Abstract

Background The aim of this study was to study ecological correlations between age-adjusted all-cause mortality rates in Australian statistical divisions and (1) the proportion of residents that self-identify as Indigenous, (2) remoteness, and (3) socio-economic deprivation.

Methods All-cause mortality rates for 57 statistical divisions were calculated and directly standardized to the 1997 Australian population in 5-year age groups using Australian Bureau of Statistics (ABS) data. The proportion of residents who self-identified as Indigenous was obtained from the 1996 Census. Remoteness was measured using ARIA (Accessibility and Remoteness Index for Australia) values. Socio-economic deprivation was measured using SEIFA (Socio-Economic Index for Australia) values from the ABS.

Results Age-standardized all-cause mortality varies two-fold from 5.7 to 11.3 per 1000 across Australian statistical divisions. Strongest correlation was between Indigenous status and mortality ($r = 0.69$, $p < 0.001$). Correlation between remoteness and mortality was modest ($r = 0.39$, $p = 0.002$) as was correlation between socio-economic deprivation and mortality ($r = -0.42$, $p = 0.001$). Excluding the three divisions with the highest mortality, a multiple regression model using the logarithm of the adjusted mortality rate as the dependent variable showed that the partial correlation (and hence proportion of the variance explained) for Indigenous status was 0.03 (9 per cent; $p = 0.03$), for SEIFA score was −0.17 (3 per cent; $p = 0.22$); and for remoteness was −0.22 (5 per cent; $p = 0.13$). Collectively, the three variables studied explain 13 per cent of the variability in mortality.

Conclusions Ecological correlation exists between all-cause mortality, Indigenous status, remoteness and disadvantage across Australia. The strongest correlation is with Indigenous status, and correlation with all three characteristics is weak when the three statistical divisions with the highest mortality rates are excluded. Intervention targeted at these three statistical divisions could reduce much of the variability in mortality in Australia.

Keywords: mortality; Australia; indigenous

Introduction

Despite a steady decline in all-cause mortality in Australia in recent decades, we have demonstrated that in 1997 there was substantial variation in the risk of mortality across Australia. Measuring mortality in 57 statistical divisions all-cause age-standardized mortality was 6.98 per 1000 and this varied two-fold from 5.78 in the statistical division of Pilbara, Western Australia, to 11.30 in Northern Territory – excluding Darwin. Similar mortality variation was observed for cause-specific mortality.

What are the causes of such variation in mortality risk? In other countries factors such as variation in access to, and utilization and quality of health services have been shown to be important. A large body of evidence demonstrates the importance of socio-economic equity and income distribution within society. In Australia, Indigenous people experience mortality risk at least three times that of non-Indigenous people, and remoteness and disadvantage has been linked to reduced longevity, and wide variation in socio-economic status is recognized.

Here, we present an ecological level analysis exploring the correlation between age-adjusted all-cause mortality and Indigenous status, remoteness and socio-economic disadvantage across statistical divisions in Australia.
Methods

Data sources and definitions

Data on mortality and population in 1997 for each statistical division in Australia were obtained from the Australian Bureau of Statistics (ABS, Brisbane Office). Statistical divisions are areas defined in the Australian Standard Geographical Classification, which consist of one or more statistical subdivisions and cover, in aggregate, the whole of Australia without gaps or overlaps. The population of each division varies considerably. Statistical divisions aggregate to form States and Territories, and are used as spatial units for analysis. We excluded the statistical divisions that refer to offshore and migratory areas as the populations resident there are small, special cases (e.g. on oil rigs), or in transit. Because of the small populations in the Australian Capital Territory (ACT) outside of Canberra, here we report the ACT as a single statistical division. This leaves 57 statistical divisions for analysis.

Presentation and analysis of data

All-cause mortality data were directly age-standardized to the 1997 Australian population in 5-year age groups. Mortality rates are ranked in ascending order by statistical division for ease of presentation and interpretation.

