

Air pollution during pregnancy is associated with slower brain maturation in newborns

- ***Greater exposure of mothers to airborne particulate matter during pregnancy is linked to lower levels of brain myelination in newborns.***
- ***This is highlighted by the first study to measure neonatal brain myelination using magnetic resonance imaging (MRI). Published in the journal *Environment International*, it is the result of a collaboration between Hospital del Mar and ISGlobal.***
- ***The research shows that prenatal exposure to fine particles (PM2.5) is associated with slower brain maturation during the first month of life. Myelination is a key marker of brain development.***

Barcelona, October 16th, 2025. – A study published in *Environment International* concludes that **air pollution during pregnancy is associated with slower brain maturation in newborns**. It is the first study to analyze brain development within the first month of life and stems from the collaboration between researchers at Hospital del Mar, the Barcelona Institute for Global Health (ISGlobal) —a centre supported by the “la Caixa” Foundation—, and the CIBER area of Epidemiology and Public Health (CIBERESP).

Myelination is a **key process in brain maturation**, in which myelin coats neuronal connections and makes them more efficient for transmitting information. Newborns **of mothers exposed to higher levels of fine airborne particles during pregnancy** show slower myelination at this very early stage of life. Both a slowdown and an excessive acceleration of brain maturation can be harmful for the child. It remains to be determined whether the effect observed in this study will have negative consequences for children’s later abilities.

The analyzed pollution includes extremely small particles—about thirty times thinner than a human hair—composed of harmful elements from combustion processes and toxic organic compounds, but also of essential elements for brain development such as iron, copper, and zinc. Therefore, further research is needed to understand how each of these components affects the development of the newborn brain. In this regard, according to Gerard Martínez-Vilavella, researcher at the MRI Unit of the Radiology Department at Hospital del Mar, part of the dibi network and the Hospital del Mar Research Institute, ***“our study shows that the myelination process—a progressive indicator of brain maturation—occurs at a slower rate in newborns most exposed to PM2.5 during pregnancy.”***

Magnetic resonance imaging in the first month of life

To conduct the study, pregnant women receiving prenatal care at Hospital Clínic Barcelona, Hospital de Sant Pau, and Hospital Sant Joan de Déu were recruited. Levels of air pollutants to which they were exposed during pregnancy were monitored, and after delivery, 132 newborns were selected. These infants underwent MRI scans before their first month of life to assess the degree of brain maturation through their levels of myelination.

The results show a clear correlation between higher maternal exposure to PM2.5 during pregnancy and lower myelination in newborns’ brains. ***“Air pollution, specifically PM2.5, is associated with alterations in the myelination process, a fundamental mechanism of brain maturation. Therefore, it is essential to continue controlling pollution levels and to study how this slowdown may affect the later brain development of children”***, explains Martínez-Vilavella. The study also indicates that this effect results from the

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combination of the different components of PM2.5, without identifying a single element as the main cause.

Dr. Jesús Pujol, head of the MRI Unit of the Radiology Department at Hospital del Mar, adds, ***"In the early stages of life, brain changes are large and complex. Both excessive slowdown and acceleration of brain maturation can be harmful to the child. However, it remains to be determined whether the observed effect is necessarily detrimental. This study opens an exciting new field of research aimed at determining the optimal speed of brain maturation during pregnancy and understanding how the mother and placenta may act as effective filters to protect and optimize this process"***.

Meanwhile, ISGlobal researcher Jordi Sunyer emphasizes that ***"the findings in these newborns, born in Barcelona after the first phase of the low-emission zone, warn us that we cannot slacken our efforts to clean up city air. Further steps are needed to meet the new air quality standards"***.

Reference article

Pujol J, Martínez-Vilavella G, Gómez-Herrera L, Rivas I, Gómez-Roig MD, Llurba E, Blanco-Hinojo L, Cirach M, Persavento C, Querol X, Gascón M, Foraster M, Gispert JD, Falcón C, Deus J, Dadvand P, Sunyer J. *Unraveling the impact of prenatal air pollution for neonatal brain maturation. Environ Int.* 2025 Sep 18;204:109801. doi: 10.1016/j.envint.2025.109801. Epub ahead of print. PMID: 40986980.

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