American Journal of Respiratory and Critical Care Medicine®

American Journal of Respiratory Cell and Molecular Biology®

Proceedings of the American Thoracic Society®

We help the world breathe®
PULMONARY • CRITICAL CARE • SLEEP

National Headquarters
25 Broadway, 18th Floor
New York, NY 10004
P. (212) 315 - 8600
F. (212) 315 - 6498

Washington Office
1150 18th Street, N.W.
Suite 300
Washington, D.C. 20036
P. (202) 296 - 9770
F. (202) 296 - 9776
www.thoracic.org

Testimony of the American Thoracic Society before the House Energy and Power Subcommittee of the House Energy and Commerce Committee Presented by William N. Rom M.D., MPH On Friday, April 12, 2013

On behalf of the 15,000 members of the American Thoracic Society, I want to thank the committee for opportunity to testify before the Energy and Power Subcommittee of the House Energy and Commerce Committee.

The goal of my written comments is to provide a brief summary of the overwhelming evidence that air pollution – especially fine particulate matter pollution (PM2.5) and ozone – has a severe and negative impact on human health. Additionally, I will provide some summary information on the cost effective of science-based Clean Air Act standards.

Adverse Health Effects Caused By Particulate Matter

Research has shown definitively that $PM_{2.5}$ causes premature mortality in infants and adults; triggers systemic inflammation, alters vascular reactivity, and alters cardiac rhythms; and worsens asthma, chronic bronchitis, and other cardiopulmonary illnesses.[1] These conclusions are widely-accepted in the scientific community and are further supported by recently released studies.

$PM_{2.5}$ kills.[2] The risk of premature mortality caused by exposure to $PM_{2.5}$ is widely accepted.[3] Chronic exposure to $PM_{2.5}$ increases the risk of dying from lung cancer and cardiovascular diseases.[4]

[1] Pope CA III, Dockery DW. Health Effects of Fine Particulate Air Pollution: Lines that Connect. *J Air Waste Mange Assoc* 2006; 56:709-742.
[2] U.S.EPA, Expanded Expert Judgment Assessment of the Concentration-Response Relationship Between $PM_{2.5}$ Exposure and Mortality: Final Report, vii, 3-23, 3-24 (September 21, 2006).
[3] Health Effects Institute. *Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality*, 2000.
[4] C. Arden Pope III et al., Cardiovascular Mortality and Year-round Exposure to Particulate Air Pollution: Epidemiological Evidence of General Pathophysiological Pathways of Disease, 109 Circulation 71 (2004) (10µg/m^3 increase in $PM_{2.5}$ increased mortality risk by 8-18%); C. Arden

Acute exposure increases the risk of death from respiratory and cardiovascular causes. [5] It is important to note that these premature deaths do not represent the culling of unhealthy and frail individuals who would have likely succumbed to death from other caused. Rather these premature deaths are in people who could have otherwise continued to live full and productive lives.

Recent studies not only support this conclusion regarding the morbidity effect of $PM_{2.5}$, but also indicate that the risk of mortality from particulate matter is greater than previously believed.[6] An observational study of 66,000 women in 36 U.S. cities (the first study to rely on direct measurements of $PM_{2.5}$) found an increased relative risk of death from cardiovascular disease of 1.76 for every 10 $\mu g/m^3$, where previous, less specific studies only found an increased relative risk of 1.12 per 10 $\mu g/ m^3$.[7] These studies show that even incremental reductions in $PM_{2.5}$ exposure save lives. [8]

$PM_{2.5}$ induces a number of biological processes that contribute to cardiovascular morbidity and other life-threatening diseases. [9] Systemic inflammation caused by $PM_{2.5}$ affects the vascular system in a variety of ways.[10] Changes in platelet function can contribute to clots, heart attacks or strokes.[11] Changes in vascular reactivity can change the caliber of blood vessels and affect

---

Pope III et al., Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution, 287 J. Am. Med. Ass'n 9 (2002).

