Received: 27 January 2022 | Revised: 13 April 2022 | Accepted: 20 April 2022

DOI: 10.1002/tqem.21884

RESEARCH ARTICLE

WILEY

Impact of environmental and socio-economic stressors leading to unequal distribution of COVID-19 incidences in the state of Louisiana

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Abstract

Louisiana (LA) ranks fifth in the United States in cancer mortality rate. LA's infamous "cancer alley" is a well evidenced region near the southeast part of the Mississippi river surrounding the petrochemical hub of the state. LA has also experienced a high COVID-19 death rate and incidences compared to other states during the recent pandemic. In this study we analyzed publicly available datasets related to health and socio-economic parameters in LA to determine the factors triggering high incidences and deaths caused by COVID-19. Correlation analysis was performed to find the impact of different parameters on the outcome of COVID-19. Our analysis showed higher COVID-19 incidences in the parishes which are in and around the "cancer alley" with a correlation of $r = 0.9$. Interestingly, results also indicated a strong correlation ($r = 0.9$) between the death rates caused by asbestos toxicity to COVID-19 caused death rate. Furthermore, we found that office-administration related employment has a positive correlation to COVID-19 incidences in the "cancer alley." However, we also found both white and black races are equally affected by the COVID-19 pandemic in the "cancer alley" region. In conclusion, our analysis strongly suggests that inhabiting "cancer alley" could significantly enhance the chances of getting affected by SARS-CoV-2 virus compared to other regions in LA.

KEYWORDS
COVID-19, cancer alley, lung cancer, occupation

1 | BACKGROUND

The State of Louisiana is situated along the Gulf of Mexico. The State has been making daily news headlines because of the high number of COVID-19 related incidences and deaths during the recent pandemic. In the last year, 10 Louisiana parishes were placed among the top 25 counties in the entire country for having the highest COVID-19 cases per 100,000 people. This intrigued the authors of this paper to figure out the reason for such a huge outbreak in the state of Louisiana. While Louisiana is the 2nd poorest state in the United States, this state also stands 2nd in the nation in the percentage of African American population (census.gov).

The state of Louisiana is experiencing higher incidence rate of COVID-19 cases per capita, and more than one parish in Louisiana are in the headlines for having multiple parishes that have higher COVID-19 incidence rates than the national average (Mollalo et al., 2021). Louisiana's cancer alley refers to an 85-mile long area along an industrial stretch of the Mississippi River known for its abundance of petroleum plants (Exhibit 1). Population figures from the 2010 census or 2020 census show that the cancer alley or the LA chemical corridor

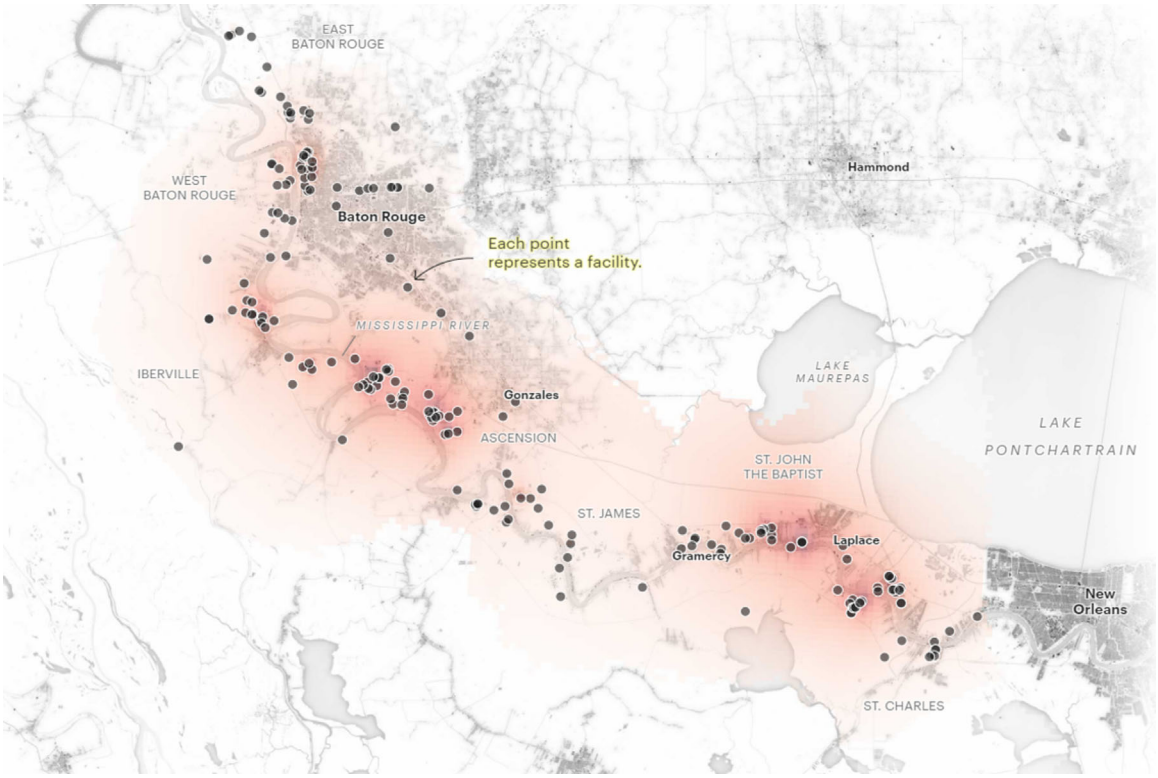

EXHIBIT 1 Mapping of Louisiana Cancer Alley and the industrial zones in this region. *Source*: ProPublica [Color figure can be viewed at wileyonlinelibrary.com]

has 81% African American population (U.S. Bureau of the Census, 2010). According to the EPA's (environmental protection agency) 2014 National Air Toxics Assessment, inhabitants of cancer alley possess risk getting cancer from air pollution at a rate of 95% higher than the most Americans. Cancer alley is located along the Mississippi River between Baton Rouge and New Orleans containing a multitude of industrial plants (Rosenfeld & Feng, 2011). This area has more clusters of cancer patients than anywhere else in the state. The state of LA is also home to chemical processing industries and petroleum refineries. Most refineries are located within miles of residential units. The EPA's Toxic Release Inventory (TRI) Data-base shows that facilities in this region release a multitude of chemicals that cause various cancers (https://enviro.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?pstate=LA&pyear=2018&pParent=TRI&pDataSet=TRIQ1).

