

Lung Cancer Hotspots in Our Communities: A Census Tract Analysis (2000–2022) in the Atrium Health Wake Forest Baptist Comprehensive Cancer Center Catchment Area

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INTRODUCTION

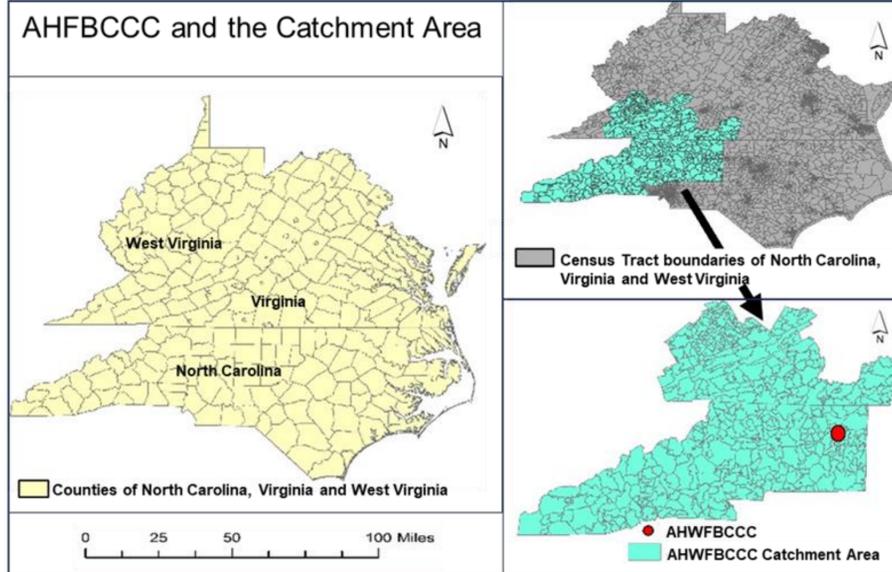
Lung cancer is the leading malignancy, but its burden differs depending upon race and region. Within the Atrium Health Wake Forest Baptist Comprehensive Cancer Center (AHWFBCCC) catchment area- spanning counties across North Carolina (NC), Virginia (VA) and West Virginia (WV) the age-adjusted lung cancer incidence rates are significantly higher especially in NC (62.6 per 100,000) and WV (76.1 per 100,000) than the National rate (53.1 per 100,000) as per the State Cancer Profile data of 2017-2021. In this study, we sought to identify geographic hotspots of lung and bronchus cancer and explore health disparities within the AHWFBCCC catchment area. We assessed the exposure to environmental risk factors like PM_{2.5}, indoor radon, ground-level ozone, and patient's smoking history that is known to influence lung cancer incidences and mortality. In addition, we examined travel distance from patient's residence to the AHWFBCCC as a healthcare access recognizing that travel times may contribute to poor outcome and potential geographic gaps in care.

GOALS

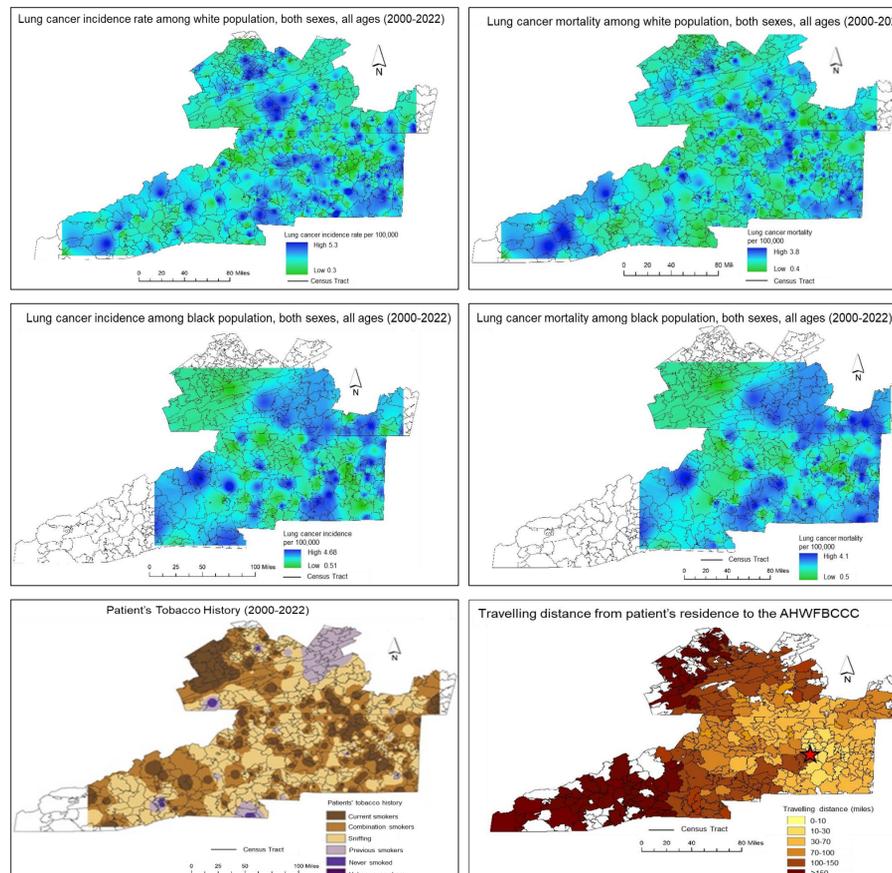
Our goal was to identify geographic hotspots of lung and bronchus cancer and to examine disparities within the AHWFBCCC catchment area in relation to environmental (PM_{2.5}, ground-level ozone and radon) and behavioral (smoking) risk factors.

