman *et al.* (2021)]. Table 1, reflects that the Covid-19 virus had greatly affected all the states in India, causing a maximum number of people to be affected during this period as compared to the previous three years. Moreover, we found as the number of BC deaths in all states during pandemics has increased from lakhs to millions, which makes a bigger challenge for the government of India these days.

Thus, we evaluate the impact of coronavirus on BC patients in all states in India, where three states have been most affected as shown in Fig. 5. Moreover, Indian Govt. has more emphasis on the deadly affected virus than screening cancer patients. To elaborate more on these changes in India, we have plotted the graphs for the last five years, which show the large scale of patients who fall under breast cancer disease.

States/UT	Before Covid-19 Pandemics			During Covid-19 Pandemics		
	2016	2017	2018	2019	2020	2021
J & K	1421	1516	1618	12675	13012	13354
HP	613	647	681	8589	8799	8978
Punjab	3321	3503	3694	37744	38636	39521
Chandigarh	196	207	219	994	1024	1053
Uttaranchal	1217	1298	1384	11216	11482	11779
Haryana	3103	3308	3526	28453	29219	30015
Delhi	3181	3351	3530	24436	25178	25969
Rajasthan	7536	7996	8483	69156	70987	72825
UP	21376	22737	24181	196652	201319	206088
Bihar	9958	10644	11378	101014	103711	106435
Sikkim	30	30	31	443	445	465
AP	82	84	85	1015	1035	1064
Nagaland	67	67	68	1719	1768	1805
Manipur	273	281	289	1844	1899	2022
Mizoram	97	99	101	1783	1837	1919
Tripura	129	130	132	2507	2574	2623
Meghalaya	104	106	108	2808	2879	2943
Assam	2406	2437	2467	36948	37880	38834
WB	10902	11550	12234	105814	108394	110972
Jharkhand	3716	3962	4225	33045	33961	34910
Orissa	4205	4448	4705	49604	50692	51829
Chhattisgarh	2944	3145	3359	27113	27828	28529
MP	8334	8858	9414	75911	77888	79871
Gujarat	8001	8504	9039	67841	69660	71507
DD	42	47	52	118	124	135
D & D	54	61	68	186	206	219
Maharashtra	14726	15522	16358	113374	116121	118906
Telangana	4633	4918	5220	46464	47620	48775
AP	5901	6251	6620	68883	70424	71970
Karnataka	8029	8527	9055	83824	85968	88126
Goa	233	247	262	1591	1618	1652
Lakshadweep	14	15	17	27	27	28
Kerala	5682	6189	6748	56148	57155	58139
TN	9486	9870	10269	86596	88866	91184
Pondicherry	227	242	257	1523	1577	1623
A & N	44	45	47	357	366	380
Total	142283	150842	159924	1358415	1392179	1426447

Table 1. Total number of breast cancer patients in 28 States and 8 union territories in India from 2016 to 2021

2.2.1 Evaluations of three major states in India

- Survey on Uttar Pradesh (UP) - In the mid of 2020, the people of UP mostly suffered as compared to other states in India with the different variants of coronavirus. Although, according to a report by WHO, the government of UP was trying to limit the contact tracing of infected people with others [NDTV (2021)]. As a result, screening BC was suddenly stopped, causing an increase in the number of patients from 24, 181 to 1, 96, 652 in the year 2019. Also, the cases gradually increased in 2020, and 2021, continuing its effect on the city.

