Variation in health inequalities according to measures of socioeconomic status and age

Tanya Mather,1 Emily Banks,1,2 Grace Joshy,1 Adrian Bauman,3 Philayrath Phongsavan,3 Rosemary J. Korda1,4

Abstract

Objective: To examine variation in the magnitude of socioeconomic inequalities in health and age-related variations in inequalities, according to the socioeconomic status (SES) measure used.

Methods: Cross-sectional study involving 205,709 participants in the 45 and Up Study. We used the Relative Index of Inequality (RII) to quantify health inequalities in relation to income, education and Socio-Economic Indexes for Areas (SEIFA). The outcomes used were heart disease and self-rated health. Analyses were stratified by age (45–64, 65–79, ≥80 years).

Results: RII were largest for income and smallest for SEIFA; they were generally largest in the youngest age group and smallest in the oldest group. Age-related differences in RII were particularly marked for income (e.g., for fair/poor health, RII=11.81, 95%CI 11.14–12.53 in the 45–64 age group and RII=2.42, 95%CI 2.10–2.78 in ≥80 group), and less marked for SEIFA (e.g., respectively, RII=2.68, 95%CI 2.53–2.84 and RII=1.32, 95%CI 1.22–1.44).

Conclusions: The magnitude of socioeconomic inequality in health varies substantially according to the type of SES measure used and age. Income is the most sensitive measure.

Implications: Researchers and policy makers should be aware of the extent to which SEIFA-based estimates underestimate the magnitude of health inequality compared to individual-level measures, especially in younger age groups.

Key words: health inequalities, socioeconomic status, SEIFA

This paper uses data from a large cohort to examine: a) the variation in the magnitude of socioeconomic inequalities in health in relation to the choice of SES measure used; and b) the extent to which age-related variations in such inequalities are sensitive to the SES measure used.

Methods

Overview

The 45 and Up Study is a study of healthy ageing involving more than 250,000 people aged 45 years and over. From January 2006 to December 2008, men and women from the general population of NSW were sampled through the Medicare Australia database, with over-sampling of individuals aged 80 years and over and those residing in rural or remote areas. At the time of our study we had data available on 266,096 individuals, who had joined the study by completing a postal questionnaire and consenting to long-term follow-up. The study is described in further detail elsewhere. For this study, data were taken from the 45 and Up baseline questionnaire (www.saxinstitute.org.au).
Socioeconomic Status and Health

Exposure and outcome variables

Three SES measures commonly used in Australian health inequalities research were analysed as exposure variables. These were: annual household income categorised into six income brackets, from "less than $20,000 per year" to "$70,000 or more per year" (Table 1); highest education qualification obtained (categorised as "no school certificate," school certificate," higher school certificate or trade/apprenticeship," certificate or diploma" or "university degree or higher"); and one of the 2006 SEIFA indexes, the Index of Relative Socio-Economic Disadvantage (IRSD). The IRSD is one of four SEIFA indexes of area-based SES, developed by the Australian Bureau of Statistics (ABS) from Census data, which summarises socioeconomic disadvantage in a particular area, giving particular weight to income, educational attainment, unemployment and occupation type.1 The higher an area’s index value, the less disadvantaged people in that area are compared with people in other areas. In our study, this variable was based on postcode of residence and categorised into population-based quintiles using cut-off scores from the 2006 Australian Census. Income and education were considered individual-level measures of SES, and SEIFA (IRSD) was considered an area-based measure. For the outcome measures, we used two commonly used health outcomes – self-rated health from the Medical Outcomes Study Short Form 36,14 dichotomised for the analysis as “excellent/very good/good” vs “fair/poor”, and ever having had doctor-diagnosed heart disease (“yes”), as reported on the 45 and Up Study baseline questionnaire.

