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P. (212) 315 - 8600
F. (212) 315 - 6498

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

Comments from the American Thoracic Society
Presented by Mary B. Rice MD MPH
Before the Senate Environment and Public Works Committee
Subcommittee on Clean Air and Nuclear Safety
on
EPA's Proposed Carbon Regulations
June 23, 2015

Ms. Chairwoman, Mr. Ranking member, my name is Dr. Mary Rice. I am an adult pulmonologist and critical care physician at Beth Israel Deaconess Medical Center and Harvard Medical School in Boston, and also Vice-Chair of the Environmental Health Policy Committee of the American Thoracic Society. When I am not caring for patients, I am engaged in research on the respiratory health effects of ambient air pollution exposure among children and adults. On behalf of the American Thoracic Society, I want to thank the Committee for the opportunity to testify regarding the proposed carbon regulations of the Environmental Protection Agency (EPA). The American Thoracic Society is a medical professional organization with over 15,000 professionals and patients who are dedicated to the prevention, detection, treatment and cure of respiratory disease, critical care illnesses and sleep-disordered breathing. We pursue our mission through research, clinical care, education and advocacy. The American Thoracic Society has identified climate change as one of the most important health issues facing our patients, who are children and adults across the United States, most of whom suffer from critical illness or lung disease(1, 2).

The 2013 Intergovernmental Panel on Climate Change (IPCC) report concluded that carbon dioxide concentrations have risen by 40% since pre-industrial times, primarily due to fossil fuel emissions, and have reached levels "unprecedented in at least the last 800,000 years"(3). The report concluded that global warming is "unequivocal" and that with 95-100% certainty, the observed warming since the 1950's is primarily due to human activity(3). In the past decade, an accumulation of scientific evidence has shown that climate change is not only an environmental and economic problem, it is a human health problem of enormous proportions. Some of the most well-described human health consequences of climate change are caused by:

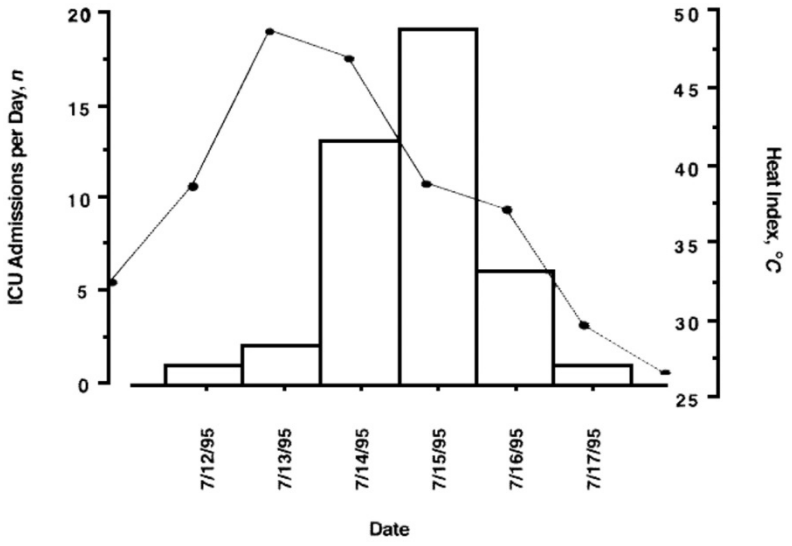
(1) heat waves
(2) spikes in ozone pollution
(3) forest fires
(4) longer and more potent pollen seasons

Last year, the American Thoracic Society Environmental Health Policy Committee collaborated with George Mason University to conduct a survey of United States American Thoracic Society members about climate change and health(4). The survey respondents were predominantly clinicians (89% held an M.D. or other clinical professional degree). Overall, 89% of member respondents judged that climate change is presently happening and 68% indicated that climate change is mostly or entirely caused by human activity. What may be especially surprising to many, is that **most physicians responding to the survey reported that they have already observed symptoms among their patients that they attribute to climate change**. For example, 77% of respondents have noted increases in the severity of chronic illness resulting from spikes in air pollution as a consequence of climate change, such as ozone or wildfires. Also, 58% noted increases in allergic disease symptoms and 48% observed heat-related health effects among patients. Of the many clinical anecdotes provided, several respondents commented about regional wildfire activity and urban high ozone events affecting their patients with asthma or chronic obstructive pulmonary disease, and many noted increases in allergic disease symptoms and injuries due to changes in weather.

