

Air pollution and associated serial lung function and respiratory symptoms among a panel of schoolchildren from the Vaal Triangle Priority Area, South Africa

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Objective: To describe, among a panel of schoolchildren resident in a high pollution region of South Africa, the prevalence of adverse respiratory outcomes, and to investigate associations between daily exposures to ambient air pollutants and changes in daily respiratory symptoms and lung function.

Materials and Methods: A total of 286 pupils from four randomly selected Grade 4 classes from four primary schools in the Vaal Triangle Air Pollution Priority Area (VTAPPA) were selected. The pupils were interviewed together with their caregivers and underwent spirometric assessment. The pupils were included in two phases of intensive lung function monitoring and symptoms logging, which were performed simultaneously across all schools. Each intensive phase was of two week duration, conducted in March 2014 (summer) and May/June 2014 (winter). Air pollution data for these intensive periods were provided by the South African Weather Services. Generalised estimating equation regression models were used to determine daily variation in respiratory outcomes and ambient pollution, adjusting for covariates. Possible lag effects (1 to 5 days) and the five-day averages were modeled to account for possible prior exposure effects.

Results. The daily median for $PM_{2.5}$ across the schools ranged from $4.8\mu g/m^3$ to $48.9\mu g/m^3$ and $6.5\mu g/m^3$ to $115.5\mu g/m^3$ in summer and winter intensive phases, respectively. The daily median for NO_x across schools was 3.4ppb to 67.1ppb in summer and 5.5 to 123.7 ppb in winter intensive phase.

Doctor-diagnosed prevalence of asthma was low (3.6%), as was the reported chronic symptoms of cough, wheeze and phlegm, with prevalences of 4.6%; 6.03% and 5.7%, respectively. ‘Symptoms-defined’ any asthma’ was 9.7%, while persistent asthma was 6%. A decreased forced expiratory volume in one second (FEV_1) was observed for interquartile increases in $PM_{2.5}$ and SO_2 , this was statistically significant only for lags 4 and 5. More consistent statistical findings were found with peak expiratory flow rate (PEFR) for $PM_{2.5}$ and SO_2 , but not for NO_x . Increased risk for increasing exposure to the different pollutants were seen consistently for wheeze, with odds ratios ranging from 0.95-1.2 (95% CI ranging from 0.9-1.3) across all estimated lags for an interquartile increase for all pollutants. Similarly consistent findings were found for chest tightness and cough with $PM_{2.5}$ and SO_2 exposure respectively.

Conclusions. While the prevalence of doctor-diagnosed asthma was low, the higher prevalence of symptoms based diagnosis suggest that there is under-utilisation of healthcare services for respiratory disorders. Our findings of ambient pollutant related respiratory outcomes require appropriate interventions to protect child respiratory health in these communities.