[5] Meredith Franklin et al., Association Between $PM_{2.5}$ and All-Cause and Specific-Cause Mortality in 27 U.S. Communities, 17 J. Exposure Sci. and Envtl. Epidemiology 279, 285 (2007) (finding association between $PM_{2.5}$ and daily mortality three times larger than mortality risk from PM_{10}); Cathryn Tonne et al., A Case Control Analysis of Exposure to Traffic and Acute Myocardial Infarction, 115 Envtl. Health Persp. 53, 53 (2007) (exposure to $PM_{2.5}$ and other traffic emissions was associated with increased risk of heart attack); Yun-Chul Hong et al., Effects of Air Pollutants on Acute Stroke Mortality, 110 Envtl. Health Persp. 187, 190 (2002) (demonstrating link between air pollution and stroke mortality)

[6] Henry A. Roman et al., Expert Judgment Assessment of the Mortality Impact of Changes in Ambient Fine Particulate Matter in the U.S., 42 Envtl. Sci. Tech. 2268 (2008) (EPA-conducted "expert elicitation" of 12 of the world's leading experts on health effects of air pollution revealed substantial agreement regarding likelihood of causal connection between exposure and premature death and suggesting larger estimates of saved lives from improved air quality); C. Arden Pope III, Mortality Effects of Longer Term Exposures to Fine Particulate Air Pollution: Review of Recent Epidemiological Evidence, 19 Inhalation Toxicology 33 (2007) (reviewing recent epidemiological studies to conclude that short-term exposure studies capture only a small amount of the overall health effects of long-term repeated PM exposure). See also Michael Jerrett et al., Spatial Analysis of Air Pollution and Mortality in Los Angeles, 16 Epidemiology 727, 732 (2005) (reviewing data from past study and finding that people living in more polluted neighborhoods are at greater risk than previously believed).

[7] Kristen A. Miller et. al., Long-Term Exposure to Air Pollution and Incidence of Cardiovascular Events in Women, 356 New England J. Med. 447 (2007); Douglas W. Dockery & Peter H. Stone, Cardiovascular Risks from Fine Particulate Air Pollution, 365 New Engl. J. Med. 511, 511 (2007) (editorial explaining significance of study).

[8] Francine Laden, et al., Reduction in Fine Particulate Air Pollution and Mortality: Extended Follow-up of the Harvard Six Cities Study, 173 Am. J. of Respiratory and Critical Care Med. 667 (2006) (In cities where the long-term average concentrations were below 13.4 $\mu g/m^3$, the linear dose-response association between $PM_{2.5}$ concentrations and total mortality persisted even at lower concentrations).

[9] Antonella Zanobetti & Joel Schwartz, The Effect of Particulate Air Pollution on Emergency Admissions for Myocardial Infarction: A Multicity Case-Crossover Analysis, 113 Envtl. Health Persp. 978 (2005); Daniela D'Ippoliti et al., Air Pollution and Myocardial Infarction in Rome: a Case-Crossover Analysis, 14 Epidemiology 528 (2003).

[10] See, e.g., Robert D. Brook et al., Air Pollution and Cardiovascular Disease: A Statement for Healthcare Professionals from the Expert Panel on Population and Prevention Science of the American Heart Association, 109 Circulation 2655, 2663-2665 (2004) (describing physiological responses to pollution leading to mortality and morbidity); Jiu-Chiuan Chen & Joel Schwartz, Metabolic Syndrome and Inflammatory Responses to Long Term Particulate Air Pollutants, 116 Envtl. Health Persp. 612, 616 (2008) (inflammatory response associated with long-term exposure to particulate matter); Andrew J. Ghio et al., Concentrated Ambient Air Particles Induce Mild Pulmonary Inflammation in Healthy Human Volunteers, 162 Am. J. Respir. & Critical Care Med. 981 (2000) (airway inflammation induced in healthy volunteers after short-term exposure to $PM_{2.5}$ indicated risk for vascular events).

