

# Assessment of the adverse effect of crop residue burning on respiratory health: a case study of Patiala, India

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## Abstract

**Background** Crop residue burning (CRB) is one of the top contributors to ambient air pollution (particulate matter 2.5 [PM<sub>2.5</sub>]) in north-western India. Despite the magnitude of the problems associated with high particulate amounts, there are few epidemiological data in India on the associated health effects of CRB, focusing on rural populations. The present study was conducted to quantify the effect of PM<sub>2.5</sub> from CRB on the respiratory health of agricultural community in the Nabha block in Patiala, India.

**Methods** Participants aged 10–60 years who were residents of six villages in the Nabha block in Patiala, India, who had resided in the area for at least 10 years and had self-reported as being in good health and non-pregnant women were enrolled in this cross-sectional study using purposive sampling. The participants were recruited from their residence, and all volunteered to participate in the study. The study population was surveyed for self-reported health symptoms and other exposure confounders. Lung function tests (LFTs) were done to examine forced expiratory volume in one second (FEV<sub>1</sub>), forced vital capacity (FVC), and peak expiratory flow (PEF), both during CRB and non-CRB periods. 24-h continuous PM<sub>2.5</sub> monitoring was done using the modified low-volume Combo Dust Samplers and particles were collected in glass fiber filters. The PM<sub>2.5</sub> mass concentrations were analysed using the standard gravimetric method. Multiple regression models were used to quantify the association of PM<sub>2.5</sub> from CRB on respiratory health after controlling for other exposure variables; namely, cooking fuel, ventilation, and distance from the road.

**Findings** A total of 3644 participants were enrolled from Oct 16 to 26, 2018, and March 7 to April 3, 2019 (the non-CRB periods), and from Oct 27 to Nov 20, 2018 and from Nov 3 to 13, 2019 (CRB periods). The present study showed significant associations between PM<sub>2.5</sub> exposure and poor respiratory health with an increased prevalence of respiratory symptoms and lung function decrement among the study population. The older group (>40–60 years) reported more respiratory complaints during CRB than the younger groups (10–18 and >18–40 years), including coughs (OR 1.57; 95% CI 1.14–2.16), phlegm (1.69; 1.19–2.16), and itchiness of the eyes (3.44; 2.54–4.66). The study found a decrease in the results of LFTs with increasing PM<sub>2.5</sub> across all age groups during CRB compared with the non-CRB period. The youngest group (10–18 years) had the highest reduction in lung capacity based on LFT variables. In men, FEV<sub>1</sub> declined 16% in those aged 10–18 years, 9% in those aged older than 18 to 40 years, and 10% in those older than 40 to 60 years; and in women, it declined 26% in those aged 10–18 years, 12% in those older than 18 to 40 years, and 7% in those older than 40 to 60 years, during CRB (with a mean PM<sub>2.5</sub> increase of 167 µg/m<sup>3</sup>). Similar declines were noted for the other (FVC and PEF) lung function variables.

**Interpretation** This study, which shows the adverse effects on health from CRB (increases in respiratory symptoms and poor lung function), highlights to need to accelerate policy interventions and engage farmers in discussions on CRB elimination.

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### Contributors

MS conceptualised the idea and designed the methods along with AK and SKG. MU led the survey data collection, and contributed to revising the methods with help of MS. SKG and MS did the data processing. MS and MU analysed and interpreted the figures as per the guidance of SKG and AK. KL assisted in manuscript proofreading. MU and MS wrote the manuscript with inputs from SKG, AK, and KL. MS and MU accessed and verified the data.

### Declaration of interests

We declare no competing interests.

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