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Title

Exposure to extreme heat and precipitation events associated with increased risk of hospitalization for asthma in Maryland, U.S.A.

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Abstract

Background

The Centers for Disease Control and Prevention (CDC) estimates that about 24 million people in the US today have asthma, including 6.3 million, or 8.6% of children[1]. Asthma affects the lungs, and causes repeated episodes of wheezing, breathlessness, chest tightness, and coughing[2]. There are many environmental triggers of asthma that can exacerbate asthma symptoms, especially for vulnerable populations like children. These triggers include both indoor (mold, dust, cigarette smoke, certain types of cleaning products) and outdoor allergens (pollen and air pollution like ozone)[3]. High temperatures can increase the onset and length of the pollen season, and increase ground level ozone concentrations, which can both exacerbate asthma symptoms. Precipitation events such as thunderstorms, heavy rainfall and wind may trigger releases of fungal spores carried by wind, which can exacerbate asthma symptoms as well ("thunderstorm associated asthma")[4]. These extreme temperature and/or precipitation weather events are projected to increase in frequency, duration, and intensity with climate change[5]. Previous studies have investigated the association between daily weather, including temperature and precipitation, and asthma symptoms, but there has not been much research on the impacts of increased frequency of these extreme weather events.

Objective

The objective of this study was to quantify the association between the frequency of extreme heat and precipitation events and increased risk of hospitalization for asthma in Maryland between 2000 and 2012.

Methods

The researchers gathered meteorological data on both daily maximum temperature and total precipitation for Maryland counties for the period 1960-2012, and used the data from 1960-1989 to establish a 30-year baseline of extreme daily threshold values. Daily temperature and precipitation data from the 2000-2012 study period was then defined as "extreme" if they exceeded the baseline threshold values. Hospital admission data specific to the principle diagnosis code of asthma was obtained for 2000-2012. The asthma hospitalization data was then linked to the weather data, including those days defined as "extreme", to assess the association between exposure to extreme temperature/precipitation events and the risk of hospitalization for asthma.

Results

The overall study showed that exposure to extreme heat events was associated with a 3% increase in risk of hospital admission for asthma, and the risk was higher when the analysis was restricted to the summer months. This trend of higher risk during summer months was consistent across gender, age, groups and race, except for Hispanics. The risk

[1]FastStats: Asthma. (2016, February). Retrieved July 22, 2016, from http://www.cdc.gov/nchs/fastats/asthma.htm
[2]Asthma. (2016, May). Retrieved July 20, 2016, from https://www.cdc.gov/asthma/
[3]Asthma Triggers: A Guide for Parents, Teachers, Doctors and Nurses. (2015). Retrieved July 20, 2016, from http://www.cehn.org/wp-content/uploads/2015/12/asthma_ebook_cehn.pdf
[4]A Grundstein, S E Sarnat, M Klein, M Shepherd, L Naeher, T Mote and P Tolbert. (July 2008). Thunderstorm associated asthma in Atlanta, Georgia.Thorax, 63. Retrieved from http://thorax.bmj.com/content/63/7/659.2.full.pdf+html
[5]Intergovernmental Panel on Climate Change. (2012). Managing the risks of extreme events and disasters to advance climate change adaptation. Retrieved from https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf

was highest among the 5-17 year old age group. Extreme precipitation was not associated with an increased risk for hospitalization for asthma in the overall study. However, when the study was restricted to the summer months, there was an increased 11% risk for hospitalizations, and there was a higher risk for risk for the youngest age group in the study (4 years or younger).

Conclusion

The findings of this study suggest that exposures to increased frequency of extreme heat events are associated with increased risk of asthma hospitalization of children between 5-17 years of age in Maryland, particularly during the summer months. Additionally in the summer months, extreme precipitation events also increases the risk of hospitalization from asthma, especially for the youngest age group (under 4 years).

