

HEALTH STATUS OF ADULTS EXPOSED AS CHILDREN TO AIR POLLUTION IN SOUTH AFRICA: 13-YEAR INTERVAL FOLLOW-UP STUDY

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ABSTRACT

While studies on the effects of air pollution on the health of South African children have clearly demonstrated adverse effects, little is known about the respiratory health status of adults, who spent their developing years in areas where they were exposed to air pollution. This study reviews the upper respiratory health status, lower respiratory health status and lifestyle aspects of adults who participated as 10-year-old children in the Vaal Triangle Air Pollution Health Study (VAPS) during 1990.

The study population consists of 60% females and 40% males. Most of the respondents still live in the Vaal Triangle and 39% were born there. Ninety eight percent of the individuals, who have left the Vaal Triangle, still visit the area.

Most of the respondents live in single-family houses with 3 or more bedrooms and are supplied with municipal water and electricity.

Preliminary findings of this study indicate an increase in the prevalence of upper as well as lower respiratory diseases in adulthood compared to childhood in a population exposed to air pollution during childhood. The influence of lifestyle factors is being investigated.

INTRODUCTION

Review articles on the results of numerous studies show that polluted air is associated with acute and chronic health effects [1,2]. Impacts range from an increase in death rates, through to chronic respiratory diseases, impaired development and cancer [3].

Children can be considered a sensitive population as a result of their different physiological and behavioural characteristics [4,5]. Studies conducted in the Vaal Triangle showed that children spend up to 20% more time outdoors than in the USA [6].

Epidemiological studies conducted in South Africa on air pollution and health effects in children clearly demonstrated adverse effects [7,8,9]. The respiratory health status of South African adults who spent their developing years in polluted areas is unknown. It was therefore decided to conduct such a study.

Participants from the Vaal Triangle Air Pollution and Health Study (VAPS), conducted between 1990 and 1993, were selected for this study. The main findings of VAPS as far as the respiratory health status of the children were concerned, were that almost two thirds of participants suffered from upper respiratory diseases and almost one third from lower respiratory diseases [9].

METHODOLOGY

STUDY POPULATION

All the available questionnaires of the participating children that were in grade 5 (between 10 and 11 years old) in 1990 were used to specify the study population. A total of 435 of the original (1686) study population had been located. Six of these had died of unnatural causes, 23 were working overseas without a permanent address and two individuals refused to participate in the study. Questionnaires were sent to 404 individuals. By 16 February 2004, 184 (46%) of the questionnaires had been returned. A total of 10% (39/404) of questionnaires had been returned after individuals were reminded to do so. A decision was made that this sample size was sufficient to proceed with the study.

STUDY AREA

Historically known as the Vaal Triangle, the study area extends from Randvaal in the north to Sasolburg in the southwest and Deneysville in the east. The area is 3600 m² in size and houses several sources of air pollution, including heavy industries, refineries, a 3600 Mw power station as well as motor vehicles [9].

Many households in the area are still using coal as energy carrier. The inefficient combustion of low-grade coal emits high levels of pollutants at ground level. Although domestic coal burning in the area is likely to account for only a small percentage of total emissions, the health impacts are potentially high due to the emissions being released at ground-level, and the large populations that are exposed to these emissions.

STUDY METHOD

The respiratory health status and risk profiles of individuals were characterised through self-administered questionnaires that were posted to individuals. The advantages of a questionnaire include a relatively low cost, the fact that a wide geographical area can be covered and that interviewer variation can be excluded. Disadvantages are that the response rate is generally low and people might have difficulty in completing the questionnaire, which may lead to poor quality data [10].

STATISTICAL ANALYSES

The data collected by the questionnaires were summarised by means of frequencies, percentages and cross-tabulations. At a univariate level the data from 1990 were compared with that of 2003. For 2003 outcome variables (upper respiratory and lower respiratory variables) were tested for association with demographic, risk as well as environmental factors using Fisher's exact test. The crude (unadjusted) odd ratios

(ORs) along with their 95% confidence intervals were also found. Following the within 2003 analyses demographic, risk as well as environmental factors “significant” at a 0.20 level of significance, will still be studied in a multivariate data analysis using logistic regression.

