

A pattern of Covid morbidity expression in the industrial backdrop of Paschim Burdwan

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Abstract

Objectives: The study was conducted to know how Covid-19 and TB affected the people of Paschim Burdwan, India for 12 months period (from August 2020 to July 2021).

Materials and Methods: Covid-19 cases were studied in terms of age groups (viz. ≤ 19 , ≥ 20 to ≤ 45 , ≥ 46 to ≤ 60 years and > 60 years) and genders for first and second waves of Covid -19 in the mentioned part of our country.

Results and Conclusions: It was found that most of the people of ≥ 20 to ≤ 45 years of age were affected more compared with other groups. In the 0-19 age group, females were more affected (7.44%) than males (4.74%) and few of them were statistically evaluated. Pollution parameters viz. Nitrogen oxides (NO_x), Carbon oxides (CO_x), Sulphur oxides (SO₂), particulate matters (PM_{2.5}, and PM₁₀) in the Asansol area of Paschim Burdwan were studied for the month of July 2019, 2020 & 2021 but there was no significant change and they are not linked to increased Covid-19 cases.

Introduction

The COVID-19 which is a severe respiratory disease caused by beta coronavirus (SARS-CoV-2), occurred first in the Wuhan city of China, and then rapidly spread throughout the world causing a great threat to human health and life [1]. World Health Organization (WHO) declared COVID-19 as a global pandemic on March 11, 2020. The virus was renamed from 2019-nCoV to SARS-CoV-2 due to its homology to a previous coronavirus (SARS-CoV) [2]. It is a positive-sense RNA virus [3]. The virus binds through its structural spike (S) protein to the angiotensin-converting enzyme 2 (ACE2) receptors present on nasal and bronchial epithelial cells and pneumocytes for entry [4]. On 30th January 2020, India reported its first case of COVID-19 [5]. In West Bengal, the first COVID-19 case was reported on 17th March 2020, when an 18-year-old student who had returned from the United Kingdom tested positive [6]. After which positivity increased in an exponential fashion leading to the 1st wave in 2020 and the 2nd wave in 2021 in India. For the prevention of infection and transmission of SARS-CoV-2, mass vaccination was introduced worldwide. The vaccine program commenced in India on 16th January 2021. The two vaccines which are predominantly administered in India are Covishield (the Adenovirus vector-based vaccine from Oxford University and AstraZeneca, UK) and Covaxin (the indigenous inactivated virus vaccine manufactured by Bharat Biotech). There are numerous studies have been conducted on different facets of the disease, such as demographics, clinical manifestations, and treatment measures from different parts of the world [7–9].

Paschim Burdwan (Fig. 1) is an important urban mining Industrial district in West Bengal. Many people settle in this region (Durgapur-Asansol) to earn their living. Covid cases were first reported in August 2020. Before that, no testing was done. This study was aimed at finding the number of covid cases from August 2020 to July 2021 in this industrial belt of Paschim Burdwan. The number of deaths due to the coronavirus was also recorded in the mentioned period. The study was conducted among different age

groups of patients for both males and females. The observed data were statistically evaluated to examine the effect of different parameters on the observed results. Besides Covid, the cases of TB and the death caused due to it was investigated and evaluated statistically. Further, the Asansol city of Paschim Burdwan has one of the major industries (IISCO- Indian iron and steel company) of the district, and vehicular traffic also remains high in this area. Hence this city was considered as a model for the pollution-related study. Vehicular emission contributes to the rise in air pollutants [27] and the iron & steel industries generate Sulphur dioxide and oxides of nitrogen.

The major air pollutants viz. oxides of nitrogen (NO_x), oxides of carbon (CO_x), Sulphur dioxide (SO₂), and particulate matters like PM_{2.5}, and PM₁₀ in this industrial area were therefore studied to understand the change in the pollution pattern during lockdowns which were imposed to control the Covid cases. It is also reported that air pollution adversely affects the immune defense response in severe pneumonia patients [28]. We, therefore, tried to relate the increasing covid cases with pollution of this area during the months of rising in Covid cases.

