Science

Social vulnerability and environmental cancer risk in Louisiana: a cross-sectional analysis of incidence and airborne environmental exposures

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Abstract: Cancer incidence is shaped by environmental exposures and socioeconomic factors, such as poverty, minority status, and limited access to resources. In Louisiana, these risks are exacerbated by the proximity of vulnerable communities to industrial facilities known for toxic emissions. This cross-sectional study used correlation analysis and linear regression models to analyze public datasets to examine the relationships among cancer incidence, point source cancer risk, and key Social Vulnerability Index (SVI) factors. Populations residing near industrial facilities experienced higher point source cancer risk, with demographic patterns: racial and ethnic minority communities, as well as low-income populations, have a disproportionate burden of exposure, indicating geographic concentration of exposure. Combined effects of point source risk, crowding, and no vehicle access also increased cancer incidence. These findings highlight the urgent need for policy reforms, community-based interventions, and enhanced environmental monitoring to reduce cancer disparities in vulnerable Louisiana populations. Targeted health initiatives and updated exposure assessments are also essential to support equitable cancer prevention in Louisiana's high-risk communities.

Keywords: Air toxins, Cancer incidence, Environmental hazards, Louisiana, Social vulnerability.

Introduction

Louisiana is one of the most industrialized states in the United States, boasting numerous refineries and petrochemical manufacturing facilities, with hundreds of these facilities distributed throughout the state (Juhasz, 2024). However, these facilities are mostly aggregated in areas such as Calcasieu Parish in the southwestern portion of the state and in an 85-mile stretch of land situated between Baton Rouge and New Orleans in the southeast, which is colloquially referred to as “Cancer Alley” (Bakshi et al., 2022; Juhasz, 2024). Residents living in the communities surrounding these areas, known as fence-line communities, are exposed to constant pollution from toxic air pollutants released by these facilities (Fos et al., 2021; Juhasz, 2024). Environmental health disparities exist throughout various regions of the United States (Jbaily et al., 2022). However, a large portion of Louisiana is exposed to an extremely disproportionate burden of disease due to environmental exposures, particularly in communities near industrial corridors like Cancer Alley, which face compounding structural and infrastructural disadvantages (Fos et al., 2021; Terrell & St Julien, 2022a). Cancer remains a leading cause of death in Louisiana, further exacerbating public health disparities across vulnerable populations (Terrell & St Julien, 2022a; Callison et al., 2022).

Point source cancer risk refers to the potential health threat caused by exposure to carcinogenic air pollutants emitted from fixed, identifiable sources such as industrial facilities, refineries, and manufacturing plants (Madrigal et al., 2024). The United States possesses some of the strictest regulatory laws regarding fossil fuels, but enforcement of these laws is critically insufficient (Juhasz, 2024). According to the U.S. Environmental Protection Agency (U.S. EPA)’s 2019 Toxics Release Inventory and Risk-Screening Environmental Indicators (RSEI) model, Louisiana has released more pounds of industrial toxic air pollution than any other state (U.S. EPA, 2022; Terrell & St Julien, 2022b). The U.S. EPA continues to comprehensively screen and evaluate the emission of pollutants throughout the country using the National-Scale Air Toxics Assessment (NATA; U.S. EPA, 2025). The NATA provides estimates of the risk of cancer and other serious health effects from inhaling air toxics to inform both national and localized efforts to identify and prioritize air toxics, emission source types, and locations that are of greatest potential concern in terms of contributing to population risk (U.S. EPA, 2015).

Social vulnerability refers to demographic and socioeconomic factors, such as poverty, limited access to transportation, and overcrowded housing, that adversely affect communities that encounter hazards and other community-level stressors (Cimino et al., 2020; Decker et al., 2024). The *Social Vulnerability Index* (SVI) is a place-based index, database, and mapping application designed to identify and quantify communities experiencing social vulnerability (CDC/ATSDR, 2024). The health impacts of air pollution vary across regions, often depending on proximity to emission sources and the availability of healthcare, transportation, and housing infrastructure (Woodruff et al., 2003; Tessum et al., 2019; Colmer et al., 2020). Exposure to pollutants emitted from these facilities is known to contribute to various health conditions, including cancer and respiratory diseases (Ajayi & Ogunjobi, 2024; Lo et al., 2024). Contemporary research has also shown that social vulnerabilities play a significant role in the progression of these conditions. Lack of access to healthcare, poverty, low educational attainment, and minority status are just a few examples of factors that disproportionately affect residents in fence-line communities (Mikati et al., 2018; Colmer et al., 2020; Ard & Smiley, 2021).

The unequal exposure to environmental hazards in specific locations has recently become a focus for policymakers and researchers (NAACP LDF, Inc., 2021; Fos et al., 2021). However, few studies have examined the interaction between social vulnerability and exposure to air toxins, or how the interaction may impact an individual's risk of developing adverse health conditions (Chakraborty, 2022). Building upon our previous spatial analysis (Smith et al., 2025), we investigated how social and environmental factors correlate with cancer incidence in Louisiana. To study this, publicly available datasets were utilized to identify disparities across Louisiana. This study aims to understand how integrating environmental exposure data with demographic and social indicators such as income levels, education, race/ethnicity, and housing conditions reveals disparities in cancer risk and incidence linked to environmental injustices.

Methods

Study design

This study employs a cross-sectional design to investigate the relationship between cancer incidence, point source cancer risk, and social vulnerability at the parish level across Louisiana. Data sources utilized in the analysis are summarized in Table 1. All datasets were aggregated at the parish level. Data collected between 2011 and 2020 from 63 of Louisiana's 64 parishes were included; Tensas Parish was excluded due to missing cancer incidence data from the Louisiana Tumor Registry (LTR; Maniscalco et al., 2024). The selection of SVI indicators was based on literature identifying transportation, minority status, and housing conditions as key contributors to health vulnerability. Specifically, 'no vehicle access' and 'crowding' were prioritized due to their established association with limited access to healthcare services and increased risk of environmental exposure. These factors have been repeatedly cited in public health literature as indicators of structural disadvantage that amplify disease burden in underserved populations.

It is essential to note that the U.S. EPA's point source cancer risk data are from 2011 (U.S. EPA, 2025), whereas the cancer incidence data span the period from 2011 to 2020. This temporal mismatch limits causal inference and may affect alignment between exposure and disease outcomes.

