# Non-Lung Cancer Mortality Risk and Fine Particulate Air Pollution in a Large, Representative Cohort of U.S. Adults

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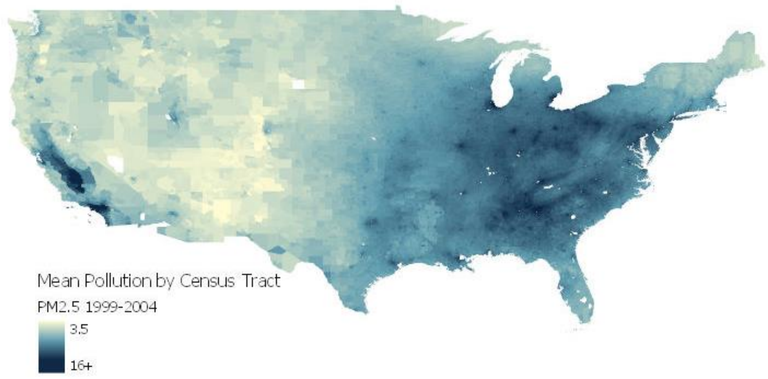
## Background

- The International Agency for Research on Cancer (IARC) and recent studies have determined that airborne particulate matter ($PM_{2.5}$) is carcinogenic to humans for lung cancer.
- $PM_{2.5}$ could feasibly affect chronic systemic inflammation, oxidative stress, and DNA damage in tissues other than lung.
- The current study attempts to utilize a nationally representative cohort to explore the association between $PM_{2.5}$ and selected cancers to determine if air pollution could contribute to global burden of disease for non-lung cancers.




## Methods

- National Health Interview Survey (NHIS) and mortality follow-up data were used to configure a study population of 635,539 individuals surveyed over a period of 29 years. Information on age, sex, race/ethnicity, income, marital status, educational attainment, census tract, interview date, smoking status, BMI, mortality status, and date of death (if deceased) were included.
- Individuals in the study population were assigned $PM_{2.5}$ exposure by census tract using modeled annual $PM_{2.5}$ exposure.
- The individuals were divided into two cohorts: one containing all 635,539 individuals (full cohort) and the other containing 341,665 of the full cohort who were never-smokers (sub cohort).
- A Cox Proportional Hazard model was utilized to estimate hazard ratios and confidence intervals for cancer-specific mortality with adjustments for individual cofactors.
- Analysis was performed on aggregate non-lung cancer mortality as well as individual types of cancer as classified by ICD 10 codes, which separated the cancer types into oral and oropharyngeal, esophageal, stomach, colorectal, lung, liver, pancreatic, laryngeal, melanoma, breast, cervical, uterine, ovarian, prostate, kidney, bladder, brain, and total lymphoid cancers, which were broken down to subcategories of Hodgkin's disease, non-Hodgkin's lymphoma, leukemia, multiple myeloma, and other lymphoid cancers.

