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Symptoms: a Systematic Review and Meta-analysis**

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**Gudrun Weinmayr, Elisa Romeo, Manuela De Sario,  
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**Short Term Effects of PM<sub>10</sub> and NO<sub>2</sub> on Respiratory Health among Children with Asthma or Asthma-like Symptoms: a Systematic Review and Meta-analysis**

Gudrun Weinmayr<sup>1</sup>, Elisa Romeo<sup>2</sup>, Manuela De Sario<sup>2</sup>, Stephan K. Weiland<sup>1†</sup>, and Francesco Forastiere<sup>2</sup>

**Address of the institutions where the work was carried out:**

Institute of Epidemiology, Ulm University

Helmholtzstr. 22

D-89081 Ulm, Germany

Dept of Epidemiology, Local Health Authority Rome E,

Via di Santa Costanza 53

00198 Roma, Italy

<sup>1</sup> Institute of Epidemiology, Ulm University, Ulm, Germany

<sup>2</sup> Dept of Epidemiology, Local Health Authority Rome E, Rome, Italy

† deceased

Corresponding author:

Gudrun Weinmayr

Institute of Epidemiology, Ulm University

Helmholtzstr. 22

D-89081 Ulm, GERMANY

e-mail: [gudrun.weinmayr@uni-ulm.de](mailto:gudrun.weinmayr@uni-ulm.de)

phone: +49 731 50 31071

fax: +49 731 50 31069

**Short running head:** Air Pollution Short Term Effects in Asthmatic Children

**Key words:** air pollution, asthma, children, NO<sub>2</sub>, PM<sub>10</sub>, short term effects

**Competing interests:** none of the authors has any competing interests.

**Article descriptor:** asthma, children's health

**Abbreviations:**

LRS: lower respiratory symptoms

NO<sub>2</sub>: nitrogen dioxide

OR: Odds ratio

PEACE: Pollution Effects on Asthmatic children in Europe

PEF: peak expiratory flow

PM: particulate matter

PM<sub>2.5</sub>: PM with an aerodynamic diameter smaller than or equal to 2.5 µm

PM<sub>10</sub>: PM with an aerodynamic diameter smaller than or equal to 10 µm

95%CI: 95% confidence interval

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## Abstract

**Objective.** To quantify the short-term effects of PM<sub>10</sub> and NO<sub>2</sub> on respiratory health of asthmatic children from published panel studies, and to investigate the influence of study and population characteristics as effect modifiers.

**Data source and extraction.** After a systematic literature review, quantitative estimates of the association of PM<sub>10</sub> and/or NO<sub>2</sub> with respiratory symptoms and peak expiratory flow (PEF) were extracted. Combined effect estimates for an increase of 10µg/m<sup>3</sup> were calculated by random effects meta-analysis for all studies and for different strata defined by study characteristics. The effect of publication bias was investigated with Egger's and Begg's tests and "trim and fill" analyses.

**Data Synthesis.** 36 studies were identified, 14 were part of the European PEACE study. There were statistically significant adverse effects of PM<sub>10</sub> (OR=1.028, 95%CI:1.006;1.051) on asthma symptoms. There were also effects, although not reaching statistical significance, of PM<sub>10</sub> on cough (OR=1.012, 95%CI:0.997;1.026) and on PEF (decrease of -0.082 L/min, 95%CI:-0.214;0.050). For NO<sub>2</sub>, there were statistically significant effects on asthma symptoms in the overall analysis (OR=1.031, 95%CI:1.001;1.062) considering all possible lags, but not when only the 0-1 lag was evaluated.. Publication bias was not found, although it appeared when excluding the PEACE studies. When the "trim-and-fill" method was applied to the data set without the PEACE studies, the results were similar to the overall estimates from all studies. There was an indication for stronger PM<sub>10</sub> effects for studies conducted in summer, outside of Europe, longer lags, and in locations with higher NO<sub>2</sub> concentrations.

**Conclusions.** There were clear effects of PM<sub>10</sub> on the occurrence of asthma symptom episodes, and to a lesser extent on cough and PEF. The results for NO<sub>2</sub> are more difficult to interpret as they depend on the lag times examined. There was an indication of effect

modification by several study conditions.