Statistical methods

Poisson regression models with robust variance estimation were used to model the association between each SES variable and each of the health outcome variables, each model generating a summary measure of inequality, the Relative Index of Inequality (RII). The RII is a relative risk constructed by estimating a regression coefficient for the mid-point of the cumulative proportion of the population in each of the SES groups, ordered from lowest to highest. It is the ratio of the rate/proportion of the health outcome predicted for the lowest end of the socioeconomic continuum, to the rate/proportion predicted for the highest end. Advantages of the RII are that it uses all available data, allows SES variables to be treated as continuous, and allows comparison of different SES measures. Further details about how the RII is calculated are described elsewhere.11 We report the reciprocal of all RII so that the statistic is interpreted as the risk of the health outcome in the lowest SES group, relative to the risk in the highest SES group. Models were run on the whole cohort, as well as run separately for the three age categories (45–64, 65–79 and ≥80 years old). All models were adjusted for age (as a continuous variable) and sex. For each outcome, we tested equality of the coefficients (RIIs) across the different models, specifically comparing RII estimates for the three SES exposure variables within each age group, and comparing RII across age groups for each SES variable. Analyses were conducted using Stata Version 12.16

Ethics statement

Ethical approval for the study was provided by the Australian National University Human Research Ethics Committee and the University of New South Wales Human Research Ethics Committee.

Results

At the time of our study, data were available for 266,096 participants. After excluding those who had missing data for any of the three SES exposure variables (n=60,387, 22.7%), data were available for 205,709 participants. Demographic characteristics of the sample are presented in Table 1. Income varied substantially with age; 41.8% of the 45-64 age group reported income greater than $70,000 compared to only 6.6% of those aged ≥80. For education level, 30.9% of those aged 45-64 held a university degree, compared to 15.1% of those aged ≥80. There was less age variation in SEIFA and, in fact, a higher proportion of older people than younger people were in the least disadvantaged IRSD quintile (18.6%, 15.6% and 24.3% for 45–64, 64–79 and ≥80 years age groups, respectively).

The prevalence of self-reported fair/poor health increased with age, from 11.2% in the 45–64 age group to 26.1% in the ≥80 age group. This pattern was the same for doctor-diagnosed heart disease, which was reported by 6.2% of the 45–64 year age group, 19.6% in the 65–79 age group and 29.5% of the ≥80 age group (Table 1).
The proportions of participants reporting fair/poor self-rated health and heart disease, according to age group and SES categories, are displayed in Figures 1 and 2. Overall, there were clear socioeconomic gradients in the prevalence of fair/poor self-rated health, with prevalence decreasing with increasing SES, for all SES measures and all age groups. Similar patterns were seen for heart disease in the 45–64 age group and to a lesser extent in the 65–79 age group, while there were reverse gradients (i.e., prevalence increasing with increasing SES) for heart disease in those aged ≥80 years.

With few exceptions, modelled inequality estimates were statistically significant for all age groups and for each measure of SES, for both outcomes (Table 2). The exceptions were for heart disease, where among the 65–79-year-olds education and SEIFA-based RIIs were not significant; and among ≥80-year-olds where there was no significant inequality based on the income measure and significant inequality favouring lower SES based on education and SEIFA. These exceptions aside, within each health outcome, RIIs varied considerably between exposures and between age groups. RIIs were always largest for income and smallest for SEIFA, with the differences between RIIs for income and the other measures particularly large (in those <80 years). The RIIs for the different SES measures in relation to self-rated health differed significantly from one another, within the specified age groups (pairwise comparisons: p<0.001), except for the difference in RIIs between income and education for those aged ≥80 (p=0.052). Using heart disease as an outcome, all differences were statistically significant (p<0.05) except income compared to SEIFA for those aged ≥80 (p=0.13), and education and SEIFA for those aged 65–79 (p=0.25) and for those aged ≥80 (p=0.59).

