

TESTIMONY TO THE U.S. SENATE COMMITTEE ON
ENVIRONMENT & PUBLIC WORKS,
SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY

On

MORTALITY EFFECTS OF OZONE

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BY:

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Introduction

Thank you for the opportunity to speak with you regarding the relationship between tropospheric ozone pollution and mortality. I am Michelle Bell, Assistant Professor of Environmental Health at Yale University in the School of Forestry and Environmental Studies with joint appointments at the School of Public Health and the Environmental Engineering Program. My research investigates how air pollution affects human health, including the impacts of ozone pollution. I am lead author on several national studies of ozone and human mortality.

Given the pervasive high ozone levels in many parts of our country, ozone pollution is a critically important health concern. Emissions from transportation, industry, and power generation contribute to ozone. Links between ozone and various adverse health responses have been established for years, such as for increased risk of hospital admissions and respiratory symptoms. However, new scientific evidence regarding ozone's impact on mortality has been presented in recent years since the last time the U.S. Environmental Protection Agency (EPA) revised the National Ambient Air Quality Standard (NAAQS) for ozone in 1997. I will focus on this new information today, which addresses four key points.

1. The relationship between ozone and mortality
2. The impact of ozone on mortality at low ozone levels
3. The role of weather
4. The role of particulate pollution

1. The relationship between ozone and mortality

When EPA last revised the health-based ozone standards in 1997, the agency concluded that while ozone was clearly linked to many health consequences, the scientific evidence for a link between ozone and death was unclear and that more research was needed. Since that time, several studies have demonstrated that this link does in fact exist. My colleagues at Johns Hopkins University and I performed a national study of how day-to-day changes in ozone levels are associated with mortality rates for 95 U.S. urban communities over a 14-year period, from 1987 to 2000 (Bell et al. 2004). The communities are shown in Figure 1.



Figure 1. Map of the 95 U.S. urban communities used in a national ozone and mortality study (Bell et al. 2004)

This large dataset covers over 40% of the U.S. population and is one of the largest ozone studies ever conducted. This dataset is not hypothetical or laboratory-based, but rather is based on real-world data for ozone levels, weather, and mortality. The study accounts for many factors such as weather, day of the week, and seasonal trends. We found that mortality rates are higher in urban communities when the previous week's ozone levels are higher. Specifically, we found that a 10 ppb increase in the previous week's ozone levels raised mortality rates by 0.52%. To put these numbers in perspective, our results imply that a 10 ppb decrease in ozone levels would avoid about 320 premature deaths in the New York City area each year, and would save approximately 4,000 lives annually in the 95 communities studied. A larger reduction in ozone levels would avert even more deaths. This may be an underestimate of the total impact of ozone on mortality as our study only looked at how risk is affected by recent exposure over the past few days and does not include the risk from a lifetime of breathing air pollution.

We also identified a link between ozone and mortality in a meta-analysis study, which pools estimates from previously conducted research to generate an overall result (Bell et al. 2005a). Other researchers have also found that daily levels of ozone are associated with increased mortality risk including additional meta-analyses studies (Anderson et al. 2004, Ito et al. 2005, Levy et al. 2005, Stieb et al. 2002, Thurston and Ito 2001), a European study of 23 cities with an average of 5.5 years of data each (Gryparis et al. 2004), and a study of 14 U.S. cities (Schwartz 2005). In summary, several studies have provided robust evidence that ozone pollution is associated with human mortality. These studies include a range of methodologies and study locations.

2. The impact of ozone on mortality at low concentrations

In a follow-up study, we investigated the impact of ozone at low concentrations for 98 U.S. urban communities over a 14-year period (Bell et al. 2005b). In particular, we were interested in determining whether there exists a threshold level, below which ozone does not adversely impact risk of mortality. We found that even very low levels of ozone are associated with increased mortality risk, including concentrations lower than current EPA regulatory standards or California's standards and nearing natural background concentrations. We found no safe level of ozone that does not affect risk of mortality.

