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Researchers look at effects of weather, air pollution on headaches

Large-scale study finds higher temperatures, lower barometric pressures associated with severe headaches

BOSTON – Although large numbers of headache sufferers, particularly individuals who struggle with migraines, attribute their pain to the weather, there has been little scientific evidence to back up their assertions. Now, a study of more than 7,000 patients, led by researchers at Beth Israel Deaconess Medical Center (BIDMC), provides some of the first large-scale data on how environmental conditions -- weather, as well as air pollution -- influence headache pain.

Reported in the March 10 issue of the journal *Neurology*, the findings demonstrate that higher temperatures, and to a lesser degree, lower barometric pressure, contribute to severe headaches.

"Migraine headaches affect a large proportion of the population," notes Kenneth Mukamal, MD, MPH, the study's first author and a physician in the Division of General Medicine and Primary Care at BIDMC. "Approximately 18 percent of women and 6 percent of men in the U.S. report having migraine headaches, particularly young and middle-aged adults."

Knowing that migraines can be set off by "triggers," including certain foods, alcohol, stress and hormones, Mukamal and his coauthors decided to study whether environmental factors were also acting as headache triggers.

"Air temperature, humidity and barometric pressure are among the most frequent reasons that people give for their headache pain," explains Mukamal, who is also an Associate Professor of Medicine at Harvard Medical School. "But none of these reasons have been consistently verified. We wanted to find out if we could verify this 'clinical folklore.' We also wanted to determine whether air pollutants trigger headaches, much as they have been found to trigger strokes."

Mukamal and his coauthors designed a "case crossover" study, which directly compares levels of pollutants and meteorological variables at the time of the patient's hospital visit with corresponding levels on preceding days and subsequent weeks. The study looked at 7,054 patients who went to the emergency room of Beth Israel Deaconess Medical Center between May 2000 and December 2007 and were discharged with a primary diagnosis of headache (2,250 diagnosed with migraine; 4,803 diagnosed with tension or unspecified headache). Using meteorological and pollutant monitors, they then compared measurements of a number of environmental factors – air temperature, barometric pressure, humidity, fine particulate matter, black carbon, and nitrogen and sulfur dioxides -- during the three days previous to patients' hospital visits and then again at corresponding dates to determine whether these factors trigger severe headaches.

"In other words," says Mukamal, "our study design was able to directly compare weather and air pollution conditions right before an emergency visit with those same factors measured earlier and later the same month."

The findings showed that of all of the environmental factors considered, higher air temperature in the 24 hours prior to the patient's hospital visit was most closely associated with headache symptoms, with a 7.5 percent higher risk of severe headache reported for each temperature increase of 5 degrees Celsius (approximately 9 degrees Fahrenheit). To a lesser degree, lower barometric pressure 48 to 72 hours prior to patients' emergency room visits also appeared to trigger headache. The researchers found no evidence that air pollutants influenced the onset of headache, but could not rule out a smaller effect similar to that previously seen for stroke.

"Certainly our results are consistent with the idea that severe headaches can be triggered by external factors," says Mukamal. "These findings help tell us that the environment around us does affect our health and, in terms of headaches, may be impacting many, many people on a daily basis."

Mukamal recommends that headache patients sit down with their doctors to identify the triggers that lead to their headache symptoms, adding that even though the weather can't be altered, doctors might be able to prescribe medication that can be administered prophylactically to help avert the onset of weather-related headaches.

Furthermore, he adds, "On a population basis, we need to be concerned about incremental temperature rises anyhow, and should advocate for responsible environmental management.

The annual cost attributed to migraines is estimated at \$17 billion, millions of people are adversely affected and the public health implications may be enormous."

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Study coauthors include BIDMC investigators Gregory A. Wellenius, ScD, and Murray A. Mittleman, MD, DrPH; and Helen H. Suh, ScD, of the Harvard School of Public Health.

Beth Israel Deaconess Medical Center is a patient care, teaching and research affiliate of Harvard Medical School and consistently ranks in the top four in National Institutes of Health funding among independent hospitals nationwide. BIDMC is a clinical partner of Joslin Diabetes Center and is a research partners of the Dana-Farber/Harvard Cancer Center. BIDMC is the official hospital of the Boston Red Sox. For more information, visit www.bidmc.org.
