

Association Between Ozone Exposure and Death: Results from Three Recently Published Meta-Analyses

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Air Resources Board

California Environmental Protection Agency



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Thank you, Ms. Witherspoon. Good morning, Madame Chairman and members of the Board.

The focus of our update today is on three new meta analyses on the relationship between ozone exposure and premature death. As meta-analyses, these new studies pooled the data from previously conducted studies in order to strengthen their power to observe an effect.

Working independently, three different groups of researchers analyzed data from various cities and countries but obtained similar results. They all found a significant association between ozone exposure and premature death.

Ozone Exposure and Public Health

- New 8-hour Ozone Standard (0.070 ppm)
- Health effects of ozone exposure
 - Reduced lung function
 - Airway inflammation
 - Respiratory symptoms (e.g. cough, chest tightness)
 - Increased hospital and ER visits
 - Increased school absenteeism
 - Possible asthma induction in active children
 - Premature death



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As you recall, in April of this year, the Board adopted the nation's most health-protective 8-hour ozone standard by approving a new California ambient air quality standard of 0.070 parts-per-million.

That standard was based primarily on the results of human chamber studies which demonstrate a number of adverse health effects, including reduced lung function, increased airway inflammation, and respiratory symptoms such as cough and chest tightness.

In addition, epidemiological studies have shown the association between ozone exposure and increased hospital and emergency room visits, and school absenteeism. Preliminary evidence indicates that exposure to high ozone levels by active children may be related to new cases of asthma.

Finally, the ARB and OEHHA staff reviewed multi-city studies that addressed the relationship between ozone and daily death counts.

The results of the studies presented today provide further compelling evidence for the association between ozone exposure and death.

Overview of Three Studies

- Levy et al.¹ - 28 studies from 40 cities in U.S., Canada, and Europe
- Bell et al.² – 32 studies from 41 cities in U.S. and Europe
- Ito et al.³ - 43 studies from 7 U.S. cities and 32 cities in other parts of the world

¹Levy et al. (2005) *Epidemiology*, Volume 16, Number 14, pages 458-468

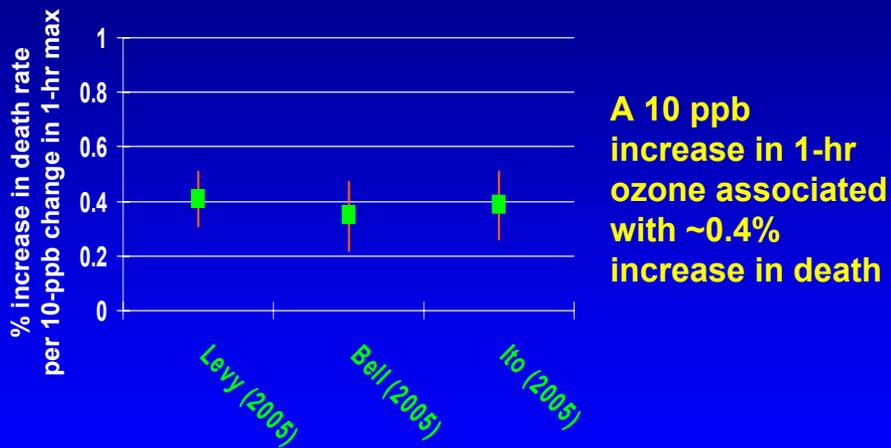
²Bell et al. (2005) *Epidemiology*, Volume 16, Number 14, pages 436-445

³Ito et al. (2005) *Epidemiology*, Volume 16, Number 14, pages 446-457



To explore the strength of the relationship between ozone and death, the U.S. EPA funded three independent teams of researchers to analyze all existing relevant data on the subject. The researchers were free to choose the datasets and to carry out the analyses that they considered appropriate. There was some overlap in the three studies since some datasets were utilized by more than one team.

