Differential impacts of health care in Australia: trend analysis of socioeconomic inequalities in avoidable mortality

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Background Recent avoidable mortality trends in Australia suggest that health care has made a substantial contribution to reducing mortality. This study investigates if the benefits of health care have been distributed equally by comparing declines in avoidable with non-avoidable mortality over time by socioeconomic status (SES).

Methods We calculated avoidable and non-avoidable mortality rates in Australia by small areas for 1986, 1991, 1997 and 2002. We performed pooled cross-sectional trend analysis of indirectly standardized mortality rates by SES and year, modelling using Poisson regression with over-dispersion. Socioeconomic inequalities were quantified using the relative (RII) and slope (SII) index of inequality.

Results The annual percentage decline in avoidable mortality at the higher end of the socioeconomic continuum (5.0%; 95% CI: 4.7–5.4%) was larger than at the lower end (3.5%; 3.2–3.8%), with increasing relative inequality between 1986 (RII = 1.54; 1.46–1.63) and 2002 (RII = 2.00; 1.95–2.06), greater than that in non-avoidable mortality (P = 0.036). In absolute terms, avoidable deaths fell annually by 7.4 (6.9–7.8) and 8.4 (7.9–8.9) deaths per 100 000 at the higher and lower end of the spectrum, respectively, with absolute inequality decreasing between 1986 (SII = 97.8; 87.6–107.9) and 2002 (SII = 81.5; 74.6–88.5).

Conclusions Health care has contributed to decreasing the absolute SES mortality gap. However, advantaged people have obtained a disproportionate benefit of health care, contributing to widening relative health inequalities. A universal health care system does not guarantee equality in health-care-related outcomes.

Keywords Socioeconomic status, inequalities, avoidable mortality, health care, Australia

Introduction

By international standards, Australia is a healthy nation with life expectancy for males and females amongst the highest in the world.1 However, as in other countries, this high level of health has not been shared equally across socioeconomic groups and gradients in mortality have been reported consistently. Further, relative inequalities in mortality rates have tended to increase in recent decades with the percentage rate of decline in mortality rates generally greater in the least disadvantaged groups than the most disadvantaged groups.5,6

Socioeconomic status (SES) may be associated with mortality because higher SES involves access to resources—including knowledge, money, power, prestige and beneficial social connections—that help people avoid diseases and minimize their negative consequences through a variety of mechanisms.7 While these mechanisms have largely been attributed to factors outside health care (e.g. housing and employment conditions), inequalities in the quantity and quality of health care consumed may also contribute to disparities in health. This may be particularly true in recent decades where health care has made a substantial contribution to increasing life expectancy in Australia.8

For Australia, as with most OECD countries, horizontal equity—equal care for equal need—is an explicit objective of
the health care system, and this equity principle underlies Australia’s universal health care system, Medicare. Nevertheless, a universal system does not guarantee equity in health care, or indeed, health-care related outcomes. In particular, because of factors such as a mixture of public and private funding, out-of-pocket expenses, gaps in services, differences in patient expectations and professional control, those who are more socioeconomically advantaged may derive more benefit from the system than those who are less advantaged. In addition, inequalities in the benefits of health care may arise because of the differential capacity of SES groups to adapt to new knowledge about causes and management of disease. Nevertheless, there is little evidence about whether or not there has been a differential impact of health care by SES, which may, in part, account for observed patterns of socioeconomic inequalities in mortality.

One approach for assessing the contribution of health care to declining mortality rates is to examine trends in avoidable mortality. Avoidable mortality refers to premature deaths from certain conditions that are considered to be largely avoidable given timely and effective health care. Because declines in avoidable mortality rates may also reflect influences of factors outside health care, such as improved living conditions, the gradient in avoidable mortality is best compared to that in non-avoidable mortality, which is also likely to be affected by such factors.

Avoidable mortality trends over the past three decades in Australia suggest that health care has made substantial contributions to the reduction in mortality. This is shown in the steady decline in avoidable mortality rates with slower declines in non-avoidable mortality rates. Between 1968 and 2001, avoidable death rates fell around 70% with non-avoidable rates falling around 34%.

The question remains as to whether individuals across the socioeconomic spectrum have benefited equally from this contribution of health care. While patterns in avoidable mortality by SES have been previously reported for Australia, these studies adopted a broader avoidable mortality classification than used here and the results were not analysed in a way to allow for conclusions to be made regarding the differential impact of care.