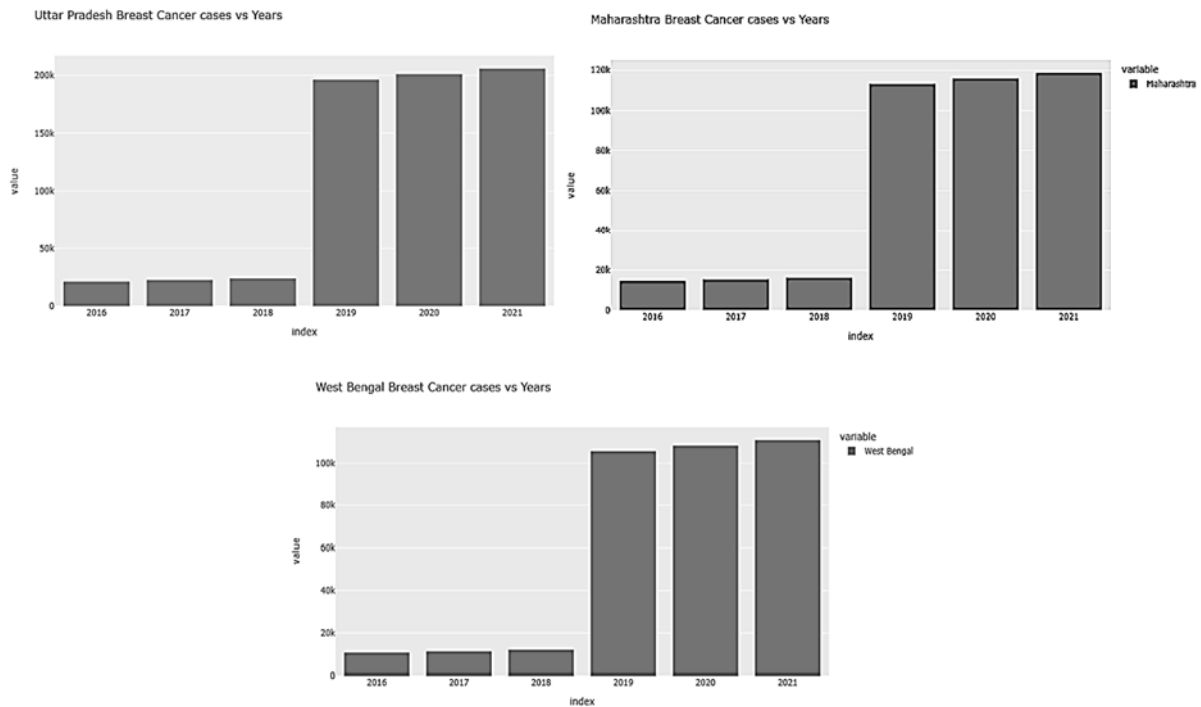
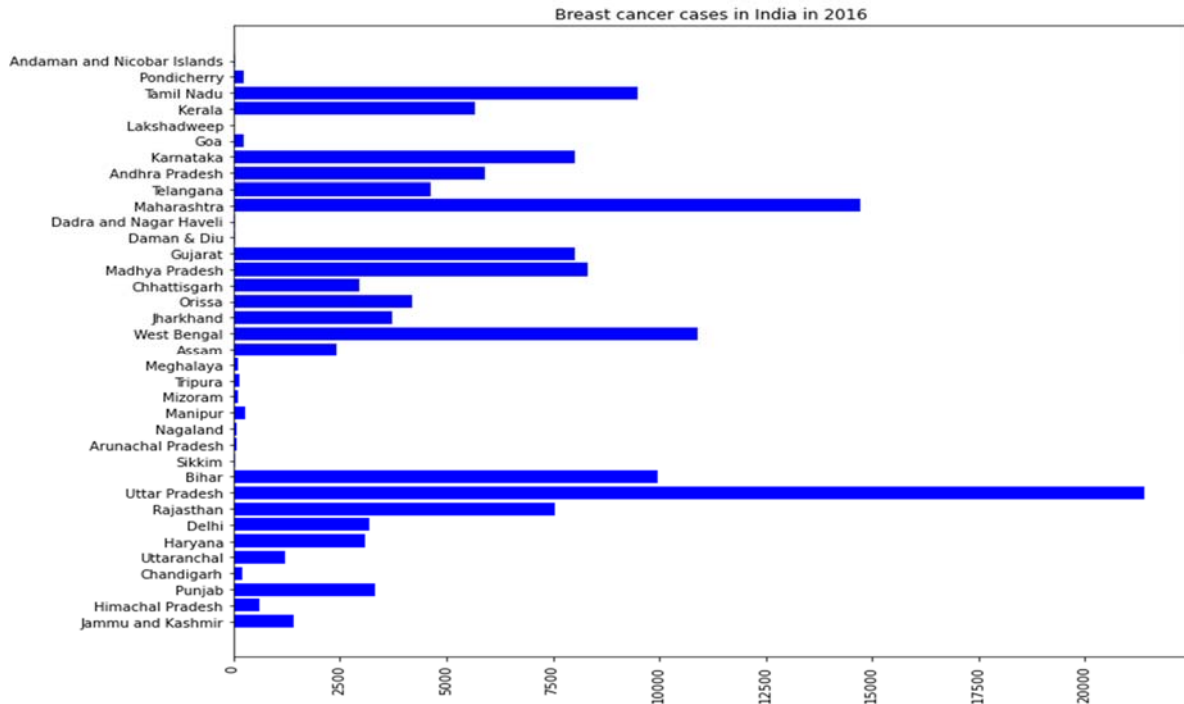