The magnitude of relative health inequality also varied significantly by age, with RIIs generally largest for the youngest age group (45–64) and smallest for the oldest group (≥80 years), see Table 2. Pairwise comparisons of the RIIs across the different age groups were all statistically significant, within the specified SES measures and outcomes (p<0.01). Age-related differences in the RII were particularly high for income. For example, the RII ranged from 11.81 (95%CI 11.14–12.53) in the 45–64 age group, to 2.42 (95%CI 2.10–2.78) in the ≥80 age group for fair/poor health. They were less marked for SEIFA, ranging from 2.68 (95%CI 2.53–2.84) in the 45–64 age group to 1.32 (95%CI 1.22–1.44) in the ≥80 age group for fair/poor health. A sensitivity analysis, with RIIs generated for finer age groups (45–54, 55–64, 65–74, 75–84 and ≥85) showed a very similar pattern of results (results available on request).

### Table 2: RIIs (95% CI) for self-rated health and heart disease according to age group, using different measures of SES.

<table>
<thead>
<tr>
<th></th>
<th>45-64 years</th>
<th>65-79 years</th>
<th>≥80 years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fair/poor self-rated health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>11.81 (11.14-12.53)</td>
<td>8.66 (7.70-9.23)</td>
<td>2.42 (2.10-2.78)</td>
<td>8.65 (8.23-9.10)</td>
</tr>
<tr>
<td>Education</td>
<td>3.99 (3.77-4.23)</td>
<td>2.71 (2.52-2.95)</td>
<td>2.09 (1.89-2.32)</td>
<td>3.21 (3.08-3.35)</td>
</tr>
<tr>
<td>SEIFA (IRSD)</td>
<td>2.68 (2.53-2.84)</td>
<td>1.78 (1.65-1.91)</td>
<td>1.32 (1.22-1.44)</td>
<td>2.83 (1.99-2.11)</td>
</tr>
<tr>
<td><strong>Heart disease (Yes)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>2.25 (2.08-2.44)</td>
<td>1.46 (1.36-1.58)</td>
<td>0.94 (0.85-1.04)</td>
<td>1.80 (1.71-1.90)</td>
</tr>
<tr>
<td>Education</td>
<td>1.56 (1.45-1.68)</td>
<td>1.05 (0.99-1.13)</td>
<td>0.84 (0.77-0.91)</td>
<td>1.21 (1.16-1.26)</td>
</tr>
<tr>
<td>SEIFA (IRSD)</td>
<td>1.42 (1.32-1.53)</td>
<td>1.01 (0.95-1.07)</td>
<td>0.86 (0.80-0.93)</td>
<td>1.15 (1.11-1.20)</td>
</tr>
</tbody>
</table>

Note: All models adjusted for age (as a continuous variable) and sex.

### Figure 1: Per cent reporting fair/poor self-rated health, according to age group and SES category.

Notes: Adjusted for age (as a continuous variable) and sex. Bars are ordered from most disadvantaged (left) to least disadvantaged (right). See Table 1 for SES category descriptions.

### Figure 2: Per cent reporting heart disease, according to age group and SES category.

Notes: Adjusted for age (as a continuous variable) and sex. Different scales used for y-axes across age groups. Bars are ordered from most disadvantaged (left) to least disadvantaged (right). See Table 1 for SES category descriptions.
Socioeconomic Status and Health

Discussion

Estimates of the relative magnitude of socioeconomic inequalities in health vary considerably in relation to the type of SES measure used and age. In general, income and to a lesser extent education, reveal significantly greater levels of inequality than the area-based IRSD measure, across all age groups. While acknowledging that no single measure captures a complete picture of socioeconomic position, the findings indicate that where SEIFA-based area measures of SES are used, they under-estimate the extent of health inequality between individuals in the population. The magnitude of inequality observed also decreased with age, irrespective of the measure used. This age-related variation is particularly noteworthy for income, with much greater income-related inequalities in health at younger compared to older ages.

