Probing secondary exposure and health data as a tool to improve public health in South Africa

by

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Submitted in fulfilment of the requirements for the degree

Doctor of Philosophy

in the

School of Health Systems and Public Health
Faculty of Health Sciences
University of Pretoria

February 2006

The financial assistance of the National Research Foundation (NRF) towards this research during 2001-2003 is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the NRF.

ACKNOWLEDGEMENTS

Although I spent many hours alone - I never felt lonely - in preparing this thesis, I could not have accomplished it without the input from many parties.

I would like to acknowledge the following persons and institutions in particular:

My supervisor, Prof Kuku V.V. Voyi. Despite all the jokes I made about you driving me *koekoes*, your *joie de vivre* for high quality research was instilled in me even during our brief encounter as colleagues at the CSIR in 1999.

My parents (Willem and Judy Wichmann), brother (André Wichmann), other close family and numerous friends scattered all over the world.

Mr Hans Linde from the City of Cape Town for granting permission to use the air quality data for free and Mr Grant Ravenscroft from the City of Cape Town for supplying the air quality data in the correct electronic format. All those involved at any stage of the design, implementation and maintenance of the Cape Town air quality monitoring network are also acknowledged.

Gratitude is also expressed towards the National Department of Health for supplying the 1998 South African Demographic and Health Survey data in the correct electronic format for free. All those involved at any stage of the 1998 South African Demographic and Health Survey are also acknowledged.

Colleagues at the School of Health Systems and Public Health, University of Pretoria and at the Institute for Risk Assessment Sciences, Utrecht University, the Netherlands.

This thesis was sponsored by contributions from a University of Pretoria Doctoral scholarship (2001), a South African National Research Foundation Doctoral scholarship (2001-2003), a High-level University Year to Gain Excellence in the Netherlands (Huygens) scholarship (2002-2003) and a Dutch Education: Learning at Top Level Abroad (DELTA) scholarship (2004).

DECLARATION

I, Janine Wichmann, declare that the dissertation/thesis, which I have submitted for the degree Doctor of Philosophy at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

_____ _____

Janine Wichmann Date

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Commissioner of Oaths Date

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ABSTRACT

The usefulness of secondary exposure and health data to improve public health in South Africa will be assessed. Given the tremendous health impact of air pollution exposure the focus of this thesis is on primary prevention, that is the identification of outdoor air pollution and the use of dirty fuels (wood, animal dung, crop residues, coal, paraffin) for cooking and heating as risk factors, whilst controlling for confounding. Hourly averaged outdoor PM_{10} mass, NO_2, NO, SO_2, O_3 data (1 August 1998 - 31 July 2003) from Cape Town were analysed in a nonparametric Spearman's Rho correlation analysis to determine the seasonal spatial correlation between the monitoring sites. Trend and descriptive analyses were conducted on the outdoor hourly and daily PM_{10} mass data to investigate the current and future health implications in the Khayelitsha sub-district, Cape Town. The 1998 South African Demographic and Health Survey (SADHS) data were analysed. The survey involved 13 826 individuals in 12 763 households. Univariate and multivariate logistic regression analyses generated crude and adjusted odds ratios and 95% confidence intervals in order to assess the influence of dirty fuel use for cooking and heating on adult (> 15 years) respiratory health, childhood (< 59 months) respiratory health and 1-59 month mortality. It was found that outdoor air pollution is not homogenously distributed in Cape Town during all seasons. Elevated PM_{10} mass concentrations are frequently present in the Khayelitsha sub-district. There is a strong case for acknowledging the large public health risk arising from air pollution exposure in South Africa, despite the limitations of the 1998 SADHS data. Not much progress has been made in air pollution epidemiology in the country during this investigation due to the identified limitations. Secondary exposure and health data are thus only useful in improving public health in South Africa by supplying baseline data for trend analysis or hypotheses generation. It is recommended that the country must develop environmental public health tracking networks, which incorporates various data sources from multi-sectoral collaborative intervention projects with analytic study designs, in all major cities in the country.

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SUMMARY

The hypothesis that air pollution (using secondary exposure and health data) poses a significant potential risk on human health (specifically respiratory health of people >15 years and <5 years as well as 1-59 month mortality) in South Africa will be tested. The focus of this thesis is on primary prevention, that is the identification of outdoor air pollution and the use of dirty fuels (wood, animal dung, crop residues, coal, paraffin) for cooking and space heating as risk factors, whilst controlling for confounding. Daily averaged (24-h) outdoor PM_{10} mass, NO_2, NO, SO_2, O_3 data (1 August 1998 - 31 July 2003) from Cape Town were analysed in a nonparametric Spearman's Rho correlation analysis to determine the seasonal inter-site correlation between the monitoring sites. Trend and descriptive analyses were conducted on the outdoor hourly and daily PM_{10} mass data to investigate the current and future health implications in the Khayelitsha sub-district, Cape Town. Limitations in the current air quality monitoring network of Cape Town were addressed. The 1998 South African Demographic and Health Survey (SADHS) data were analysed in more detail than reported in the SADHS report. The survey involved 13 826 individuals from 12 763 households. Univariate and multivariate logistic regression analyses were used to generate crude and adjusted odds ratios and 95% confidence intervals in order to assess the influence of dirty fuel use for cooking and heating on adult (> 15 years) respiratory health, childhood (< 59 months) respiratory health and 1-59 month mortality. Limitations, such as inadequate control of systematic and random errors, of the 1998 SADHS were compared to those from other local air pollution epidemiological studies. It was found that 24-h averaged outdoor air pollution is heterogenously distributed in Cape Town during all seasons. Elevated PM_{10} mass concentrations are frequently present in the Khayelitsha sub-district. There is a strong case for acknowledging the large public health risk arising from air pollution exposure in South Africa, despite the limitations of the 1998 SADHS data. Not much progress has been made in air pollution epidemiology in the country during this investigation due to the identified limitations. Secondary exposure and health data are thus only useful in improving public health in South Africa by supplying baseline data for trend analysis or hypotheses generation. It is recommended that the country must develop environmental public health tracking networks, which incorporates various data sources from multi-sectoral collaborative intervention projects with analytic study designs, in all major cities in the country.

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