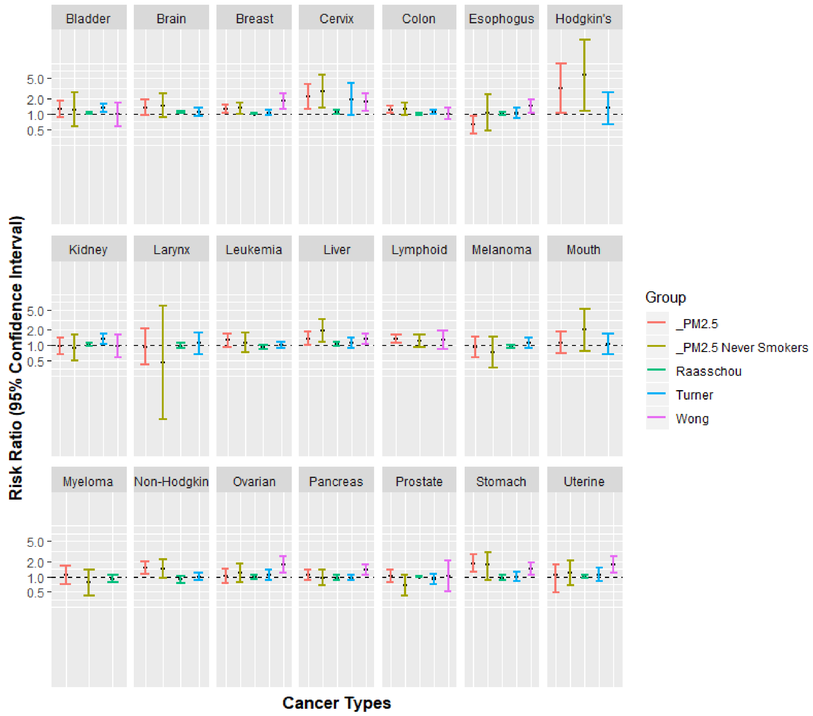
## Results

| | | Full Cohort | | Sub Cohort | |
|---|---|---|---|---|---|
| Cancer type | ICD-10 Codes | Number Of Deaths | Hazard Ratio (95% CI) | Number Of Deaths | Hazard Ratio (95% CI) |
| **All Cancer*** | (C00-C97) | 26453 | 1.15 (1.08-1.21) | 8710 | 1.19 (1.08- 1.31) |
| **Lung*** | (C33-34) | 7420 | 1.12 (1.00-1.25) | 710 | 1.77 (1.26-2.46) |
| **All non-lung*** | (C00-C32, C35-C97) | 19033 | 1.15 (1.07-1.23) | 8000 | 1.15 (1.04-1.27) |
| Oral | (C00-C14) | 374 | 1.14 (.71-1.83) | 83 | 2.00 (.77-5.23) |
| Esophageal | (C15) | 599 | 0.62 (.41-.92) | 139 | 1.06 (0.48-2.37) |
| **Stomach*** | (C16) | 525 | 1.82 (1.24-2.69) | 224 | 1.69 (0.84-3.05) |
| **Colorectal*** | (C18-C21) | 7527 | 1.23 (1.02-1.47) | 1131 | 1.28 (0.97-1.69) |
| **Liver*** | (C22) | 761 | 1.35 (.99-1.84) | 272 | 1.96 (1.17-3.30) |
| Pancreatic | (C25) | 1607 | 1.07 (.84-1.34) | 651 | 0.95 (0.67-1.36) |
| Laryngeal | (C32) | 157 | 0.94 (.42-2.12) | 15 | 0.45 (0.04-5.89) |
| Melanoma | (C43) | 392 | 0.92 (.58-1.48) | 179 | 0.73 (0.36-1.47) |
| **Breast*** | (C50) | 2099 | 1.26 (1.03-1.54) | 1150 | 1.30 (1.00-1.69) |
| **Cervical*** | (C53) | 237 | 2.21 (1.27-3.88) | 122 | 2.83 (1.34-5.97) |
| Uterine | (C54-C55) | 392 | 1.09 (.48-1.75) | 271 | 1.17 (0.67-2.05) |
| Ovarian | (C56) | 750 | 1.03 (.75-1.44) | 433 | 1.17 (0.77-1.79) |
| Prostate | (C61) | 1215 | 1.04 (.80-1.36) | 415 | 0.67 (0.42-1.07) |
| Kidney | (C64-C65) | 603 | 0.97 (.67-1.41) | 244 | 0.9 (0.50-1.63) |
| Bladder | (C67) | 589 | 1.26 (.86-1.84) | 139 | 1.21 (0.56-2.63) |
| Brain | (C70-C72) | 622 | 1.33 (.93-1.90) | 278 | 1.48 (0.87-2.51) |
| **Total Lymphoid*** | (C81-C96) | 2587 | 1.35 (1.12-1.61) | 1163 | 1.22 (0.93-1.59) |
| **Hodgkin's Disease*** | C81 | 59 | 3.23 (1.06-9.86) | 28 | 5.75 (1.13-29.40) |
| **Non-Hodgkin's Disease *** | (C82-C85) | 1016 | 1.49 (1.12-1.98) | 458 | 1.46 (0.96-2.20) |
| Leukemia | (C91-C95) | 970 | 1.27 (.95-1.71) | 406 | 1.14 (0.72-1.79) |
| Multiple Myeloma | (C88, C90) | 541 | 1.09 (.72-1.64) | 271 | 0.77 (0.43-1.39) |
| Other Cancers | (C17, C23-C24…) | 2952 | 0.92 (.77-1.10) | 1094 | 0.83 (0.63-1.09) |

- Estimated hazard ratios (95% CIs) associated with 10 µg/m$^3$ increase of $PM_{2.5}$ adjusted for individual covariates.
- If the hazard ratio is close to 1 then exposure to $PM_{2.5}$ does not affect survival for that cancer type. If the hazard ratio is less than 1, then the $PM_{2.5}$ is associated with improved survival for that cancer type. Finally, if the hazard ratio is greater than 1, then $PM_{2.5}$ is associated with increased risk for that cancer type.
- In this study, a 10 µg/m$^3$ increase of $PM_{2.5}$ was associated with a 15% increase in mortality risk for non-lung cancers in both cohorts, and a 15% and 19% risk for all cancer types.
- In addition, increase exposure to $PM_{2.5}$ resulted in a statistically significant increase in risk for lung, stomach, colorectal, liver, breast, cervical, total lymphoid, Hodgkin's Disease, and Non-Hodgkin's Disease in one or both cohorts.

National Health Interview Survey

## Literature Comparison




- Comparison between the results of the Full Cohort (PM2.5) and Sub Cohort (PM2.5 Never Smokers) and three similar studies.
- All studies are measured by a 10 µg/m$^3$ increase of a pollutant. For Wong, Turner, and the full and sub cohort, hazard ratios associated with $PM_{2.5}$ are used. For Raaschou-Nielsen, incident ratios associated with $NO_x$ are used.

## Conclusions

This study adds to the growing body of literature that exposure to fine particulate matter is a probable factor in mortality for non-lung cancers. Specifically, the results of this study and other comparable studies suggest that mortality from stomach, colorectal, liver, breast, cervical, and lymphoid cancers, specifically Hodgkin's Disease and Non-Hodgkin's disease, may be associated with exposure to ambient air pollution. The results of this paper indicate a need for further research into the possible biological pathways by which humans may be affected by ambient air pollution. While exposure to ambient air pollution is certainly not the primary cause of non-lung cancer in humans, the ubiquitous and involuntary nature of the pollution makes further study essential to public health.