The state of Louisiana ranks third among the nation for lung cancer fatality and 5 year survival rate. Both African American and Caucasian populations show poor cancer survival rates in Louisiana (Carroll et al., 2017). Most of the households in cancer alley are found to be economically challenged, and some of the representative parishes within cancer alley have a significantly higher percentage of African American population than other parishes. It has also been mentioned by the environmental protection agency (EPA) that some of the plant cities in cancer alley are "likely carcinogenic" (Groves et al., 1996). A study by Tsai et al. (2004), found little evidence of association between cancer incidence and employment at two petrochemical areas in South Louisiana and concluded that an increase in bone cancer in he employees of these two facilities might not have occurred due to the employment at these two facilities.

There has been mixed and inconclusive evidence in the literature regarding Louisiana's air expo-sure to chemical emissions. Since crude oil has been the most important source of energy since the mid-1950s, the petrochemical industries produce derivatives of crude oil and involve refining and cracking. Air pollutants like sulphur oxides, nitrogen oxides, carbon monoxide and dioxide, volatile organic compounds (VOCs), some of which are carcinogenic, are common environmental emissions of petrochemical industries (Domingo et al., 2020). Thus far there has been inconclusive evidence for Louisiana where a clear and positive correlation can be shown between residential proximity to petrochemical industries and lung cancer. However, Gottlieb et al. (1982), concluded some evidence between proximity of petrochemical industries in Louisiana and lung cancer in the residents, based on the data obtained from 1960 through 1975.

The known sources of environmental pollutants are the petrochemical complexes and oil refineries anywhere in the world (Lin et al., 2018). Recently published studies have emphasized that aerosol concentration and its sustenance in air are higher in areas that have high concentration of (particulate matter) PM 2.5, NO_2, SO_2 in the air. One such study by Frontera et al. (2020) showed positive correlation between PM2.5, NO_2 and COVID-19 outbreak. The study did show a clear cut correlation between air pollutants and covid 19 fatality in the Po valley region in Italy where severe Covid cases and deaths occurred. It was also interesting to find out that the levels of PM 2.5 and NO2 was

EXHIBIT 2 Comparison of Parishes with highest and lowest COVID-19 incidences lung and colon cancer rates

Parish (lowest COVID-19 incidence)	AGE adjusted lung cancer incidence rate- cases per 100,000/100,000
West Feliciana	412.26
Claiborne	473.34
Jackson	472
East Caroll	487
Tensas	355
Cameron	476.15
Sabine	462
Natchitozes	463
St. Helena	440.9
Parish (highest COVID-19 incidence)	
Tangipahoa	467.54
East Feliciana	489.35
Livingston	473.88
St. Charles	454.54
St. Tammany	501.86
West Baton Rouge	505.46
St. John the Baptist	476.67
St. James	462.64
Vermillion	497.1
Iberia	496.34
St. Mary	471.76
Iberville	523.28

St. Tammany, West Baton Rouge, Vermillion, Iberia (common between highest lung and highest COVID-19); East Feliciana, Iberville, St. James, St. Mary (Common between highest colon cancer and highest COVID-19).

in an increased level prior to the COVID-19 outbreak in the PO valley. Similar results were found in another 2020 study by Liang et al. (2020), that found urban air quality and air pollution are suggestive of Covid19 case fatality and mortality rates in the United States. This study showed that among the 3122 US counties selected for all over the US, highest NO2 levels were detected in New York, New Jersey, and Colorado. California, South Dakota, and Pennsylvania were identified with highest PM2.5 concentrations. Results showed that NO2 concentrations were positively correlated with both Covid19 fatality and mortality rates in the United States. However, the PM2.5 levels were not positively associated with Covid19 case-fatality rate but was marginally associated with Covid 19 mortality rates. Another study by Wang et al. (2020), analyzed the satellite data for assessing the air pollution and found that COVID-19 fatality increased with increase in 1% CO_2 emission. This study emphasized that reduction in CO_2 emitting activities would be beneficial for a reduction of COVID-19 mediated fatalities and therefore would be beneficial for public health. Yet another 2020 study conducted by Wu et al. (2020), evidenced that if the long term average of PM 2.5 is increased by 1 μg/m3 then it is is associated with a statistically significant 11% (95% CI, 6 to 17%) increase in the county's COVID-19 mortality rate. Curtis, 2021 in a review study about the effect of environmental air pollutants on covid 19 fatality found that in addition of correlation between PM2.5, NO_2, SO_2 on covid19 fatality, soot, and ash particles generated in California wild fire significantly raised the fatality numbers in those particular regions of California. The study points out that oxidation and inflammation of the lungs due to the air pollutants is the main reason behind increase in COVID-19 fatality in those areas.

Similar correlations between the air pollutants and COVID-19 fatality have been reported for different countries in Asia (China, India, Pakistan, Japan, Republic of Korea, Iran, and Bangladesh), America (Canada, USA, Central and South America), Europe (Spain, United Kingdom) and Middle East (Saudi Arabia) (Marquès & Domingo, 2021).

