Heat-Related Deaths

This indicator presents data on deaths classified as "heat-related" in the United States.

Background

When people are exposed to extreme heat, they can suffer from potentially deadly heat-related illnesses, such as heat exhaustion and heat stroke. Heat is the leading weather-related killer in the United States, even though most heat-related deaths are preventable through outreach and intervention (see EPA's *Excessive Heat Events Guidebook* at: www.epa.gov/heatisland/about/pdf/EHEguide_final.pdf).

Unusually hot summer temperatures have become more frequent across the contiguous 48 states in recent decades[1] (see the High and Low Temperatures indicator), and extreme heat events (heat waves) are expected to become longer, more frequent, and more intense in the future.[2] As a result, the risk of heat-related deaths and illness is also expected to increase.[3]

Increases in summertime temperature variability may increase the risk of heat-related death for the elderly and other vulnerable populations.[4] Older adults have the highest risk of heat-related death, although young children are also sensitive to the effects of heat. Across North America, the population over the age of 65 is growing dramatically. People with certain diseases, such as cardiovascular and respiratory illnesses, are especially vulnerable to excessive heat exposure, as are the economically disadvantaged.

Some studies suggest that the number of deaths caused by extremely cold temperatures might drop in certain areas as the climate gets warmer, while others do not expect the number to change at all.[5,6] Any decrease in cold-related deaths will most likely be substantially less than the increase in summertime heat-related deaths.[7,8,9]

About the Indicator

This indicator shows the annual rate for deaths classified by medical professionals as "heat-related" each year in the United States, based on death certificate records. Every death is recorded on a death certificate, where a medical professional identifies the main cause of death (also known as the underlying cause), along with other conditions that contributed to the death. These causes are classified using a set of standard codes. Dividing the annual number of deaths by the U.S. population in that year, then multiplying by one million, will result in the death rates (per million people) shown in Figure 1.

This indicator shows heat-related deaths using two methodologies. One method shows deaths for which excessive natural heat was stated as the underlying cause of death from 1979 to 2013. The other data series shows deaths for which heat was listed as either the underlying cause or a contributing cause, based on a broader set of data that at present can only be evaluated back to 1999. For example, in a case where cardiovascular disease was determined to be the underlying cause of death, heat could be

listed as a contributing factor because it can make the individual more susceptible to the effects of this disease. Because excessive heat events are associated with summer months, the 1999–2013 analysis was limited to May through September.

Key Points

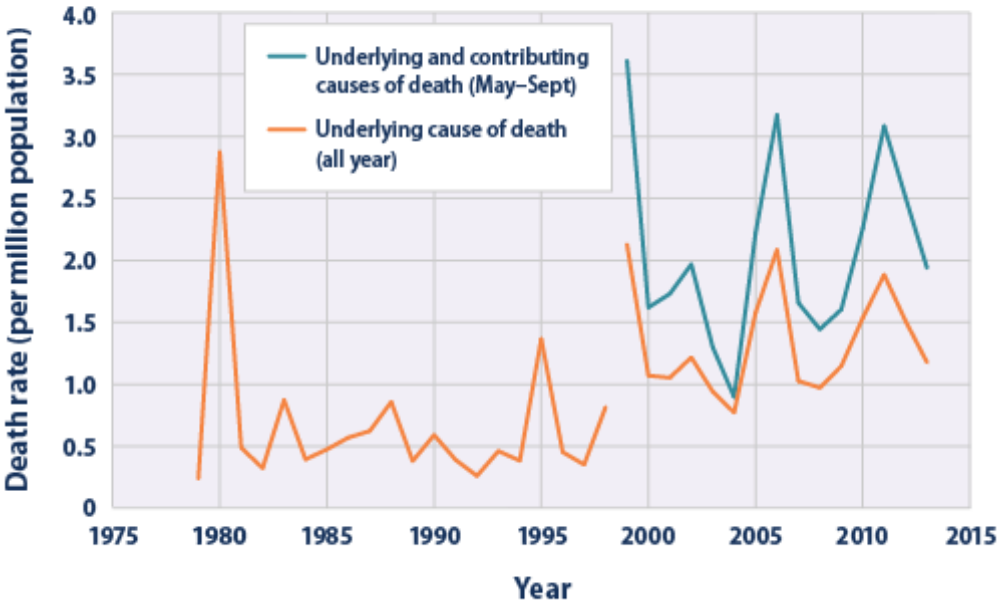
- Between 1979 and 2013, the death rate as a direct result of exposure to heat (underlying cause of death) generally hovered around 0.5 deaths per million population, with spikes in certain years (see Figure 1). Overall, a total of more than 9,000 Americans suffered heat-related deaths since 1979. This number does not capture the full extent of heat-related deaths for several reasons (see example figure).