Table 1

Data sources with references

Variable	Data source	Definition	Reference
Cancer incidence	Louisiana Tumor Registry (LTR), 2011-2020 Data Years	The number of newly diagnosed cancer cases in a specified population during the specified years, expressed as the number of cancers per 100,000 people.	(Maniscalco et al., 2024)
Point source cancer risk	National Air Toxics Assessment (NATA), 2011 Data Year	Pollution that comes from a single, identifiable source, such as a pipe, a ditch, or a factory smokestack.	(U.S. EPA, 2025)
Social vulnerability	Social Vulnerability Index (SVI), 2022 Data Year	The demographic and socioeconomic factors (such as poverty, lack of access to transportation, and crowded housing) that adversely affect communities that encounter hazards and other community-level stressors.	(CDC/ATSDR, 2024)

Statistical analysis

SPSS Statistics v. 26 (IBM, Inc., 2019) was utilized to conduct correlation, regression, and interaction analyses. Before performing the analysis, exploratory data analysis (EDA) was conducted to gain a better understanding of the distributions and potential issues within the data. The primary steps of the EDA included examining skewness, kurtosis, box plots, and histograms.

To meet the assumptions of linear regression and enhance the model's fitness, a log base 10 transformation was applied to the point source cancer risk. For simplicity, the transformed point source cancer risk is referred to as 'Tr point source cancer risk'. Following the transformation, the normality of residuals and homoscedasticity were re-evaluated using diagnostic plots. The linear regression assumptions were subsequently verified and found to be adequately satisfied. Multicollinearity among predictor variables was also assessed, with no evidence of extreme correlations observed. In the regression analysis, cancer incidence was the dependent variable and point source cancer risk and social vulnerability indicators such as income level, educational attainment, and minority status were the independent variables.

Interaction terms were selected a priori based on theoretical frameworks and prior studies suggesting that combined effects of environmental exposures and social vulnerability, such as limited mobility or overcrowded living conditions, can amplify cancer risk beyond the impact of individual factors alone (Smith et al., 2025).

A hotspot analysis was conducted on point source cancer risk in ArcGIS Pro 3.4 (Esri, Inc., 2024). This spatial analysis helped to identify and evaluate statistically significant spatial and geographic clusters. The K closest point sources are identified as the neighborhoods for each target source. This method offers a consistent and reasonably reliable spatial neighborhood definition, particularly for regions that have varying densities of point source cancer risks, ensuring that each source is analyzed in relation to a minimum number of nearby sources, even in areas where there are fewer point sources.

Results

Descriptive statistics

Table 2 presents the descriptive statistics for key variables used in the study across 63 parishes in Louisiana. The average cancer incidence rate was 484.19 cases per 100,000 population (*SD* = 27.41). The estimated point source cancer risk varied widely, with values ranging between 0.025 to 225.22 and a mean of 5.60 cases per million (*SD* = 28.39). This wide range highlights the disproportionate impact of localized air pollution, particularly in parishes with a high concentration of petrochemical facilities, which significantly contributes to elevated point source cancer risk. These findings suggest that environmental exposure, industrial activity, and population vulnerability were not uniform throughout Louisiana. Figure 5 (Appendix B) illustrates the distribution of cancer incidence and point source cancer risk in Louisiana.

Table 2. Descriptive statistics

Variable	Nature of variable	***N***	**Min.**	**Mean**	**Max.**	***SD***
Cancer incidence	Continuous	63	41.53	484.19	531.91	27.41
point source cancer risk	Continuous	63	0.025	5.60	225.22	28.39
Tr point source cancer risk	Continuous	63	8.40	9.89	12.35	0.68

Correlation Analysis

The correlation analysis revealed a weak but statistically significant positive association between racial and ethnic minority status and point source cancer risk (r = 0.26, P = 0.03), indicating that communities with higher proportions of racial and ethnic minorities tend to experience greater exposure to environmental hazards. As shown in Figure 2 (Appendix A), these associations are spatially concentrated in industrial corridors, such as Cancer Alley. Research has shown that in Louisiana, many industrial facilities are often located adjacent to predominantly Black neighborhoods (Terrell & St Julien, 2022a). These findings highlight patterns of environmental risk clustering in socially vulnerable areas, underscoring the role of structural and geographic inequities in shaping cancer risk exposure.

Multivariate Linear Regression

Multivariate regression analysis between Cancer incidence and SVI factors.

The multivariate regression analysis revealed a significant positive relationship between lack of vehicle access and cancer incidence, with a regression coefficient of 48.71 (P = .002; see Table 3). This suggests that communities with limited transportation resources may experience higher cancer incidence rates, potentially due to reduced access to healthcare, preventive services, and timely medical interventions. As illustrated in Figure 1 (Appendix

A), a clear upward trend in cancer incidence is observed in parishes with higher proportions of households without vehicles.

A negative relationship was identified between cancer incidence and poverty, likely due to limited access to preventive healthcare services in these populations, which can result in cancers going undetected or diagnosed at later stages.

Table 3. Linear regression analysis between Cancer incidence and no vehicle access

Variable	**Coefficient**	**Std. Error**	***t***	***P***	**95% CI**
C	503.69	10.29	48.97	0.00	483.10 - 524.28
no vehicle access	48.71	14.63	3.33	0.002	19.41 - 77.99

Adjusted R^2: 0.18

Multivariate regression analysis between point source cancer risk and SVI factors. Table 4 illustrates the positive relationships identified in the multivariate regression analysis. The multivariate regression model indicates that racial and ethnic minority status was positively correlated with point source cancer risk ($\beta = 1.28$, $P < 0.001$, 95% CI: 0.81–1.74), explaining 55% of the variance (Adjusted $R^2 = 0.55$).

Table 4. Linear regression analysis between Tr point source cancer risk and the racial and ethnic minority status

Variable	**Coefficient**	**Std. Error**	***t***	***P***	**95% CI**
C	10.873	0.23	51.55	0	10.45 - 11.29
minority status	1.28	0.23	5.55	0.00	0.81 - 1.74

Adjusted R^2: 0.55

As shown in Figure 2 (Appendix A), a higher minority status is correlated with increased pollution exposure in southeastern parishes. The findings from Callison et al. (2021) and Terrell and St. Julien (2022a) highlight that social vulnerability factors, especially racial and ethnic minority status, significantly influence exposure to environmental cancer risks. Black populations are disproportionately located near industrial facilities, increasing their risk of exposure to harmful pollutants. This underscores the urgent need for targeted public health interventions and policy strategies to address these disparities.

Multivariate regression analysis between interaction terms (Tr point source cancer risk with SVI) and cancer incidence.

