Cardiovascular Disease Mortality, Socio-Economic Status and Air Pollution: Understanding the Geographical Patterns.

Ivan Hanigan, 2005.

Is cardiovascular disease (CVD) mortality across Sydney influenced by socio-economic circumstances and by air pollution? This project investigated these relationships and also compared the usefulness of data aggregated to spatial units of different sizes: the small Postal Areas (POA) and large Statistical Local Areas (SLA) of the Census. This is an important unresolved issue in epidemiological studies of health and environmental data.

Modern data modelling techniques were used to link mortality data with socio-demographic and air pollution data for the period 1996-1998. Four consecutive six-month seasons were selected to control for the strong seasonal variation of CVD deaths. Regression tree models and stratified linear regression were used to reveal relationships among CVD mortality rates in winter; a Socio-Economic Status (SES) index derived from the 1996 census; and particulate matter with a diameter less than 10 microns (PM_{10}). Regression tree analysis is a data-mining tool that explores data to identify complex relationships among large numbers of variables. The three key variables identified were included in linear regression models in the disadvantaged areas to see the effect of PM_{10} on winter CVD mortality rates and to adjust for the interaction observed between SES and PM_{10}.

CVD mortality rates in Sydney have complex spatiotemporal patterns: the mortality rate of Sydney as a whole increases approximately 60% each winter and the mortality rates of some POAs are close to tenfold those of the lowest rates. The difference between the rates calculated at the two levels of aggregation showed that some SLAs mask important variation within their boundaries. When POAs with both high and low rates are aggregated to SLA level, the region will have medium rates (figures 1 and 2). Socio-economic status and air pollution concentrations also vary spatially and these were overlayed with mortality maps to examine the relationships. The regression tree results suggest that winter CVD death rates in the most disadvantaged areas are influenced by relatively low PM_{10} concentrations.

These results show that in winter, socio-economic disadvantage and high concentrations of PM_{10} define regions with high rates of CVD mortality in both POAs and SLAs. It also appears that only disadvantaged populations are influenced by PM_{10} in winter while the least disadvantaged groups are not (figures 3 and 4). The left hand plots show this relationship when the spatial units are stratified into two SES classes, defined by the split level found using regression trees. The right hand plots show the relationship when the spatial units are stratified into 4 equal sized groups. These relationships were observed at both spatial scales, but the magnitude of the association was different.

The results of this study imply that the spatial scale of analysis influences the understanding of geographical patterns of CVD mortality. Therefore epidemiologists should use the smallest spatial units possible to avoid missing strong local effects when considering the geographical patterns of diseases.

Maps of Sydney CVD mortality rates during winter 1996 to 1998.

The spatial variation in CVD mortality rates across the city during winter show concentration in the west and southwest regions. There are also some areas that show clustering of POAs with high rates that do not appear in the SLA map. These maps highlight the difference between the patterns observed at the different spatial scales.