Fig. 5. Rising number of BC patients in three states in India

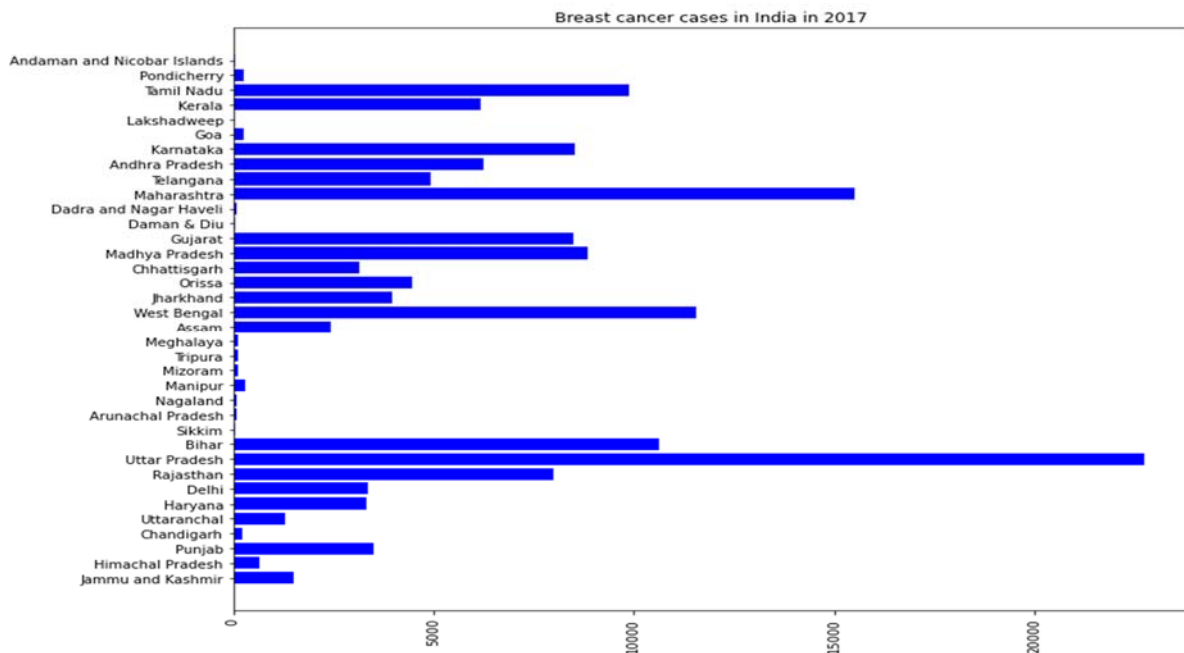
- Survey on Maharashtra (MR) - One of the most crowded cities Mumbai in MR had comparably more affected by covid-19 viruses, accounting for nearly 22% of total cases in India [Hindustan Times (2020)]. Although, made a huge impact on the whole state that caused a sudden rise without any disruption. Thus, the government of MR had only focused on infected people rather than on BCSP, accounting second most BC cases after UP i.e. approximately 30% more in comparison to 2018.
- Survey on West Bengal (WB) - Although, the pandemic had greatly affected this city with a total of 1, 09, 806 active cases, 15, and 120 death cases as of 28th May 2021 [West Bengal (2021)]. This affected most of the patients who had not gone for BCSP due to fear of the covid-19 virus. The government of WB had faced so much criticism from the opposition party for not handling properly covid-19 pandemics [Debobrat (2020)]. This resulted to give much priority to diagnosing covid-19 patients concerning other diseases. This led to an increase in BC patients in 2019 (i.e. 1, 05, 814) as previously in 2018 (i.e. 12, 234). This, resulted in a huge burden for the state government to minimize the BC disease in these pandemic years as shown in Fig. 5.

2.2.2 Analysis

- Before the Covid-19 pandemic from 2016 to 2018- Demographic analysis is playing a crucial role in the pandemic in forecasting the most well from the worst scenarios to assist policymakers in putting the greatest public health plans into action. Before the pandemic, population modeling of BCSPs had a strong base, and as a result, a wide range of really well models are available to help assess the intra- and extra effects of coronavirus diagnosis and medical care [Arevalo (2016), Tsochatzidis *et al.* (2019), Samala *et al.* (2019), Kooi *et al.* (2017), Yann *et al.* (2015), and Ruholla *et al.* (2018)]. Fig. 6(a), 6(b), and 6(c) show BC patients before covid-19 pandemic started in India.