Table 5 summarizes the positive relationships identified in the analysis. The interaction analysis revealed that the combined effect of point source cancer risk and two key social vulnerability indicators, crowding and lack of vehicle access, significantly contributed to increased cancer incidence. Specifically, the interaction between point source cancer risk and crowding was statistically significant, with a regression coefficient of 2.45 ($P = 0.03$). This indicates that crowded living conditions in marginalized communities, which are often located near industrial facilities or high-emission zones, increase cancer incidence due to heightened exposure to environmental pollutants.

Furthermore, the interaction between point source cancer risk and no vehicle access demonstrated an even stronger association. Individuals without vehicle access may experience greater isolation and mobility limitations, which can hinder their ability to avoid polluted areas and access timely medical care. Figures 3 and 4 (Appendix A) illustrate these relationships through scatterplots, revealing two key trends: firstly, the combination of higher environmental cancer risk and crowded living conditions appears to be associated with a marginal increase in cancer incidence. Secondly, as the interaction between environmental cancer risk and limited vehicle access increases, cancer incidence tends to rise slightly.

Table 5. Linear regression analysis between interaction terms (Tr point source cancer risk with SVI factors) and Cancer incidence

Variable	**Coefficient**	**Std. Error**	***t***	***P***	**95% CI**
C	495.66	11.16	44.42	0.00	473.31 - 518
Tr point source cancer risk*crowding	2.45	1.12	2.11	0.03	0.12 - 4.77
Tr point source cancer risk*no vehicle	5.1	1.47	3.46	0.00	2.15 - 8.04

Adjusted R^2: 0.21

Hotspot analysis

Figure 6 (Appendix B) illustrates the hotspot analysis of point source cancer risk, which identifies statistically significant spatial clusters. This approach enables a more effective identification of risk assessment and management strategies for higher-vulnerability geographic areas. The red shaded areas indicate that statistically significant hotspots of higher cancer risk are concentrated in the southeastern part of the state, an area where industrial facilities are densely populated. Analysis employing the K-nearest neighbors also supplied better estimates of spatial clustering, which supported the results. Figure 7 (Appendix B) also highlights regions with elevated cancer incidence rates with higher point source cancer risk; zones with the highest confidence ratings are located in the southeastern region of the state.

1.1.1 ***Discussion***

This study highlights the interaction among environmental risk factors, social vulnerability indicators, and cancer incidence in Louisiana, a state with one of the highest concentrations of industrial facilities in the United States. These findings expand upon Smith et al.'s (2025) prior spatial analysis of cancer risk and social vulnerability in Louisiana, which demonstrated regional disparities in cancer outcomes driven by environmental exposure and social factors.

Overall, the study found a significant and positive association between racial and ethnic minority status and point source cancer risk ($\beta = 1.28$, $P < 0.001$). Notably, Zavala et al. (2020) highlighted systemic disparities in environmental exposures, such as proximity to industrial pollution sources, as a key driver of elevated cancer risk among racial and ethnic minorities. Similarly, Terrell and St Julien (2022b) found significantly higher pollution-related cancer risks in predominantly Black and low-income communities between Baton Rouge and New Orleans. These results are consistent with national studies, demonstrating that Louisiana ranks among the top five U.S. states for both industrial air pollution and cancer mortality (Juhasz, 2024; CDC, 2024).

Transportation is an important yet often overlooked element in the delivery of high-quality and accessible cancer care. The multivariate regression analysis, along with interaction terms, revealed no vehicle access as a significant positive predictor. This finding is consistent with research by Graboyes et al. (2022), which found that transportation barriers prevent many patients with cancer from accessing timely and effective care. Additionally, these results align with research conducted by Larsen, Rydz, and Peters (2023), indicating that exposure to hazardous air pollutants tends to be more pronounced in areas characterized by limited access to infrastructure and essential services.

A negative relationship was found between cancer incidence and poverty ($\beta < -31.9$, $P = 0.04$). One potential explanation is underdiagnosis in low-income populations due to reduced access to preventive care and screenings. This aligns with studies such as Caraballo et al. (2022), which found systemic barriers to timely medical care among disadvantaged groups. Alternatively, misclassification or data gaps in rural and underserved parishes may contribute to this unexpected finding.

Housing insecurity encompasses challenges such as high housing costs, frequent relocation, crowding issues, and homelessness. A study conducted by Fan et al. (2022) showed there was a strong connection between housing insecurity and negative cancer outcomes, reiterating the need to routinely identify housing needs in patients, including homelessness, crowding, and unsafe or unstable housing, Similarly, this study found that crowding, along with environmental cancer risk, predicts higher cancer incidence.

These findings underscore the need for targeted public health interventions in communities that bear the disproportionate burden of environmental pollution and social vulnerability. Politically, stricter emissions regulations are appropriate, particularly in areas like Cancer Alley. Stricter policies should include real-time air pollution monitoring to ensure compliance and allow regulators to manage excess emissions to reduce environmental impacts on vulnerable communities.

Limitations

While the findings contribute valuable insights, certain limitations must be considered. Key confounding variables, such as smoking, obesity, alcohol consumption, and other environmental exposures (e.g., water contamination, radiation, and occupational hazards), were not included in this analysis. Future research should consider all these factors in subsequent studies. Additionally, the use of parish-level data may miss more minute differences in the correlations.

The use of 2011 NATA data (U.S. EPA, 2025) may introduce a temporal mismatch with cancer incidence data from 2011-2020. More recent data may have a greater impact in this type of analysis. Additionally, using secondary data that was collected for a different purpose limits causal inference and may introduce bias due to a lack of control over data collection. The use of this cross-sectional study design does not allow for causal inferences to be made. Future studies should implement a longitudinal study design, which may further strengthen causal insights by capturing temporal changes in both exposure and health outcomes over time.

Conclusion

The findings of this study underscore the urgent need for targeted policy interventions to address environmental health disparities in Louisiana, particularly in high-risk areas such as Cancer Alley. The observed associations between cancer incidence, point source cancer risk, and social vulnerability highlight the importance of integrating public health and environmental justice efforts, as well as strengthening enforcement of the Clean Air Act to reduce harmful emissions from industrial sources that disproportionately impact vulnerable communities. Expanding mobile cancer screening programs and improving transportation infrastructure can enhance access to care in underserved regions. Beyond strengthening policy enforcement and emissions monitoring, it is essential to integrate community-based cancer screening initiatives into environmental response plans, especially in industrial zones. Community participatory research is also critical to building trust and capturing lived experiences, which can inform targeted interventions and drive effective policy reform.