At least two recent studies have indicated that environmental pollutants such as PM2.5 increase the susceptibility to COVID-19 incidences (Conticini et al., 2020; He et al., 2020). He et al. (2020) emphasized that geographical proximity to the petrochemical wastes could significantly increase the risk of COVID-19 susceptibility. This study focused on different areas of China with higher and lower concentrations of petrochemical industries and the risk of COVID 19 at those locations. A positive correlation between concentration of petrochemical industries and COVID 19 risk was concluded.

2 | AIM OF THE STUDY

Louisiana is subjected to a failure of clean air act (Keehan, 2018) especially in its southern part where the petrochemical hub is located, popularly named as cancer alley due to the high rates of cancer. It is our particular interest to determine the environmental characteristics of those parishes that are showing a higher number of COVID-19 fatalities and high cancer rate in this state (especially the cancer alley). We hypothesized that the COVID-19 cases are higher in parishes where people are already exposed to several lung irritants, chemicals, or lung carcinogens. We further hypothesized that there must be multiple environmental sources present in Louisiana which are responsible for triggering lung related diseases and COVID fatalities. Therefore, the aim of this paper is to analyze and associate Louisiana areas (parishes) with higher lung cancer rates, COVID rates, the type of major industries, race and median household income in that respective area.

As of today, there have been no controlled studies performed on how different parishes in the state of Louisiana differ between lung disease and COVID-19 susceptibility. We have analyzed the COVID-19 and Lung cancer cases along with their mortality rates in the parishes where the potential environmental carcinogens reported to be present through industrial source. Therefore, the objective of this research is to find out a) the environmental characteristics of the parishes that have high COVID-19 incidences, b) the socio demographics of the residents in those parishes.

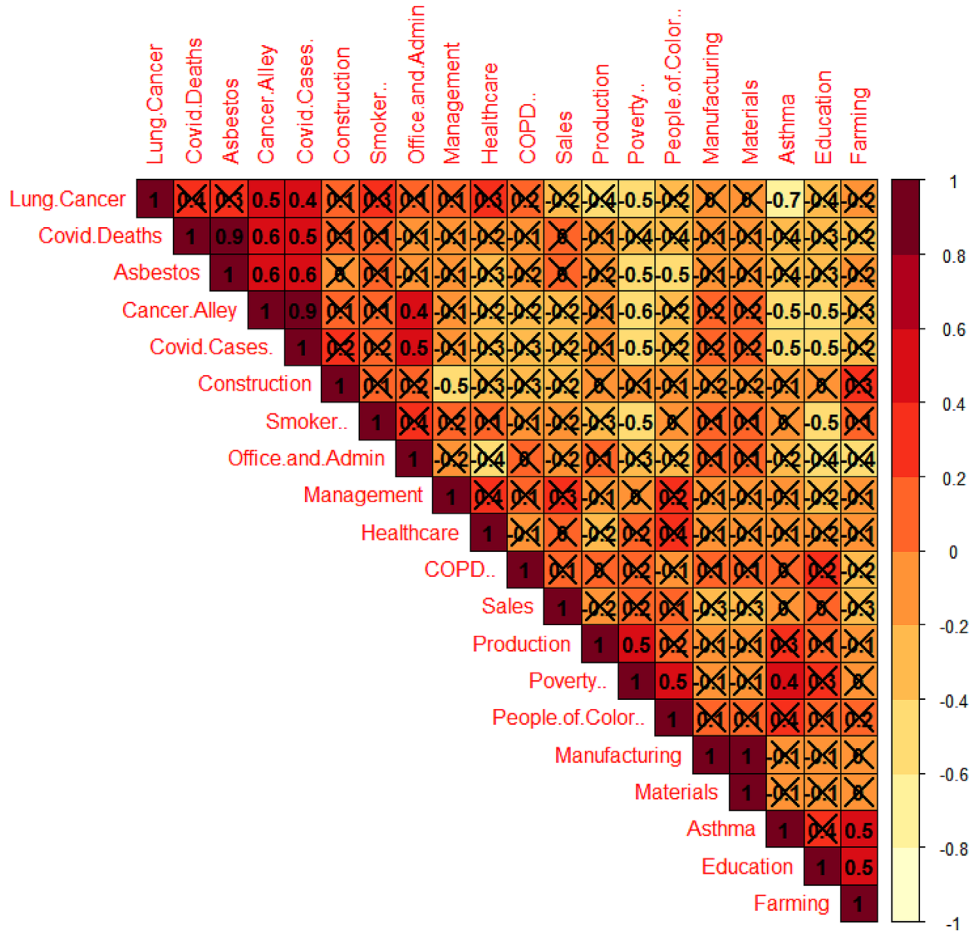

EXHIBIT 3 Analysis of health conditions, environmental factors, socio-economic parameters and COVID-19 incidences different parishes in Louisiana [Color figure can be viewed at wileyonlinelibrary.com]

Owing to the high number of parishes in Louisiana which are showing outrageous numbers of COVID-19 cases, we attempted to identify the "COVID alley" and the socio-demographic parameters of the highly affected parishes.

Our analysis also included socio-economic factors such as poverty rate, ethnic group data, education, employment type, and percentage from each of the selected parishes. The socio-economic data were collected from US census tract data.

3 | METHODS

3.1 | Data collection

Age standardized COVID-19 incidence rate per 100,000 population in LA parishes were obtained from the CDC (cdc.gov). We have also included lung/bronchus, thyroid, and colon cancer cases (available from LA cancer registry), asbestos exposure mediated death (CDC wonder database), and cases of chronic obstructive pulmonary disorders (COPD) and asthma (CDC) in the selected parishes. We have analyzed the COVID-19 incidences in LA parishes based on rates per 100,000 population. We sorted the parishes with highest (13 parishes) and lowest (10 parishes) incidences of COVID-19 in LA (Exhibit 2). These two groups of parishes were created with the lowest and highest incidences to further analyze associated factors which might have a direct or indirect effect on COVID-19 cases.