Material And Methods

Covid-19 data was collected from the offices of the Asansol Municipal Corporation and Chief Medical Officer of Health (Fig. 1) and the nature of the two successive waves for Covid-19 cases and deaths viz first and second waves were studied, infectivity concerning age and gender were analyzed for 2020 and 2021. The population was divided into 4 different age groups: ≤19 years, >= 20 years to <= 45 years, > 45 years to <= 60 years, and > 60 years, and, accordingly, the number of positive cases were noted for each age group. The percentage of COVID-19 positive individuals for each age group was calculated and a comparison of the age group wise COVID-19 positive percentages for the years 2020 and 2021 was determined. The numbers of male and female COVID-19 positive individuals for each age group were calculated and compared. The Test statistics used were the 1-sample and 2-sample test or equality of proportions using Chi-square test. Statistical analysis was done using Statistical package R version 4.1.1. The Chi-square test was used for determining the statistical significance of the results. A p-value of < 0.05 was considered significant. Records of TB cases and deaths during 2019, 2020 and 2021 were also collected and compared. Pollution data viz Nitrogen oxides (NO_x), carbon oxides (CO_x), Sulphur oxides (SO₂), and particulate matters (PM_{2.5}, and PM₁₀) were collected from the CPCB website (Central pollution control board) for the Asansol area which is a major industrial area of Paschim Burdwan West Bengal.

Results

A month-wise study of Covid cases and deaths from August 2020 to July 2021 (Fig. 2)

As per the data available from the offices of the Asansol Municipal Corporation and Chief Medical Officer of Health, a total of 55,752 positive cases were found between August 2020 to July 2021. It is seen from Fig. 2 that the number of Covid affected cases started to increase from the month of August 2020, reaching the highest peak in September 2020 (3965 cases) and then gradually started declining till the month of January 2021. During the next two months; February 2021 to March 2021, the number of affected cases was much less, approaching the baseline in the graph (the number of cases was 200 in February and 377 in March). The cases then suddenly started rising exponentially from April 2021, which marked the onset of the 2nd wave, attaining the peak in the month of May 2021 (21132 cases). This is followed by a drastic drop in the next two months; to 294 cases in July 2021.

The total number of deaths due to Covid-19 were (199) between August 2020 to July 2021. The number of death cases due to Covid-19 increased along with the number of infectivity cases in August 2020 with the highest peak (24 deaths) in November 2020. After that, the death pattern follows almost with that of Covid-19 infected cases. During the 2nd wave, the highest death cases were recorded in May 2021 (63 deaths) followed by a gradual decline in the next two months; to only 2 deaths in July 2021. In general, the month-wise number of Covid-19 positive cases and the number of deaths were highly correlated (Pearson Correlation Coefficient + 0.9073, Fig. 2).

Age-wise comparison of Covid-19 positive cases in Paschim Burdwan (2020 vs. 2021)(Fig. 3)

A comparative percentage study of Covid-19 was performed among four age groups between 2020 and 2021; ≤ 19 years ($n = 759$ in 2020, $n = 2441$ in 2021), ≥ 20 to ≤ 45 years ($n = 6388$ in 2020, $n = 19429$ in 2021), ≥ 46 to ≤ 60 years ($n = 4189$ in 2020, $n = 12447$ in 2021), and > 60 years ($n = 2746$ in 2020, $n = 7353$ in 2021) This is depicted by a bar graph in (Fig. 3).

When the positivity rate was calculated from the total number of positive cases tested for Covid-19, the ≤ 19 age group showed an increase in positivity from 5.38% in 2020 to 5.85% in 2021; for ≥ 20 to ≤ 45 years age group, the positivity raised from 45.36% in 2020 to 46.62% in 2021. Similarly, for the ≥ 46 to ≤ 60 years age group the positivity slightly increased from 29.74% in 2020 to 29.87% in 2021. Except in > 60 age group the positivity reduced from 19.50% in 2020 to 17.64% in 2021. Among all positive cases, the age group ≥ 20 to ≤ 45 years showed a maximum percentage of positivity in both 2020 and 2021. The distribution of cases across the age groups is not independent across the years. p-value was found to be significant (< 0.05), so at a 95% level of significance we cannot accept the hypothesis that age group across time is not affecting the number of cases.

