# PREVALENCE OF RESPIRATORY ILLNESSES IN DIFFERENT REGIONS OF SOUTH AFRICA

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## INTRODUCTION

The epidemiology of disease is influenced by many factors of which the state of the environment is one of the most important. In conjunction with the positive changes in awareness of the importance of environmental protection, public focus on and concern about environmental respiratory tract diseases has changed. In many areas in South Africa and the world, air quality has improved over the past two decades with the emphasis being shifted from higher exposures producing clinically measurable diseases to lower levels which can increase population risks and produce more subtle effects[1,2]. However, other areas in South Africa not declared as smoke-free zones under the air Pollution Prevention Act are facing air quality conditions similar to those documented in Europe during the 1950s[3]. This paper summarizes some of the respiratory disease prevalance data collected in three different geographical areas in the Transvaal, South Africa. The three areas include two polluted areas and a reference area. Air pollution data collected in the different areas is not covered in this paper but will be referred to.

## METHODOLOGY

The respiratory tract disease prevalence data in three different areas - the Vaal Triangle, Klerksdorp and the East Rand - were collected as part of a cross-sectional survey conducted in November 1992 (summer period). A modified version of the Vaal Triangle Air Pollution Health Study's questionnaire was used to collect the data.

The questionnaires were distributed to children in the 8 to 12 age group in Vanderbiljpark (Vaal Triangle), Edenvale, Kempton Park, Germiston (AIRKEM) and Klerksdorp. The respondent was usually the mother or female guardian. Questionnaires were distributed in Afrikaans and English depending on home language. The detailed methodology has been published elsewhere[4,5].

Specific details of the three study areas are given below to highlight the differences and similarities.

### Vaal Triangle

This area is one of the most diverse for industrial processes in South Africa. It is known as the industrial heartbeat of South African and is situated on the Transvaal Highveld, notorious for its atmospheric stability during winter resulting in poor dispersion and dilution of air pollution. Apart from major industrial activities ranging from chemical, petrochemical, power generation (coal-fired power stations) and metallurgical processes there are approximately 700 000 people using coal as primary energy source for cooking and space heating. Levels of total suspended particles (TSP) monitored since 1990 are 150% above the annual USA standard of 1972 (185 $\mu g/m^3$ annual average).[6] The TSP:$PM_{10}$ ratio calculated from data collected over 12 months through co-located sampling of the two size fractons was 1:0,57. This illustrates therefore that 57% of the TSP is respirable ($PM_{10}$. Using this calculation the annual average $PM_{10}$ levels in the Vaal Triangle can be projected as 105 $\mu g/m^3$ (the health standard is 50 $\mu g/m^3$). Gaseous pollutants such as sulphur dioxide ($SO_2$), nitrogen oxides ($NO_x$) and ozone are generally far below the short and longer term health standards[6]. Levels of bio-aerosols were found to exceed acceptable limits during 1991.

### AIRKEM area

The area includes Edenvale, Kempton Park and Germiston on the East Rand. It is a completely urbanized area with heavy traffic arteries, an international airport and heavy industries such as chemical plants, a coal-fired power station, a class one hazardous waste site and a variety of smaller manufacturing facilities[5]. The area neighbours two townships where coal is used as part of the household energy mix. Air pollution levels monitored since 1991 indicated isolated episodes of $SO_2$ exceeding the 24-hour health standard as well as several episodes where the $PM_{10}$ 24-hour standard of 150 $\mu g/m^3$ was exceeded[5] ($PM_{10}$ is particulate matter with a diameter of less than 10 $\mu m$ and is therefore respirable).

### Klerksdorp

This rural town in the western Transvaal was selected as reference area for the Vaal Traingle and AIRKEM. The town has almost no industrial activities listed as scheduled processes under the Air Pollution Prevention Act. The residential areas using coal/wood as household energy sources are located outside the prevailing wind directions. Major mining activities are 10-15 km from the town and fall outside the prevailing wind directions. The socio-economic status of Klerksdorp as well as the climatological conditions are similar to those of the Vaal Triangle towns (Vanderbijlpark, Vereeniging, Meyerton). and Sasolburg). Data collected on TSP levels since November 1992 indicate some peaks associated with dust storms. The overall average levels of TSP are however under 100 $\mu g/m^3$ 24-hour averages.

## RESULTS

A total of 4 713 children participated in the summer cross-sectional survey (2 433 from Klerksdorp, 1 659 from Vanderbijlpark and 621 from AIRKEM). The median age was 10 and the boy:girl ratio 1:1. Comparisons between the prevalences of upper and lower respiratory illnesses in the different areas are given in Table 1 as an odds ratio (OR) indicating the relative risk associated with living in the different areas. Data was controlled for socio-economic status (SES), age, gender and parental smoking. The comparisons are drawn between lower respiratory illnesses (LRI), upper respiratory illnesses (URI) combined, as well as specific respiratory symptoms and illnesses for the different areas. An odds ratio is statistically significant if one is not included in the confidence intervals.

Lower respiratory illnesses (LRI) have been defined as bronchitis and/or pneumonia during the last two weeks while upper respiratory illnesses (URI) are defined as earache, croup, hayfever, sinusitis and rhinitis during the last two weeks.

LRI and URI during the past year were defined as above but adding "chest illness which kept the child in bed for 3 days or more" and asthma to the LRI category.

The overall response rates for the three areas were above 80% in all cases (Vaal Triangle 88,8%; Klerksdorp 94,3%; AIRKEM 80,1%).