3.2 | Statistical analysis

Correlation analysis was conducted on the data set using R (Larsen & Marx, 2018). The null hypothesis is as follows:

1. There is a lack of evidence of association between the two variables (independence),
2. The variables are associated (dependence).

The significance level is taken to be 0.05. That is, at this level, we reject the null hypothesis and there is evidence of an association. The Pearson correlation matrix was computed in R using the "rcorr" function, which is part of the "Hmisc" package. For simulation purposes the parishes were encoded 0 and 1 for a parish located outside and inside the cancer alley region, respectively. The results are displayed graphically in Exhibits 3–6.

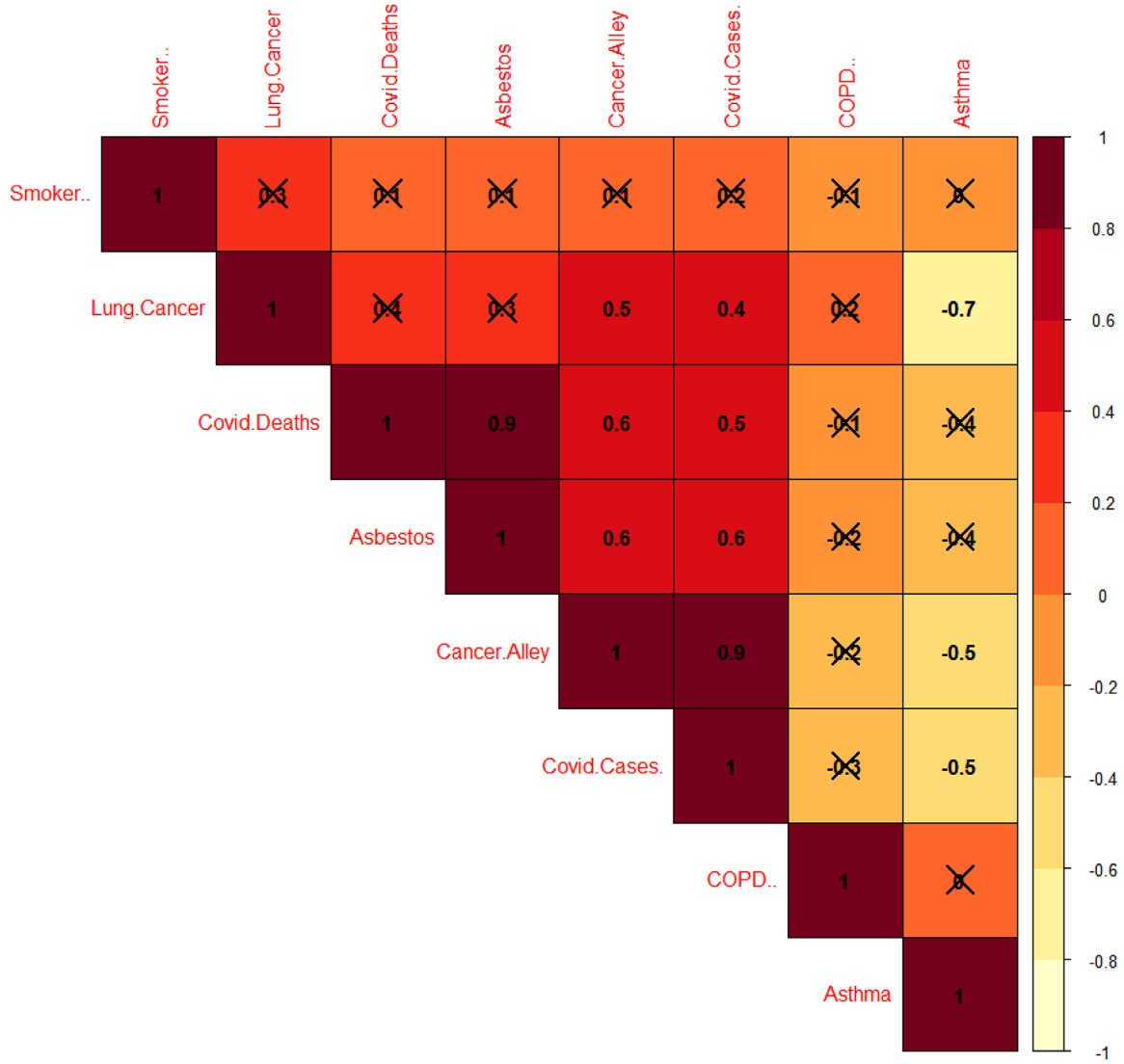

EXHIBIT 4 Analysis of health conditions [Color figure can be viewed at wileyonlinelibrary.com]

3.3 | Data visualization

The visualization for this task is done by using the Plotly package of Python. We explored Plotly-database for obtaining information on each state of the United States and their corresponding country information. To visualize each country of Louisiana we have used three Python packages named geopandas, pyshp, and shapely for color coding.

4 | RESULTS

The lung cancer rate in LA (66.6 people among 100,000) is much higher than the national rate of lung cancer, that is, 58.8 (out of 100,000 people). We have sorted the LA parishes on the basis of highest incidences of lung cancer (rates per 100,000 population). Exhibit 7 represents the top 13 parishes in LA on the basis of lung cancer rates. Since LA has the 3rd highest incidence rate of colon cancers in the United States, we ranked the top 13 parishes in LA based on higher rates of colon cancer. These parishes are listed in Exhibit 8.

