Breathing easy: Modelling air pollution on a spatial scale in Sydney

A Geographical Information Systems (GIS) approach to modelling air pollution in Sydney, whilst examining the effect socioeconomics have to play. Study showed low socio economics were significantly more likely to be affected by diseases with established links to air pollution.

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Urban growth rates are increasing exponentially compared to their rural counterparts, with more than half the population to live in urban centres by 2020 (1). In order to accommodate for this influx of people, cities have sprawled outwards, deteriorating their natural surroundings to increasing degrees. Further damaged by increased industrialisation since the 1840s, which due to increased incomplete combustion has changed and increased air pollutants. Therefore, the majority of sources for air pollutants is industrial burning or traffic related sources. Air movement also varies depending on valley morphology, wind tunnels, source locations and city layout, thus air pollution moves differently in every city, making universal modelling virtually impossible. Therefore, classical epidemiological studies can fail to capture the complexity of the social and physical parameters that influence air pollutant related health effects.

Land modelling using geographical information systems (GIS) has been used to accurately model multiple air pollutants (2) and is better adapted to handling larger data input. Sadly, current papers only include a handful of individual input variables and only examined the hospital effects of air pollution on a few diseases at a time. This study examined the relationships between air pollution, land uses, socioeconomic status (SES) and morbidity and mortality over a range of 12 diseases across a range of cardiovascular, pulmonary and neurodegenerative diseases. Air pollution has shown to increase inflammatory effects which increase morbidity and mortality of cardiovascular diseases and even short-term exposures is linked with adverse health reactions (3). Whilst there are already strong established links between these diseases and air pollution, previous studies have failed to appropriately account for social status when examining spatial trends in epidemiology. Therefore, this research presents brand new information that should be used and adopted by policymakers and local governments to better improve and care for their local residents.

In Australia, people of lower SES levels are at greater risk of poor health, have shorter lives and are at a greater likelihood of disability, illness, or death (4). Low SES groups are less likely to seek medical assistance due to the disparities in access. Additionally, many fear out of pocket expenses and many families can face poverty from sustained health costs in combination from time off work or termination of employment (5). Therefore, governments have been working to try to identify the reasons for the health disparity in an attempt to mitigate it. However, currently health data doesn't include socioeconomics and this limits the ability to demonstrate the relationship between these two factors. My research by combining data sources over a spatial scale allows such comparison. Highlighting trends on a local government scale to show strong trends and relationships between SES levels, air pollution and disease exacerbation.

By spatially overlaying and comparing SES inputs, land uses, and air pollution data, my study directly managed to model which variables had the greatest influence on each disease. McGinnis & Foege (6) highlights that low SES are underlying factors for a number of diseases. Our study is innovative in the way it overlays this with exposure levels, to provide distinct and uniquely accurate insight into individual's exposure levels. It is also the most comprehensive attempt at modelling that we were able to find in literature, as many previous studies had only focused on one parameter to determine SES level.

Our study showed that; coronary disease, heart failure, Strokes, asthma hospitalisations, chronic obstructive pulmonary disease and dementia were most determined by SES levels. Additionally, local government areas of Sydney can be examined based on the levels of air pollutants, SES scores or disease levels. This enables policy and decision makers to determine whether mitigation for air pollution is needed, or health care infrastructure or social programs. Areas of low SES should be the targets for governmental reforms. These

people not only are the least likely to seek help but therefore are the most in need of assistance. Sadly whilst low SES individuals aren't always seen as worthy in a modern view, it is hard to always have funding to run such programs. But whether society fails to see the intrinsic worth in another human is a debate for another time. These individuals need to be cared for with respect and are worth the effort and time that is required in order to reduce the health care disparity. Not only is this study revolutionary as it allows governments to accurately focus their efforts and resources to meet the needs of the people but also ensures that the appropriate measures are being taken in each local area.

Innovative studies like this are needed to continue to illustrate the concerns and matters facing Australia as the population continues to grow. Additionally, climate change is expected to increase the number of concerning air quality days, even recently as bushfires spiked air pollution related to hospital visits (7). No longer is it viable for governments to imagine that air pollution problems are restricted to industrial intensive cities like Beijing or Kanpur. Governments require accurate and integrated studies to best inform decision making to prevent the disparity between rich and poor from growing.

In conclusion, Australian healthcare already fails those with lower socioeconomics. Sadly, the previous modelling fails to include inefficient methods for measuring the relationship between low SES individuals and air pollutant related health effects, governments will be ineffective in their management and mitigation plans. We believe this study will revolutionalise the way in which Australian governments are able to support their people and manage Sydney's growing air pollution problems.

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