Our patients and their families are already suffering as a result of greenhouse gas emissions, and the healthcare system is already paying the cost of hospitalizations, doctor visits and drug prescriptions to treat these problems. Without efforts to reduce greenhouse gas emissions, the human health toll for American families will continue to rise. I will review some of the human health consequences of climate change for which there is a high level of confidence and scientific evidence of health effects, with a focus on cardiopulmonary health.

1. Heat Waves

Heat waves have well-documented adverse health effects. It is therefore highly concerning that climate models predict up to a 50% increase in the frequency in the hottest (ie, the top 5th percentile based on historical records) days by mid-century(5, 6). Extreme heat increases mortality, especially among the elderly and those with chronic disease(7, 8). The heat wave that hit western Europe in August 2003 resulted in an excess of 15,000 deaths in France alone(9). In July 1995, Chicago experienced a heat wave that resulted in more than 600 excess deaths, 3,300 excess emergency department visits, and a large number of intensive care unit admissions for near-fatal heat stroke(10). Heat stroke patients admitted to the intensive care unit suffered from brain impairment, kidney failure and derangement of the clotting system, and 21% died during their hospital admission(10). The chart below demonstrates the increase in intensive care unit admissions for near-fatal heat stroke in 12 Chicago-area hospitals during the 1995 heat wave:



Relation between admissions to the intensive care unit (ICU) for near-fatal heat stroke (bar graph) and the heat index (line chart) during the height of the heat wave. Admissions increased 24 hours after the peak heat index on 13 July 1995. The peak admission rate occurred 2 days later, on 15 July 1995. Intensive care unit admissions coincided with heat-related deaths reported by the Cook County Medical Examiner's office. From: Dermatte et al. Ann Intern Med. 1998;129(3):173-181

Extreme heat events are linked to higher rates of hospitalization for respiratory and heart disease. Acute increases in temperature and humidity are associated with increased emergency department visits and hospitalizations for asthma in children and adults (11, 12). For example, a study of 12.5 million Medicare beneficiaries found that each 10°F increase in daily temperature was associated with a 4.3% increase in same-day emergency hospitalizations for respiratory diseases(13). A study examining hourly temperature and incidence of heart attacks found that when temperatures exceeded a threshold of 68 °F, people's risk of heart attack increased 1-6 hours later(14). There is also evidence that extreme heat may trigger exacerbations of congestive heart failure(12).

People living in cities, particularly low income families living in neighborhoods with large buildings and little open space, are especially vulnerable to extreme heat(15), because of an urban "heat island" effect. As average temperatures increase, populations will adjust to a higher temperature range, but they will continue to be vulnerable at temperature extremes(16). Recent studies have examined the effect of adaptation (including air conditioning use) on heat-related mortality, and have concluded that adaptation does reduce premature mortality due to extreme heat(17, 18). If greenhouse gas emissions continue without abatement, the need for measures such as widespread subsidies for air conditioning for low income families, the construction of cooling centers, and surveillance programs for the frail and elderly to prevent premature death and hospitalization due to extreme heat is likely to become an essential public health priority in cities across the United States.

