Exposure to Traffic-related Air Pollution and Risk of Development of Childhood Asthma: A Systematic Review and Meta-analysis

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Exposure to Traffic-related Air Pollution and Risk of Development of Childhood Asthma: A Systematic Review and Meta-analysis

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Background and Objective

The question of whether children's exposure to traffic-related air pollution (TRAP) contributes to their initial development of asthma is an unresolved one. We conducted a systematic review and performed a meta-analysis to examine the association between TRAP and asthma development in childhood.

Data Sources

We systematically reviewed epidemiological studies published until 6th March 2016 and available in the Embase, Ovid MEDLINE (R), and Transport databases.

Study Eligibility Criteria, Participants and Interventions

We included studies that examined the association between children's exposure to TRAP metrics and their subsequent risk of "*asthma*" development through birth to age 18 years old.

Study Appraisal and Synthesis Methods

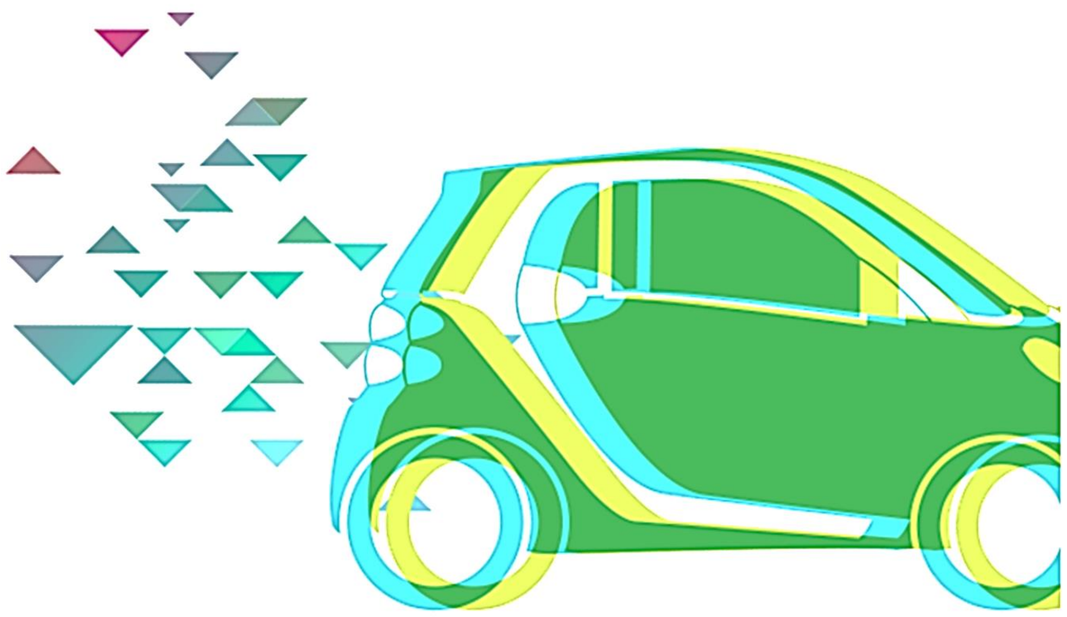
We extracted and tabulated key characteristics of each included study using a predefined piloted data template. We used the Critical Appraisal Skills Programme checklists to assess the risk of bias for each included study. Where four or more independent odds ratios (OR) were available for a continuous pollutant exposure, we conducted random-effects and age-specific (below and above 6 years old) meta-analyses. We conducted four sensitivity analyses for each summary meta-analytic exposure-outcome association to test the robustness of findings.

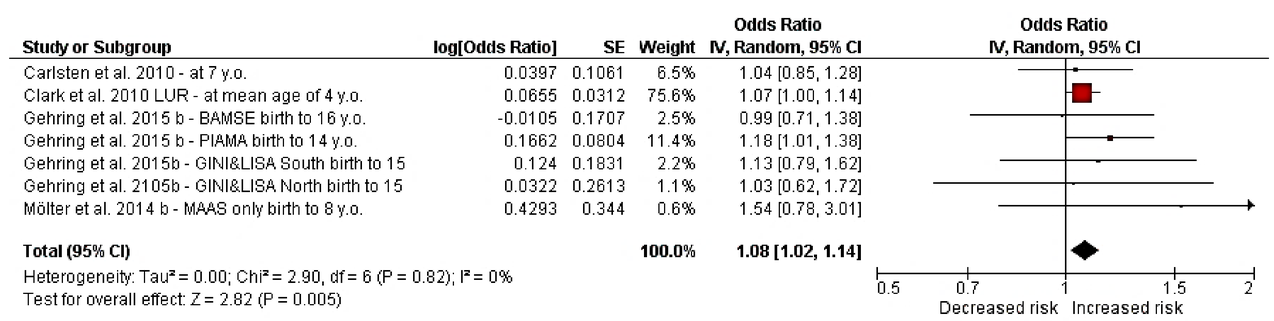
Key Findings

Thirty-eight studies met our eligibility criteria. There was notable variability in asthma definitions, TRAP exposure assessment methods and selections for confounder adjustment. The summary overall random-effects ORs were 1.08 (95% CI 1.02, 1.14) per 0.5 x 10^{-5} m^{-1} black carbon (BC), 1.04 (95% CI 1.01, 1.08) per 4 µg/m^3 NO_2, 1.46 (95% CI 0.77, 2.78) per 30 µg/m^3 NO_x, 1.04 (95% CI 0.99, 1.08) per 1 µg/m^3 $PM_{2.5}$ and 1.05 (95% CI 1.01, 1.10) per 2 µg/m^3 PM_{10}. The least heterogeneity was seen for the BC and PM_{10} estimates whilst the most heterogeneity was seen for NO_2 and NO_x. Fixed-effects models and sensitivity analyses supported these findings. The age-specific models suggested that the effects were more robust in the older children where diagnosis is likely more reliable. There was suggestion that effects were different between sexes and that they may be limited to non-atopic asthma.