Next, we ranked the parishes with highest (13 parishes) and lowest (10 parishes) incidences of COVID-19 in Table 3. We found 8 of the highest ranked parishes (East Feliciana, St. Tammany, W. Baton Rouge, St. James, Vermillion, Iberia, Iberville, St. Mary) in Exhibit 2 being common between the parishes with higher lung cancer and colon cancer incidence rates. Interestingly, none of the parishes were common among the COVID-19 incidences (13 parishes) and the parishes with highest thyroid cancer death rates (data not shown).

We have further demonstrated the socio-economic and environmental parameters in the lowest and highest COVID-19 occurring parishes in Exhibit 9 for better understanding. We have included the racial data (white and black), poverty rate, educational level, and major occupation in each of these parishes.

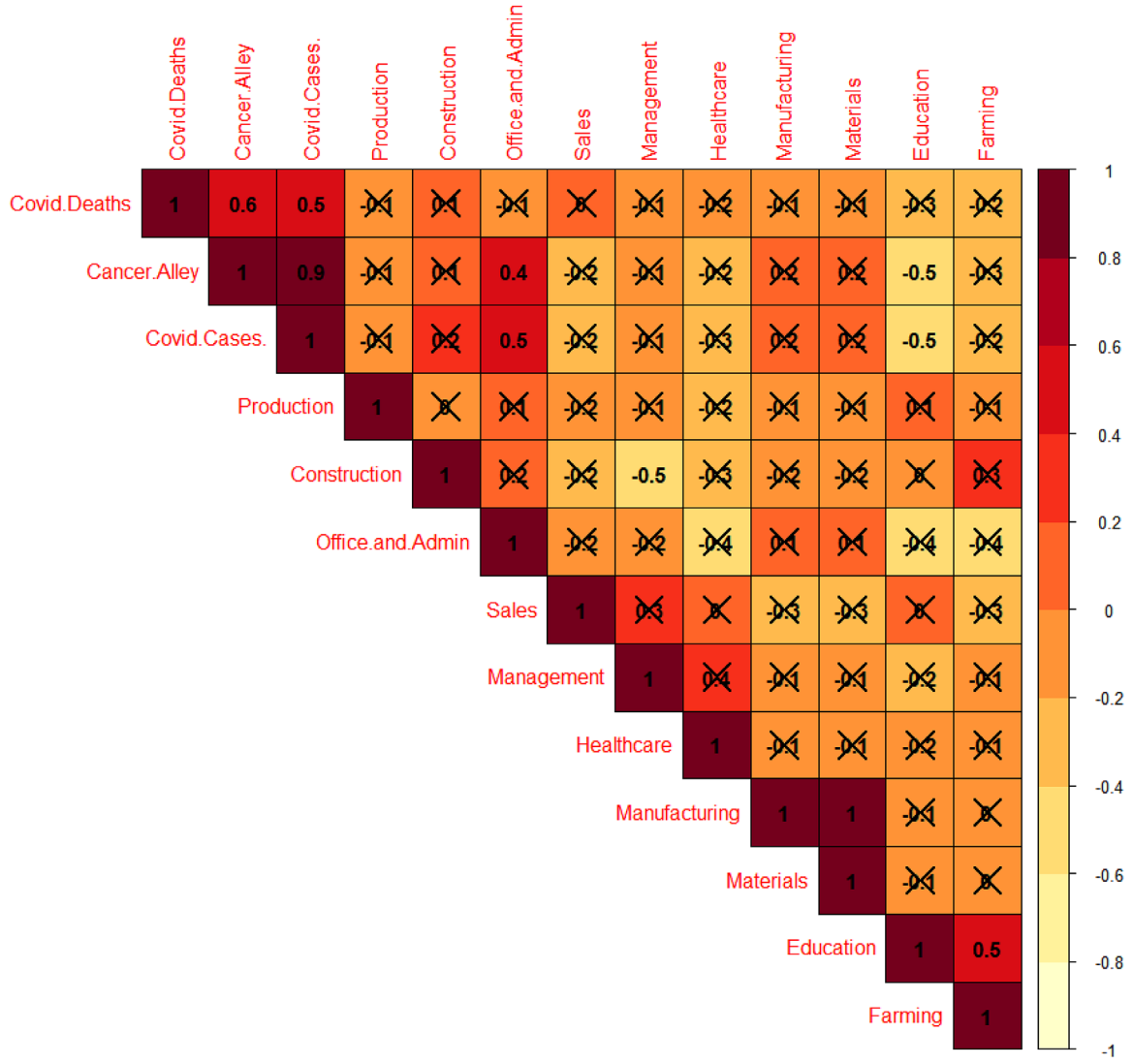

EXHIBIT 5 Analysis of environmental factors [Color figure can be viewed at wileyonlinelibrary.com]

Next, we determined various factors which may impact the distribution of COVID-19 cases in and around cancer alley by performing correlation analysis as demonstrated in Exhibit 3. It is to be noted that red denotes a positive correlation while yellow denotes a negative correlation. Any squares marked with an X indicate there is no evidence of association. From Figure 2 we observe that there is evidence of a positive correlation between cancer alley and COVID-19 related deaths/cases, lung cancer, asbestos, and careers in office and administration. Mathematically, we can interpret this as follows: as a person moves toward the cancer alley region (from 0 to 1) the COVID-19 related deaths/cases, lung cancer rates, and asbestos-related deaths increase. Furthermore, the correlation between cancer alley and COVID-19 cases is very strong. Equally as strong is the association between asbestos and COVID-19-related deaths. Office and administration related employment also showed a relationship with increasing COVID-19 cases.

For simplicity, those variables which were positively correlated are shown in Exhibits 4–6 for health related conditions, environmental factors, and socioeconomic parameters respectively. Our analysis showed a higher number of COVID-19 incidences in the parishes in and around the infamous cancer alley with a correlation of $r = 0.9$. Interestingly, we also found a strong correlation ($r = 0.9$) between the asbestos related death rate to COVID-19 death rate. We also found that office-administration related employment has a positive correlation to COVID incidences in the cancer alley. We found both Caucasian and African American races are equally affected by the COVID-19 pandemic in the cancer alley region.