Mandatory emissions monitoring in fence-line neighborhoods would improve transparency and accountability. Supporting localized assessments can improve understanding of health risks and guide more effective policy responses. Reducing geographic disparities in cancer outcomes requires improved distribution of healthcare resources, policy reforms, and integration of housing assessments into routine care. Investments in affordable, stable housing and public health infrastructure are critical to advancing health equity and reducing the burden of environmental cancer risk. To meaningfully reduce the burden of cancer, we must commit to a comprehensive approach that combines environmental accountability, equitable healthcare access, and housing stability.

Author contributions:

SSa: Conceptualization, Project administration, Methodology, Data curation, Data analysis, Writing. SSm: Writing- original draft, reviewing, and editing. CMG: Writing- original draft GMW: Conceptualization, Writing, reviewing, and editing.

Financial support and sponsorship:

The authors declare that no financial support was received for the research, authorship and/or publication of this article.

Conflict of interest:

The authors declare that the research was conducted without any commercial or financial relationships that could potentially create a conflict of interest.

References

Ajayi, R. O., & Ogunjobi, T. T. (2024). Environmental exposures and cancer risk: a comprehensive review. *Medinformatics*, 1–13. https://doi.org/10.47852/bonviewMEDIN42023598

Ard, K., & Smiley, K. (2021). Examining the relationship between racialized poverty segregation and hazardous industrial facilities in the U.S. over time. *American Behavioral Scientist*, *66*(7), 1–15. https://doi.org/10.1177/00027642211013417

Bakshi, A., Van Doren, A., Maser, C., Aubin, K., Stewart, C., Soileau, S., Friedman, K., & Williams, A. (2022). Identifying Louisiana communities at the crossroads of environmental and social vulnerability, COVID-19, and asthma. *PLoS ONE*, *17*(2). https://doi.org/10.1371/journal.pone.0264336

Caraballo, C., Ndumele, C. D., Roy, B., Lu, Y., Riley, C., Herrin, J., & Krumholz, H. M. (2022). Trends in racial and ethnic disparities in barriers to timely medical care among adults in the US, 1999 to 2018. *Journal of the American Medical Association*, *3*(10), Article e223856. https://doi.org/10.1001/jamahealthforum.2022.3856

Callison, K., Segal, L., & Zacharia, G. (2022). Medicaid expansion and cancer mortality by race and sex in Louisiana. *American Journal of Preventive Medicine*, *62*(4), e242-e247. https://doi.org/10.1016/j.amepre.2021.09.005

CDC/ATSDR. (2024). *Social Vulnerability Index – 2022 Data Year*. Centers for Disease Control and Prevention (CDC)/Agency for Toxic Substances and Disease Registry (ATSDR). https://www.atsdr.cdc.gov/place-health/php/svi/index.html

Chakraborty, J. (2022). Disparities in exposure to fine particulate air pollution for people with disabilities in the US. *Science of the Total Environment*, *842*. https://doi.org/10.1016/j.scitotenv.2022.156791

Colmer, J., Hardman, I., Shimshack, J., & Voorheis, J. (2020). Disparities in $PM_{2.5}$ air pollution in the United States. *Science*, *369*(6503), 575–578. https://doi.org/10.1126/science.aaz9353

Cimino, T., Said, K., Safier, L., Harris, H., & Kinderman, A. (2020). Psychosocial distress among oncology patients in the safety net. *Psycho-Oncology*, *29*(11), 1927–1935. https://doi.org/10.1002/pon.5525

Decker, H., Colom, S., Evans, J. L., Graham-Squire, D., Perez, K., Kushel, M., Wick, E., Raven, M. C., & Kanzaria, H. K. (2024). Association of housing status and cancer diagnosis, care coordination and outcomes in a public hospital: a retrospective cohort study. *BMJ Open*, *14*(9), Article e088303. https://doi.org/10.1136/bmjopen-2024-088303

Esri, Inc. (2024). *ArcGIS Pro* (Version 3.4). [Computer software]. https://www.esri.com/en-us/arcgis/products/arcgis-pro/overview

Fan, Q., Nogueira, L., Yabroff, K. R., Hussaini, S. M., & Pollack, C. E. (2022). Housing and cancer care and outcomes: a systematic review. *Journal of the National Cancer Institute*, *114*(12), 1601–1618. https://doi.org/10.1093/jnci/djac173

Fos, P. J., Honoré, P. A., Honoré, R. L., & Patterson, K. (2021). Health status in fence-line communities: The impact of air pollution. *International Journal of Family Medicine & Primary Care*, *2*(3), Article 1040. https://www.remedypublications.com/international-journal-of-family-medicine-primary-care-abstract.php?aid=7944

IBM, Inc. (2019). *SPSS Statistics* (Version 26). [Computer software]. https://www.ibm.com/products/spss-statistics

Jbaily, A., Zhou, X., Liu, J., Lee, T.-H., Kamareddine, L., Verguet, S., & Dominici, F. (2022). Air pollution exposure disparities across US population and income groups. *Nature*, *601*, 228–233. https://doi.org/10.1038/s41586-021-04190-y

Juhasz, A. (2024). *"We're Dying Here": The Fight for Life in a Louisiana Fossil Fuel Sacrifice Zone* (pp. 1–125). Human Rights Watch. https://www.hrw.org/report/2024/01/25/were-dying-here/fight-life-louisiana-fossil-fuel-sacrifice-zone

Lo, C.-H., Tun, K. M., Pan, C.-W., Lee, J. K., Singh, H., & Jewel Samadder, N. (2024). Association between social vulnerability and gastrointestinal cancer mortality in the United States counties. *Gastro Hep Advances*, *3*(6), 821–829. https://doi.org/10.1016/j.gastha.2024.05.007

Maniscalco, L., Yi, Y., Lefante, C., Mumphrey, B., Wagner, I., Hsieh, M., & Wu, X.-C. (eds.). (2024). *Cancer Incidence in Louisiana by Census Tract, 2011-2020* (pp. 1–257). Louisiana Tumor Registry. https://sph.lsuhsc.edu/louisiana-tumor-registry/data-usestatistics/monographs-publications/cancer-incidence-in-louisiana-by-census-tract-2024/

Mikati, I., Benson, A. F., Luben, T. J., Sacks, J. D., & Richmond-Bryant, J. (2018). Disparities in distribution of particulate matter emission sources by race and poverty status. *American Journal of Public Health*, *108*(4), 480–485. https://doi.org/10.2105/AJPH.2017.304297

Madrigal, J. M., Pruitt, C. N., Fisher, J. A., Liao, L. M., Graubard, B. I., Gierach, G. L., Silverman, D. T., Ward, M. H., & Jones, R. R. (2024). Carcinogenic industrial air pollution and postmenopausal breast cancer risk in the National Institutes of Health AARP Diet and Health Study. *Environment International*, *191*, Article 108985. https://doi.org/10.1016/j.envint.2024.108985