(a)



(b)

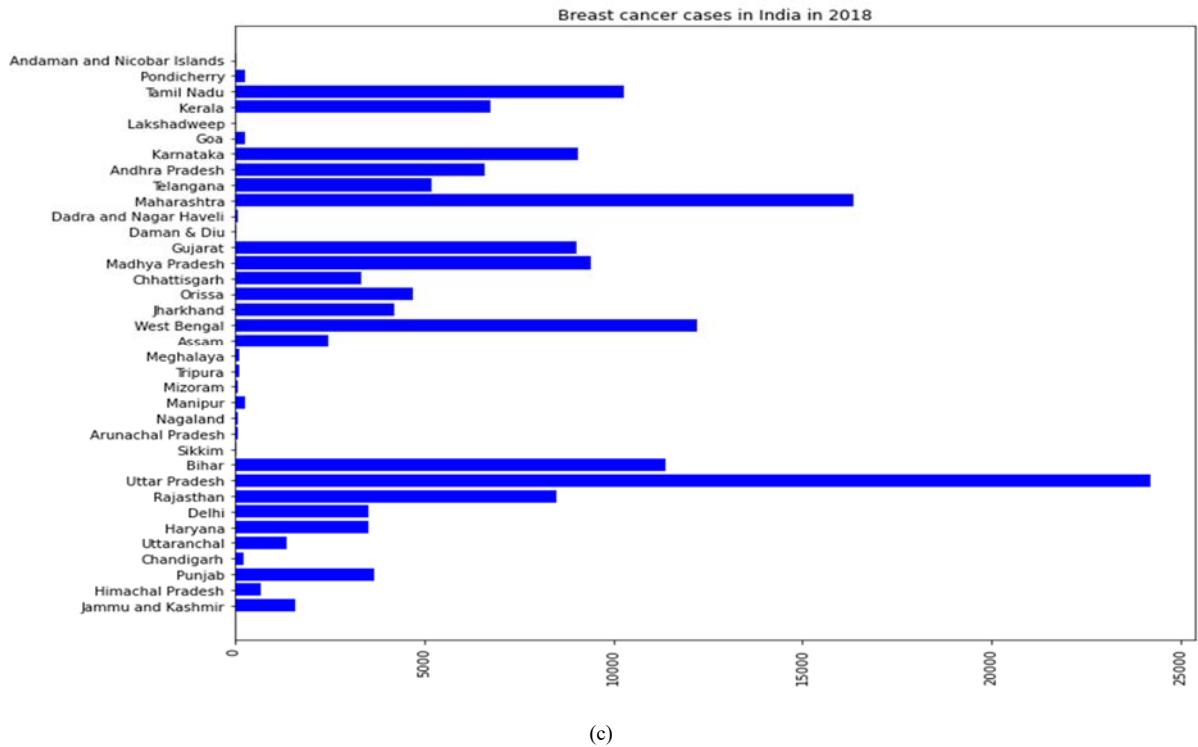
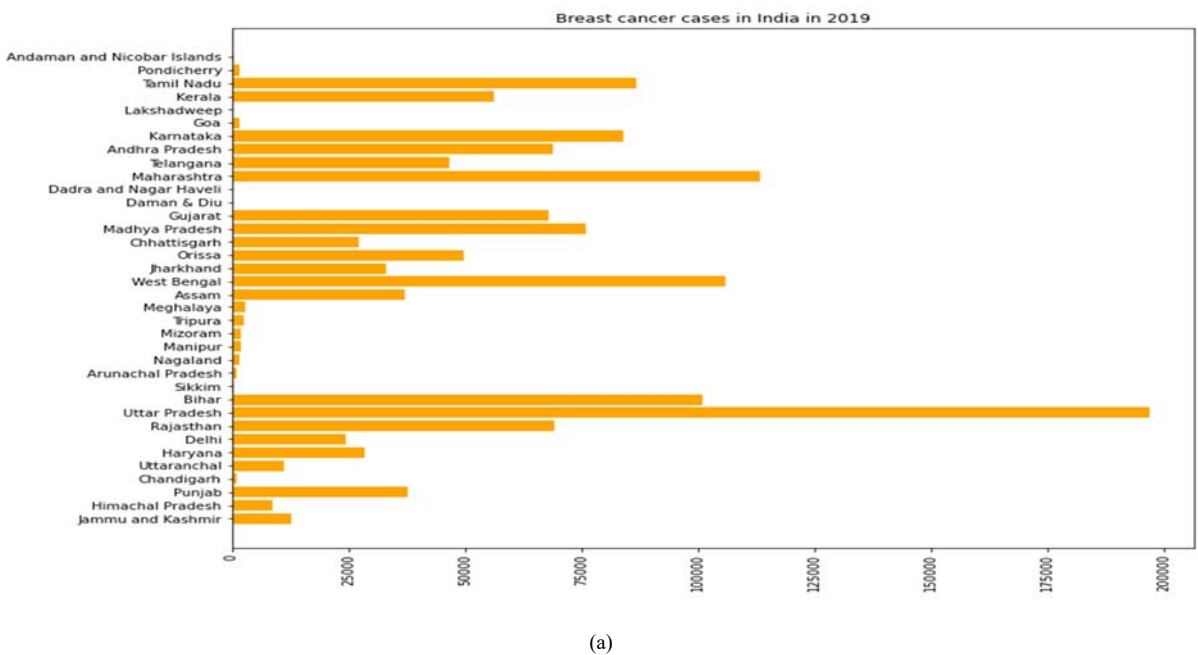
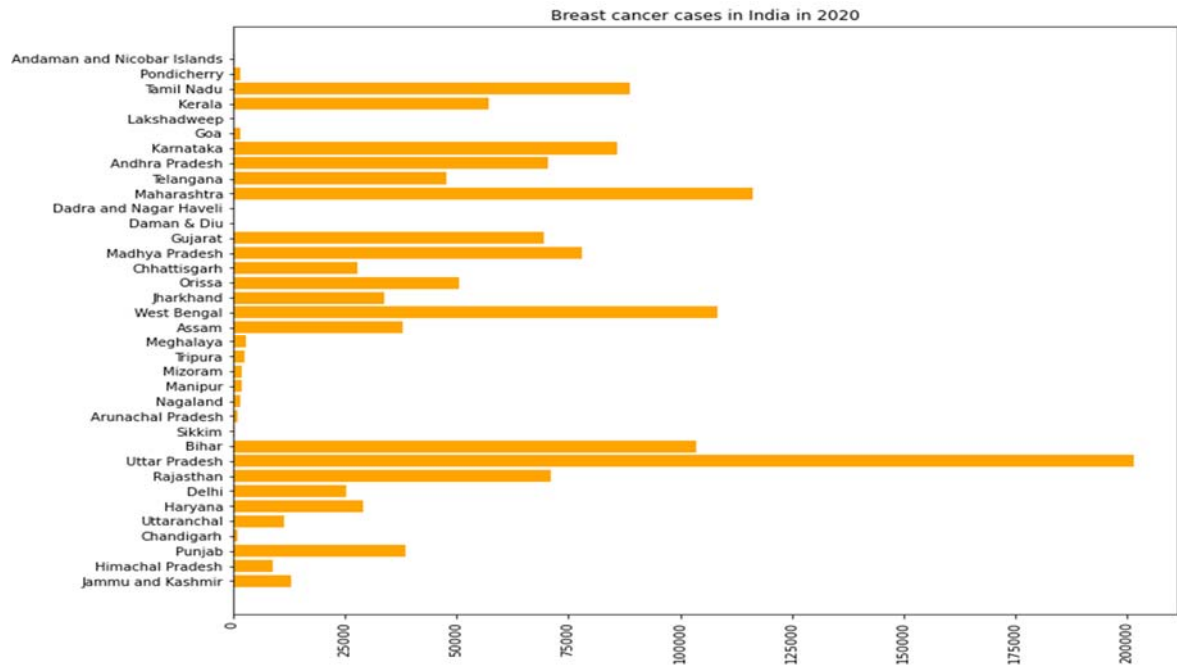