Finally, we demonstrate the visual representation of the selected Parishes in this study which are either near to the cancer alley with increased incidences of COVID-19 or located outside cancer alley with a lower number of COVID-19 incidences. Figure 6 shows the parishes with highest COVID-19 incidences as yellow color coded whereas the green color coded refer to the lowest COVID-19 incidences. We further coded red to depict the parishes with higher COVID-19 incidences which are geographically located in and around Cancer Alley.

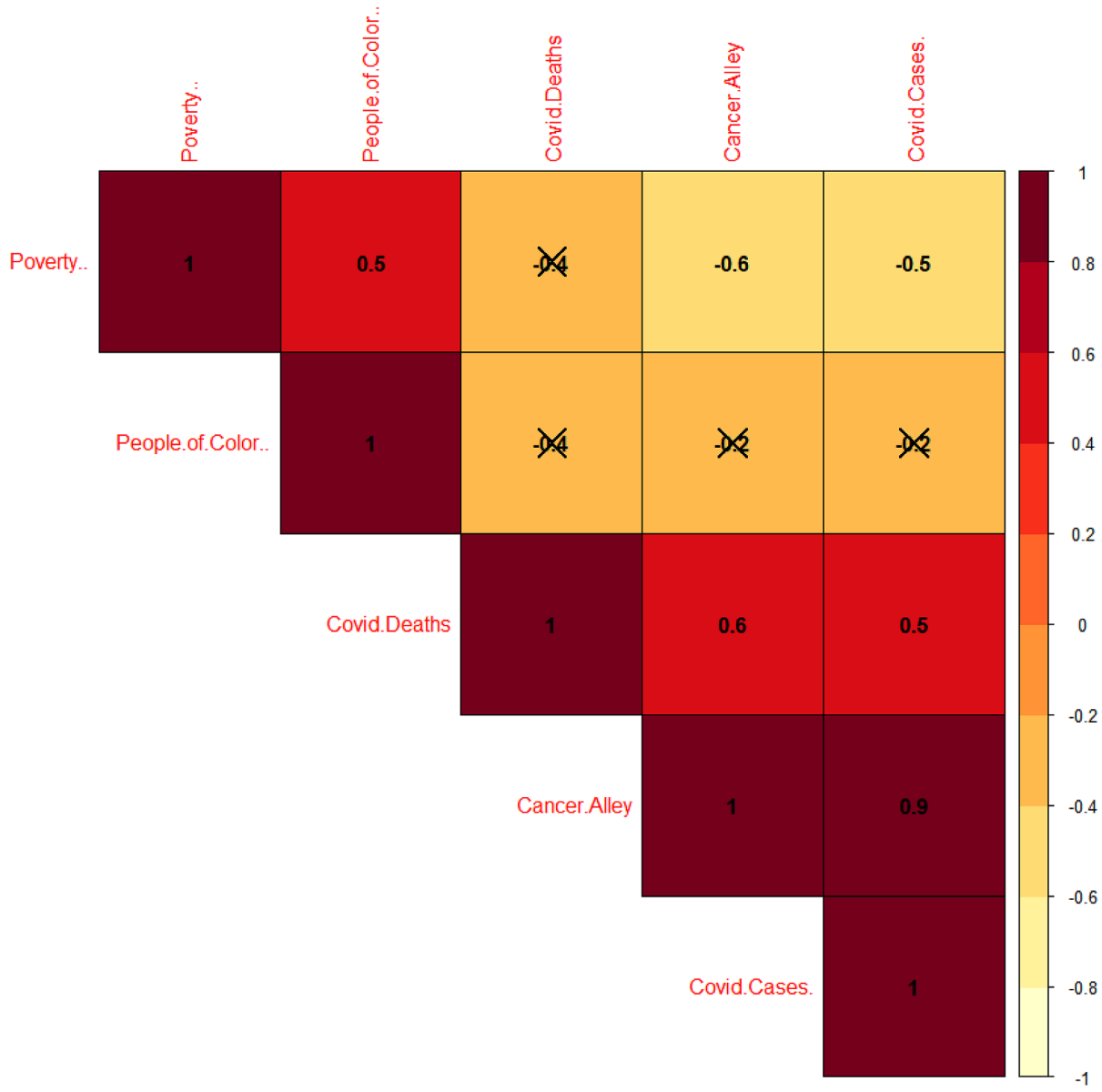

EXHIBIT 6 Analysis of socioeconomic parameters [Color figure can be viewed at wileyonlinelibrary.com]

5 | DISCUSSION

Louisiana (LA) has experienced a disproportionate distribution of COVID-19 cases throughout the state. While some parishes in LA were ranked among the most severely affected by COVID-19 pandemic in the United States, at the same time some areas were among the least affected. Our analysis indicated that the parishes in or around the infamous cancer alley region have significantly accounted for higher amounts of COVID-19 cases compared to the rest of the state.

Previous reports have shown that cancer alley is infested with several industries and plants which are responsible for the high concentration of industrial zones in a stretch of 85 miles. This area has been found to have increased over the last 10–15 years as well, which increased the severity of diseases in those areas including, cancer, COPD, and metabolic diseases.

Previous studies, although few, have indicated an impact of social disparity in the cancer alley being a major force triggering the incidences of cancer. In our study we indeed found poverty to be a significant factor as almost half of the parishes in the cancer alley region have a higher poverty level than the Parishes which have lower COVID-19 cases. A few studies have indicated race to be a predictor of higher incidences of COVID-19 (Sarkar et al., 2021). We strongly refute this point, and it seems one of the most prominent findings of our work. Race was not established as a factor that predicted the outcome of COVID-19 fatality in the selected parishes in our study. Having almost equal amounts of African Americans in both the high fatality and low fatality parishes in Louisiana resulted in a negative correlation between race and COVID-19 fatality.