Extreme heat also impairs outdoor worker productivity, because unprotected outdoor work in extreme heat can lead to heat stroke and heat exhaustion, electrolyte disturbances and dehydration. A number of indexes have been developed, including indices from the Occupational Safety & Health Administration (OSHA) and the US army, to establish safe temperature ranges for outdoor work of varying work intensities(19, 20). Greenhouse gas

emissions increase the frequency of days with heat levels that are unsafe for continuous outdoor work, mandating more breaks and reducing worker productivity. Emissions also increase the frequency of days that are unsafe for any heavy outdoor work, such as occupational lifting, carrying and digging(21). One study estimated that global warming since the pre-1960 baseline has decreased global working capacity by 3 % during the peak summer season, and predicts that if greenhouse gas emissions rates continue along their historical trajectory, future global working capacity will drop to below 40 percent during the peak summer season (21). Workers in mid-latitude regions such as the US east of the Rockies, are expected to be exposed to dangerous environmental heat stress, experienced today only by the most extremely hot regions of the Earth, if greenhouse gas emissions continue along their historical trajectory(21).

2. Ozone Pollution

Ground-level ozone is a major component of photochemical smog that is formed through atmospheric reactions of nitrogen oxides and volatile organic compounds (both emitted by motor vehicles and fossil fuel burning) in the presence of sunlight. Ozone formation increases with more sunlight and higher temperature(22).

The frequency and intensity of ozone episodes during summer months are projected to increase as a result of rising temperatures(23, 24). Recent heat waves have been associated with ozone levels that exceeded air quality standards(25). Because ozone is a lung and airway irritant(26, 27), people with pre-existing lung disease like asthma or chronic obstructive pulmonary disease are particularly susceptible to adverse health effects of ozone exposure. A substantial body of evidence has shown that modest short-term increases in ground-level ozone increase risk of acute care visits and hospitalization for asthma (28–31) and chronic obstructive pulmonary disease(32, 33). Ozone exposure also been associated with deterioration in asthma control, resulting in increased medication use and missed school and work days (34, 35).

Spikes in ozone have been associated with increases in all-cause mortality(36). The deadly heat wave of 2003 in Europe was accompanied by high levels of ozone that are thought to have contributed to excess mortality in addition to the mortality caused by the heat itself(25, 37).

