

## Introduction

Pollutant exposure during pregnancy could influence the organ development in the foetus, which subsequently impacts on the newborn's risk for acquiring diseases in childhood and later life. A birth cohort study design allows for observing adverse outcomes, including respiratory effects, in the newborn and into early childhood.

The south of the city is characterised by communities living in close proximity to large scale industrial enterprises. Previous studies have indicated higher levels of childhood asthma in the south as compared to the north communities. The objective of this cohort was to identify ante-natal and early life risk factors, particularly ambient pollutants, for adverse respiratory outcomes.



## Methods and Materials

### Selection of Ante-natal Clinics

Public sector ante-natal clinics of similar socio-economic profiles, were selected in the industrially polluted south and the lesser polluted north of the city.

### Selection of Participants

All pregnant females who met the inclusion criteria we recruited Human immunodeficiency virus (HIV) positivity assessed during ante-natal testing was not an exclusion criteria.

### Standardised Interviews of Participants

Trained interviewers conducted standardised face-to-face interviews of all participants. Repeated interviews were conducted during pregnancy and in infancy.

### Exposure Data

A passive sampling programme for oxides of nitrogen was conducted, repeated over the Winter and Summer seasons. Land-use regression modelling described home-address measures of exposure.

### Postnatal Data

Time of birth data included delivery type, APGAR scores, and baby anthropometric measurements.

### Clinical Assessments

All babies were assessed by paediatricians at six months of age.

## Results

### Exposure Assessment

Table 1. NO<sub>x</sub> levels in north and south during winter and summer

Geographical Location	Winter Phase NO <sub>x</sub> (mg/m <sup>3</sup> ) (mean (range))	Winter Phase NO <sub>x</sub> (mg/m <sup>3</sup> ) (mean (range))
North (n=10)	32.01 (15.4 – 51.6)	11.3 (8.4-13.9)
South(n=32)	54.9 (33.6-84.4)	13.9 (7.7 – 21.7)

### Demographics and Risk Factors

Table 2. Demographic and Risk Factors

	Total Sample (n=555)
Age (mean (years) (SD))	25.7 (5.9)
African ethnicity	419 (75)
Marital Status: Single	458 (82.5)
HIV positive	207 (36.1)
Living in industrial south	314 (56.6)
High School	454 (81.8)
Post High School training	81 (14.6)
Annual Income: R0 - R100 000	345 (62.2)
Living in an informal home	78 (13.2)
Water damage at home	74 (13.3)
Biomass fuel usage	15 (2.7)
Current smoker	11 (1.9)
Alcohol intake during pregnancy	32 (5.8)
Environmental tobacco smoke	123 (22.2)
Predicted NO <sub>x</sub> (ug/m <sup>3</sup> ) (mean (SD))	29.7 (10.8)
Unless otherwise indicated, all variables: n (%)	

### Birth Outcomes

Various adverse outcomes were described in the cohort from stillbirths (2.5%), miscarriages (6%), pre-term births (10%) and low 5 minute APGAR (3.1%). Reduced anthropometric birth measures (head circumference (11.4%), body length (9.8%) and low birth weight (12.6%) was also recorded, providing an overall adverse birth outcome prevalence of 33.2%.

## Results (continued)

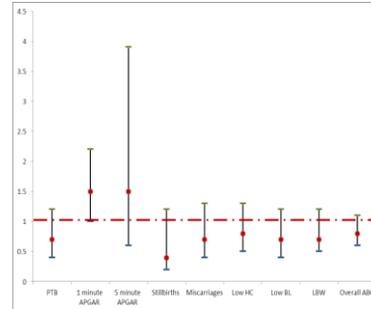


Figure 1. Adjusted odds ratios (95% CI) for adverse outcomes for one unit increase in NO<sub>x</sub> interquartile range (15.8ug/m<sup>3</sup>). Logistic regression models adjusted for age, education, income, current smoking, environmental tobacco smoke, alcohol during pregnancy, HIV status, race, biomass fuel usage and indoor mould. (PTB= preterm birth (<37 weeks); HC= head circumference (low: <32cm); BL=body length (low: <46cm); LBW=low birth weight (<2500g); low APGAR score: <8; ABO=adverse birth outcome (composite of outcomes))

### Developmental and Respiratory Outcomes at six months of age

The prevalence of anthropometric abnormalities (body length, head circumference and body weight as compared to growth charts) was substantial (23%). However, developmental abnormalities (gross motor) was low (6.9%). Doctor prescribed treatment for reported respiratory problems in the first six months was high. However, in a very small number of cases did these warrant either hospitalisation or nebulisation.

