

# New link between pollution, temperature and sleep-disordered breathing

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Researchers from Brigham and Women's Hospital and the Harvard School of Public Health have established the first link between air pollution and sleep-disordered breathing (SDB), a known cause of cardiovascular diseases.

Antonella Zanobetti, Ph.D., Susan Redline, MD, MPH, Diane Gold, M.D., M.P.H. and colleagues explored the link between [air pollution](#) levels, temperature increases and [sleep-disordered breathing](#) using data from the Sleep Heart Health Study, which included more than 6,000 participants between 1995 and 1998, and EPA air pollution monitoring data from Framingham (Massachusetts), Minneapolis, New York City, Phoenix, Pittsburgh, Sacramento, and Tucson.

The study appears online ahead of the print edition of the [American Journal of Respiratory and Critical Care Medicine](#) on the American Thoracic Society's Web site.

SDB affects up to 17 percent of U.S. adults, many of whom are not aware that they have a problem. Air pollution is also an endemic issue in many of the nation's urban areas. Both SDB and pollution have been associated with a range of health problems, including increased cardiovascular mortality. "The influence of air pollution on SDB is poorly understood," said Dr. Zanobetti. "Our hypothesis was that elevation in ambient air pollution would be associated with an increased risk of SDB and nocturnal hypoxia, as well as with reduced sleep quality." The researchers further hypothesized that seasonal variations in

temperature would exert an independent effect on SDB and sleep efficiency.

To test their hypotheses, the researchers used linear regression models that controlled for seasonality, mean temperature and other factors known to be associated with SDB, such as age, gender and smoking.

To examine the role of seasons, they performed a separate analysis, adding the interaction of season with the level of air pollution in the form of particulate matter under 10  $\mu\text{m}$ , which is commonly associated with traffic. They evaluated long-term effects by computing the moving 365-day average of PM10.

In total, they included more than 3,000 individuals in their analysis.

"We found novel evidence for pollution and temperature effects on sleep-disordered breathing," said Dr. Zanobetti. "Increases in apnea or hypopnea...were associated with increases in short-term temperature over all seasons, and with increases in particle pollution levels in the summer months."

Over all seasons, the researchers found that short-term elevations in temperature were associated with increased in Respiratory Disturbance Index (RDI), which was used to gauge the severity of SDB. In the summer, increases in PM10 were also associated with an increase in RDI (representing a 12.9 percent increase), as well as with an increase in the percent of time that blood oxygen saturation levels fell below 90 percent (representing a nearly 20 percent increase) and a decrease in sleep efficiency. There were no such statistically significant associations of particulate pollution with SDB in other seasons.

This is the first study to link pollution exposure and SDB.

"Particles may influence sleep through effects on the central nervous system, as well as the upper airways," wrote Dr. Zanobetti. "...Poor sleep [associated with poor health outcomes] may disproportionately afflict poor urban populations. Our findings suggest that one mechanism for poor sleep and sleep health disparities may relate to environmental pollution levels."

Other research has found an association between elevation in pollution and increased risk of sudden infant death syndrome (SIDS). There is a known overlap between etiologic factors for SIDS and SDB. Given the results of the current research, "the mechanisms that increase the risk of SIDS in associations with ambient pollutants may be similar to the mechanisms that underlie the risk of SDB...,[which] may include pollutant-associated effects on central or peripheral neurotransmitters that influence sleep-state stability," said Dr. Zanobetti.

Several studies have also reported that temperature predicts mortality. "The association we found between short-term temperature and RDI could represent one possible mechanism by which changes across the range of [temperature](#) could predict mortality," said Dr. Zanobetti.

Perhaps most importantly, the prevalence of SDB in the United States may increase as obesity rises. "While therapies are available for the disorder, the majority of adults with SDB are not being treated and many people are resistant to therapy," said Dr. Zanobetti. "Along with reduction in obesity, these new data suggest that reduction in air pollution exposure might decrease severity of SDB and nocturnal hypoxia and may improve cardiac risk."

John Heffner, M.D., past president of the American Thoracic Society observed, "This study gains even greater importance as scientists increasingly demonstrate the critical importance of sleep to health and well being. SDB increases risks for [cardiovascular disease](#), strokes and

other major health conditions. Air pollution is an independent contributor to most of these disorders and may produce its negative health effects by promoting SDB as an intermediary step in the pathway toward disease."

Provided by American Thoracic Society

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