

## **Air Pollution Induces Subclinical Structural Changes in Children's Brains**

*Study analyses the relationship between exposure to polycyclic aromatic hydrocarbons, basal ganglia volumes, and symptoms of attention-deficit hyperactivity disorder*

Chronic exposure to polycyclic aromatic hydrocarbons (PAHs) in preadolescent children is associated with subclinical changes in the caudate nucleus of their brains, even when ambient concentrations of PAHs are below the maximum levels established by the European Union. This was the main conclusion of [a study](#) published recently in the journal *Environment International*, which was led by scientists from the Barcelona Institute for Global Health (ISGlobal), a centre supported by the "la Caixa" Foundation.

PAHs are a group of air pollutants formed during the incomplete combustion of organic material. They are generated as a result of the combustion of fossil and biomass fuels and also found in other media, including cigarette smoke and charcoal-grilled food. In cities such as Barcelona, where the study was carried out, the predominant source of PAHs is vehicular traffic. Earlier studies had observed an association between PAHs and attention deficit hyperactivity disorders (ADHD) in children exposed during the prenatal period, a finding the authors consider to be "particularly worrying".

The present study, which formed part of the BREATHE project, measured air pollution levels in 39 schools in Barcelona and acquired cerebral images via magnetic resonance imaging for 242 children (boys and girls) between the ages of 8 and 12 years. The participating children were also assessed for the presence of ADHD symptoms. The aim of the study was to investigate the effects of exposure to PAHs at school on the volume of the children's basal ganglia, a brain structure consistently reported as reduced in ADHD children, and the possible association with symptoms of ADHD.

"Our findings indicate that increased exposure to PAHs—in particular benzo[a]pyrene—is associated with a decrease in the size of the caudate nucleus, one of the components of the basal ganglia", explains Marion Mortamais, ISGlobal researcher and lead author of the study. An increase of approximately 70 pg/m<sup>3</sup> in indoor and outdoor levels of benzo[a]pyrene was associated with a reduction of almost 2% in caudate nucleus volume. However, this reduction in the size of the caudate nucleus appears to be subclinical because it was not significantly associated with ADHD symptoms.

Marion Mortamais concludes by saying that "the consequences these changes in brain structure may have on the children's behaviour were not identified in this study but, given the key role played by the caudate nucleus in many cognitive processes and crucial behaviours, any reduction in the volume of this structure is cause for concern in the context of childhood neurodevelopment".

In the opinion of Jordi Sunyer, head of ISGlobal's Child Health programme and professor at the Pompeu Fabra University (UPF), "the findings of this study add to the already abundant evidence that underscores the urgent need to reduce air pollution, in particular traffic-related

contamination, and also indicates a need to reassess the annual maximum levels for PAHs established by European regulations”.

## Reference

Mortamais M, Pujol J, van Drooge BL, et al. Effect of exposure to polycyclic aromatic hydrocarbons on basal ganglia and attention-deficit hyperactivity disorder symptoms in primary school children. *Environ Int.* 2017 May 5;105:12-19. [doi: 10.1016/j.envint.2017.04.011](https://doi.org/10.1016/j.envint.2017.04.011).

## 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. The pivotal mechanism of its work model is the transfer of knowledge generated by scientific research to practice, a task undertaken by the institute’s Education and Policy and Global Development departments. ISGlobal a member of the CERCA programme of the Generalitat de Catalunya.

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