



# Obesity, tidal volume, and pulmonary deposition of fine particulate matter in children with asthma

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Changes in breathing patterns due to obesity may explain why obesity increases susceptibility to air pollution <https://bit.ly/36768Pk>

**Cite this article as:** Afshar-Mohajer N, Wu TD, Shade R, *et al.* Obesity, tidal volume, and pulmonary deposition of fine particulate matter in children with asthma. *Eur Respir J* 2022; 59: 2100209 [DOI: 10.1183/13993003.00209-2021].

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This article has an editorial commentary: <https://doi.org/10.1183/13993003.02505-2021>

Received: 23 Jan 2021  
Accepted: 30 June 2021

## Abstract

**Background** Obese children with asthma are more vulnerable to air pollution, especially fine particulate matter (PM<sub>2.5</sub>), but reasons are poorly understood. We hypothesised that differences in breathing patterns (tidal volume, respiratory rate and minute ventilation) due to elevated body mass index (BMI) may contribute to this finding.

**Objective** To investigate the association of BMI with breathing patterns and deposition of inhaled PM<sub>2.5</sub>.

**Methods** Baseline data from a prospective study of children with asthma were analysed (n=174). Tidal breathing was measured by a pitot-tube flowmeter, from which tidal volume, respiratory rate and minute ventilation were obtained. The association of BMI z-score with breathing patterns was estimated in a multivariable model adjusted for age, height, race, sex and asthma severity. A particle dosimetry model simulated PM<sub>2.5</sub> lung deposition based on BMI-associated changes in breathing patterns.

**Results** Higher BMI was associated with higher tidal volume (adjusted mean difference (aMD) between obese and normal-range BMI of 25 mL, 95% CI 5–45 mL) and minute ventilation (aMD 453 mL·min<sup>-1</sup>, 95% CI 123–784 mL·min<sup>-1</sup>). Higher tidal volumes caused higher fractional deposition of PM<sub>2.5</sub> in the lung, driven by greater alveolar deposition. This translated into obese participants having greater per-breath retention of inhaled PM<sub>2.5</sub> (aMD in alveolar deposition fraction of 3.4%, 95% CI 1.3–5.5%), leading to worse PM<sub>2.5</sub> deposition rates.

**Conclusions** Obese children with asthma breathe at higher tidal volumes that may increase the efficiency of PM<sub>2.5</sub> deposition in the lung. This finding may partially explain why obese children with asthma exhibit greater sensitivity to air pollution.