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Urban traffic air pollution could affect children attention at school

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English key words: air pollutants, vehicle emissions, attention, neurodevelopment.

Spanish key words: contaminantes del aire, emisiones de vehículos, atención, neurodesarrollo.

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Original article: Sunyer J, Suades-González E, García-Esteban R, Rivas I, Pujol J, Alvarez-Pedrerol M, *et al.* Traffic-related air pollution and attention in primary school children: short-term association. *Epidemiology*. 2017;28:181-9.

Abstract

Authors' conclusions: there is a short-term association between traffic-related air pollutants and fluctuations in attention, which could have deleterious effects on neurodevelopment.

Reviewers' commentary: the results found in this study seem applicable to our environment, due to the characteristics of the population and the type of pollution studied. Although we cannot yet quantify the medium- and long-term impact of urban pollution, it seems to be some risk, which must be taken into account, because it is preventable, when establishing recommendations and restrictions in our cities.

Key words: air pollutants, vehicle emissions, attention, neurodevelopment.

La contaminación urbana por tráfico podría afectar a la atención escolar infantil

Resumen

Conclusiones de los autores del estudio: existe asociación a corto plazo entre contaminantes atmosféricos relacionados con el tráfico y fluctuaciones en la atención, que podría tener efectos nocivos sobre el neurodesarrollo.

Comentario de los revisores: los resultados encontrados en este estudio parecen aplicables a nuestro medio por las características de la población y el tipo de contaminación estudiadas. Aunque no podemos todavía cuantificar la repercusión a medio-largo plazo de la contaminación urbana, parece existir cierto riesgo, que debe ser tenido en cuenta por ser prevenible, a la hora de establecer recomendaciones y restricciones en nuestras ciudades.

Palabras clave: contaminantes del aire, emisiones de vehículos, atención, neurodesarrollo.

STRUCTURED ABSTRACT

Objective: to assess the association between daily variations in traffic-related air pollution and attention in primary school children.

Design: cohort study between January 2012 and March 2013.

Setting: classrooms in 39 schools in Barcelona (Catalonia, Spain).

Study population: primary school students (aged 7-10 years) without special education needs. The authors invited

5019 schoolchildren to participate, and obtained consent from the families of 2897 (59%).

Risk factor assessment: air quality levels were assessed through the levels of nitrogen dioxide (NO₂) and elemental carbon (EC) in particle filters < 2.5 µm (PM 2.5). Measurements were made daily at a city monitoring station and twice in schools, 6 months apart, for four full days, Monday through Thursday. Schools were categorised by pollution level into high and low, by type into public or private, and by the socioeconomic vulnerability index of the neighbourhood (based on educational attainment, unemployment and occupation). The following were also measured: mean daily temperature and

relative humidity, long-term exposure to NO₂ and EC in the home based on the geographical location of the home address, and indoor noise level in each classroom.

Outcome measurement: cognitive development was assessed through change in attention and working memory functions. The authors assessed four domains of children's attention processes every 3 months over four visits lasting 40 minutes each. They used the child attention network test (ANT) and the *n*-back task to assess working memory. Children with more than 30% of errors in any visit were excluded from the analysis (1.4%). Children performed the tasks on laptop computers with a specific psychology software (E-Prime, version 2.0). Teachers reported the presence or absence of symptoms of attention-deficit hyperactivity disorder (ADHD). Parents completed a strengths and difficulties questionnaire (SDQ) on child behavioural problems. The authors fit linear mixed effects models to test for associations between daily levels of pollutants and the quantitative outcomes at each visit, and negative binomial mixed regression models to assess associations with semiquantitative outcomes. Child and school variables were included as random effects in the models. The authors performed sensitivity analysis and assessed effect modification. Temporal trends were adjusted by semiparametric methods.

Main results: complete data were obtained for 2687 children. Daily ambient levels of both NO₂ and EC were negatively correlated to every attention process. Children in the bottom quartile of daily exposure to ambient NO₂ levels had a 14.8 ms (95% confidence interval [95 CI]: 11.2 to 18.4) faster time response than children in the top quartile, which was equivalent to a 1.1-month delay (95 CI: 0.84 to 1.37) in the natural developmental improvement in response speed with age. The results did not change significantly using alternative statistical models, or adjusting for indoor pollution in classrooms, sex, maternal educational attainment, ADHD symptoms, season or noise.

Attention parameters were moderately correlated with working memory, but the authors did not observe short-term associations between pollution and working memory.

Conclusion: The short-term association of traffic-related air pollutants with fluctuations in attention adds to the evidence that air pollution may have harmful effects on neurodevelopment.

Conflicts of interest: the authors declared that they had no conflicts of interest.

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COMMENTARY

Justification: chronic exposure to urban air pollutants is associated with an increased risk of cardiovascular and respiratory disease and could have neuropsychological and behavioural effects. These pollutants could cause brain damage through inflammatory processes, glial activation or white matter injury. There are studies that suggest that traffic-related pollution is associated with the level of attention in schoolchildren, which could affect the learning process.¹ However, establishing the neurotoxic effects of pollution is complicated on account of the limitations of conducting studies in the general population and the multiplicity of factors involved in neurodevelopmental processes.

Validity or scientific rigour: this was a well-designed and executed study, with an appropriate definition of the population, exposure and effect under study. The percentage of participation was 59%, although the final sample appears to be representative. The main limitation has to do with the difficulty in establishing a temporal sequence linking measured pollution and other possible covariates with the level of attention, despite using different methods and statistical adjustments that yielded consistent results. It is not possible to exclude the potential influence of social and familial environmental factors associated with the pollution level that could affect attention without having a direct toxic effect.

Clinical relevance: lower levels of traffic-related urban pollution (bottom quartile versus top quartile of NO₂ levels) were associated with a quicker response speed in attention tests. The authors estimated that the delay was equivalent to a 1.1-month retardation in the maturation of the response speed. Establishing the clinical relevance of this delay is difficult insofar as these are short-term outcomes whose future repercussions cannot be guessed. In this study, memory test outcomes were not associated to short-term pollution, which had already been observed in a previously published study by the same authors, who propose that the reason for this is that working memory is more stable over time than attention.¹ There is evidence from animal experiments that supports the observed results, but the type of exposure and the effects under study do not allow making comparisons.^{2,3}

Applicability to clinical practice: the findings of this study seem applicable to Spain given the characteristics of the population and the type of pollution under study. Although we are still unable to quantify the medium- to long-term impact of urban air pollution, there seems to be a certain risk, which, being preventable, should be taken into account when it comes to making recommendations and placing restrictions in our cities.

Conflicts of interest: the authors of the commentary have no conflicts of interest to declare.

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