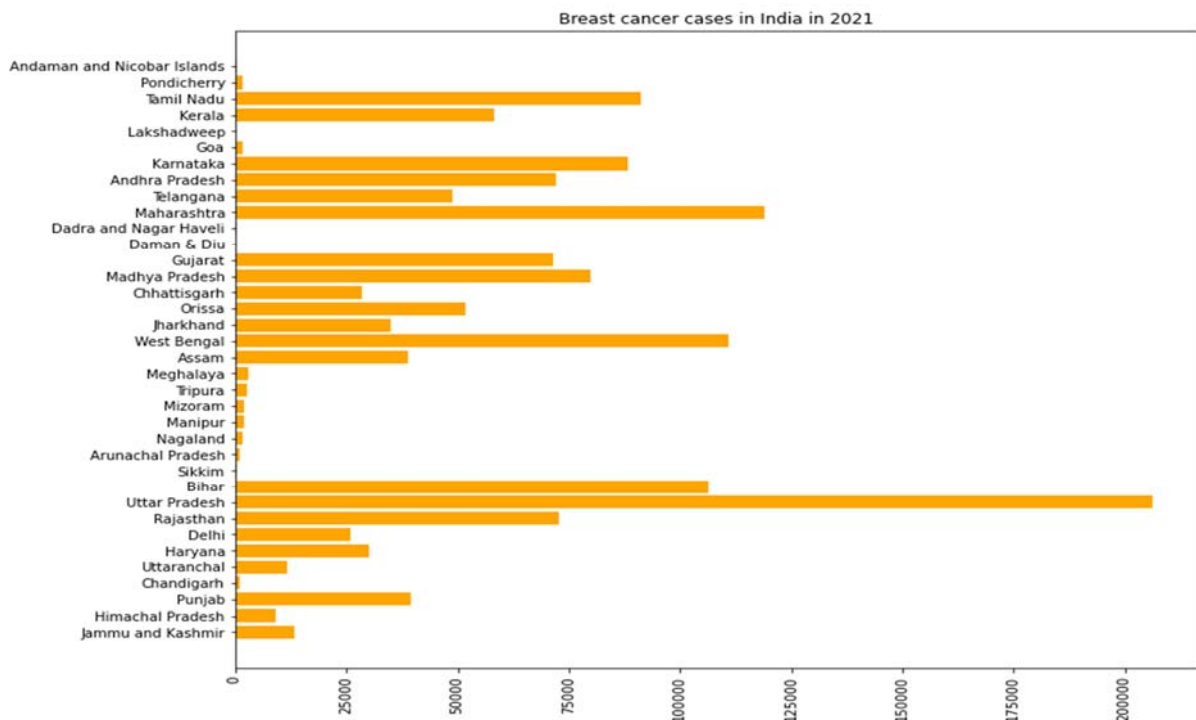
Fig. 6. Total number of BC patients in all states in India for the year (a) 2016, (b) 2017, and (c) 2018