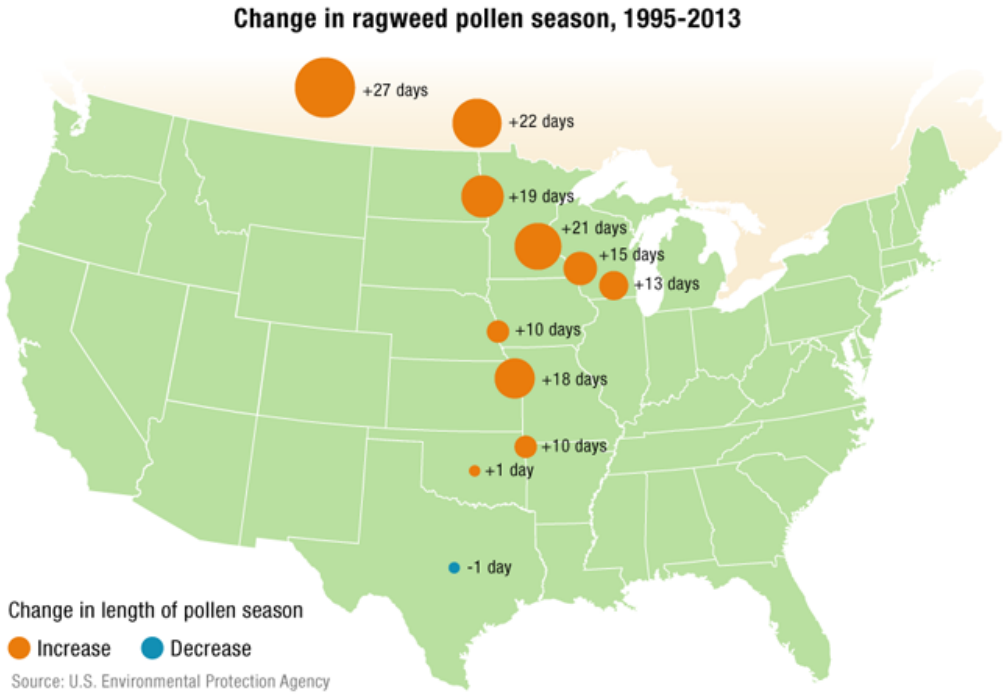
3. Forest Fires

Climate models indicate that with 1°C of warming, wildland fire risk may increase 2- to 6-fold over the 1950-2003 baseline in most of the continental U.S. west of the Mississippi(38). When forests burn they release a range of pollutants, from particulate matter and acrolein (a respiratory irritant) to carcinogens such as formaldehyde and benzene. For example, wildfire in the Pocosin Lakes National Wildlife refuge in North Carolina produced smoke and haze intermittently for a number of weeks in 2008. Maximum daily smoke-related fine particulate matter levels reached as high as 129 $\mu g/m^3$, which is nearly 4 times the current EPA daily standard of 35 $\mu g/m^3$ for fine particulate matter(39). Studies suggest that particles in wildfire smoke are more toxic to the lung than particulate matter from other sources of pollution(40).

The number of wildfires over 1,000 acres in size in the region stretching from Nebraska to California increased by a rate of seven fires a year and 88,000 acres burned per year from 1984 to 2011(41). Although forest fires may ignite in only certain regions, their smoke plumes may extend over great distances. During the Russian heat wave of 2010, for instance, smoke from more than 500 wildfires stretched across more than 1800 miles – roughly the distance from San Francisco to Chicago (42). Exposure to wildland fire smoke has been associated with asthma and chronic obstructive pulmonary disease emergency room visits and hospitalizations(43–45), congestive heart failure episodes(39) and overall mortality(46). For example, the 2008 wildfires in North Carolina increased risk of asthma hospitalization by 66% for every 100 $\mu g/m^3$ increase in fine particulate matter(39).

4. Pollen Season

Higher levels of carbon dioxide and a warming climate worsen the global burden of allergic disease, which has been increasing in prevalence in the industrialized world for more than 50 years(47). Worldwide, between 10 and 30% of people suffer periodically from seasonal allergies and up to 40% show evidence in their blood of sensititivity to allergens in the environment(47). Warmer temperatures lengthen the pollen season because plants bloom earlier in the spring. Between 1995 and 2009, the pollen season lengthened 13-27 days above 44 degrees north in the U.S.(48). Ragweed pollen season has lengthened by 24 days in the Minnesota-North Dakota region between 1995 and 2011 (49). Higher levels of carbon dioxide in the atmosphere have also been found to increase pollen productivity and the allergic potency of pollen(50, 51).



Higher pollen levels are linked to allergic sensitization in the blood(52) and more healthcare utilization for allergic disease, measured in terms of over-the-counter allergy medication use(53), and emergency room and physician office visits for allergic disease(54, 55).

Longer, more potent allergy seasons are especially detrimental to people with asthma. Numerous studies have found increases in asthma and wheeze-related emergency room visits when pollen levels are higher(56–59)

In 2010, Americans with seasonal allergies spent approximately 17.5 billion on health-related costs, lost more than 6 million work and school days, and made 16 million visits to their doctors(60). Seasonal allergies already exert a huge toll on the health of the American public. Rising carbon dioxide emissions are expected to continue to worsen this problem by lengthening the pollen season and further increasing pollen production across the United States.

Conclusion

People across the United States with lung, heart and allergic disease, and especially the frail and elderly, are already suffering the health consequences of climate change. Physicians of the American Thoracic Society are observing these symptoms among our patients in our clinics, emergency departments and intensive care units nationwide. There is an urgency to reduce greenhouse gas emissions for the sake of human health.

I would be happy to answer any questions.

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