- For years in which the two records overlap (1999–2013), accounting for those additional deaths in which heat was listed as a *contributing* factor results in a higher death rate—nearly double for some years—compared with the estimate that only includes deaths where heat was listed as the *underlying* cause. However, even this expanded metric does not necessarily capture the full extent of heat-related deaths.

- The indicator shows a peak in heat-related deaths in 2006, a year that was associated with widespread heat waves and was the second-hottest year on record in the contiguous 48 states (see the U.S. and Global Temperature indicator).

- Considerable year-to-year variability in the data and certain limitations of this indicator make it difficult to determine whether the United States has experienced a meaningful increase or decrease in deaths classified as “heat-related” over time. Dramatic increases in heat-related deaths are closely associated with both the occurrence of hot temperatures and heat waves, though these deaths may not be reported as “heat-related” on death certificates. For example, studies of the 1995 heat wave event in Chicago (see example figure) suggest that there may have been hundreds more deaths than were actually reported as “heat-related” on death certificates.

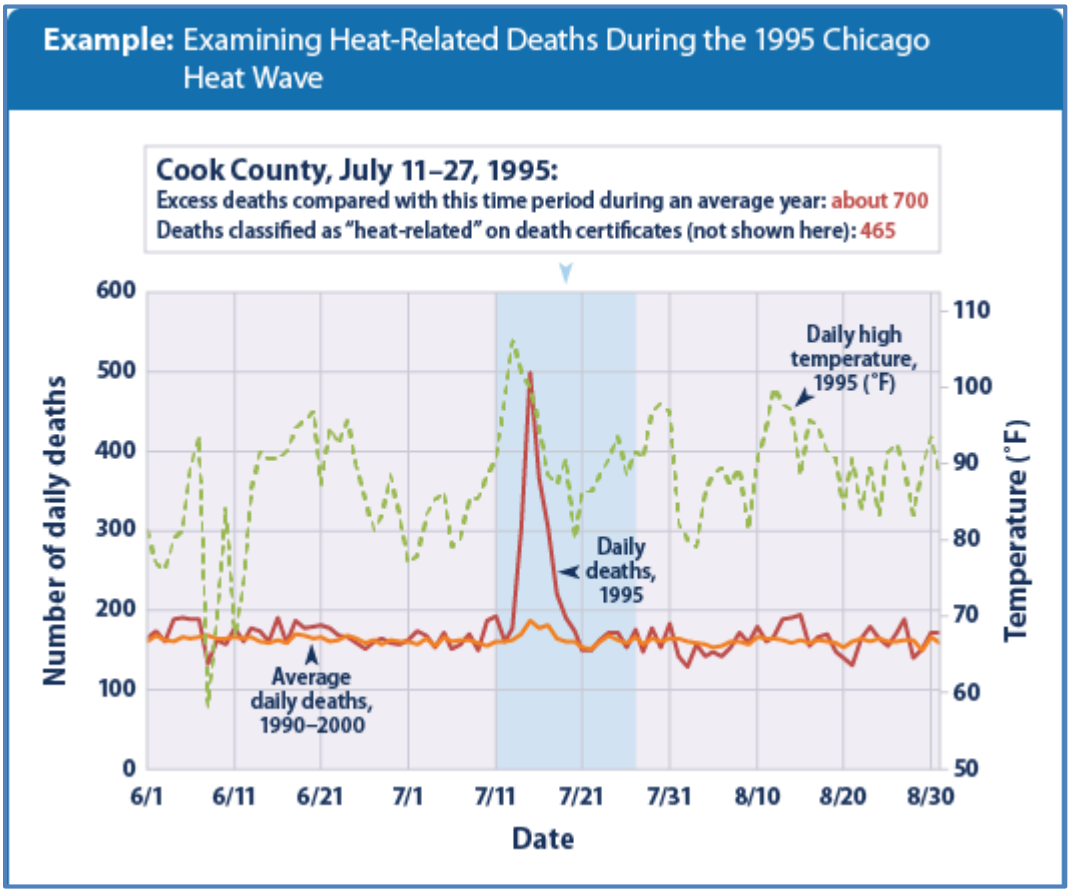
Figure 1. Deaths Classified as "Heat-Related" in the United States, 1979–2013



This figure shows the annual rates for deaths classified as "heat-related" by medical professionals in the 50 states and the District of Columbia. The orange line shows deaths for which heat was listed as the main (underlying) cause. The blue line shows deaths for which heat was listed as either the underlying or contributing cause of death during the months from May to September, based on a broader set of data that became available in 1999.*

* Between 1998 and 1999, the World Health Organization revised the international codes used to classify causes of death. As a result, data from earlier than 1999 cannot easily be compared with data from 1999 and later.