- During the Covid-19 pandemic i.e. from 2019 to 2021- Fig. 7(a), 7(b), and 7(c) show the expected effects of delayed in timely diagnosis commencement on the distribution of BC stages and causing higher death rates for three consecutive years 2019, 2020, and 2021 respectively. This led to an increase of 8.5 percent in 2019 over 2018 and a modest continuation in the following years. However, if this disruption will continue in the coming years, then it might become a serious burden for both the hospitals and the government to handle BC patients [Agarwal *et al.* (2019), Chougrad *et al.* (2018), Prusty *et al.* (2022), and Zhang *et al.* (2021)].





(b)



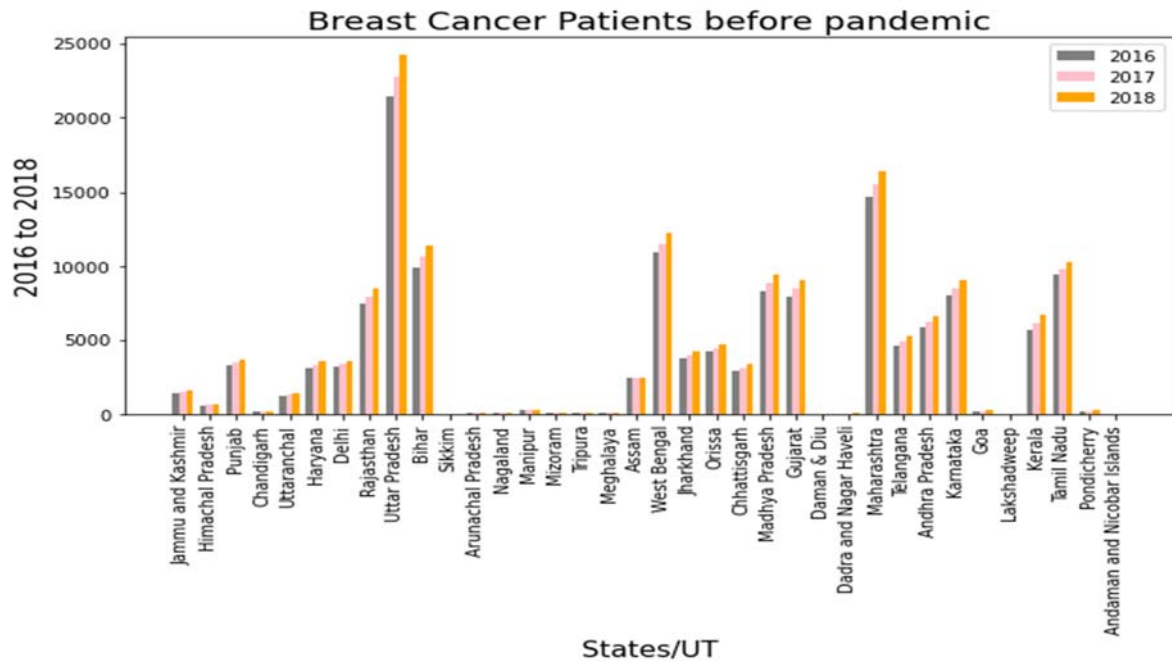
(c)

