

Childhood air pollution exposure linked to poor mental health at age 18

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A multidecade study of young adults living in the United Kingdom has found higher rates of mental illness symptoms among those exposed to higher levels of traffic-related air pollutants, particularly nitrogen oxides, during childhood and adolescence.

Previous studies have identified a link between air pollution and the risk of specific mental [disorders](#), including depression and anxiety, but this study looked at changes in [mental health](#) that span all forms of disorder and psychological distress associated with exposure to traffic-related air pollutants.

The findings, which will appear April 28 in *JAMA Network Open*, reveal that the greater an individual's exposure to nitrogen oxides across childhood and adolescence, the more likely they are to show any signs of mental [illness](#) at the transition to adulthood, at age 18, when most symptoms of mental illness have emerged or begin to emerge.

The link between [air pollution exposure](#) and young

adult mental illness symptoms is modest, according to the study's first-author Aaron Reuben, a graduate student in clinical psychology at Duke University. But "because harmful exposures are so widespread around the world, outdoor air pollutants could be a significant contributor to the global burden of psychiatric disease," he said.

The World Health Organization (WHO) currently estimates that 9 out of 10 people worldwide are exposed to high levels of outdoor air pollutants, which are emitted during fossil fuel combustion in cars, trucks, and powerplants, and by many manufacturing, waste-disposal, and industrial processes.

In this study, air pollution, a neurotoxicant, was found to be a weaker risk factor for mental illness than other better-known risks, such as family history of mental illness, but was of equal strength to other neurotoxicants known to harm mental health, particularly childhood exposure to lead.

In a previous study in the same cohort, Helen Fisher of King's College London's Institute of Psychiatry, Psychology & Neuroscience, and coauthor and principal investigator for this study, linked childhood air pollution exposure to the risk of psychotic experiences in young adulthood, raising concern that air pollutants may exacerbate risk for psychosis later in life.

When combined with studies showing increased hospital admissions for many psychiatric illnesses during "poor" air quality days in countries like China and India, the current study builds on past findings to reveal that "air pollution is likely a non-specific risk factor for mental illness writ large," said Fisher, who noted that exacerbations of mental illness risk may show up differently in different children.

The subjects of this study are a cohort of 2,000 twins born in England and Wales in 1994-1995 and followed to young adulthood. They have regularly

participated in physical and mental health evaluations and have provided information about the larger communities in which they live.

Researchers measured exposure to air pollutants—particularly nitrogen oxides (NO_x), a regulated gaseous pollutant, and fine particulate matter (PM_{2.5}), a regulated aerosol pollutant with suspended particles below 2.5 microns in diameter—by modeling air quality around study member's homes at ages 10 and 18 years using high-quality air dispersion models and data provided by the UK National Atmospheric Emissions Inventory and the Imperial College's UK road-traffic emissions inventory. Twenty-two percent of the study members were found to have had exposure to NO_x that exceeded WHO guidelines, and 84% had exposure to PM_{2.5} that exceeded guidelines.

The research team, based at Duke and King's IoPPN, also assessed participant mental health at age 18. Symptoms associated with ten different psychiatric disorders—dependence on alcohol, cannabis, or tobacco; conduct disorder and attention-deficit/hyperactivity disorder; major depression, generalized anxiety disorder, post-traumatic stress disorder, and eating disorder; and thought disorder symptoms related to psychosis—were used to calculate a single measure of mental health, called the psychopathology factor, or "p-factor" for short.

The higher an individual's p-factor score, the greater the number and severity of psychiatric symptoms identified. Individuals can also differ on their mental health across sub-domains of psychopathology, which group together symptoms of distress or dysfunction that are manifested in outwardly visible ways (externalizing problems, like conduct disorder), experienced largely internally (internalizing problems, like anxiety), and via delusions or hallucinations (thought disorder symptoms). Air pollution effects on mental health were observed across these subdomains of psychopathology, with the strongest links to thought disorder symptoms.

Unique to this study, the researchers also assessed characteristics of children's neighborhoods to

account for disadvantageous neighborhood conditions that associate with higher air pollution levels and greater risk of mental illness, including socioeconomic deprivation, physical dilapidation, social disconnection, and dangerousness. While air pollution levels were greater in neighborhoods with worse economic, physical, and social conditions, adjusting the study results for neighborhood characteristics did not alter the results, nor did adjustment for individual and family factors, such as childhood emotional and behavioral problems or family socioeconomic status and history of mental illness.

"We have confirmed the identification of what is essentially a novel risk factor for most major forms of mental illness," said Reuben, "one that is modifiable and that we can intervene on at the level of whole communities, cities, and or even countries."

In the future, the study team is interested in learning more about the biological mechanisms that link early life air pollution exposure to greater risk for mental illness at the transition to adulthood. Previous evidence suggests that air pollutant exposures can lead to inflammation in the brain, which may lead to difficulty regulating thoughts and emotions.

While the findings are most relevant to high-income countries with only moderate levels of outdoor air pollutants, like the US and the UK, there are also implications for low-income, developing countries with higher air pollution exposures, like China and India. "We don't know what the mental health consequences are of very high [air pollution](#) exposures, but that is an important empirical question we are investigating further," said Fisher.

More information: "Association Of Air Pollution Exposure in Childhood and Adolescence With Psychopathology at the Transition To Adulthood," Aaron Reuben, Louise Arseneault, Andrew Beddows, Sean D. Beevers, Terrie E. Moffitt, Antony Ambler, Rachel M. Latham, Joanne B. Newbury, Candice L. Odgers, Jonathan D. Schaefer, and Helen L. Fisher. *JAMA Network Open*, April 28, 2021 [DOI: 10.1001/jamanetworkopen.2021.7508](https://doi.org/10.1001/jamanetworkopen.2021.7508)

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