[11] Andrea Baccarelli et al., Exposure to Particulate Air Pollution and Risk of Deep Vein Thrombosis, 168 Archives of Internal Med. 920, 926 (2008) (finding association between blood clots in legs and exposure to PM10); Andrew J. Ghio et al., Exposure to Concentrated Ambient Air Particles Alters Hematologic Indices in Humans, 15 Inhalation Toxicology 1465 (2003) (blood changes in healthy volunteers after PM exposure).

the amount of blood that gets to organs like the heart or brain.[12] $PM_{2.5}$ can also inhibit the body's ability to vary the heart rate in response to environmental or situational changes,[13] which can result in arrhythmia, the immediate cause of death for most heart attacks.[14] In fact, studies have linked short-term increases in PM to increased hospitalization for cardiovascular diseases.[15]

$PM_{2.5}$ can also affect blood vessel reactivity,[16] reducing the ability of blood vessels to provide adequate blood flow, and potentially reducing the effectiveness of medicines designed to increase blood flow. Year-round exposure to PM can significantly damage the small airways of the lungs.[17]
More recent studies have strengthened the conclusion that exposure to PM causes decreased lung function, even at levels below the NAAQS,[18] and that improvement in air quality can improve lung function.[19]

$PM_{2.5}$ can be particularly dangerous for vulnerable populations. Exposure to $PM_{2.5}$ and ozone increases the risk of pulmonary exacerbations and a significant loss in lung function for patients with cystic fibrosis.[20] $PM_{2.5}$ also affects children and infants.[21] Infants face 9% greater risk of bronchiolitis for each 10 $\mu g/m^3$ increase in $PM_{2.5}$.[22]

Exposure to $PM_{2.5}$ also has non-morbid effects that are expensive, harmful, and inconvenient. It can aggravate asthma.[23] Asthma is a medical condition in which the smooth muscles of the bronchial wall tighten in response to stimulants, like allergens, or pollutants.

---

[12] Miriam Lemos et al., Chronic Exposure to Urban Air Pollution Induces Structural Alterations in Murine Pulmonary Coronary Arteries, 18 Inhalation Toxicology 247 (2006) (study of mice exposed to PM and other traffic pollutants developed significant thickening of arterial wall); Robert D. Brook et al., Inhalation of Fine Particulate Air Pollution and Ozone Causes Acute Arterial Vasoconstriction in Healthy Adults, 105 Circulation 1534, 1535 (2002) (vasoconstriction caused by short-term inhalation of $PM_{2.5}$ reflects risk for myocardial infarction, stroke, or other cardiovascular events).
[13] R.B. Devlin et al., Elderly Humans Exposed to Concentrated Air Pollution Particles Have Decreased Heart Rate Variability, 21 European Respiratory. J. 76s (Supp. 2003);Y.C. Huang et al., The Role of Soluble Components in Ambient Fine Particles-Induced Changes in Human Lungs and Blood, 15 Inhalation Toxicology 327 (2003).
[14] S. Vedal et al., Air Pollution and Cardiac Arrhythmias in Patients with Implantable Cardioverter Defibrilators, 16 Inhalation Toxicology 252 (2004) (link between SO_2 exposure and implanted defibrillator activation).
[15] Francesca Dominici et al. Fine Particulate Air Pollution and Hospital Admission for Cardiovascular and Respiratory Diseases, 295 J. Am. Med. Assoc. 1127 (2006) (increase in hospital admissions associated with $PM_{2.5}$); Shang-Shyue Tsai et al., Evidence for an Association Between Air Pollution and Daily Stroke Admissions in Kaohsiung, Taiwan, 34 Stroke 2612 (2003).
[16] Bruce Urch, Relative Contributions of $PM_{2.5}$ Chemical Constituents to Acute Arterial Vasoconstriction in Humans, 16 Inhalation Toxicology 345 (2004) (exposure to $PM_{2.5}$ and ozone increased blood pressure).
[17] Andrew Churg et al., Chronic Exposure to High Levels of Particulate Air Pollution and Small Airway Remodeling, 111 Envtl. Health Persp. 714, 718 (2003).
[18] Morton Lippman, Health Effects of Airborne Particulate Matter, 357 New Engl. J. Med. 2395, 2396 (2007) (data from two recent studies indicate that low levels of airborne particles have adverse effects on human health).
[19] Sara H. Downs et al., Reduced Exposure to PM10 and Attenuated Age-Related Decline in Lung Function, 357 New Engl. J. Med. 2338, 2346 (2007) (concluding that relatively small reductions in particulate pollution could have measurable benefits for lung function). Schindler C, Keidel D, Gerbase MW, et al. Improvements in PM10 Exposure and Reduced Rates of Respiratory Symptoms in a Cohort of Swiss Adults (SAPALDIA). Am. J. Respiratory and Critical Care Med, 2009; 179: 579-587.
[20] Christopher H. Goss et al., Effect of Ambient Air Pollution on Pulmonary Exacerbations and Lung Function in Cystic Fibrosis, 169 Am. J. Respiratory and Critical Care Med. 816 (2004).
[21] See, e.g., Thais Mauad, Chronic Exposure to Ambient Levels of Urban Particles Affects Mouse Lung Development, 178 Am. J. Respiratory and Critical Care Med. 721, 727 (2008) (research findings suggest that exposure to ambient levels of $PM_{2.5}$ and other urban pollutants may adversely impact lung growth and development).
[22] Catherine Karr et al., Effects of Subchronic Exposure to Ambient Air Pollutants on Infant Bronchiolitis, 165 Am. J. Epidemiology 553, 557 (2007).
[23] Verena Morgenstern et al., Atopic Diseases, Allergic Sensitization, and Exposure to Traffic-Related Air Pollution in Children, 177 Am. J. Respiratory and Critical Care Med. 1331 (2008) (finding link between allergic sensitivity, including asthma, and $PM_{2.5}$ exposure).