Summary Findings of Three Studies



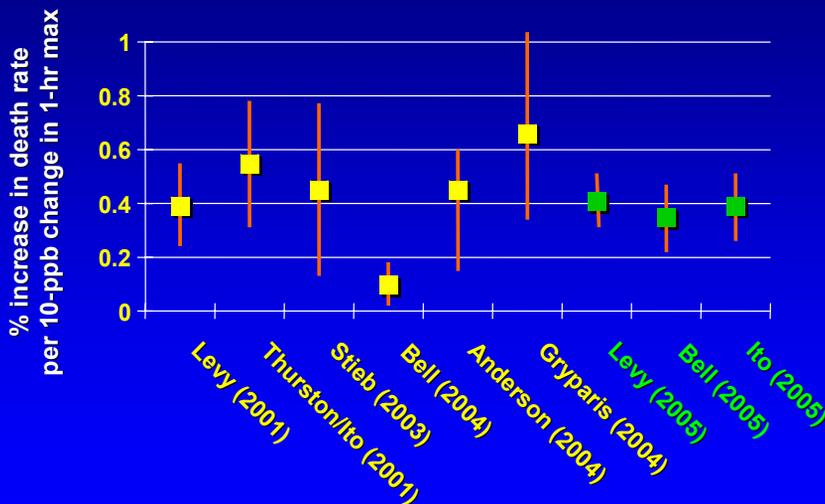
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From the analysis of the health and exposure data of their respective studies, the authors found fairly similar results. They found that a 10-parts-per-billion increase in the 1-hour maximum ozone level was associated with a 0.4% increase in the non-injury related death rate.

The confidence intervals are shown as vertical lines. These reflect the uncertainty in the estimates and range from 0.22 to 0.51%.

In addition, they found that ambient PM did not influence the result from ozone exposure. Also, Levy and his colleagues found that the prevalence of residential air-conditioning might result in a lower ozone-mortality effect due to lower personal exposure to ozone.

Effect of Ozone Exposure on Death Results of Studies (2001-2005)



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To put the results in perspective, we compared the latest findings from these three meta-analyses to other studies that were included in the ozone standard review.

Six major studies were published between 2001 and 2004. As you can see, the effect estimates from these analyses range from 0.1% to 0.66% increase in daily deaths per 10-ppb change in 1-hour maximum ozone.

(CLICK HERE)

The results from the three new meta-analyses we have just discussed, shown in green, lie within the range of the estimates.

The smallest estimate is the 2004 study by Bell and colleagues, who may have over-controlled for the confounding effects of weather, which would explain the small estimate in the graph. On the other hand, results from the 2004 study by Dr. Gryparis, the highest in the chart, apply to the summer season only. Since ozone is typically higher in the summer, it is expected that the summer effect would be higher.

The difference in the estimates among these studies, and among cities within the studies, are likely due to variation in a number of characteristics of the populations in the cities.

However, it should be noted that the three teams of researchers independently found consistent results on the association between ozone exposure and premature death, and these results are in fair agreement with previously published work.

Health Benefits of Reducing Ozone in California

- An estimated 630 deaths (probable range: 310 to 950) avoided annually if the 8-hour standard of 0.070 ppm is attained
 - 3 new studies consistent with the other meta-analyses and these results
- Methodology peer-reviewed by experts in the field and is similar to U.S. EPA's



Although the studies on premature death did not form the basis for the ozone standard, they do play a vital role in our health impacts assessments of ozone exposure in California.

As presented at the April Board hearing on the ozone standard, ARB staff used results from the 2001-2004 studies to estimate the health benefits of reducing ozone exposure in California. We estimate that about 630 deaths would be avoided each year if statewide ozone concentrations were reduced to attain the 0.070 ppm level of the newly approved 8-hour ozone standard.

The results from the three new studies discussed today are consistent with the previous studies, and our methodology has undergone peer review by several experts in the field of air pollution health effects and is similar to that used by U.S. EPA.

Ozone Effects on Health: Summary

- Ozone effects on death supported by analyses
 - Additional evidence of health benefits from reduced ozone pollution
- Studies support conclusions for ozone standard approved by Board in April 2005
- Future research addresses biological mechanisms of ozone effects on premature death



In summary, the three recent analyses show a link between exposure to ambient ozone and premature death. Together, they add substantially to the growing body of evidence of the public health benefits from reducing ozone pollution, and they provide further support for the new ambient ozone standard approved by the Board in April of this year.

Research into the biological mechanisms that could help explain the association between ozone exposure and death is underway and includes a study approved by the Board last December to investigate the relationship between ozone exposure and heart disease.

That concludes my presentation. Thank you for your attention. I'll be happy to answer any of your questions.