Age group-based comparison between genders in term of COVID-19 positivity (2020 vs 2021)(Fig. 4)

A comparison between male and female Covid-19 positive individuals, among the total number of positive cases ($n = 55752$) during the study period, was done. This revealed that a greater number of

males were affected (males- 35194 i.e., 63.13%) than females (females- 20558 viz., 36.87%).

As depicted in Fig. 4 all age groups showed male domination over females in terms of positivity percentage, except for the age ≤ 19 age group. where females were more affected than males (7.45% female; 4.74% male). p-value was found to be significant (< 0.05), so at a 95% level of significance we cannot accept the hypothesis that gender is not affected by cases (Chi-square value = 175.5604931, p-value = 8.01918E-38).

Comparison of the number of Tuberculosis cases and deaths due to it during 2019–2021(Fig. 5)

The data of the number of tuberculosis cases and deaths due to it was collected for three years viz. 2019, 2020, and 2021. The line graph in Fig. 5 shows that TB cases and deaths due to tuberculosis declined in 2020 (cases-2467; deaths-87) concerning 2019 (cases-3130; deaths-145). It further declined in 2021 (cases-1399; deaths-40) with a significant change in a p-value of < 0.05 , therefore cases and deaths due to TB are not the same across the years at a 95% level of significance (Chi-square value = 8.769229433, p-value = 0.012467691).

Comparison of the pollution parameters in the Asansol area of Paschim Burdwan during 2019–2021

Pollution parameters viz. NO_x, CO_x, SO₂, PM_{2.5}, and PM₁₀ in the Asansol area of Paschim Burdwan were studied for July 2019,2020 & 2021 and tabulated in Table 1.

Table 1
 Nitrogen oxides(Nox), Carbon oxides(Cox),
 Sulphur oxides(SO₂), particulate matters (PM_{2.5}, and PM₁₀) values for 2019,2020 and 2021

Parameters	2019	2020	2021
NOx (ppb)	24.54	18.56	27.92
Cox mg/m ³	0.36	0.42	0.55
SO ₂ µg/m ³	5.10	3	8.05
PM _{2.5} g/m ³	28.31	23.33	24.80
PM ₁₀ µg/m ³	44.70	44.66	53.61

Discussion

Paschim Burdwan(Fig. 1) is a densely populated area with 2,882,031 people in it [11]. The district is identified as the major industrial hub in eastern India [12]. To the best of our knowledge, this is the first such study concerning patient demographics and pollution change in this area of the country.

From the study period, it is reported that the Covid 19 cases gradually increased in this area to 1537 during August and the number reached 3965 in September 2020. The curve flattened in January, February, and March 2021. This concluded that the surge of the first wave was in September 2020 declined in December 2020. It is important to note that during this time (30th December 2020) Kolkata reported the First Bengal strain emerged (variant VUI-202012/01 or B.1.1.7) which has 17 mutations, [13, 14]. After that, there was a sudden rise of positive cases in April 16743, which heralded the second wave in the month of April 2021. The month of May experienced the maximum number of cases of 21132, which can be attributed to the heavy public gatherings before elections which were held on 26th April 2021 in the district. In June 2021 the cases dropped and further declined in July 2021, which supports the study by Sharma N *et al*, which also shows the exponential growth of positivity from April 2021 onwards [29]. Mainly the double mutant 'Delta' strain (B.1.617) and the triple mutant 'Bengal Strain' (B.1.618) were responsible for the increase of positive cases during the 2nd wave [15, 16]. The 'Delta' strain along with the triple mutant 'Bengal strain' show higher transmissibility

The number of deaths also increased along with the infectivity in the second wave (Fig. 2). This may be attributed to the explosive nature of the second wave led to a large number of people being affected in a short span. This may have put the health infrastructure under pressure, making hospitalization possible for only more severe patients, which may have resulted in higher mortality among the hospitalized patients [21].

