

Preadolescents Exposed to High Levels of Air Pollution in their First Years of Life Display Changes in Brain Connectivity

The study is the first to explore the association between exposure to traffic-related air pollution and noise during pregnancy and childhood, and whole-brain connectivity

Barcelona, 15 June, 2022- Higher exposure to air pollution is associated with higher functional brain connectivity among several brain regions in preadolescents, while exposure to traffic noise was not, according to a study led by ISGlobal, an institution supported by “la Caixa” Foundation. The findings also identify the first years of life as the most sensitive period of exposure to air pollution.

Traffic-related air pollution and noise are affecting an increasing number of people worldwide. “We already know that **children are particularly vulnerable** to the effect of these exposures, because of their immature metabolism and developing brain,” says ISGlobal researcher and senior author **Mónica Guxens**. In fact, several studies by Guxens and others have found an association between exposure to traffic-related air pollution during early childhood and [alterations in the brain structure](#).

In this study, the research team used **magnetic resonance imaging** (MRI) to explore whether higher exposure to air pollution or noise could also be associated with possible **alterations in brain connectivity** (i.e. the way in which different brain regions interact). “The use of MRI has opened up new possibilities in epidemiological research for investigating the structure and the functioning of the brain,” says Guxens.

The researchers used **data of 2,197 children** from the [Generation R Study](#), born between April 2002 and Jan 2006 and living in Rotterdam, the Netherlands. Using land use models, they estimated levels of nitrogen oxides (NO_x and NO₂) and particulate matter (PM) at the participants’ homes at different time periods: during pregnancy, from birth to 3 years, from 3 to 6 years, and from 6 years of age to the age at which the MRI scan was performed. Noise levels due to traffic road were estimated using existing noise maps. Between 9 and 12 years of age, the participants were invited to undergo an MRI scan in the resting state (i.e. with no external stimuli).

The findings show that **higher exposures to NO₂ and PM_{2.5} absorbance** (an indicator of black carbon particles) from birth to 3 years, and to **NO_x** from 3 to 6 years of age were associated with **higher functional brain connectivity** among several brain regions in the preadolescents. The associations were identified in brain areas predominantly involved in **two networks** that have strongly opposing functions: the task negative (or “default-mode”) network tends to be activated in resting conditions and the task positive network tends to be activated during tasks that demand attention. “We still have to understand the consequences of this **increased activity of both networks** in resting conditions, but for now we can say that the brain connectivity in children exposed to higher levels of air pollution is **different from what we would expect**,” says **Laura Pérez-Crespo**, first author of the study.

The period from **birth to 3 years was the one with the highest susceptibility** to air pollution, and **black carbon** was the pollutant most associated with brain connectivity changes. As the authors note, the main source of black carbon and nitrogen

oxide gases in European cities are diesel vehicles. Noise exposure at home was not associated with differences in brain connectivity, even though several studies show that [noise affects cognitive development](#) in children.

Reference:

L Pérez-Crespo, MSW Kusters, M López-Vicente, MJ Lubczyńska, M Foraster, T White, G Hoek, H Tiemeier, RL Muetzel, M Guxens. Exposure to traffic-related air pollution and noise during pregnancy and childhood, and functional brain connectivity in preadolescents. Environ Int. 2022 Jun;164:107275. doi: 10.1016/j.envint.2022.107275. Epub 2022 May 5.

About ISGlobal

The Barcelona Institute for Global Health, ISGlobal, is the fruit of an innovative alliance between the "la Caixa" Foundation and academic and government institutions to contribute to the efforts undertaken by the international community to address the challenges in global health. ISGlobal is a consolidated hub of excellence in research that has grown out of work first started in the world of health care by the Hospital Clínic and the Parc de Salut MAR and in the academic sphere by the University of Barcelona and Pompeu Fabra University. Its working model is based on the generation of scientific knowledge through Research Programmes and Groups, and its translation through the areas of Training and Analysis and Global Development. ISGlobal has been named a Severo Ochoa Centre of Excellence and is a member of the CERCA system of the Generalitat de Catalunya.

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