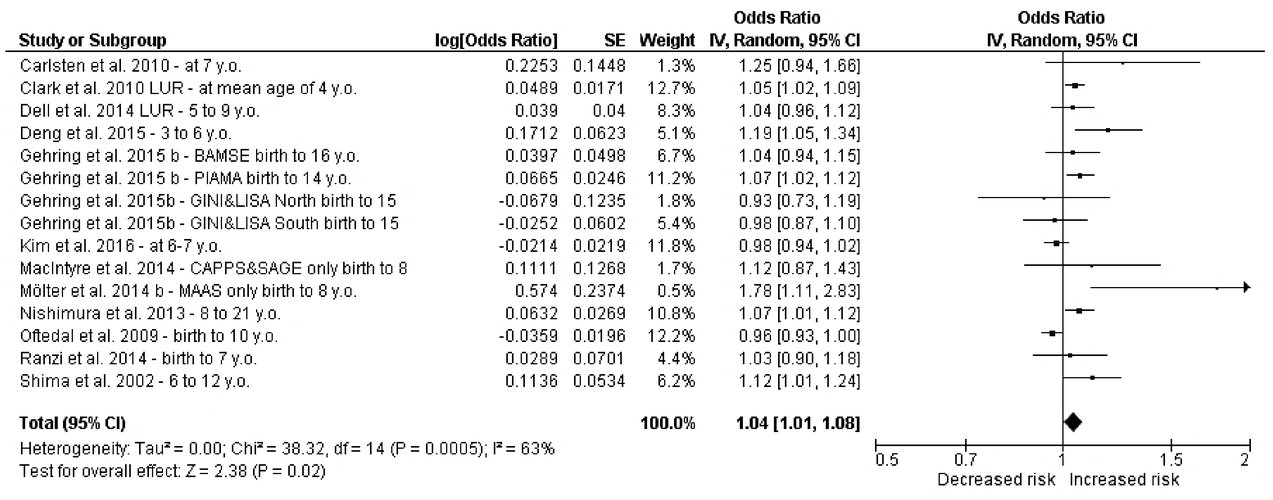
Conclusions and Implication of Key Findings

Recently, there has significant advances in the field, yet we highlight important gaps in the current state of research particularly in the exposure assessment, lack of outcome harmonization and systematic evaluation of subgroups and phenotypic characterization of asthma. Improvements in these areas, albeit challenging, are central to better understanding the role of TRAP in asthma pathogenesis. As it stands, the impact of TRAP on asthma prevalence could be considerable because of the high numbers of children exposed. Our findings underlie the need to reduce childhood exposures to TRAP and suggest a value of BC as an additional indicator in air quality management.

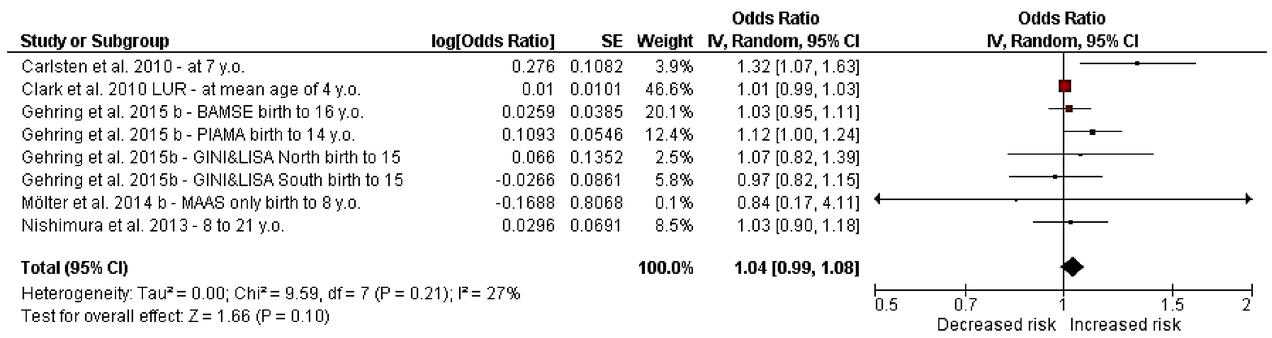




BC meta-analysis: Individual and summary random effects estimates for associations between BC per 0.5 x 10^{-5} m^{-1} and asthma at any age



NO_2 meta-analyses: Individual and summary random effects estimates for associations between NO_2 per 4 µg/m^3 and asthma at any age



$PM_{2.5}$ meta-analyses: Individual and summary random effects estimates for associations between $PM_{2.5}$ per 1 µg/m^3 and asthma at any age

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