Previous studies in Australia and elsewhere have found the magnitude of inequality varies based on the measure used, and by age, and previous methodological work has cautioned on the use of SEIFA. A study using the New Zealand equivalent of SEIFA, the NZDep, also found that individual measures had more explanatory power than area-based measures. However, to our knowledge, no Australian studies have directly quantified the differences in the magnitude of inequality across individual/ household-level and SEIFA-based measures of SES, despite SEIFA being such a widely-used measure in Australian research.

Our large sample of people aged ≥80 years enabled us to investigate the relative sensitivity of these SES measures in the elderly. Nevertheless, while we examined SES variables that are commonly available in datasets, a limitation of our study is that data on wealth were not available, which may be a more appropriate measure than income, particularly for older individuals who no longer work. Also, we were unable to use equalised household income, arguably a better indicator of the economic resources available to an individual, as we did not have information on household size and composition. In addition, because of missing data and the fact that outcomes were self-reported, inequality estimates may have been over or under-estimated. However, because the aim of the study was to internally compare inequality estimates, these issues are unlikely to materially affect the conclusions regarding variation in estimates in relation to type of measure used and age.

While highlighting the difference in sensitivity between individual and area-based measures of SES, it should be noted when interpreting inequality estimates that sensitivity of these measures will also vary depending on the accuracy and precision of measurement and level of aggregation. With regard to the latter, for example, SEIFA-based measures will vary depending on the level at which the SEIFA scores are assigned. Like many studies, we used postcode to assign SEIFA scores to individuals; however, if scores can be assigned at a smaller area level, such as collector’s district, then this is likely to be more sensitive.

Conclusions and implications

Using SEIFA scores as a proxy for individual-level SES has become routine in Australian research on health inequalities and provides estimates of inequality where individual measures are not available. Nevertheless, when forming conclusions about the extent of inequality based on area-level inequality estimates, and making decisions based on these conclusions, it should be acknowledged that the magnitude of socioeconomic inequality in health between individuals is likely to be much greater than that estimated. It is also important to consider that age-related differences in the magnitude of inequalities will vary substantially depending on the measure used. Researchers examining age-related variation in the SES-health relationship should be aware of how their choice of measure will influence results. Indeed, the ABS itself cautions against the use of SEIFA as a proxy for individual measures, and highlights the problem of the ecological fallacy when inferences about individuals are made based on aggregate data from the population.

This study does not imply that SEIFA scores should never be used in research. Often individual-level data are not available; further, no SES measure has been identified as the ‘gold standard’ for estimating health inequalities and no single measure of SES will be able to fully account for the socioeconomic conditions that influence an individual’s health. The most appropriate measure will depend not only on availability of data, but also on the underlying research or policy questions. For example, when estimating socioeconomic inequalities in the burden of disease, household income may be considered a good measure of SES, given the particularly strong relationship between household income and health. On the other hand, if the research question is one of causality, such as SES increasing the risk of serious disease or disability, one would need to be cautious in using household income given the strong possibility of reverse causality (i.e. serious disease/disability leading to lower income), especially amongst the working-age population. Of course, none of this applies if area-level inequalities persist are the focus of the research and policy development, necessitating the use of area-level measures. But, given that individual inequalities in health are a major public health concern, in order to better understand and monitor these inequalities at the population level, consideration should be given to collecting individual-level SES data in administrative data sets.

Acknowledgements

This research was completed in collaboration with the 45 and Up Study (www.saxinstitute.org.au). The 45 and Up Study is managed by the Sax Institute in collaboration with major partner Cancer Council NSW; and partners: the National Heart Foundation of Australia (NSW Division); NSW Ministry of Health; beyondblue; Ageing, Disability and Home Care, Department of Family and Community Services; the Australian Red Cross Blood Service; and UnitingCare Ageing. We thank the many thousands of people participating in the 45 and Up Study. This specific project was part of the Study of Economic and Environmental Factors in health program supported by the National Health and Medical Research Council of Australia (NHMRC); grant reference: 402810. EB is supported by the NHMRC.

References