The decreased radius of the bronchial tube increases the effort of breathing by the power of four. Asthma attacks can be frightening. The onset is often sudden, and it feels like breathing through a straw. Patients often say that they feel like they are suffocating or smothering. Besides this painful suffering and inconvenience, untreated asthma can scar the lungs and bronchial tubes, reducing lung function by as much as sixty percent.

These non-fatal health effects exact a toll on lives and budgets. Short-term increases in PM are linked to a rise in hospitalizations for children with aggravated asthma attacks.[24] Hospitalization is expensive. It can also cause lost work or lost school days. Reductions in $PM_{2.5}$ yield public health benefits.[25] In 2009, a study explored the effect of improved air quality by comparing data on $PM_{2.5}$ pollution and life expectancy in 51 cities throughout the U.S. for two periods of time—from the late 1970s and early 1980s and from the late 1990s to the early 2000s. After controlling for socioeconomic, demographic, and social factors (like smoking), the study revealed that a decrease of 10 $\mu g/m^3$ of fine particulate matter was associated with an increase in life expectancy of six months to two years, and reductions in air pollution accounted for as much as 15% of the overall increase in life expectancy seen in the study areas.[26] Following up on those communities, a study published this winter looked at mortality in 545 counties in the U.S. in 2000-2007 and found that cleaner air in those counties was associated with four additional months added to the average person's life.[27] Other studies released since trial also show that reductions in air pollution could be expected to produce substantial improvements in public health.[28]

Adverse Health Effects Caused By Ozone

Like $PM_{2.5}$, ozone endangers and inconveniences the health of children and adults, even at levels below the NAAQS. The EPA recently published it Integrated Science Assessment for Ozone, concluding that ozone causes respiratory harm, and likely causes premature death, cardiovascular harm, and is suggestive of causing central nervous system effects and

[24] James C. Slaughter et al., Effects of Ambient Air Pollution on Symptom Severity and Medication Use in Children with Asthma, 91 Annals of Allergy, Asthma, & Immunology 346 (2003) ($PM_{2.5}$ associated with aggravated asthma attacks); S. Lin et al., Childhood Asthma Hospitalization and Residential Exposure to State Route Traffic, 88 Envtl. Res. 73 (2002); Gary Norris et al., An Association Between Fine Particles and Asthma Emergency Department Visits for Children in Seattle, 107 Envtl. Health Persp. 489 (1999); Paige E. Tolbert et al., Air Quality and Pediatric Emergency Room Visits for Asthma in Atlanta, Georgia, 151 Am. J. Epidemiology 798 (2000).