NAACP LDF, Inc. (2021). *St. John the Baptist Parish Public Schools Environmental Conditions FAQ*. NAACP Legal Defense and Educational Fund, Inc. https://www.naacpldf.org/case-issue/st-john-the-baptist-parish-schools-environmental-conditions/

Smith, S., Sakhamuri, S., Guidry, C. M., & Mustata Wilson, G. (2025). Social vulnerability and cancer risk from air toxins in Louisiana: a spatial analysis of environmental health. *Frontiers in Public Health*, *13*, Article 1601868. https://doi.org/10.3389/fpubh.2025.1601868

Terrell, K. A., & St Julien, G. N. (2022a). Air pollution is linked to higher cancer rates among black or impoverished communities in Louisiana. *Environmental Research*

Letters, *17*(1). https://doi.org/10.1088/1748-9326/ac4360

Terrell, K., & St Julien, G. (2022b). Discriminatory outcomes of industrial air permitting in Louisiana, United States. *Environmental Challenges*, *10*, Article 100672. https://doi.org/10.2139/ssrn.4276748

U.S. EPA. (2025). *2011 NATA: Assessment Results* (National Air Toxics Assessment). United States Environmental Protection Agency. https://www.epa.gov/national-air-toxics-assessment/2011-nata-assessment-results

U.S. EPA. (2015). *Appendix B: Metadata – National Air Toxics Assessment (NATA)*. United States Environmental Protection Agency. https://www.epa.gov/sites/default/files/2015-05/documents/aceappendixb_nationalairtoxicsassessment.pdf

U.S. EPA. (2022). *Risk-Screening Environmental Indicators – 2020 Data Year*. United States Environmental Protection Agency. https://edap.epa.gov/public/extensions/EasyRSEI/EasyRSEI.html

Woodruff, T. J., Parker, J. D., Kyle, A. D., & Schoendorf, K. C. (2003). Disparities in exposure to air pollution during pregnancy. *Environmental Health Perspectives*, *111*(7), 942-946. https://doi.org/10.1289/ehp.5317

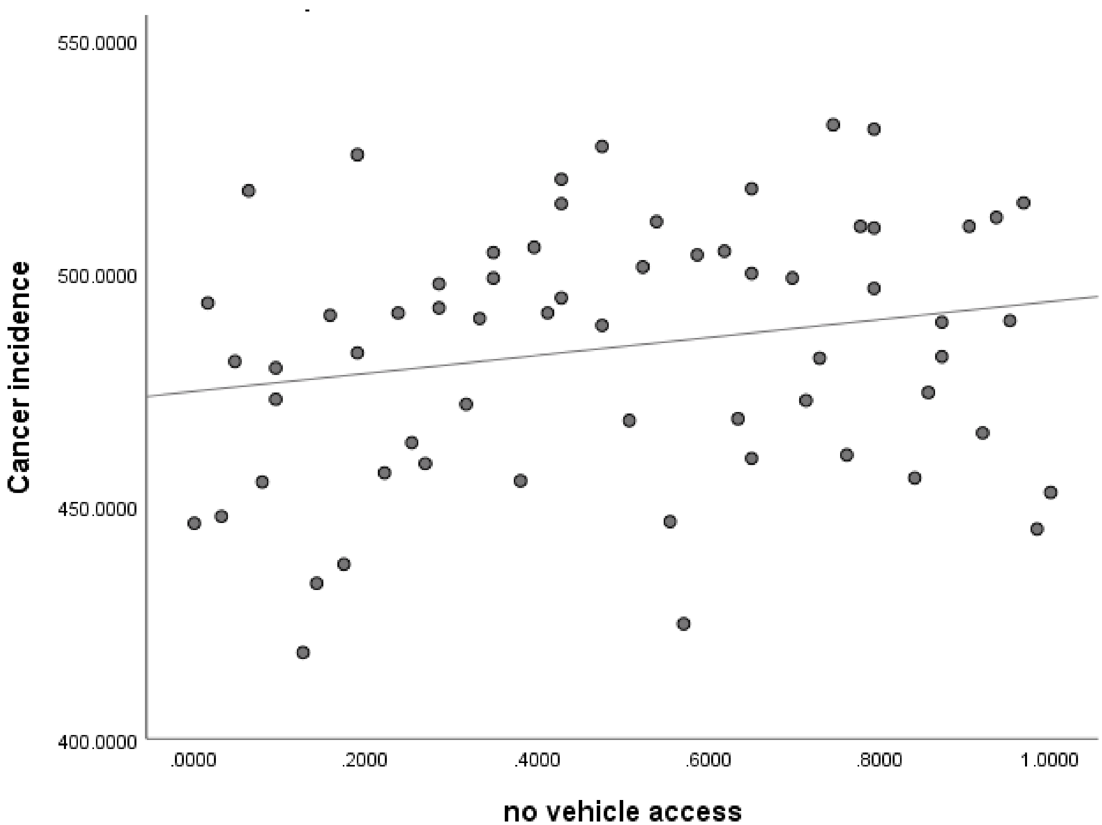
Zavala, V. A., Bracci, P. M., Carethers, J. M, Carvajal-Carmona, L., Coggins, N. B., Cruz-Correa, M. R., Davis, M., de Smith, A. J., Dutil, J., Figueiredo, J. C., Fox, R., Graves, K. D., Gomez, S. L., Llera, A., Neuhausen, S. L., Newman, L., Nguyen, T., Palmer, J. R., Palmer, N. R., Pérez-Stable, E. J., Piawah, S., Rodriquez, E. J., Carolina, M., Sanabria-Salas, M. C., Schmit, S. L., Serrano-Gomez, S. J., Stern, M. C., Weitzel, J., Yang, J. J., Zabaleta, J., Ziv, E., & Fejerman, L. (2020). Cancer health disparities in racial/ethnic minorities in the United States. *British Journal of Cancer*, *124*(2), 315-332. https://doi.org/10.1038/s41416-020-01038-6