In this study, we investigate trends in avoidable and non-avoidable mortality across socioeconomic strata to determine whether there has been inequality in the impact of health care in Australia between 1986 and 2002. If it is assumed that the need for health care within SES strata is proportional to the avoidable mortality rate and there is equal benefit for equal need, then the percentage declines over time in avoidable mortality (compared with non-avoidable mortality) should be equal across SES strata and relative inequality should remain unchanged over the period. At the same time, given higher avoidable mortality rates at the lower end of the SES spectrum at the start of the period, these assumptions imply absolute inequality should fall. Alternatively, if higher SES strata have received a disproportionate benefit from health care, this will be shown in greater percentage declines in avoidable mortality (compared with non-avoidable mortality) in those strata and increasing relative inequality.

**Methods**

**Data**

We used anonymized unit record mortality data and population data from the Australian Bureau of Statistics, aggregated to the level of the Statistical Local Area (SLA). Before aggregating the death data, we classified each death as either avoidable or non-avoidable based on the International Classification of Disease (ICD) code for underlying cause of death. Avoidable deaths comprised two categories of conditions: (i) those amenable to medical care [‘medical care indicators’ (MCI)] and (ii) those responsive to health policy but that lack effective treatment once the condition has developed [‘health policy indicators’ (HPI)]. The list of avoidable conditions is shown in Table 1. Medical care indicators are conditions that are considered to have identifiable effective interventions that are administered by health care providers. They exclude preventable conditions that have a relative lack of effective treatment once the condition has developed.

Our list is based on that developed by Nolte and McKee. Their justification for the selection of the conditions and the age limit imposed (at 74 years for most causes) is outlined in their review, and our modifications to the list have been outlined in a previous publication. The three HPI causes on our list are those consistently used in studies that include such causes in the definition of avoidable mortality. The non-avoidable category includes the remaining causes of death (e.g. metabolic disorders, most neurological disorders, diseases of the musculoskeletal system).

Death data were aggregated on the basis of the SLA in which the person was residing at the time of death. SES was assigned to each SLA using the Socioeconomic Indexes for Areas (SEIFA). SEIFA are summary area measures of socioeconomic conditions based on aggregated census data (e.g. percentage of low-income families, percentage of early school leavers), produced by the Australian Bureau of Statistics. There are four versions of the SEIFA, based on 1986, 1991, 1996 and 2001 census data, and each version has several indexes. Of these, the Index of Relative Socioeconomic Disadvantage was chosen for this study as it is the most general index and uses the same underlying variables in all versions of the SEIFA. The Index of Disadvantage is an ordinal ranking of disadvantage.

The geographic boundaries (Australian Standard Geographical Classification) upon which the SLAs are based change approximately every two years, thus SLAs vary across time in both the SEIFA (census) and mortality unit record data. To match the geographic areas in the mortality data with those used in the SEIFA, years in which the mortality data were coded using the same version of the SEIFA were selected for analysis—1986, 1991, 1997 and 2002. There were between 1314 (1997) and 1335 SLAs (1991) in each of these years for which there was a SEIFA code. Due to substantial changes in boundaries, no attempt was made to match areas over time. Analysis was restricted to mortality below the age of 75 years in each of these years, including deaths registered in the year of death (~95% of the deaths) or in the following year. There was a small percentage of records within SLAs for which there was no matching SEIFA index—2.2% in 1986, 0.2% in 1991, 0.8% in 1997 and 0.9% in 2002. These records were excluded.
### Table 1  Avoidable causes of death