[25] Joel Schwartz et al., The Effect of Dose and Timing of Dose on the Association between Airborne Particles and Survival, 116 Envtl. Health Persp. 64, 68 (2008) (finding no evidence of a threshold in the association between exposure to PM2.5 and the risk of death, suggesting that efforts to reduce particle concentrations as low as feasible is the most effective way to improve public health).

[26] C. Arden Pope III et al., Fine Particulate Air Pollution and Life Expectancy in the United States, 360 New Eng. J. Med. 371 (2009).

[27] Corriea AW, Pope CA III, Dockery DW, Wang Y, Ezzarti M, Domenici F. Effect of Air Pollution Control on Life Expectancy in the United States: An Analysis of 545 U.S. Counties for the Period from 2000 to 2007. *Epidemiology,* 2013; 24: 23-31.

[28] Antonella Zanobetti & Joel Schwartz, The Effect of Fine and Coarse Particulate Air Pollution on Mortality: a National Analysis, 117 Envtl. Health Persp. 898, 902 (June 2009) (concluding that the strong association between particle pollution and deaths suggests that tens of thousands of early deaths per year could be avoided by reducing particle concentrations and recommending controls on power plants); Robin C. Puett et al., Chronic Particulate Exposure, Mortality and Coronary Heart Disease in the Nurses' Health Study, 168 Am. J. Epidemiology 1161, 1167 (Oct. 2008) ("[O]ur findings add to a growing coherence of literature across multiple time scales indicating that the public health benefits of reducing particle concentrations will be realized within years, not decades, of the reduction."); Antonetta Zanobetti et al., Particulate Air Pollution and Survival in a COPD Cohort, 7 Environ Health 48 (Oct. 2008) (concluding that results of study heightens the urgency for pollution control measures because "reductions in air pollution should be followed quickly by improvements in public health").

reproductive and developmental effects.[29] These conclusions reflect consensus in the scientific community and are further supported by recently released studies.

Short-term exposure to high levels of ozone can shorten life.[30] "A series of recently published meta-analyses and primary national scale epidemiological studies have documented consistent associations between premature mortality and ozone exposures below the current 8-hour national ambient air quality standard."[31] In 2008, a report by the National Academy of Sciences confirmed that the premature deaths caused by ozone are not restricted to people who are already near death, and that the relationship between reductions in ozone concentrations and reductions in premature mortalities is generally linear, even below the NAAQS.[32] In other words, reducing ozone concentrations saves lives.

Exposure to ozone endangers children and adults. It has been linked to increased hospitalizations, emergency room visits, and decreased pulmonary function in children.[33] "The relation between ozone and respiratory illness is so well-established that emergency admissions have been suggested as a surrogate measure of ozone."[34] In Canada's largest cities, ozone was associated with increased hospitalization for respiratory problems in babies under 1 month. [35] In another study, Virginia infants had difficulty breathing when exposed to ozone levels lower than the current NAAQS.[36] Children are among those most vulnerable to ozone pollution because they have a higher level of activity and higher minute ventilation, increasing the effective dose of inhaled pollutant.[37]

Additionally, because 80% of the essential air sacs in the lungs (alveoli) grow after birth and because lung growth continues through adolescence, exposure to pollution, including ozone, is particularly harmful to children.[38] Harm from this exposure to high ozone levels can stay with

---

[29] U.S. EPA. Integrated Science Assessment of Ozone and Related Photochemical Oxidants (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-10/076F, 2013.

[30] Michelle L. Bell et al., A Meta-Analysis of Time-Series Studies of Ozone and Mortality with Comparison to the National Morbidity, Mortality, and Air Pollution Study, 16 Epidemiology 436, 442 (2005); Jonathan I. Levy et al., Ozone Exposure and Mortality: An Empiric Bayes Metaregression Analysis, 16 Epidemiology 458 (2005); Kazuhiko Ito et al., Associations Between Ozone and Daily Mortality: Analysis and Meta-Analysis, 16 Epidemiology 446 (2005); Steven N. Goodman, The Methodologic Ozone Effect, 16 Epidemiology 430 (2005); Michelle L. Bell et al., Ozone and Short-Term Mortality in 95 US Urban Communities, 1987-2000, 292 J. Am. Med. Ass'n 2372, 2377 (2004); Alexandros Gryparis et al., Acute Effects of Ozone on Mortality from the "Air Pollution and Health: A European Approach" Project, 170 Am. J. Respiratory & Critical Care Med. 1080, 1083 (2004).

