**A new research frontier: The effect of fine particulate matter on the respiratory morbidity and cancer mortality of young cancer survivors**

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Children, the elderly, and persons with pre-existing respiratory and cardiovascular conditions are considered at-risk for adverse events associated with air pollution, a known carcinogen and potent physiologic stressor. Young persons with cancer (survivors) are at risk for cancer mortality and have a prevalence of comorbid respiratory and cardiovascular conditions similar to elderly adults, attributed to the toxic effects of cancer therapy. Yet the health effects of fine particulate matter pollution (PM2.5) among young cancer survivors are understudied. We present results from the first studies in the nation that provide evidence of significant associations between PM2.5 and morbidity and mortality in young cancer survivors living in Utah, a state with severe PM2.5 pollution.

First, we conducted a case crossover study to examine short-term exposure to PM2.5 and respiratory hospitalization and emergency department visits among younger cancer survivors (diagnosed ages 0-39). Survivors were alive 5-years after diagnosis and resided in Utah. PM2.5 was measured per 10 µg/m3 using cumulative three-day averages. Using conditional logistic regression, we identified the odds among survivors. We also compared the odds of an event between survivors treated with chemotherapy to an age-matched, cancer-free population sample. Among survivors, PM2.5 had a significant association with respiratory hospitalization (odds ratio [OR]=1.84, 95% CI=1.13-3.00) and hospitalization for respiratory infection (OR=2.09, 95% CI=1.06-4.14). Among chemotherapy-treated survivors, PM2.5 was associated with respiratory hospitalization (OR=2.03, 95% CI=1.14-3.61); their odds were significantly higher than an age-matched, cancer-free sample (OR=0.84, 95% CI=0.57-1.25).

Second, a cohort study of 2,444 pediatric (diagnosed age 0-14) and 13,459 adolescent and young adult (AYA, diagnosed age 15-39) patients examined the association of chronic PM2.5 exposure starting at diagnosis and mortality from cancer and all-causes. Discrete-time Cox models determined the association of PM2.5 per 5 µg/m3 to mortality at 5- and 10-years after diagnosis. We also examined the association at PM2.5≥12 µg/m3 and effect modification by stage. In pediatric patients, PM2.5 was associated with cancer mortality in lymphomas (hazard ratio [HR]5-years=1.34 [95%CI=1.06-1.68]) and CNS tumors (HR5-years=1.34 [1.06-1.68]; HR10-years=1.27 [1.05-1.52]), and all-cause mortality in lymphoid leukemias (HR5-years=1.32 [1.02-1.71]).

Among AYAs, PM2.5 was associated with cancer mortality in CNS tumors (HR5-years=1.20 [1.06-1.36]) and carcinomas (HR5-years=1.14 [1.06-1.22]; HR10-years=1.10 [1.02-1.18]) and all-cause mortality for all AYA cancer types (HR5-year =1.06 [1.01-1.13]). PM2.5≥12µg/m3 was associated with cancer mortality among breast (HR5-year =1.50 [1.29-1.74]; HR10-year =1.30 [1.13-1.50]) and colorectal cancers (HR5-year =1.74 [1.29-2.35]; HR10-year =1.67 [1.20-2.31]). Effect modification by stage was significant and local tumors had the highest risk estimates.

Studies of environmental pollutants and environmental carcinogenesis typically exclude cancer survivors. Our research suggests that the toxicity from cancer therapies increases survivors’ risk for PM2.5-associated morbidity. Results from the cohort study suggest that PM2.5 may play a role in cancer outcomes, perhaps through the acceleration of carcinogenesis. Currently, no policies recognize that the treatment-induced toxicity present among cancer survivors may increase their risk for adverse events due to PM2.5 or other pollutants. Recognition of medical treatments as a source of vulnerability to pollution could have far-reaching consequences for environmental policy. These results warrant future investigation.