Fig. 7. Total number of BC patients in all states in India for the year (a) 2019, (b) 2020, and (c) 2021

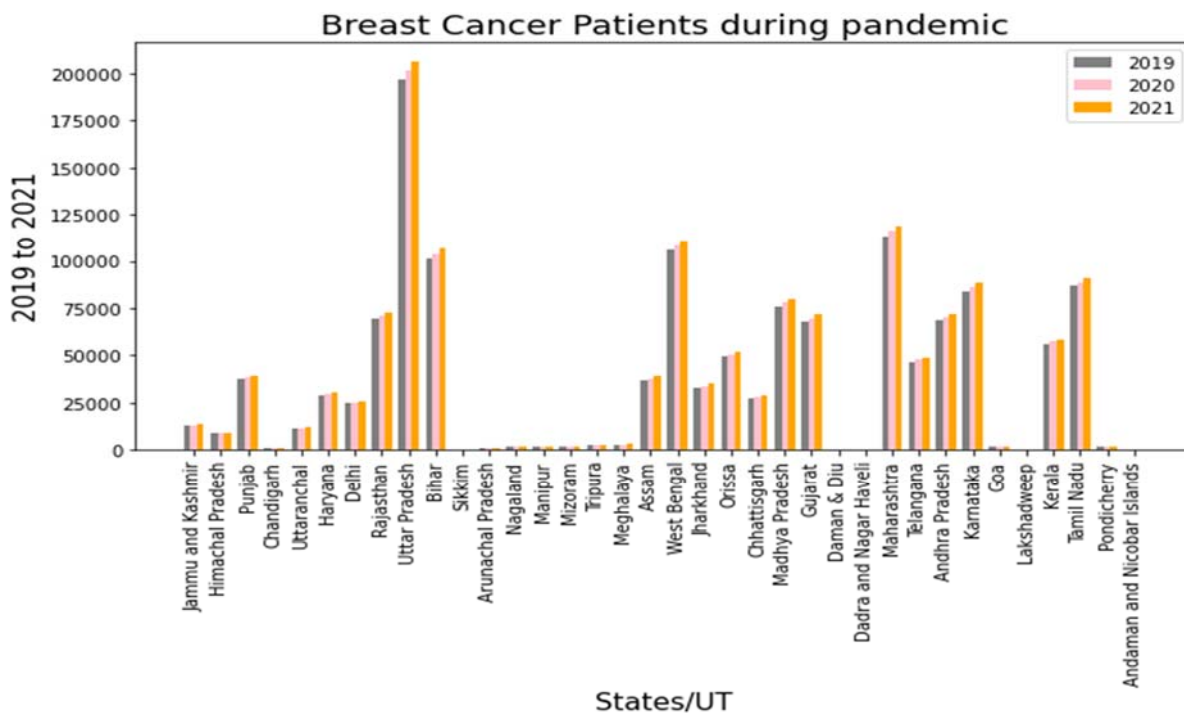
3. Result Analysis

BC incidence was shown to be lower in India's cancer registry data before the epidemic in 2018 when fewer individuals were aware of the deadly disease. Further, the increase in infection rates due to covid-19 caused the delay in cancer screening. Thus, more people were felled with BC, which made pressure to give attention to the government of India. From Fig. 8(a) and 8(b), we have seen that UP is the most affected state among all states in

India while maximizing the number of deaths from thousands to lakhs before and during the covid-19 pandemic. Furthermore, Fig. 8(b) reflects that effect of covid-19 caused approximately 2 lakh people to affect BC in 2019, where it was near about 25000 in 2018 as in Fig. 8(a).



(a)



(b)

Fig. 8. Representing the total number of BC patients for all states in India using a bar plot from (a) 2016 to 2018, (b) 2019 to 2021

From this analysis, we found that this deadly disease had badly affected Asian women in the past years and also continues to increase the mortality rates despite advanced technologies. Highly populated cities in India like

Mumbai, Delhi, Chennai, and West Bengal have found a large number of BC patients in the last 3 years than in previous years. This implies how severely covid-19 virus has affected cancer screening programs during these periods. Furthermore, we have taken three major infected states and implemented the EDA technique to visualize data using bar graphs in Fig. 5.