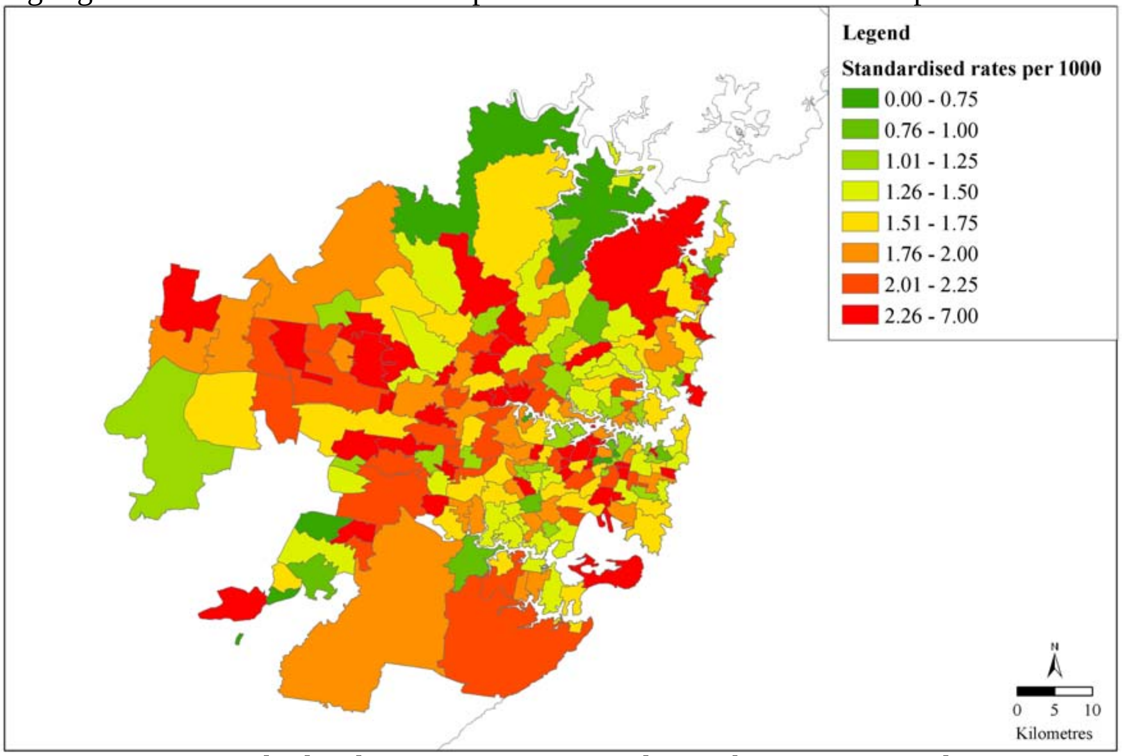

Figure 1: POA Standardised CVD Rates Averaged over the Winter Periods 96 to 98

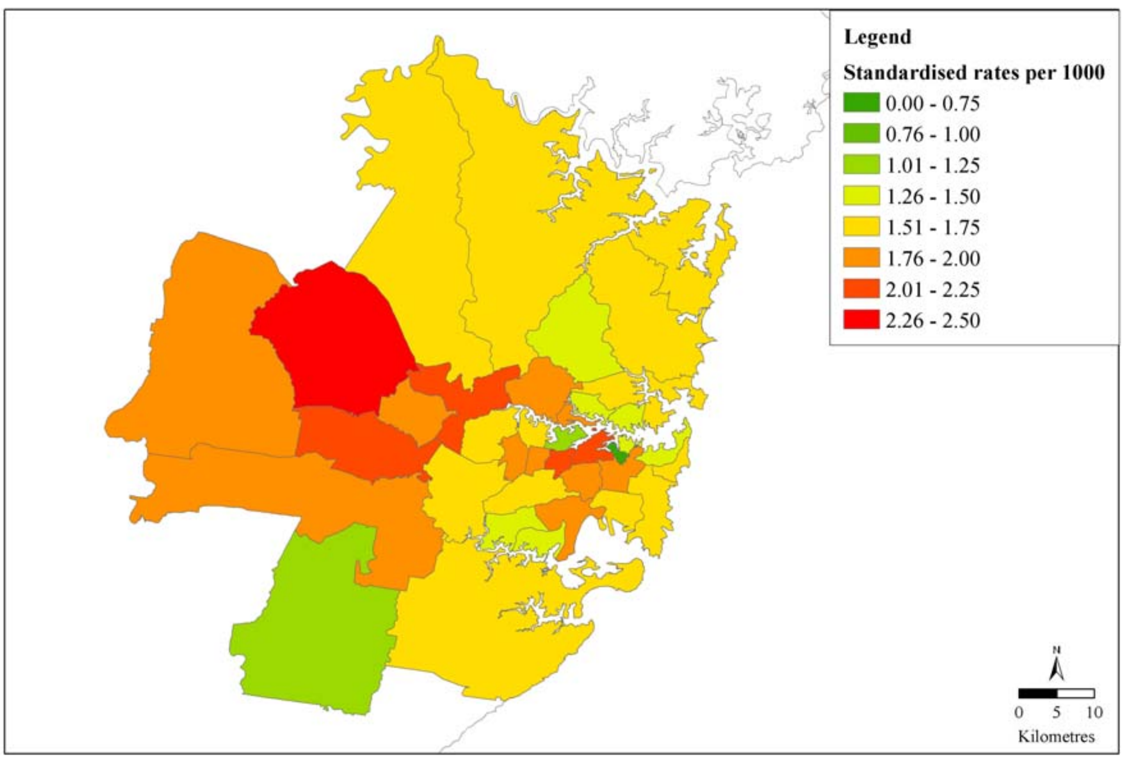

Figure 2: SLA Standardised CVD Rates Averaged over Winter Periods 96 to 98

<u>Analysis of the relationship between CVD mortality, SES and PM_{10}</u>

Stratified analyses suggest that only disadvantaged populations (with low index scores) are influenced by PM_{10} in winter while advantaged groups are not. The air pollution exposure variable is 6-month averages of 24-hour PM_{10} (μg/m³).