In the ≤ 19 age group for the first wave, the positivity rate was (5.38%) which increased to (5.85%) for the second wave. A similar finding is reported by Kumar *et al* which showed higher positivity in < 20 individuals by the second wave [21]. The lower Covid-19 cases in the age group ≤ 19 among all other age groups was probably due to better immunity of the younger generation. Affected children were also considered the potential indicator for the second wave, as they are likely to have heavy nasal loads and would be silent spreaders of the disease especially during the sequential opening of the schools [14]. The maximum affected age group for both the waves was the ≥ 20 to ≤ 45 years age group. The higher rate of infection in this group is probably due to the presence of more working people, compared with the first group, who had higher environmental exposure [21]. A similar result is also reported in the literature which indicated a higher proportion of patients found in the age group of 20–39 years [21].

People of the age groups of ≥ 45 to ≤ 60 and above were found to be slightly more affected in the second wave. Supporting our result many previous studies showed that elderly people were more susceptible to Covid-19 and the pathogenic severity which is also higher for those who had co-morbidities like hypertension, diabetes, structural lung diseases, etc. [18, 20, 14]. As the age increases the innate immune responses decrease, and a shift in T-cell subpopulations leads to a decrease in naïve T-cells and an increase in memory T-cells, which reduces the response against novel infectious agents [14]. But, interestingly the number of cases decreased in the second wave for (≥ 60 years) age group and may be due to the government's initial vaccination drive which began from 1st March 2021 for senior citizens and above 45 years. Senior citizens were first vaccinated according to the government's guidelines [30].

In the age-group-wise comparison between genders in terms of % positivity (2020 and 2021), (Males: 63.12% and Females: 36.87%) it was found that the males were more affected in all the age groups except for the ≤ 19 age group in which males were 4.74% positive but percentage increased to 7.44% in case of females. Sex hormones are very crucial for the development and activity of the immune system against viral infections [22]. This may have contributed to the sexual dimorphism observed in immunological responses to the virus. ACE2 expression and activity are higher in males than females which may have resulted in the differences in COVID-19 infection and fatality in males and females. ACE2 activity is found to be higher in males than in females as reported in some studies [22, 23]. Though, it may be true that females acquire lesser severity in females than males [24]. As they possess higher cell-mediated and humoral immune responses [25]. The result may be explained by a study done by Pinchoff J *et al* in Uttar Pradesh and Bihar which reveals that women were less likely to practice COVID guidelines as they are unable to identify the main Covid-19 symptoms correctly, due to challenges in accessing information or receiving less accurate information of Covid-19 symptoms.

It is seen from Fig. 4 that the cases and deaths of TB reduced from 2019 to 2021. Apparently, the increased use of masks and frequent lockdowns were the reasons for this reduction in the number of cases and deaths of TB. But this may not be true as a report released on 12 May 2020 by WHO suggested that the COVID-19 pandemic led to a global reduction of 25% in expected TB detection for 3 months. In support of this report, other studies showed that the cases were undetected as the number of testings was hampered during the covid months [26, 27]

Another concern would be that Covid-19 has "TB-like" symptoms and covid-19 carries a stigma in many communities and this stigma may transfer to individuals with TB as well [28]. As the p-value is less than 0.05, cases and deaths are not the same across the years at a 95% level of significance.

The area remains heavily polluted throughout the year. The investigation was aimed at examining whether the pollution got controlled during the lockdown months for various parameters NO_x, CO_x, and SO₂ as well as PM_{2.5} and PM₁₀ and it was seen from the table that there was no reasonable variation in these parameters during the study period of July of 2019, 2020 and 2021. Though it was expected that the values of these parameters would drop due to lockdown. The reason for no appreciable change in these values may be because the industries were in operation during the lockdown phase also. The assumption that pollution may cause a rise in the number of cases among age groups was not found correct. Pollution was not found to have any impact on the increasing Covid cases and deaths during the study period of the mentioned district.

Declarations

Competing interests: The authors declare no competing interests.

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Figures

Figure 1

Map showing the geographical area of data collection..