[31] Kent E. Pinkerton et al., Ozone, a Malady for All Ages, 176 Am. J. Respiratory and Critical Care Med., 107 (2007).

[32] National Research Council, Estimating Mortality Risk Reduction and Economic Benefits from Reducing Ozone Air Pollution: Executive Summary 8, 9 (April 2008).

[33] Jennifer L. Peel et al., Ambient Air Pollution and Respiratory Emergency Department Visits, 16 Epidemiology 164 (2005); Toby C. Lewis et al., Air-Pollution Associated Changes in Lung Function Among Asthmatic Children in Detroit, 113 Envtl. Health Persp. 1068 (2005); Richard T. Burnett et al., Association Between Ozone and Hospitalization for Acute Respiratory Diseases in Children Less than 2 Years of Age, 153 Am. J. Epidemiology 444, 449 (2001); George D. Thurston et al., Summertime Haze Air Pollution and Children with Asthma, 155 Am. J. Respiratory & Critical Care Med. 654 (1997).

[34] David V. Bates, Ambient Ozone and Mortality, 16 Epidemiology 427, 428 (2005).

[35] Robert E. Dales et al., Gaseous Air Pollutants and Hospitalization for Respiratory Disease in the Neonatal Period, 114 Env. Health Persp. 1751, 1754 (2006);

[36] Elizabeth W. Triche et al., Low-level Ozone Exposure and Respiratory Symptoms in Infants, 114 Env. Health Persp. 911, 915 (2006).

[37] Pinkerton et al., supra 30 at 107.

[38] Janice J. Kim et al., Ambient Air Pollution: Health Hazards to Children, 114 Pediatrics 1699, 1699-1700 (2004) (policy statement by American Academy of Pediatrics, Committee on Environmental Health); W. James Gauderman et al., The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age, 351 New Engl. J. Med. 1057, 1063 (2004) ("the greatest effect of pollution-related deficits may occur later in life, since reduced lung function is a strong risk factor for complications and death during adulthood.").

children for life. In California, a study followed 3535 children from schools in twelve southern California communities for up to five years and found that children who played team sports in communities with high daytime ozone concentrations had a 3.3% greater risk of developing asthma.[39] A study of 255 college freshmen found that students who grew up in areas with more ambient ozone had decreased lung function, a risk factor for lung disease later in life.[40]

Ozone endangers adults as well,[41] leading to decreased lung function[42],increased susceptibility to respiratory infections,[43] and asthma exacerbations.[44] Controlled human exposure studies of healthy adults demonstrate reduced lung function, respiratory symptoms, changed airway responsiveness, and airway inflammation following exposure to ozone at and, for some, below the current NAAQS.[45] A clinical study published this summer confirmed that healthy adults exposed to ozone concentrations below the current NAAQS experienced significant reductions in lung function and subjective respiratory symptoms—the higher the level of ozone exposure, the greater the decrease in lung function.[46]

Ozone also exacerbates asthma. Health experts warn that air pollution, including ozone, is "one of the most under-appreciated contributors to asthma exacerbation."[47] Asthma exacerbations are dangerous, expensive, and inconvenient because they can lead to hospitalization, increased medicine use, and potentially permanent scarring.

Dr. Peden's testimony that he typically sees a rise in hospitalizations and receives more requests for inhalers or anti-inflammatory asthma medication refills 24 to 48 hours after an ozone event is consistent with the studies cited above.[48] Hospitalization and medication are expensive. An emergency visit begins at $1,300 to $1,500, and admission to the hospital averages a minimum of $5,000. Asthma medication is also expensive.

