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## Long-Term Ozone Exposure and Mortality

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### ABSTRACT

**Background** Although many studies have linked elevations in tropospheric ozone to adverse health outcomes, the effect of long-term exposure to ozone on air pollution–related mortality remains uncertain. We examined the potential contribution of exposure to ozone to the risk of death from cardiopulmonary causes and specifically to death from respiratory causes.

**Methods** Data from the study cohort of the American Cancer Society Cancer Prevention Study II were correlated with air-pollution data from 96 metropolitan statistical areas in the United States. Data were analyzed from 448,850 subjects, with 118,777 deaths in an 18-year follow-up period. Data on daily maximum ozone concentrations were obtained from April 1 to September 30 for the years 1977 through 2000. Data on concentrations of fine particulate matter (particles that are  $\leq 2.5$   $\mu\text{m}$  in aerodynamic diameter [ $\text{PM}_{2.5}$ ]) were obtained for the years 1999 and 2000.

Associations between ozone concentrations and the risk of death were evaluated with the use of standard and multilevel Cox regression models.

**Results** In single-pollutant models, increased concentrations of either  $\text{PM}_{2.5}$  or ozone were significantly associated with an increased risk of death from cardiopulmonary causes. In two-pollutant models,  $\text{PM}_{2.5}$  was associated with the risk of death from cardiovascular causes, whereas ozone was associated with the risk of death from respiratory causes. The estimated relative risk of death from respiratory causes that was associated with an increment in ozone concentration of 10 ppb was 1.040 (95% confidence interval, 1.010 to 1.067). The association of ozone with the risk of death from respiratory causes was insensitive to adjustment for confounders and to the type of statistical model used.

**Conclusions** In this large study, we were not able to detect an effect of ozone on the risk of death from cardiovascular causes when the concentration of  $\text{PM}_{2.5}$  was taken into account. We did, however, demonstrate a significant increase in the risk of death from respiratory causes in association with an increase in ozone concentration.

### Source Information

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