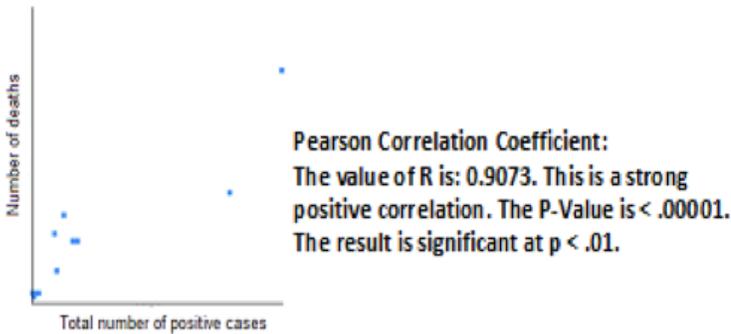
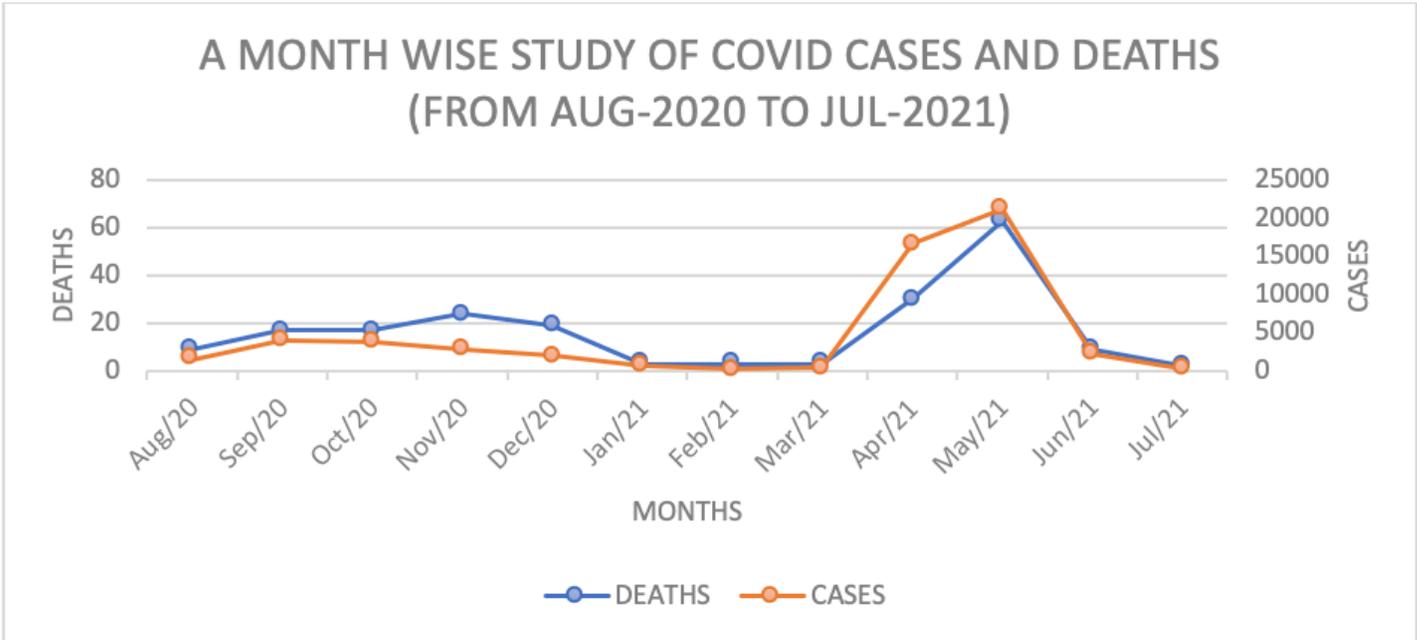


Figure 2

Monthly distribution of number of Covid positive cases and deaths due to Covid from August 2020 to July 2021. Pearson Correlation Coefficient value shows they are highly correlated

Figure 3

Age-wise comparison of the positive cases in Paschim burdwan (2020 vs 2021)

Figure 4

Age group-based comparison between gender in term of COVID-19 positivity (2020 vs 2021)

Figure 5

Total number of TB cases and deaths in 2019, 2020 & 2021