Policy Implications

Climate change occurs when there is a significant change in climate conditions that last for a decade or longer. Changes in the pattern and intensity of rainfall, temperature, and wind have been scientifically associated with increased carbon dioxide (CO_2), methane and other greenhouse gases released into the environment[6]. Indeed, the burning of fossil fuels in response to U.S. population growth and high energy demand is the main driver of climate change in the U.S[7]. According to the U.S. Environmental Protection Agency (EPA), CO_2 emissions have increased by 9% from 1990 to 2014. Moreover, the first half of 2016 broke global warming records with the warmest months experienced since 1880[8]. These changes come with substantial societal costs on public health and our economy.

Hotter days and longer heat wave events will impact the number and frequency of heat-related illnesses and deaths overall, with urban centers being especially vulnerable. Warmer days will likely be accompanied with higher ground-level ozone, a very harmful air pollutant[9]. Because ground-level ozone can trigger respiratory conditions like asthma, 24 million Americans – including 6 million children - already suffering from this condition will be visiting the hospital even more than they already are[10].

These projected climate change impacts on human health indicate an intense need for policy that will prepare society to respond to and mitigate negative health impacts like asthma. EPA has set national carbon pollution standards for power plants under President Obama's Clean Power Plan with the goal of reducing national CO_2 emissions by 32% by 2030. While the Plan has been halted by Supreme Court ruling, it would require states to transform how they produce energy – encouraging them to reduce their reliance on fossil fuels and shift to clean energy production powered by wind and solar[11]. Whether or not the Plan is implemented will likely fall into the hands of the next administration. Reducing greenhouse gas emissions, especially for those impacted the most – children, elderly, people of color and the poor – **must** be a national priority[12]. Societal adaptation in both the private and government sectors will be needed to reduce negative impacts on human health, infrastructure and our economy. The economic cost of not having timely and sufficient climate policy in place is estimated to be at least $150 billion per year[13].

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[6]Climate Change Causes: A blanket around the earth. (July 2016). Retrieved from http://climate.nasa.gov/causes/
[7]Overview of Greenhouse Gases. (May 2016). Retrieved July 20, 2016, from https://www3.epa.gov/climatechange/ghgemissions/gases/co2.html
[8]2016 climate trends continue to break records. (July 19, 2016). Retrieved July 20, 2016, from https://www.nasa.gov/feature/goddard/2016/climate-trends-continue-to-break-records
[9]Climate Impacts on Human Health. (2016, April). Retrieved July 20, 2016, from https://www3.epa.gov/climatechange/impacts/health.html
[10]Asthma Facts. (August 2015). Retrieved July 20, 2016 from https://www.epa.gov/sites/production/files/2015-10/documents/asthma_fact_sheet_eng_july_30_2015_v2.pdf
[11]A historic commitment to protecting the environment and reversing climate change. Retrieved July 20, 2016 from https://www.whitehouse.gov/sites/whitehouse.gov/files/achievements/atf_climate_booklet.pdf
[12]Asthma Facts: CDC's national asthma control program grantees. (July 2013). Retrieved July 20, 2016 from https://www.cdc.gov/asthma/pdfs/asthma_facts_program_grantees.pdf
[13]The cost of delaying action to stem climate change. (July 2014). Retrieved July 20, 2016 from http://bit.ly/2acSG2b

In general, all climate change policies, planning and response measures should consider and address child-specific vulnerabilities and needs. Investments in, and implementation of, preventive strategies such as surveillance and early warning systems are needed, as are continued and increased support for state and local health departments and partners to adapt to the present and future health effects of climate change. The adoption of certain non-health sector policies, such as smart community design and healthy food production, may also serve to reduce harmful emissions, and these co-benefits should be sought in policymaking across sectors.

Because the effects of climate change can be geographically-specific, it is important that similar geographically-focused research studies be done in other cities and states. This study's findings highlight the need to address climate change at the national and local level to protect the health of communities, especially vulnerable populations.

Reference

Article available in Environmental Health.

Keyword(s)

Asthma, Climate Change, Extreme weather