However, e.g. Fig. 6 and 7, we can compare the breast cancer patients in every individual state and union territory in India before and during the pandemic. This indicates approximately 8.5% increasing cases in 2019 than its preceding year, which is a major concern in those days. From then, these cases continues to rise rapidly and caused unnatural deaths at regular intervals in India. Fig. 8, shows a comparative analysis of BC patients, where 8 (a) starts from 2016 to 2018 and 8 (b) from 2019 to 2021.

4. Conclusion & Future Scope

Access to cancer control services is an issue as the pandemic continues to have an impact on global health and economies. Disruptions to population BCSP and other attempts to discover BCs early are a worldwide problem that necessitates a global response. We'll learn more about the impact of delays in BC diagnosis during pandemics on prevention and diagnosis as time goes on. As we discussed, UP had mostly affected cities among other cities in India, where BCSP had fully stopped due to the entry of coronavirus syndrome. Meanwhile, collaborative modeling through groups will make a great impact in predicting best-and-worst-case outcomes and assisting policymakers in creating optimal recovery plans. A clear evaluation and analysis of BC patients for the last five years were taken over here. It has been found that before the pandemic i.e. from the beginning of 2016 to the mid of 2019, the number of BC patients in all states was very less compared to during the pandemic i.e. from the mid of 2019 to the end of 2021. Fig. 3 and 4, clearly state that the state government, as well as the government of India, should take the necessary action to continue their BCSP simultaneously with the treatment of covid-19 patients in the coming days.

From the above experiments, we can say that every country should be more serious at diagnosing cancers and should take necessary actions at the beginning stages because we have seen many developed countries unable to stop cancer deaths, while they have new technologies. However, screening at the initial stages in females can reduce unwanted deaths. In contrast, the unavailability of sufficient beds in medicals becomes a challenge not only for the government but also for doctors to diagnose cancer disease in future days. Although cancer patients felt fear to go outside, were not concerned with doctors, avoided to go hospitals for screening, and ignored medical treatments, which were much necessary to avoid any unconditional deaths. Thus, patients should be aware of this disease and should more focus on screening at regular intervals without ignoring it.

Conflict of interest

All authors declare no conflicts of interest in this paper.

Data Availability

<https://www.kaggle.com/datasets/nitishsinghal/breast-cancer-india-statewise-20162021/download?datasetVersionNumber=1>

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Authors Profile





Mr. Sashikanta Prusty    received an MCA degree in Computer Science & Engineering from Purusottam Institute of Engineering & Technology (PIET), Rourkela, Odisha, India in 2010. MTech degree in Computer Science & Engineering from Raajdhani Engineering College, Bhubaneswar, Odisha, India in 2020. He is currently pursuing his Ph.D. in Computer Science and Engineering at Siksha ‘O’ Anusandhan (Deemed to be University), Bhubaneswar, India. He has published one Transaction paper, one SCIE, 3 Scopus-indexed Journals, and 10 Conferences. Although, he has 5+ years of teaching experience and 3 years of industry experience.



<https://scholar.google.co.in/citations?user=0dR3Ii4AAAAJ&hl=en>

<https://orcid.org/0000-0003-2306-5336>





Dr. Srikanta Patnaik   is Director of IIMT, Bhubaneswar, India. He received his Ph. D. in Computational Intelligence from Jadavpur University, India in 1999. Dr. Patnaik is the Editors-in-Chief of IJICT and IJCVR published by Inderscience Publishing House, England, and also the Editors-in-chief of the Book Series on “MOST” published by Springer, Germany, Book Series on ACEE, and Book Series on AMTCP, published from IGI-Global, USA. Also, Editor of the JICCE, published by the Korean Institute of Information and Communication Convergence Engineering. He is also Associate Editor of IJGRSIS and the International Journal of Telemedicine and Clinical Practices, published by Inderscience Publishing House, England.



Dr. Sujit Kumar Dash   heads the Corporate, Training & Placement at Siksha ‘O’ Anusandhan University, Bhubaneswar, Odisha. He pursued Electrical Engineering from VSSUT, Burla, Odisha, followed by post-graduation (MTech) in Industrial Engineering & Management from IIT, Kharagpur. Later he earned his Ph.D. in Electrical Engineering from SOA University, Bhubaneswar. Dr. Dash has 18+ years of teaching experience for undergraduate and postgraduate students in Engineering. Dr. Dash has published in Scopus-indexed journals.



Mrs. Sushree Gayatri Priyadarsini Prusty   received an M. Tech degree in Computer Science & Engineering (CSE) from Eastern Academy of Science & Technology, Bhubaneswar, Odisha, India in 2017. She is currently pursuing his Ph.D. in CSE at SOA University, Bhubaneswar, India, and has published in one International Journal and two Conferences. Although, she has 3+ years of teaching experience in a reputed Engineering College.