One approach used in this analysis is the Subset Method in which only days with ozone levels below a specified value are included in the analysis. Figure 2 shows the percent increase in the risk of mortality per 10 ppb increase in the average of the same and previous days' (Lag 01) ozone levels using all data and using the subset approach, for cutoff values of 30 to 60 ppb. The points represent the central estimate, and the vertical lines reflect the 95% posterior interval, which relates to the certainty of the estimate. For example, the vertical line at the left side of the graph demonstrates an association between ozone and mortality, including only days with levels below 30 ppb.

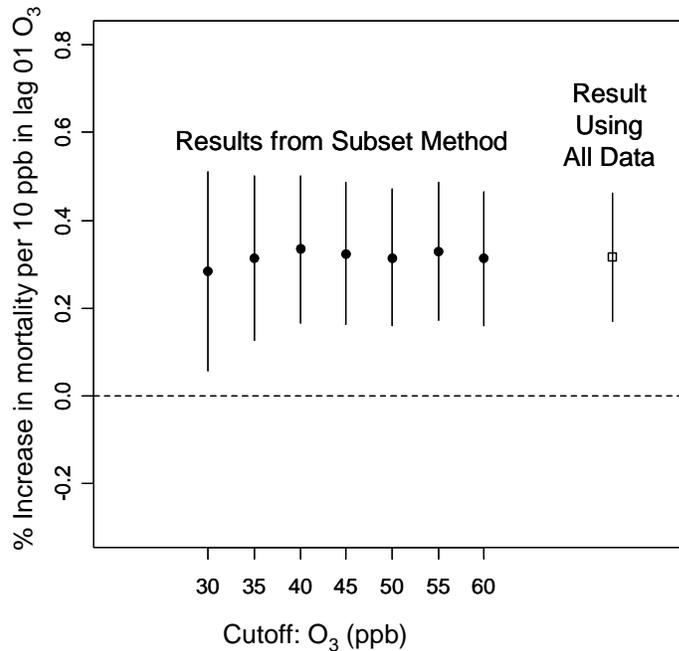


Figure 2. Percent increase in mortality per 10 ppb increase in the average of the same and previous days' ozone levels using the subset approach and all data (Bell et al. 2005b)

The role of weather

A significant question regarding the ozone and mortality relationship is the role of weather. Temperature influences ozone formation through the emissions of some natural gases that contribute to ozone and through acceleration of ozone chemistry. Ozone levels tend to be higher when temperature is higher, such as during the summer. Thus, we conducted extensive sensitivity analysis to investigate the role of weather in the ozone and mortality relationship. Using a range of different techniques, we consistently found an effect of ozone on mortality, independent of temperature. In other words, our results show that the relationship we observed between ozone and mortality is not an artifact of high temperatures or heat waves. This conclusion was confirmed by a study led by Dr. Joel Schwartz of Harvard University who also identified an impact of ozone on mortality, independent of temperature, for 14 U.S. cities (Schwartz 2005).

3. The role of particulate pollution

A wealth of literature exists on the health impacts of particulate pollution. Our national studies on ozone and mortality account for particle pollution through a variety of different approaches. Results from these multiple analyses consistently show that the mortality risk from ozone cannot be attributed to particulate matter pollution. Other work also found an impact of ozone on mortality, independent of the mortality risk from particles (Bell et al. 2005a, Ito et al. 2005, Gryparis et al. 2004, Schwartz et al. 2005, Stieb et al. 2002, Thurston and Ito 2001). The scientific findings support a mortality effect from ozone, separate from the mortality effect from particles.

Conclusion

In conclusion, the health impacts of ozone have been vigorously studied for many years. The connection between ozone and health is well-established based on evidence from epidemiology studies using real-world data, laboratory data using human exposure, and animal models. We now have strong scientific evidence that ozone also increases risk of human mortality. This increase in mortality risk is persistent even at very low levels of ozone near natural background concentrations. Other recent research also identified effects at ozone levels lower than the current regulatory standard, such as a Yale University study finding ozone is associated with use of asthma medication and respiratory symptoms in asthmatic children under 12 years (Gent et al. 2003). The current state of the science is evidenced by the Clean Air Scientific Advisory Committee's (CASAC's) unanimous conclusion that adverse health outcomes occur at the level of the current regulatory standard. Our research indicates that health benefits would result from lowering ozone concentrations, even in communities with currently low levels.

Thank you for the opportunity to testify on this important issue.

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