Data source: CDC, 2015[10,11]



Many factors can influence the nature, extent, and timing of health consequences associated with extreme heat events.[12] Studies of heat waves are one way to better understand health impacts, but different methods can lead to very different estimates of heat-related deaths. For example, during a severe heat wave that hit Chicago between July 11 and July 27, 1995, 465 heat-related deaths were recorded on death certificates in Cook County.[13] However, studies that compared the total number of deaths during this heat wave (regardless of the recorded cause of death) with the long-term average of daily deaths found that the heat wave likely led to about 700 more deaths than would otherwise have been expected.[14] Differences in estimated heat-related deaths that result from different methods may be even larger when considering the entire nation and longer time periods.*

** This graph shows data for the Chicago Standard Metropolitan Statistical Area.*

Data sources: CDC, 2012;[15] NOAA, 2012[16]

Indicator Notes

Several factors influence the sensitivity of this indicator and its ability to estimate the true number of deaths associated with extreme heat events. It has been well-documented that many deaths associated with extreme heat are not identified as such by the medical examiner and might not be correctly coded

on the death certificate. In many cases, the medical examiner might classify the cause of death as a cardiovascular or respiratory disease, not knowing for certain whether heat was a contributing factor, particularly if the death did not occur during a well-publicized heat wave. By studying how daily death rates vary with temperature in selected cities, scientists have found that extreme heat contributes to far more deaths than the official death certificates might suggest.[17] This is because the stress of a hot day can increase the chance of dying from a heart attack, other heart conditions, or respiratory diseases such as pneumonia.[18] These causes of death are much more common than heat-related illnesses such as heat stroke. Thus, this indicator very likely underestimates the number of deaths caused by exposure to heat.

Just because a death is classified as "heat-related" does not mean that high temperatures were the only factor that caused or contributed to the death. Pre-existing medical conditions can significantly increase an individual's vulnerability to heat. Other important factors, such as the overall vulnerability of the population, the extent to which people have adapted and acclimated to higher temperatures, and the local climate and topography, can affect trends in "heat-related" deaths. Heat response measures, such as early warning and surveillance systems, air conditioning, health care, public education, cooling centers, infrastructure standards, and air quality management, can also make a big difference in death rates. For example, after a 1995 heat wave, the city of Milwaukee developed a plan for responding to extreme heat conditions; during the 1999 heat wave, heat-related deaths were roughly half of what would have been expected.[19]

Future development related to this indicator should focus on capturing *all* heat-related deaths, not just those with a reported link to heat stress, as well as examining heat-related illnesses more systematically.

Data Sources

Data for this indicator were provided by the U.S. Centers for Disease Control and Prevention (CDC). The 1979–2013 underlying cause data are publicly available through the CDC WONDER database at: http://wonder.cdc.gov/mortSQL.html. The 1999–2013 analysis was developed by CDC's Environmental Public Health Tracking Program, which provides a summary at: www.cdc.gov/nceh/tracking.

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3 IPCC (Intergovernmental Panel on Climate Change). 2014. Climate change 2014: Impacts, adaptation, and vulnerability. Working Group II contribution to the IPCC Fifth Assessment Report. Cambridge, United Kingdom: Cambridge University Press. www.ipcc.ch/report/ar5/wg2.

4 Zanobetti, A., M.S. O'Neill, C.J. Gronlund, and J.D. Schwartz. 2012. Summer temperature variability and long-term survival among elderly people with chronic disease. P Natl. Acad. Sci. USA 109(17):6608–6613.

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[10] CDC (U.S. Centers for Disease Control and Prevention). 2015. CDC WONDER database. Accessed June 2015. http://wonder.cdc.gov/mortSQL.html.

[11] CDC (U.S. Centers for Disease Control and Prevention). 2015. Indicator: Heat-related mortality. National Center for Health Statistics. Annual national totals provided by National Center for Environmental Health staff in June 2015. http://ephtracking.cdc.gov/showIndicatorPages.action.

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[17] Medina-Ramón, M., and J. Schwartz. 2007. Temperature, temperature extremes, and mortality: A study of acclimatization and effect modification in 50 U.S. cities. Occup. Environ. Med. 64(12):827–833.

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