RESULTS AND DISCUSSION

DEMOGRAPHIC AND DESCRIPTIVE STATISTICS OF THE STUDY POPULATION

Sixty percent (110/184) of the study population were female and 40% (74/184) were male. Afrikaans is the home language of 89% (163/184) of the study population, English that of 10% (19/184) and 1% (2/184) reported their home language as “other”, of whom one individual specified it as German. The majority (63%) of the population still resides in the Vaal Triangle. Thirty nine percent (71/184) of the study population indicated that they still lived in the town in which they were born. Of those who had left the area, 98% still visit the Vaal Triangle. Most (60%) of them visit the Vaal Triangle for 30 days or more per year.

LIVING CONDITIONS OF THE STUDY POPULATION

HOUSES

Sixty nine percent of respondents (121/175) indicated that they live in single-family houses not attached to other houses while 13% (23/175) live in flats. Most (75% or 136/181) of the individuals live in a residence with three or more bedrooms. None of the respondents live in informal houses or pre-fabricated houses.

WATER AND ENERGY SOURCES

The majority (93% or 170/182) of the respondents rely on municipal water for domestic use. This figure shows no change compared with the 1990 data. Seventeen percent have access to private borehole water as well. Electricity is used by 97% (176/182) of the households for cooking purposes, which again represents no change compared to 1990.

The preferred choice of apparatus for space heating in 2003 was electric heaters (56%), followed by gas heaters (13%).

LIFESTYLE OF THE STUDY POPULATION

The following lifestyle factors are considered to potentially have an influence on the respiratory health status of the study population:

HOBBIES

Only 38% of respondents exercise any form of hobby. The most popular hobbies were painting (10%), woodwork (8.4%) and working on cars (mechanical/electrical) (8.33%).

EATING AND DRINKING HABITS

Chicken and/or fish are more popular than red meat, with 97% (176/182) of respondents having chicken on a regular (at least once a week) basis, while 88% (160/181) would have red meat on a regular basis. Processed food is less popular, with 44% (78/177) of respondents having this on a regular basis.

As far as fried food is concerned, it is evident that 97% (178/184) of respondents use oil to fry food. Of these, 10% (17/178) do so on a daily basis, 45% (80/178) on a weekly basis and 46% (81/178) only occasionally.

SMOKING HABITS

Twenty seven percent (46/168) of respondents are currently smoking, while 12% (20/168) have stopped smoking and 61% (102/168) have never smoked. Adult smoking in South Africa decreased from 34% in 1996 to 24% in 1998¹¹. It is believed that the increase of smoke free zones in most buildings was responsible for this decrease.

RESPIRATORY HEALTH STATUS OF THE STUDY POPULATION

PREVALENCE OF UPPER RESPIRATORY ILLNESSES

The prevalence of upper respiratory illness (URI) was determined by a “yes” answer to either of the questions on having had sinusitis, hay fever or earache during the past year. Fifty nine percent (104/177) of respondents had sinusitis during the year preceding the 2003 survey, while 48% (86/178) had hay fever and 36% (62/174) earache. When comparing these results with those from 1990, the following became evident: 40% (68/172) had sinusitis ($p < 0.001$), 27% (46/173) had hay fever ($p < 0.001$) and 37% (62/169) earache ($p = 0.811$).

PREVALENCE OF LOWER RESPIRATORY ILLNESSES

Should the prevalence of lower respiratory illness (LRI) be determined by a “yes” answer to either having had bronchitis, pneumonia or asthma during the past year, then the current prevalence of LRI is 18%, since 18% (32/174) of respondents had bronchitis during the year preceding the 2003 survey. During the 1990 survey, this figure was 14% (25/178) ($p = 0.343$). Four percent (7/172) had pneumonia, compared to the 0% of 1990 ($p = 0.008$) and 8% (13/173) had asthma compared to the 4% (8/179) of 1990 ($p = 0.034$).