METHOD

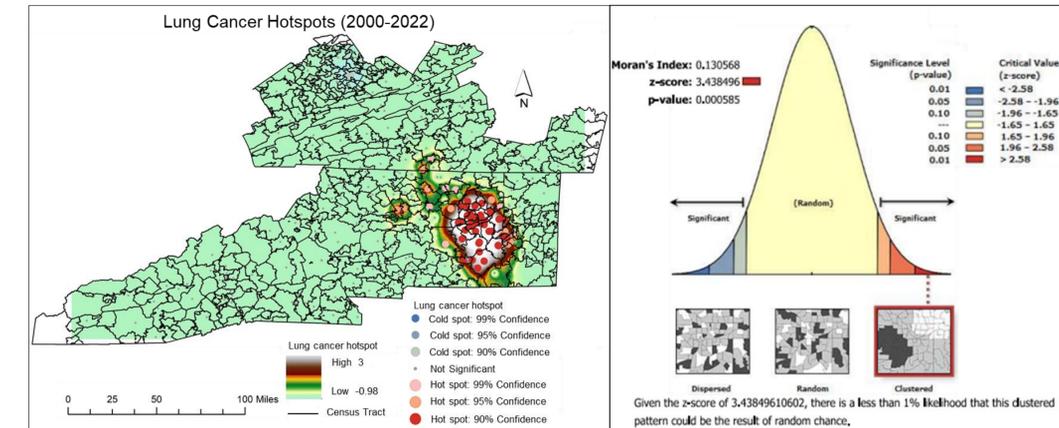
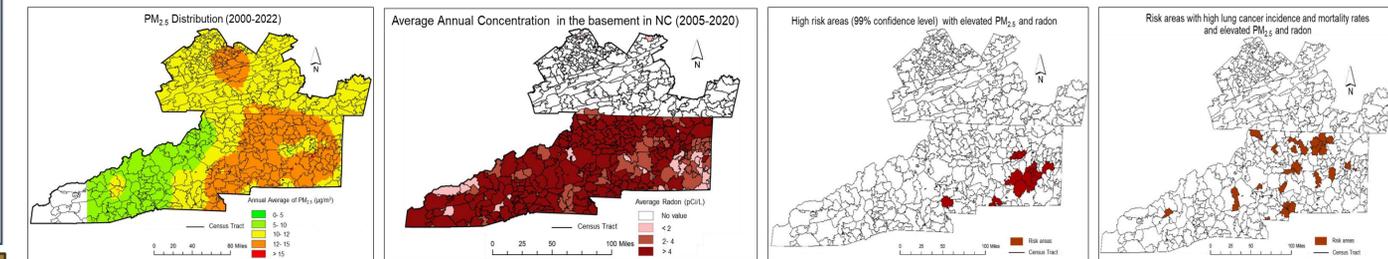
This study analyzed 8,609 de-identified lung cancer cases diagnosed from 2000–2022 in the Wake Cancer Registry (IRB00079757). Residential addresses were geocoded in ArcGIS Pro, and ZIP code centroid points were linked to census tracts to protect privacy and enable ZIP-level analysis. Age-adjusted incidence and mortality rates were calculated using the standard million population. Spatial clustering was assessed using Getis-Ord Gi* hot-/cold-spot analysis and validated with Moran's I. Associations between hotspot locations and environmental exposures (PM_{2.5}, ground-level O₃, indoor radon), patient smoking history, and travel distance to the hospital were evaluated to understand factors contributing to lung cancer burden and health disparities. The data was sourced from the U.S. Census Bureau, Environmental Protection Agency (EPA) and vendor-provided MLS listings



RESULTS



Our analysis identified statistically significant lung cancer hot and cold spots using the Getis-Ord-GI* method and validated by Moran's I (z-score = 3.438, p = 0.0005), confirming significant spatial autocorrelation highlighting the eastern and southeastern tracts as high burden areas of lung cancer. These hotspots display a strong east-west socioeconomic gradient with lower median household incomes and large poverty populations (data not shown) reflecting inequalities and disparities in lung cancer burden across the census tracts. Patients in these areas had to travel longer and burdensome distances for care. The spatial analysis integrating environmental risk factors- PM_{2.5}, and indoor radon accounting for race and smoking history revealed 24 ZIP codes across 23 census tracts as high-risk areas with 99% confidence. In total, 29 high-risk zip codes were identified having elevated PM_{2.5} (>10 µg/m³) and indoor radon (4 and >4 pCi/L) particularly in homes with basement tested for radon. Ozone levels remained well below the EPA's 0.07ppm standard. These hotspots strongly associated with higher lung and bronchus cancer incidence and mortality, particularly among populations stratified by race and smoking history.



CONCLUSION

We identified statistically significant hotspot and high-risk areas of lung cancer incidence and mortality stratified by race and smoking. These critical areas need intervention, prevention, targeted screening and smoking cessation programs especially in the eastern and southeastern tracts. The study suggests on strengthening the lung cancer screening programs, mobile clinics in identified hotspots, collaboration with community organizations for tobacco cessations and implement radon testing and mitigation programs. Finally, establish a geospatial surveillance unit within the AHWFBCCC for spatial monitoring of these lung cancer hotspots.

ACKNOWLEDGEMENT

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