Appendix A

Scatterplots

Figure 1

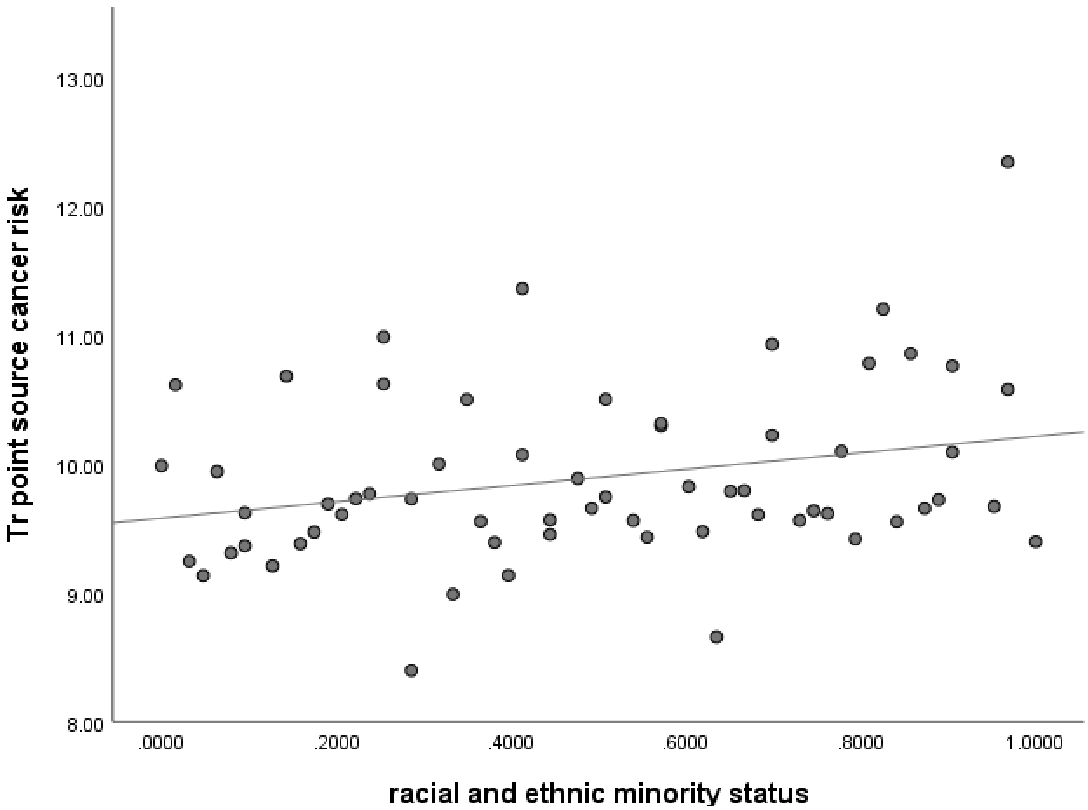
Simple scatter with a fit line of Cancer incidence and no vehicle access



Note. Scatterplot illustrating the positive relationship between cancer incidence and lack of vehicle access across Louisiana parishes. Parishes with higher proportions of households without vehicles exhibit higher cancer incidence rates.

Figure 2

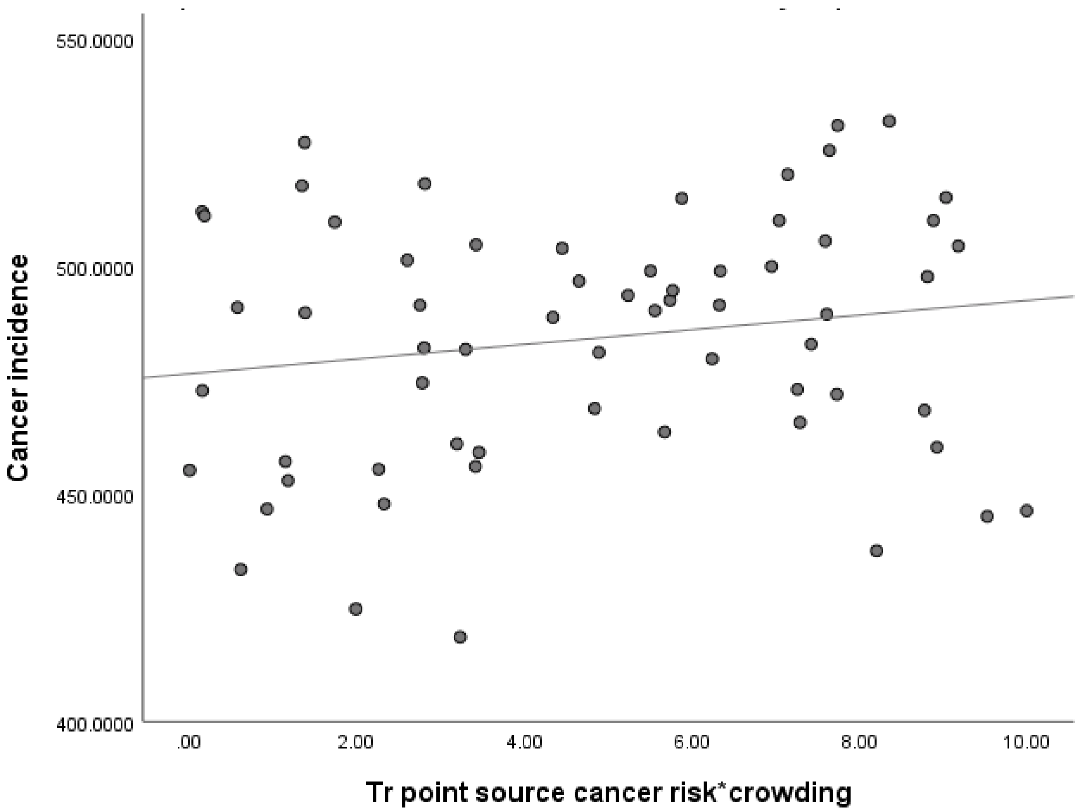
Simple scatter with fit line of Tr point source cancer risk and racial and ethnic minority status



Note. Scatterplot illustrating the positive relationship between log-transformed point source cancer risk and the proportion of racial and ethnic minority populations in each parish.