RISK FACTORS ASSOCIATED WITH URI AND LRI IN 2003

The variables, which reached significance ($0 < p \leq 0.05$) on a 95% confidence level in the univariate analysis, were amongst others, having an allergy, which was associated with upper respiratory illnesses such as earache, sinusitis and hay fever as well as with lower respiratory illnesses such as bronchitis and asthma. Pneumonia was associated with the consumption of more than 7 drinks per week. It is envisaged however; that during logistic regression, a confounding factor (possibly smoking), will emerge for this phenomenon. Being male was found to be protective of bronchitis ($p = 0.009$).

Although not statistically significant, elevated (≥ 1.5) crude odds ratios were found for some factors associated with URI and LRI.

UPPER RESPIRATORY ILLNESSES (URIs)

The risk of contracting earache is 1.5 times higher for 'ever-smokers' (individuals who have at some stage smoked two or more cigarettes per day) than for 'never-smokers' (never smoked more than one cigarette per day). Individuals who are overweight have a 1.7 times higher risk of having sinusitis than individuals who are either underweight or have normal weight.

Having worked in an environment where they have been exposed to chemicals for more than a year increases an individual's risk of suffering from hay fever by 1.6 times. Other risks associated with hay fever, are having the perception that the air pollution problem in the Vaal Triangle is serious (OR= 1.8), the same is true for having the perception that air pollution is a serious problem in the area (outside the VT) where the individual currently live (OR=1.5).

LOWER RESPIRATORY ILLNESSES (LRIS)

PNEUMONIA

The risk of contracting pneumonia is nearly 4 times higher for a man than for a woman. The risk for an ever-smoker is 3.4 times higher and for an individual living in a house where people are smoking, is 3 times higher.

An overweight person has a 1.8 times higher risk for contracting pneumonia, one that has worked in a dusty environment for at least a year has a 3 times higher risk, and one who was exposed to chemicals in the working environment for at least a year, a 2.4 times higher risk. An individual having the perception that the air pollution in the area outside the Vaal Triangle (where he or she resides) is serious has a 1.9 times higher risk of contracting pneumonia.

BRONCHITIS

Three risk factors were found to be associated with bronchitis. These are being overweight (2.2 times higher risk), living in a house where people smoke (1.5 times higher risk) and having the perception that the air pollution in the area (outside the Vaal Triangle) where they live is serious (1.5 times higher risk).

ASTHMA

For asthma, five risk factors were identified on the ground of an elevated OR. The risk factor with the highest risk (3.3 times) was the habit of consuming more than 7 drinks per week. As mentioned before, it is believed that a confounder such as smoking might play a role in this finding and the issue will therefore be addressed when logistic regressions are performed.

Being an ever-smoker was associated with a three times higher risk, being overweight with a 2.2 times higher risk and working for more than a year in an environment exposed to chemicals, with a 1.7 times higher risk.

An unexpected risk factor that was found to be associated with asthma was living outside the Vaal Triangle (2.7 times higher risk). It is envisaged that an explanation for this phenomenon will be found during logistic regression.

SUMMARY

A study was conducted to determine the respiratory health status in adults who spent their childhood in a polluted area in South Africa.

The study population was a group of individuals who participated as ten year olds in 1990, in the VAPS study, a study on air pollution and health effects on children. Their respiratory health status as children is therefore known.

The adulthood respiratory health status of the individuals was compared to their childhood respiratory health status. A statistically significant increase in the prevalence of the upper respiratory illnesses, sinusitis ($p < 0.001$) and hay fever ($p < 0.001$) as well as in the lower respiratory illnesses, pneumonia ($p = 0.008$) and asthma ($p = 0.034$) was found.

Univariate analysis performed on the data identified preliminary risk factors. Being allergic was the one factor statistically significantly associated with most of the respiratory illnesses. Logistic regressions still have to be performed on the data to control for confounding factors.

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