Association of Environmental Toxic Chemical Releases with NHL and Breast Cancer

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Background

- Environmental exposure to toxic air pollutants has been implicated in cancer risk. Industrial releases of hazardous chemicals may contribute to population-level exposure through contaminated air.
- Breast cancer remains a major public health concern in the United States, affecting about 1 in 8 women during their lifetime, while non-Hodgkin lymphoma (NHL) is the seventh most common cancer.
- However, evidence linking environmental toxic chemical releases to cancer incidence (Breast and NHL) at the community level remains limited.

Objectives

We evaluated the associations between ambient concentrations of Ethylene Oxide (EtO), Benzene, and Naphthalene and the incidence of breast cancer (including in situ cases) and NHL across Louisiana census tracts from 2012 to 2021

Methods

- Mean ambient and exposure chemical concentrations (µg/m³) were obtained from the National Air Toxics Assessment (199-2011)
- Cancer incidence data (2012–2021) were sourced from the Louisiana Tumor Registry and aggregated at the census-tract level (N=1,139). Other covariates included mean age and Social Vulnerability Index (SVI).
- Negative binomial regression models were used to assess associations. Benzene and naphthalene were modeled together due to shared combustion/fuel sources, while EtO was modeled separately, reflecting distinct industrial emissions

Results

Variable	*IRR*	*95% CI*	*P*
Non-Hodgkin Lymphoma			
EtO Concentrations	3.59	0.11-126.60	0.482
Breast Cancer			
EtO Concentrations	1.12	0.11-11.31	0.923
Model 2			
Non-Hodgkin Lymphoma			
Benzene concentrations	0.97	0.91-1.04	0.442
Naphthalene concentrations	0.48	0.13-1.84	0.286
Breast Cancer			
Benzene concentrations	1.05	1.00-1.09	0.033*
Naphthalene concentrations	0.90	0.42-1.97	0.800

» Both models were adjusted for age and SVI, IRR = Incidence rate ratio

Concentrations are averaged ambient (1999-2011)

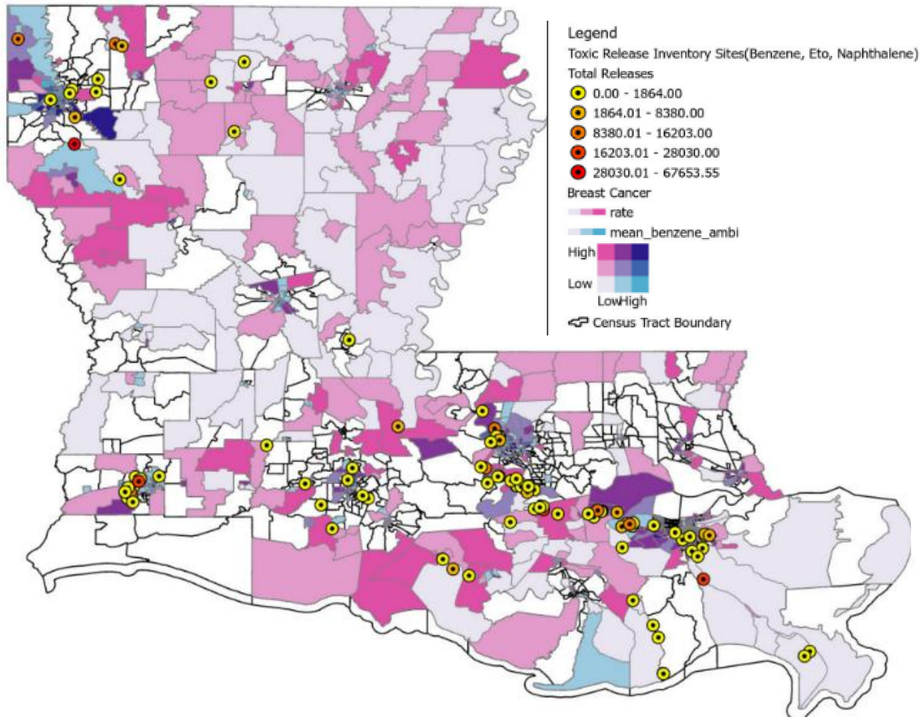

Fig 1: Benzene ambient concentrations vs Breast Cancer (2012-2021)