Figure 3

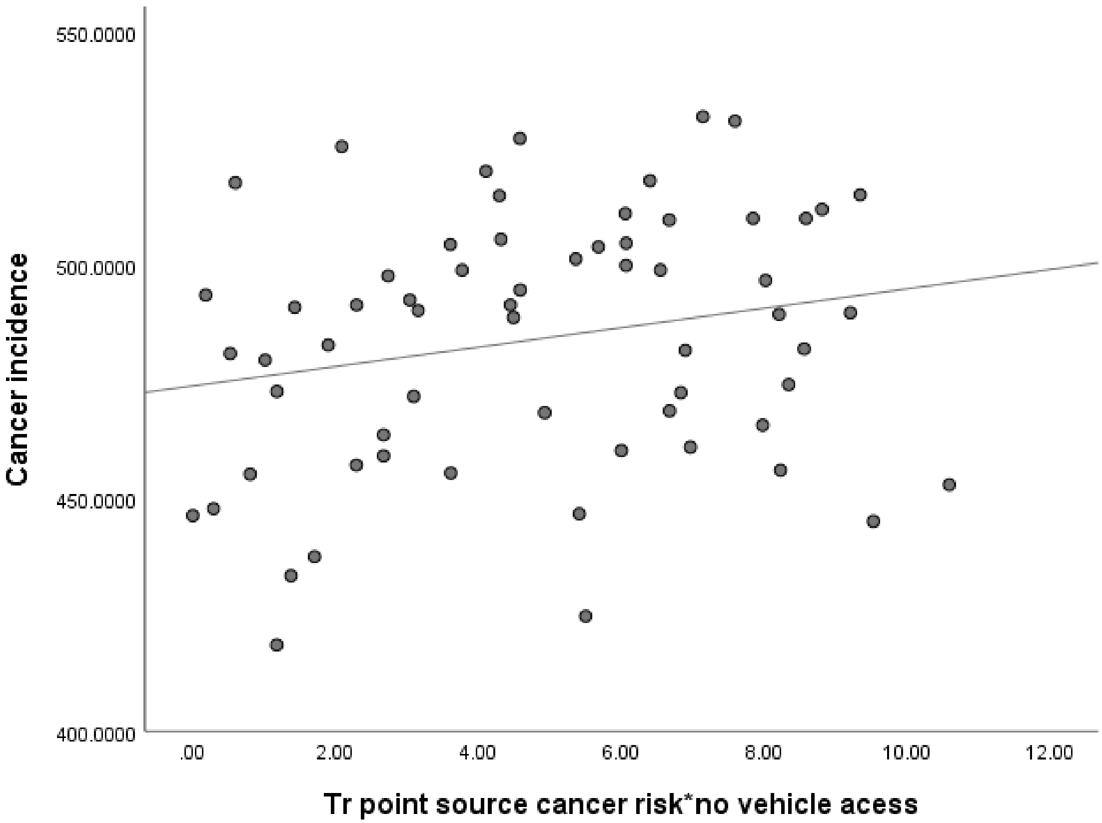
*Simple scatter with fit line of cancer incidence by Tr point source cancer risk*crowding*



Note. Scatterplot illustrating the interaction effect between point source cancer risk and household crowding on cancer incidence. Higher cancer incidence is observed in areas with higher population density and higher pollution levels.

Figure 4

*Simple scatter with fit line of Cancer incidence by Tr point source cancer risk*no vehicle access*



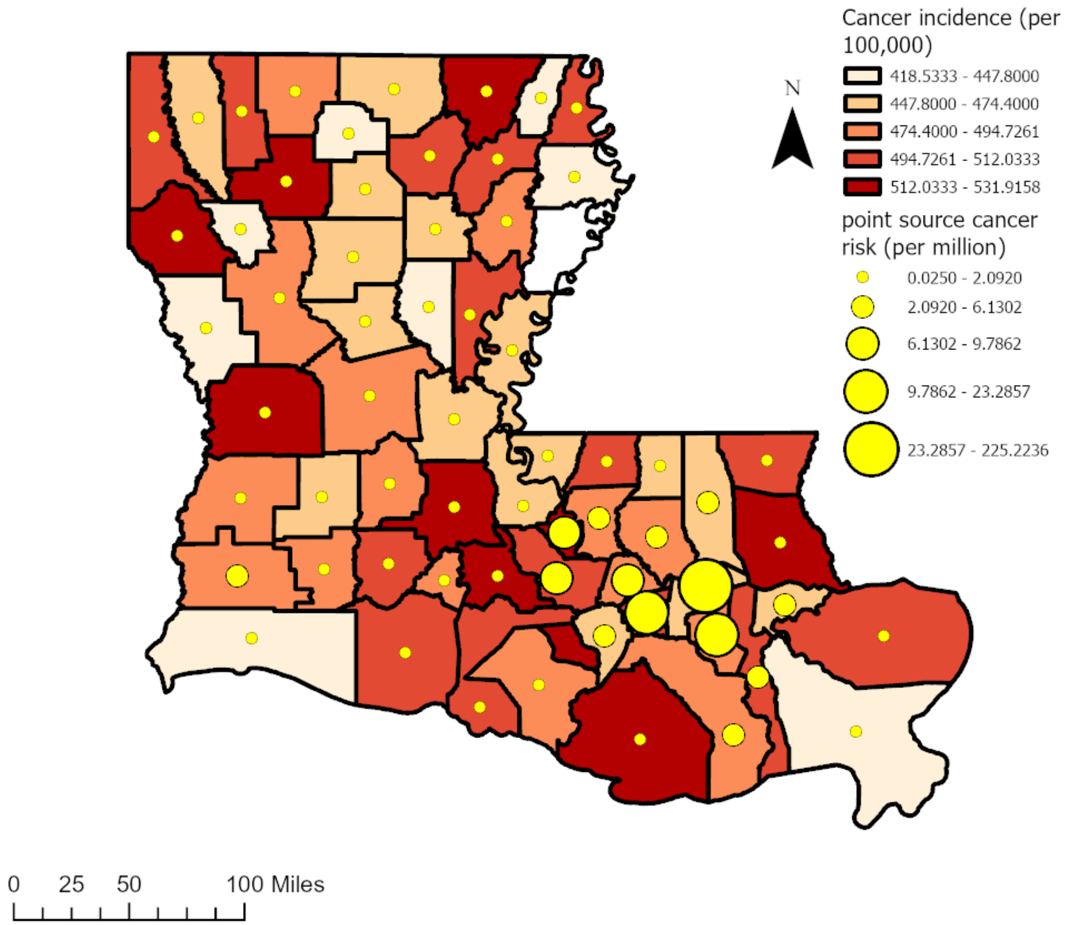
Note. Scatterplot showing the interaction between point source cancer risk and lack of vehicle access. Cancer incidence increases significantly when both risk factors are present.