**Table 1.** Odds ratios (OR) for respiratory illnesses comparing Vanderbijlpark, Klerksdorp and the East Rand AIRKEM areas (controlled for SES, age, gender and parental smoking)

| AREA AND ILLNESS | PREVALENCE | OR | CONFIDENCE INTERVALS |
|---|---|---|---|
| **Vaal Triangle vs Klerksdorp** | | | |
| LRI last 2 weeks | 2,6 vs 2,2 | 1, 28 | 0,82 - 1,98 |
| LRI last year | 16.2 vs 12,7 | 1,34 | 1,11 - 1,62 |
| URI last 2 weeks | 38,5 vs 32,0 | 1,39 | 1,21 - 1,60 |
| URI last year | 69,2 vs 66,4 | 1,21 | 1,04 - 1,39 |
| Allergies ever | 18,5 vs 19,8 | 0,96 | 0,81 - 1,15 |
| Asthma ever | 9.5 vs 9,6 | 1,01 | 0,80 - 1,27 |
| Cough currently | 10,32 vs 5,4 | 2,03 | 1,74 - 2,37 |
| Phlegm currently | 17.6 vs 10,1 | 1,97 | 1,44 - 2,69 |
| Wheezy chest currently | 5.4 vs 4,5 | 1,30 | 0,96 - 1,77 |
| **Airkem vs Klerksdorp** | | | |
| LRI last 2 weeks | 4,8 vs 2,2 | 2,05 | 1,23 - 3,40 |
| LRI last year | 20,1 vs 12,7 | 1,77 | 1,30 - 2.12 |
| URI last 2 weeks | 47,6 vs 32,0 | 1,87 | 1,55 - 2,27 |
| URI last year | 77,5 vs 66,4 | 1,66 | 1,33 - 2,07 |
| Allergies ever | 28.3 vs 19,8 | 1,59 | 1,27 - 1,99 |
| Asthma ever | 13,2 vs 9,6 | 1,35 | 1,01 - 1,79 |
| Cough currently | 17.6 vs 5,4 | 3,59 | 2,68 - 4,79 |
| Phlegm currently | 22,9 vs 10,1 | 2,64 | 1,81 - 3,84 |
| Wheezy chest currently | 13.3 vs 4,5 | 3,23 | 2,34 - 4,46 |
| **Airkem vs Vaal Triangle** | | | |
| LRI last 2 weeks | 4,8 vs 2,6 | 1,67 | 0,97 - 2,86 |
| LRI last year | 20,1 vs 16,2 | 1,23 | 0,95 - 1,51 |
| URI last 2 weeks | 47,6 vs 38,5 | 1,31 | 1,07 - 1,61 |
| URI last year | 77,5 vs 69,2 | 1,38 | 1,08 - 1,74 |
| Allergies ever | 28,3 vs 18,5 | 1,63 | 1,27 - 2,08 |
| Asthma ever | 13,2 vs 9,5 | 1,35 | 0,99 - 1,84 |
| Cough currently | 17.6 vs 10,3 | 1,74 | 1,30 - 2,31 |
| Phlegm currently | 22,9 vs 17,6 | 1,37 | 0,94 - 1,99 |
| Wheezy chest currently | 13,3 vs 5,4 | 2,54 | 1,80 - 3,59 |

## DISCUSSION

In this preliminary investigation comparing the relative risk of upper and lower respiratory illnesses of 8 to 12-year-old children living in two polluted and one unpolluted area, it is evident that Klerksdorp (unpolluted in respect of absence of industrial sources) is associated with lower risks for upper and lower respiratory illnesses. The asthma and allergy rates (conditions generally not caused by outdoor air pollution but aggravated by it) of Klerksdorp children compared with Vaal Triangle children is not statistically different. However, in the AIRKEM area significantly higher asthma rates are reported compared to the unpolluted Klerksdorp area, while the differences between the Vaal Triangle and AIRKEM are not significant. This may be related to the urban environment compared with the two more rural towns.

It is important at this time looking at summer data which represents the low pollution period in the Vaal Triangle (mainly due to the absence of coal burning for space heating as well as atmospheric conditions conducive to rapid air pollution dispersion and dilution) that differences could be demonstrated. Although November in the Western Transvaal, an agricultural and mining area is associated with dust storms which may affect respiratory illness rates, the trend is however clearly towards higher disease rates associated with living in the Vaal Triangle and the East Rand (the polluted areas) compared with Klerksdorp (unpolluted) when controlling for important confounding variables such as age, gender, SES and parental smoking.

Comparisons between Klerksdorp and AIRKEM indicated that the overall strong trend is towards a higher risk associated with living in the AIRKEM areas. When comparing the risks of upper and lower respiratory illnesses in children living in the Vaal Triangle with those in the AIRKEM area it is evident that there is a tendency for a higher risk for URI, allergies, coughing and wheezing in the AIRKEM area.

The most significant increased risk of more than double (OR 2,03 : 1,73-2,37) between the Vaal Triangle and Klerksdorp was found for coughing, a combination of lower respiratory and upper respiratory tract irritation. The results of this cross-sectional survey support the hypothesis that air pollution in the Vaal Triangle and the AIRKEM study areas, both heavily industrialized and densely populated, adversely affects the health of children. This implies that the health of other more sensitive individuals in the population, such as the newborn, the elderly and those with predisposing respiratory illnesses could also be affected.

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