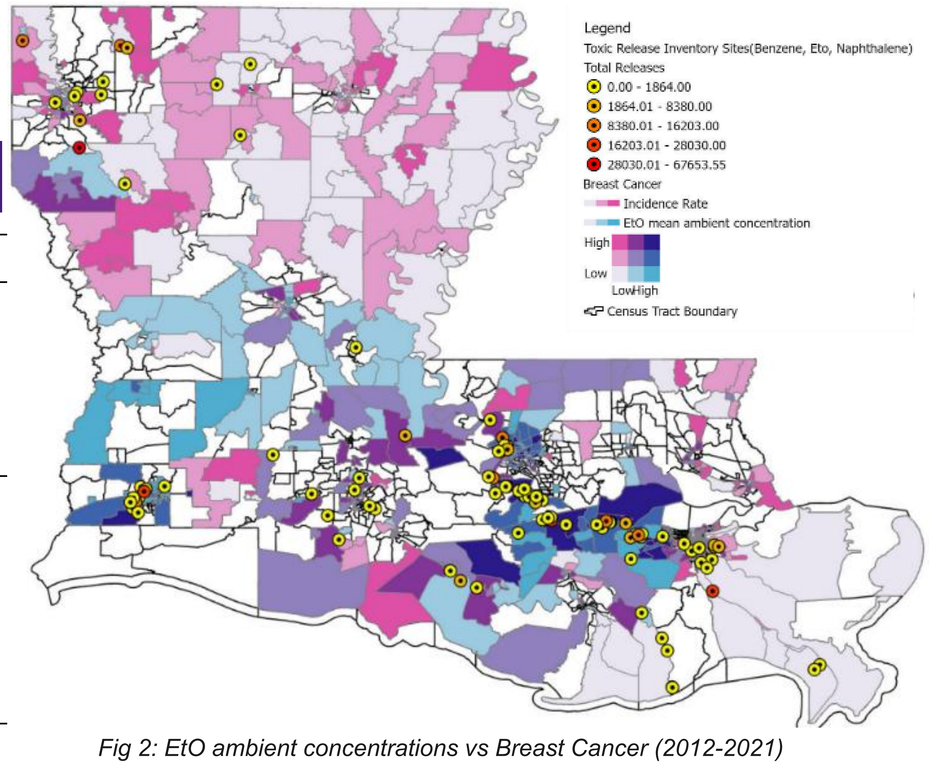

Fig 2: EtO ambient concentrations vs Breast Cancer (2012-2021)

Discussion

- In this ecological analysis, ambient EtO concentrations were not significantly associated with the incidence of NHL or breast cancer at the census tract level, although IRRs suggest a positive direction data sparsity might have contributed to the non-significance.
- In contrast, benzene concentrations were positively associated with breast cancer incidence in adjusted models (IRR = 1.05), suggesting a modest but statistically significant increase in risk.
- Bivariate mapping of EtO and benzene concentrations in relation to breast cancer incidence showed spatial variability across census tracts, though without a consistent pattern for EtO
- *Benzene bivariate maps:* Some overlap between higher breast cancer incidence and higher benzene levels, especially in southeastern Louisiana, but patterns are inconsistent. Suggests localized clustering without a strong spatial relationship, consistent with the modest association (IRR ≈ 1.05) *(fig 1)*
- *EtO bivariate maps:* More heterogeneous pattern with limited overlap between high exposure and high cancer rates. No clear spatial relationship, supporting the non-significant regression findings. *(fig 2)*
- *Limitations:* Ecological design limits individual-level inference; exposures are modeled (not measured); possible familial clustering in registry data may inflate tract-level rates; residual confounding may remain

Future Steps

- Future studies will be carried out using individual data to adjust for individual level risk factors. Spatial cluster analyses will also be conducted to identify geographic patterns of elevated cancer incidence and potential environmental hotspots.
- Distance from the industries to the households will be included in the model to evaluate whether residential proximity to TRI releasing sites is associated with increased incidence of NHL and breast cancer, considering distance as a proxy for exposure.

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