---

[39] Rob McConnell et al., Asthma in Exercising Children Exposed to Ozone: a Cohort Study, 359 Lancet 386 (2002).
[40] Ira B. Tager et al., Chronic Exposure to Ambient Ozone and Lung Function in Young Adults, 16 Epidemiology 751 (2006).
[41] Helene Desqueyroux et al., Effects of Air Pollution on Adults with Chronic Obstructive Pulmonary Disease, 6 Archives Envtl. Health 554 (2002); Peter Höppe et al., Environmental Ozone Effects in Different Population Subgroups, 206 Int'l J. Hygiene & Envtl. Health 505 (2003); Ralph J. Delfino et al., Emergency Room Visits for Respiratory Illnesses Among the Elderly in Montreal: Association with Low Level Ozone Exposure, 76 Envtl. Res. 67 (1998); John M. Peters et al., A Study of Twelve Southern California Communities with Differing Levels and Types of Air Pollution II: Effects on Pulmonary Function, 159 Am. J. Respiratory & Critical Care Med. 768 (1999); Patrick L. Kinney & Mortin Lippmann, Respiratory Effects of Seasonal Exposures to Ozone and Particles, 55 Archives Envtl. Health 210 (2000).
[42] Chang-Chuan Chan & Tsung-Huan Wu. Effects of Ambient Ozone Exposure on Mail Carriers' Peak Expiratory Flow Rates. *Environ Health Perspec* 2005; 113:735-738. Ira Tager, et al. Chronic Exposure to Ambient Ozone and Lung Function in Young Adults. *Epidemiology* 2005; 16:751-759.
[43] John Hollingsworth et al., Ozone and Pulmonary Innate Immunity, 4 Proc. Am. Thoracic Soc'y 240, 243-44 (2007).
[44] Helene Desqueyroux et al., Short-Term Effects of Low-Level Air Pollution on Respiratory Health of Adults Suffering from Moderate to Severe Asthma, 89 Envtl. Res. 29 (2002); Richard T. Burnett et al., Association Between Ozone and Hospitalization for Respiratory Diseases in 16 Canadian Cities, 72 Envtl. Res. 24 (1997).
[45] See, e.g., William C. Adams Comparison of Chamber 6.6 Hour Exposures to .04-.08 PPM Ozone Via Square-Wave and Triangular Profiles on Pulmonary Responses, 18 Inhalation Toxicology 127 (2006); Williams C. Adams, Comparison of Chamber and Face-Mask 6.6 Hour Exposures to Ozone on Pulmonary Function and Symptoms Responses, 14 Inhalation Toxicology 745 (2002) (finding effects on lung and respiratory symptoms as low as .06 ppm); R.B. Devlin et al., Exposure of Humans to Ambient Levels of Ozone for 6.6 Hours Causes Cellular and Biochemical Changes in the Lung, 4 Am. J. Respiratory Cell Molecular Biology 72 (1991); D.H. Horstman et al., Ozone Concentration and Pulmonary Response Relationships for 6.6 Hour Exposures with Five Hours of Moderate Exercise to 0.08, .10, and .12 ppm, 142 Am. Rev Respir Dis 1158 (1990).
[46] Edward S. Schelegle et al., 6.6-Hour Inhalation of Ozone Concentrations from 60 to 87 Parts Per Billion in Healthy Humans, 180 Am. J. Respiratory & Critical Care Med. 265 (2009).
[47] George D. Thurston & David V. Bates, Air Pollution as an Underappreciated Cause of Asthma Symptoms, 290 J. Am. Med. Ass'n 1915, 1915 (2003).
[48] See, e.g., National Research Council supra note 32.

A patient with mild symptoms may take only one type of medicine, at $200 a month; while more severe asthmatics or asthmatics with allergies may spend up to $800 a month for as many as six types of medicine. This cost is borne by the state and federal government in Medicare, Medicaid and other federal health program payments as well as individuals. Ozone exacerbates reactions to allergens, which can also trigger asthma attacks and increased use of medication.