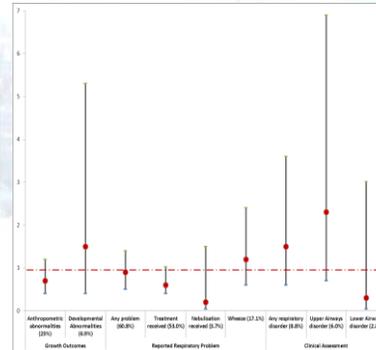


Figure 2. Adjusted odds ratios (95% CI) for outcomes at 6 months of age for one unit increase in NO<sub>x</sub> interquartile range (15.8ug/m<sup>3</sup>). Logistic regression models adjusted for age, education, income, current smoking, environmental tobacco smoke, alcohol during pregnancy, HIV status, adverse birth outcome, breastmilk/formula feed, race, biomass fuel usage and indoor mould

### Other risk factors (not shown in tables/figures)

Our regression models adjusted for key other risk factors, both at birth and at six months. Being married, alcohol consumption in pregnancy and current smoking were significantly associated with stillbirth. Despite low reporting, alcohol consumption was also significantly associated with increased risk for miscarriages, and with overall adverse birth outcomes.

Formula or mixed feeding at 6 months was associated with a statistically significant increased risk (OR: 2.5 (95%CI: 1.1-5.5) and 1.7 (1.0-4.3) respectively) for reported respiratory problems, compared against breast only, and similarly for those prescribed medication by a doctor for a respiratory problem (OR: 2.4 (1.1-5.2) and 1.8 (1.01-4.7) respectively). These estimates were substantially increased for reported wheezing (OR: 7.3 (1.5-35.2) and 8.3 (1.6-44.7) respectively).

Evidence of water damage (dampness, mould etc.) in household was associated with reported wheeze (OR: 3.0 (1.01-8.8) and miscarriages (OR: 4.9 (1.8-13.3).

Although being HIV positive was persistently associated with an increased risk (OR>1), it was never statistically significant for any outcome.

## Discussion

The interim results emerging from this South African birth cohort study showed modest impacts of pollution on birth outcomes and infant respiratory health.

In this young, predominantly single cohort with a high prevalence of HIV positive status (36.1%), we were able to describe several risk factors, document a range of birth outcomes and measure pollutant levels.

Our findings of possible pollutant-related adverse birth outcomes differing among geographically distinct samples within same cities, have been documented in previous studies.

While the APGAR score was the only outcome statistically significantly associated with an increased pollutant-related odds ratio, other outcomes reflected an increased risk, particularly outcomes assessed at six months.

Most studies which have investigated pollutant associated birth outcomes, have reported modest elevated risk, thus huge sample sizes are necessary. Birth record studies provide one approach to this problem. These restrict the ability to address antenatal factors such as alcohol and dietary consumption, occupational and environmental histories. The MACE Cohort has the ability to measure these factors and explore the relationship with ambient pollution.

The one striking feature of this pilot study was the influence of HIV status on outcomes. Despite the high prevalence of the disease, HIV was not a predictor of adverse outcomes in bivariate or adjusted multivariate analyses.

Apart from the current size of the cohort, the other limitations at this point is the characterisation of exposure. Our first sampling of NO<sub>x</sub> revealed substantial geographical and season differences. To better characterise exposure, additional sampling to describe exposure by trimester, and additional criteria pollutants and volatile organic compounds are necessary.

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## Objective and Aims

The overall objective of the cohort study is to determine the association of environmental pollution (Indoor and ambient) with adverse birth outcomes and subsequent respiratory health in early childhood, among a sample of pregnant mothers and their newborns, in communities exposed to industrial pollution, compared to communities without such exposures. The specific aims relevant to this report are:

- To characterise ambient environmental exposure to oxides of nitrogen.
- To determine the prevalence of adverse birth outcomes
- To describe respiratory outcomes in 6-month old infants
- To determine pollutant related adverse outcomes adjusting for individual, behavioural and environmental risk factors.