We chose to explore ecological level correlation between age-adjusted all-cause mortality and three variables reported to be important predictors of mortality in Australia and other developed countries: Indigenous status, remoteness and socio-economic disadvantage. Initial scatter plots demonstrated substantial variation in mortality across the statistical divisions, with particularly high mortality in three divisions. We therefore calculated Pearson correlation coefficients between age-adjusted all-cause mortality and Indigenous status, remoteness and socio-economic disadvantage separately for all 57 statistical divisions, and again with the three statistical divisions with the highest mortality rates excluded. Data on Indigenous status were extracted for each statistical division from the 1996 Census of Population and Housing; data on SEIFA (Socio-Economic Index For Australia) scores were obtained directly from the ABS; and ARIA (Accessibility and Remoteness Index for Australia) scores for each statistical division were provided by the National Key Centre for the Social Applications of Geographical Information Systems (http://www.gisca.adelaide.edu.au/).

To estimate how much of the remaining variation in mortality among the remaining 54 statistical divisions (after excluding the three with the highest mortality) was explained by the three variables studied, we developed a multivariate model. As age-adjusted all-cause mortality is not near-normally distributed, use of a linear regression model is inappropriate. However, adjusted all-cause mortality is not near-normally distributed, variables studied, we developed a multivariate model. As age-

Results

In 1997, age-standardized all-cause mortality varied two-fold from 5.7 to 11.3 per 1000 across Australian statistical divisions. Three statistical divisions, Northern Territory – excluding Darwin, Kimberly (Western Australia), and North West (Queensland), have particularly high mortality rates (Figure 1).

The strongest correlation we measured was between Indigenous status and mortality \( r = 0.69, p < 0.001 \) but this fell to 0.3 \( p = 0.03 \) when the three statistical divisions with the highest mortality rates were excluded from analysis (Figure). Correlation was modest between SEIFA score and mortality \( r = -0.42, \ p = 0.001 \), and this fell to \(-0.20 (p = 0.2)\) with the three divisions excluded. Correlation between ARIA score and mortality was also modest \( r = 0.39, p = 0.002 \), and fell to 0.16 \( p = 0.3 \) with the three divisions excluded.

Excluding the three divisions with the highest mortality, a multiple regression model using the logarithm of the adjusted mortality rate as the dependent variable showed that the partial correlation (and hence proportion of the variance explained) for Indigenous status was 0.03 (9 per cent; \( p = 0.03 \)), for SEIFA score was –0.17 (3 per cent; \( p = 0.22 \)), and for remoteness was –0.22 (5 per cent; \( p = 0.13 \)). Collectively, the three variables studied explain 13 per cent of the variability in mortality.

Discussion

This analysis demonstrates statistically significant ecological correlation between all-cause age-adjusted mortality and each of Indigenous status, social and economic disadvantage, and remoteness in Australia. Correlation was strongest with the proportion of people in a statistical division that self-identify as Indigenous, and was more modest for SEIFA and ARIA scores. With the three statistical divisions with the highest mortality rates excluded from analysis only Indigenous status remained significantly correlated with mortality risk (although the level of correlation was modest). Collectively, the three variables studied explain only 13 per cent of the variability in mortality among these 54 divisions.

Our ecological analysis needs to be interpreted with caution as the ecological fallacy \(^5\) may hold. For example, SEIFA scores of individual people cannot be linked to their mortality experience. However, there is literature linking Indigenous status, \(^3\) lower socio-economic status \(^3\) and remoteness \(^5\) to increased mortality risk. The benefit of an ecological approach is that it provides a community-level analysis and, as public health interventions are typically applied at community level, additional insight may be provided through this approach.

The three statistical divisions in Australia with the highest mortality also have the highest proportion of Indigenous people making up the population, two of them have the lowest SEIFA scores, and they are among the most remote areas in Australia. Interventions targeted at these three divisions have the potential to substantially reduce variation in mortality in Australia. Inter-
ventions could include improved employment opportunities, improved housing and sanitation, more accessible quality health services and public health programmes, as well as broader racial reconciliation.9

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Figure 1 Correlation between age-adjusted all-cause mortality and Indigenous status, (a) with and (b) without the three statistical divisions with the highest mortality rates.
References


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