Even in healthy adults, ozone can inflame the lungs and cause immediate discomfort, including shortness of breath, chest pain, wheezing and coughing.[49] William Steven Harlan, a competitive distance runner who runs everything from marathons to 100-mile races, found himself incapacitated by this effect. On July 19, 2003, as he ran along the Tennessee-North Carolina border through the Great Smoky Mountains National Park, he began feeling light-headed, tightness in his chest, and an inability to inhale deeply. Id. at 873-74. Eventually, his breathing became so labored that he could only walk 100 yards at a time before he had to sit down on the trail to catch his breath. This experience, the first time in Mr. Harlan's life that he could not breathe, happened on an ozone alert day.[50]

Other Pollutants

While most research has focused on ozone and PM2.5 other air pollutants, like mercury, lead, acid gases, NOx, SOx, and heavy metals are equally well documented in their adverse human health effects.

Recently, studies have found more evidence linking air pollution to birth defects and pediatric cancers. A study published in the American Journal of Epidemiology linked exposure to air pollution – in this case carbon monoxide and nitrogen oxides - in the first two months of pregnancy to increased chance of neural tube defects. [51] In a study presented Tuesday at the American Association of Cancer research, scientist presented evidence linking exposure to from roadway vehicle exhaust with increased odds of developing pediatric cancer of the eyes and cells that develop into the reproductive system.[52]

Benefits of the Clean Air Act

The health and economic benefits of the Clean Air Act far exceed compliance costs. External analysis of 1990-2020 benefits of the Clean Air Act standards estimate that the $65 billion spent to comply with pollution standards will result in $2trillion in avoided health expenditures by 2020. Even under the most conservative cost benefit analysis – which removes the cost savings attributed to air pollution control driven reductions mortality – Clean Air Act standards will still generate $137 billion in benefits versus an estimated $65 billion in compliance costs.

---

[49] Ian S. Mudway & Frank J. Kelly, An Investigation of Inhaled Ozone Dose and the Magnitude of Airway Inflammation in Healthy Adults, 169 Am. J. Respiratory and Critical Care Med. 1089, 1093 (2004); W.F. McDonnell et al., Ozone-Induced Respiratory Symptoms: Exposure-Response Models and Association with Lung Function, 14 European Respiratory J. 845 (1999).

[50] Trial Tr. vol. 4A, 864-65. (July 17, 2008).

[51] Padula AM, Tager IB, Carmichael SL, Hammond K, Lurmann F, Shaw GM. The Association of Ambient Air Pollution and Traffic Exposures with Selected Congenital Anomalies in the San Joaquin Valley of California. Am J Epidemiology 2013; doi: 10.1093/aje/kws367.

[52] Ostrow, Nicole. "Air Pollution Expousre in Pregnancy Linked to Cancers." Bloomberg, April 9, 2013. Available at http://www.bloomberg.com/news/print/2013-04-09/air-pollution-exposure-in-pregnancy-linked-to-cancers.html.

Below is a table that list the estimated adverse health events avoided by Clean Air Act standards.

Health Effect Reductions (PM2.5	Pollutant(s)	Year	Year 2020
PM2.5 Adult Mortality	PM		160,000
PM2.5 Infant Mortality	PM		230
Ozone Mortality	Ozone		4,300
Chronic Bronchitis	PM		54,000
Acute Bronchitis	PM		130,000
Acute Myocardial Infarction	PM		130,000
Asthma Exacerbation	PM		1,700,000
Hospital Admissions	PM, Ozone		86,000
Emergency Room Visits	PM, Ozone		86,000
Restricted Activity Days	PM, Ozone		84,000,000
School Loss Days	Ozone		3,200,000
Lost Work Days	PM		13,000,000

(*source: The Benefits and Costs of the Clean Air Act from 1990 to 2020: Summary Report, page 14*)

Summary

The adverse health effects of air pollution are well known and fully documented in the scientific literature. Equally well established are the health and economic benefits associated with reductions in air pollution. For these reasons, the American Thoracic Society strongly urges Congress to reject any legislation that limits, weakens or delays the ability of the Environmental Protection Agency to implement the science based standards of the Clean Air Act.