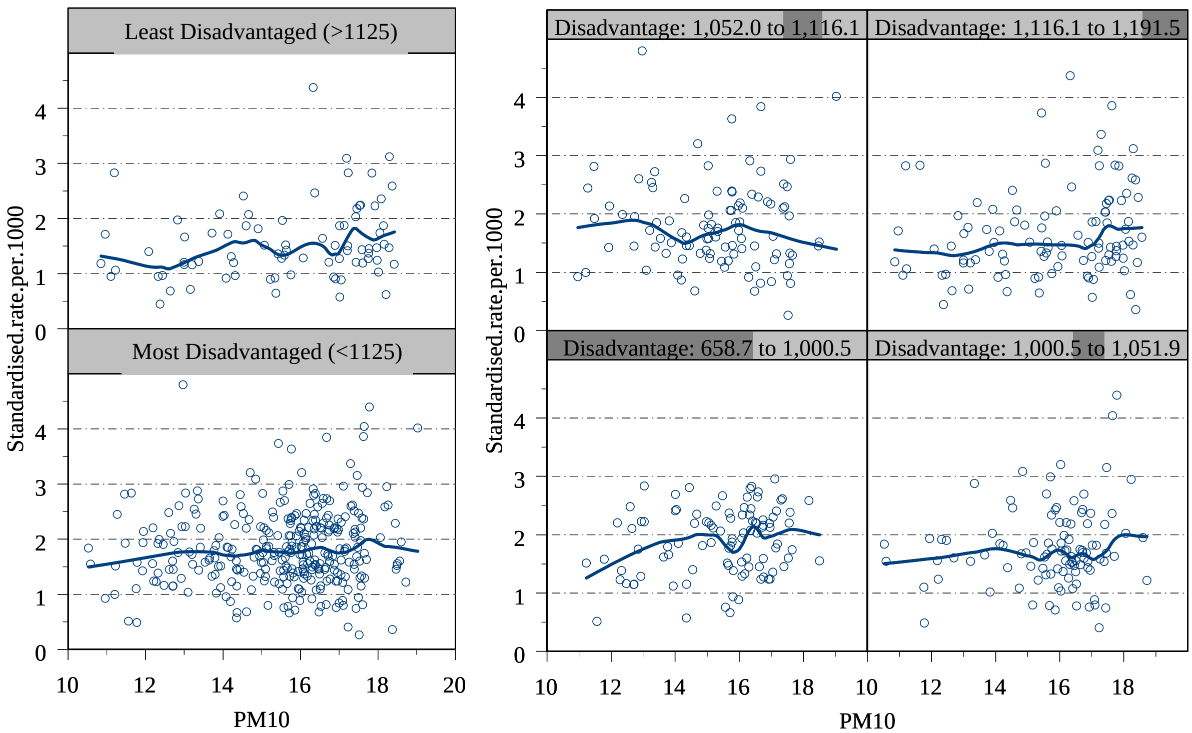

Figure 3: Winter POA CVD mortality rates against PM_{10} by disadvantage groups

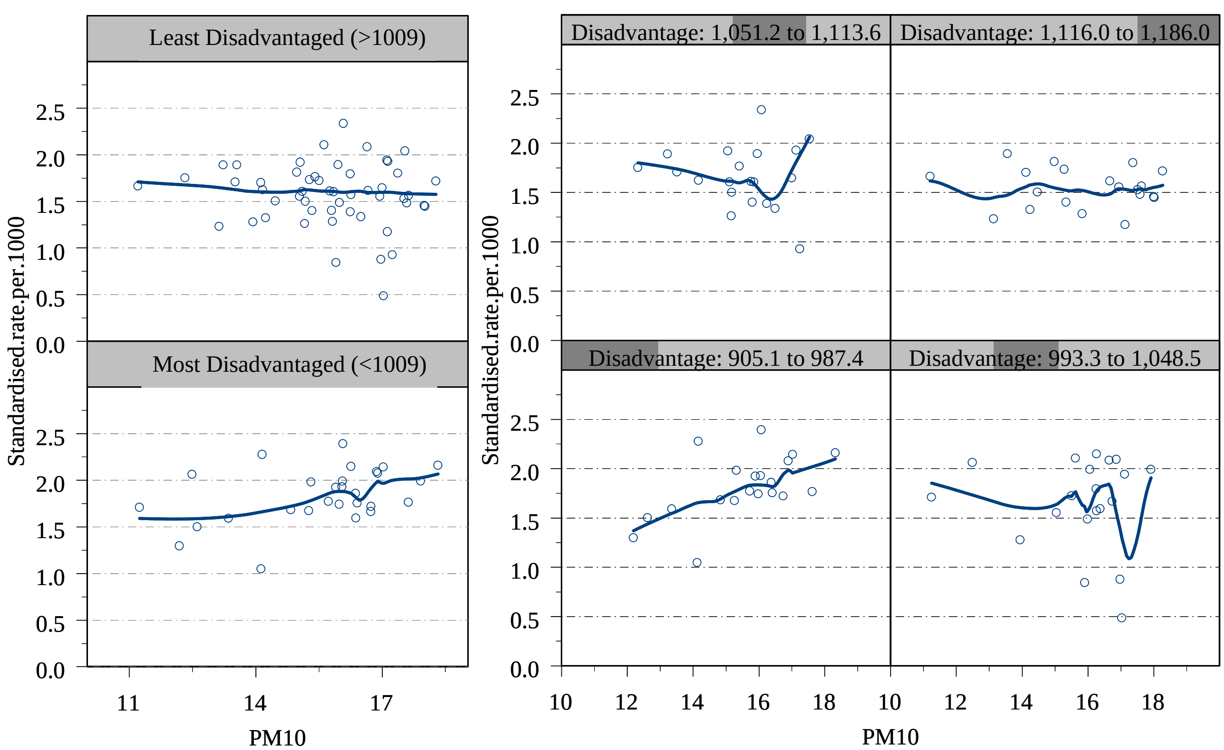

Figure 4: Winter SLA CVD mortality rates against PM_{10} by disadvantage groups