Appendix B

Maps

Figure 5

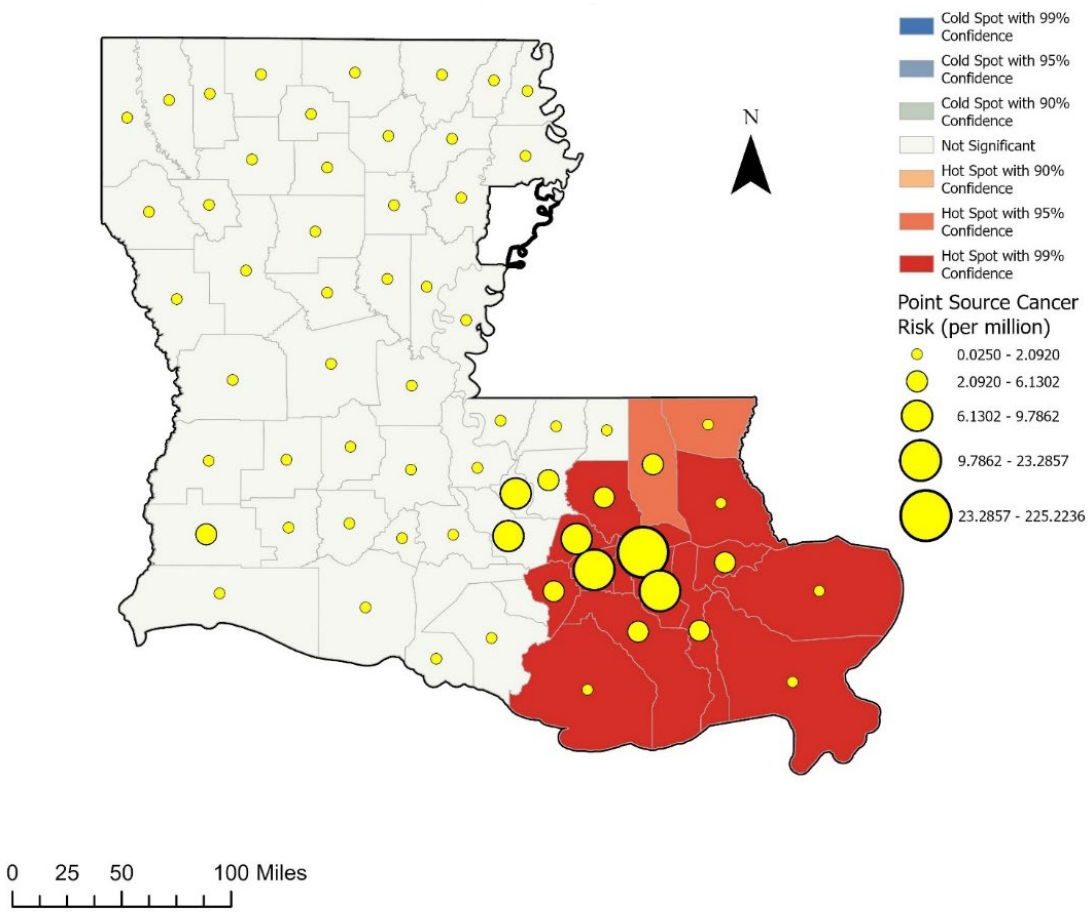
Cancer incidence and point source cancer risk



Note. Comparison of parish level cancer incidence and point source cancer risk across Louisiana. Visual differences illustrate spatial disparity in environmental exposures and health outcomes.

Figure 6

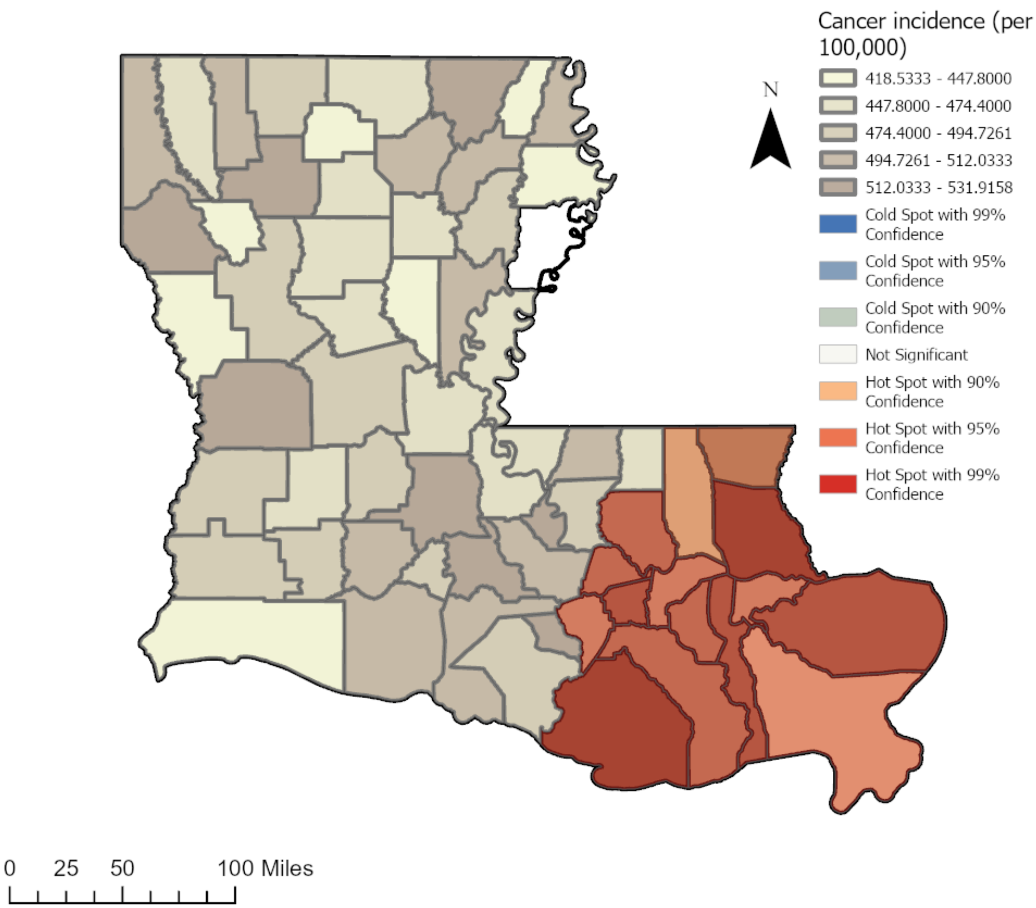
Hotspot analysis



Note. Hotspot analysis highlighting statistically significant clusters of elevated point source cancer risk, concentrated in southeastern Louisiana near industrial zones.

Figure 7

Cancer incidence and hotspots with higher point source cancer risk



Note. This hotspot analysis map highlights areas with elevated cancer incidence rates, particularly in the southeast, where clusters of hotspots show 95% and 99% confidence levels. These findings suggest a significant concentration of higher cancer incidence in these areas, potentially linked to environmental or point source factors.