We did not find a strong correlation between asthma and COVID-19 risk. There are a few other studies, similar to us, that have not

EXHIBIT 7 Parishes with highest lung cancer incidences in LA

Parishes with highest lung cancer ratess	Rates per 100,000 population
Bossier	53.8
De Soto	50.8
Iberville	52.3
St Bernard	53.0
St Landry	50.1
St. Martin	50.0
St. Tammany	50.1
Vernon	63.5
Washington	51.8
West Baton Rouge	50.5
Vermillion	49.7
Terrebone	49.6
Iberia	49.6

EXHIBIT 8 Parishes with highest colon cancer incidences in LA

Parishes with highest colon cancer rates	Rates per 100,000 population
Catahoula	63.43
Concordia	62.4
De Soto	70.63
East Carroll	80.15
East Feliciana	60.65
Iberville	61.3
Madison	80.15
St. Helena	60.16
St. James	60.16
St. Landry	64.37
St. Martin	59.26
St. Mary	62.08
Winn	66.5

found strong correlation between pre-existing asthma and COVID-19 outcome. A study by Han et al. (2021), attempted to investigate the impact of asthma on the risk of COVID-19 fatality. The review based on 56 studies showed that asthma was rather a protective factor against COVID-19.

It is to be noted that workers and residents in cancer alley are exposed to several industrial and harmful petro-chemicals daily through polluted air and water, resulting in alarmingly high statistics of cancer cases (Iqbal et al., 2007; Fos et al., 2021; Presley et al., 2010). Metal concentrations were observed in schoolyard soils from New Orleans, Louisiana before and after Hurricanes Katrina and Rita (Presley et al., 2010). However, there are not a lot of published studies that have identified the exact chemical pollutants or carcinogens and a possible correlation with the existing lung cancer cases in the cancer alley.

We emphasized on another strong finding of this study which is the correlation between lung cancer cases and COVID-19 fatalities. There was a positive correlation between these two, especially in the parishes that are in cancer alley. Historically, these parishes are also high in poverty rate and therefore might lack the necessary medical care that help them avoid cancer. Nevertheless, the existence of toxic air does not seem inevitable due to the location of 150 petrochemical companies. Interestingly, there have not been a lot of studies that focused on assessing the air quality of cancer alley, such as the density of lung pollutants but anecdotal studies do focus on the poor air quality assessment of cancer alley (Rosenfeld & Feng, 2011). Therefore, we strongly suggest that the lungs of the cancer alley residents are already vulnerable to the COVID-19 virus attack. Our claim is based on the strong correlation between cancer alley and COVID-19 fatality that we found in our study.

Our analysis on the data from cancer alley did not find a correlation between the poverty rate and COVID-19 incidences, similar to the study by Fielding-Miller et al. (2020), where poverty was not among the contributing socio-economic factors which enhanced the risk of COVID-19 in a specific population of farm workers. One of the reasons behind this could be the pre-disposition of environmental pollutants in a large amount in cancer alley which has already produced damage to the health and wellness of individuals in this region which is not restricted or regulated by poverty rate. We have established that the parishes that are high in lung cancer cases were also high in COVID-19 spread. Among them some parishes are situated directly in cancer alley and some parishes are situated close to cancer alley. However, parishes that have shown minimum cases of lung cancer and minimum cases of COVID-19 spread are located far from cancer alley. Therefore, we conclude that the cancer alley area is one of the strongest predictors of the spread of COVID-19 and the high number of lung cancer cases in the state of Louisiana. That implies the vulnerability of the lung tissues relate to the fatality of COVID-19.

The result of our study strongly indicates that the cancer alley has been turned into a COVID-19 infested region, more so for office workers inside the cancer alley area. It can be due to the fact that office space is not in an open-air environment and hence air exchange might be limited. Individuals employed in office-administration are found to have higher incidences of COVID-19 compared to other professions in our study. It is important that during COVID-19 pandemic, many workers remain home bound and in many industries social distancing was employed strictly implemented. However, office workers in medical facility or dental facility or offices where social distancing is not well maintained, in these circumstances' employees were more prone to be infected with COVID-19 incidences (Zhang, 2020). Another study by Baker et al. (2020), also found that individuals in office administrations are among the top employment categories which were exposed more to COVID-19, which again correlated to out finding as well. Office administration employee could include, medical office secretaries, patient appointment schedulers, etc.

The animated Louisiana (Exhibit 10) map shows that the parishes with highest COVID-19 cases are residing in cancer alley or are very

EXHIBIT 9 Tabular representation of socio-economic data in lowest and highest COVID-19 occurring data in different parishes

PARISH	White	Black	Poverty	Education (High school graduate or higher)	Occupation
West Feliciana	52.4	44.4	21.9	82.1	Education
Claiborne	45.8	51.8	31.9	79.5	Management/Legislators
Jackson	71.01	27.87	20.9	77	Sales/management
East Caroll	29.1	68.8	37.6	70.9	Sales/management
Tensas	42.2	55.4	30.8	78.9	Sales/management
Cameron	93.3	3.88	13.1	84.7	Management/Legislators
Sabine	69.5	16.8	18.6	85.4	Management/Legislators
Natchitozes	57.85	38.43	21.7	87.9	Management/Legislators
St. Helena	44.1	52.5	22.7	79.1	Construction/education
Tangipahoa	69.76	28.35	21.08	82.1	Construction/office Administration
East Feliciana	55.1	42.7	16.35	79.5	office administration/sales
Livingston	90	7.1	11.86	87.1	office administration/construction
St. Charles	70.2	26.5	10.96	90	office administration/sales
St. Tammany	83.2	12.7	11.4	90.5	sales
West Baton Rouge	57.6	39.9	14.1	86.8	office administration/production
St. John the Baptist	38.4	58.4	15.82	85.6	office administration/sales
St. James	49.7	48.8	16.37	85.4	office administration/material handling
Vermillion	81.5	14.3	16.83	77.9	office administration/construction
Iberia	61.9	32.8	21.56	79.9	office administration/sales
St. Mary	61.8	31.9	23.56	82.8	Office administration/Sales
Iberville	49.7	48.4	16.51	79.6	office administration/healthcare

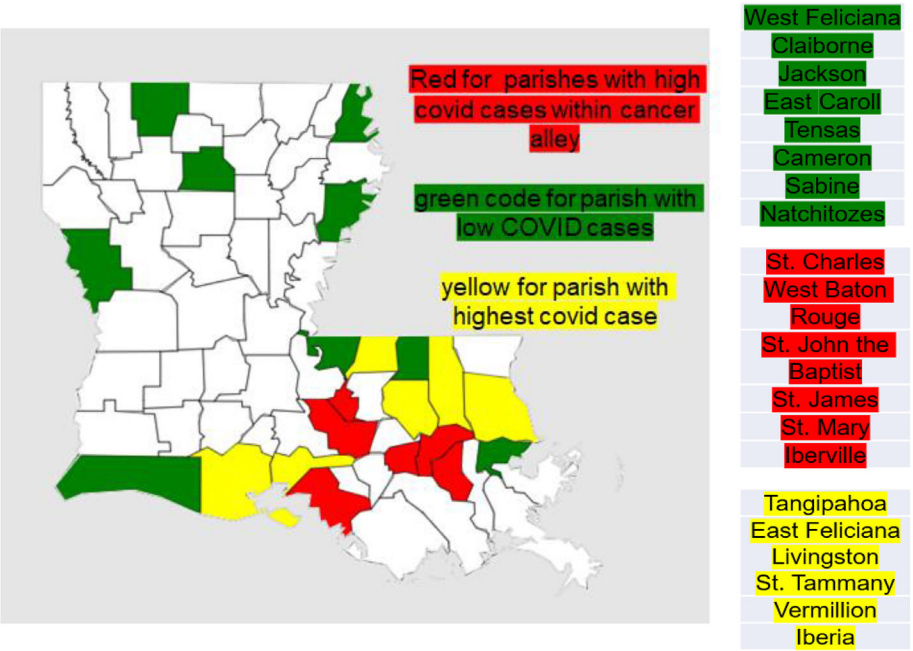

EXHIBIT 10 Visualization of Parishes with low and high COVID-19 cases in respect to cancer alley [Color figure can be viewed at wileyonlinelibrary.com]

close to it. The parishes with low COVID-19 cases are residing at a greater distance from cancer alley. We, therefore, strongly argue that the spread of the virus was more virulent within people from the cancer alley parishes. Since our results also show that there was no significant difference between the colored and Caucasian population for the spread of the disease, we take the parameter of location (close or far) from Cancer Alley as the main predictor of the spread of the virus. It is interesting to observe that yellow and red coded parishes are more concentrated towards cancer alley, whereas the green coded parishes are distributed throughout the state. This result indicates that COVID-19 incidences are more frequently observed in and around cancer alley which may be due to environmental or socio-economic factors.

6 | CONCLUSIONS

Cancer alley is an 85-mile-long stretch from the Mississippi river to the Gulf of Mexico that consist of 12 Louisiana parishes. These parishes in our research have shown high incidences of lung cancer and other asbestos related deaths and high spread of COVID-19 cases in 2020 and 2021. We also found that in cancer alley, people who are working in offices were highly correlated with the spread of COVID-19 disease. We have shown that race was not at all correlated with the spread of the COVID-19 in this area. Interestingly, a study by Jones et al. (2018), carried out in Tennessee also concluded there was no relation at all between race and lung cancer outcome.

Although coastal pollution has been reported in a 2007 study done by Iqbal et al. (2007)), the nature and density of air pollutants in the gulf area has not been assessed yet in detail. Nevertheless, the risk of cancer and other health hazards for people living near the petrochemical industry have been reported in the literature (Domingo et al., 2020). We strongly suggest that more research needs to be done on cancer alley regarding the air particle assessment in that area which would enable us to document if people living in those areas are inhaling carcinogenic particles for which their lungs are already experiencing plaques and therefore further viral infection would enhance the severity of the disease. As we mentioned, a similar causal association has been reported in a recent study which was conducted in India (Manoj et al., 2020). Therefore, it would of interest to find out if the residents of these Parishes that have suffered or deceased from COVID-19 were already lung cancer or other lung disorder patients. In other words, prevalence of chronic and fatal lung diseases such as cancer in the selected parishes of our study needs to be further explored to know if there is a correlation between the cancer cases with race or poverty.

ACKNOWLEDGMENTS

Dr. Dasgupta thanks department of industrial engineering and technology at Southeastern Louisiana University; Dr. Roy thanks department of biological sciences at Alcorn State University. Authors declare that this research is not supported by any funding agencies.

CONFLICT OF INTEREST

The authors declare that there are no competing interests.

DATA AVAILABILITY STATEMENT

Data and material used are from publicly available data sources will be available upon request.

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How to cite this article: Dasgupta, P., Kuhn, L., Massawe, E., Williams, M., Perrone, J., Dutta, P., & Roy, D. (2022). Impact of environmental and socio-economic stressors leading to unequal distribution of COVID-19 incidences in the state of Louisiana. *Environmental Quality Management*, 1–11. https://doi.org/10.1002/tqem.21884.