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Age range</th>
<th>ICD-8</th>
<th>ICD-9</th>
<th>ICD-10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medical care indicators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intestinal infections</td>
<td>0–14</td>
<td>000–009</td>
<td>001–009</td>
<td>A00–A09</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>0–74</td>
<td>010–019</td>
<td>010–018, 137</td>
<td>A15–A19, B90</td>
</tr>
<tr>
<td>Other infections (diphtheria, tetanus, poliomyelitis)</td>
<td>0–74</td>
<td>032, 037, 040–043</td>
<td>032, 037, 045</td>
<td>A36, A35, A80</td>
</tr>
<tr>
<td>Whooping cough</td>
<td>0–14</td>
<td>033</td>
<td>033</td>
<td>A37</td>
</tr>
<tr>
<td>Septicemia</td>
<td>0–74</td>
<td>038</td>
<td>038</td>
<td>A40–A41</td>
</tr>
<tr>
<td>Measles</td>
<td>1–14</td>
<td>055</td>
<td>055</td>
<td>B05</td>
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<tr>
<td>Malignant neoplasm of colon and rectum</td>
<td>0–74</td>
<td>153–154</td>
<td>153–154</td>
<td>C18–C21</td>
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<tr>
<td>Malignant neoplasm of skin (excl. melanoma)</td>
<td>0–74</td>
<td>173</td>
<td>173</td>
<td>C44</td>
</tr>
<tr>
<td>Malignant neoplasm of breast</td>
<td>0–74</td>
<td>174</td>
<td>174</td>
<td>C50</td>
</tr>
<tr>
<td>Malignant neoplasm of cervix uteri</td>
<td>0–74</td>
<td>180</td>
<td>180</td>
<td>C53</td>
</tr>
<tr>
<td>Malignant neoplasm of cervix uteri and body of uterus (excl. overlap with above codes)</td>
<td>0–44</td>
<td>182</td>
<td>179, 182</td>
<td>C54–C55</td>
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<tr>
<td>Malignant neoplasm of testis</td>
<td>0–74</td>
<td>186</td>
<td>186</td>
<td>C62</td>
</tr>
<tr>
<td>Hodgkin’s disease</td>
<td>0–74</td>
<td>201</td>
<td>201</td>
<td>C81</td>
</tr>
<tr>
<td>Leukaemia</td>
<td>0–44</td>
<td>204–207</td>
<td>204–208</td>
<td>C91–C95</td>
</tr>
<tr>
<td>Disease of the thyroid</td>
<td>0–74</td>
<td>240–246</td>
<td>240–246</td>
<td>E00–E07</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>0–49</td>
<td>250</td>
<td>250</td>
<td>E10–E14</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>0–74</td>
<td>345</td>
<td>345</td>
<td>G40–G41</td>
</tr>
<tr>
<td>Chronic rheumatic heart disease</td>
<td>0–74</td>
<td>393–398</td>
<td>393–398</td>
<td>I05–I09</td>
</tr>
<tr>
<td>Hypertensive disease</td>
<td>0–74</td>
<td>400–404</td>
<td>401–405</td>
<td>I10–I13, I15</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>0–74</td>
<td>430–438</td>
<td>430–438</td>
<td>I60–I69</td>
</tr>
<tr>
<td>All respiratory diseases (excl. pneumonia/influenza)</td>
<td>1–14</td>
<td>460–466</td>
<td>460–479</td>
<td>J00–J06</td>
</tr>
<tr>
<td>Influenza</td>
<td>0–74</td>
<td>470–474</td>
<td>487</td>
<td>J10–J11</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0–74</td>
<td>480–486</td>
<td>480–486</td>
<td>J12–J18</td>
</tr>
<tr>
<td>Peptic ulcer</td>
<td>0–74</td>
<td>531–533</td>
<td>531–533</td>
<td>K25–K27</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>0–74</td>
<td>540–543</td>
<td>540–543</td>
<td>K35–K38</td>
</tr>
<tr>
<td>Abdominal hernia</td>
<td>0–74</td>
<td>550–553</td>
<td>550–553</td>
<td>K40–K46</td>
</tr>
<tr>
<td>Cholelithiasis and Cholecystitis</td>
<td>0–74</td>
<td>574–575</td>
<td>574–575.1</td>
<td>K80–K81</td>
</tr>
<tr>
<td>Nephritis and Nephrosis</td>
<td>0–74</td>
<td>580–584</td>
<td>580–589</td>
<td>N00–N07, N17–N19, N25–N27</td>
</tr>
<tr>
<td>Benign prostatic hyperplasia</td>
<td>0–74</td>
<td>600</td>
<td>600</td>
<td>N40</td>
</tr>
<tr>
<td>Maternal deaths</td>
<td>All</td>
<td>630–678</td>
<td>630–676</td>
<td>O00–O99</td>
</tr>
<tr>
<td>Congenital cardiovascular abnormalities</td>
<td>0–74</td>
<td>746–747</td>
<td>745–747</td>
<td>Q20–Q28</td>
</tr>
<tr>
<td>Perinatal deaths (excl. stillbirths)</td>
<td>All</td>
<td>760–779</td>
<td>760–779</td>
<td>P00–P96, A33–A34</td>
</tr>
<tr>
<td>Misadventures to patients during surgical and medical care (incl. complications)</td>
<td>All</td>
<td>E930–E936, E870–E876, E878–E879</td>
<td>Y60–Y69, Y83–Y84</td>
<td></td>
</tr>
<tr>
<td>Asthma</td>
<td>0–74</td>
<td>493</td>
<td>493</td>
<td>J45–J46</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>0–74</td>
<td>410–414</td>
<td>410–414</td>
<td>L20–L25</td>
</tr>
</tbody>
</table>

### Health policy indicators

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Age range</th>
<th>ICD-8</th>
<th>ICD-9</th>
<th>ICD-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant neoplasm of trachea, bronchus and lung</td>
<td>0–74</td>
<td>162</td>
<td>162</td>
<td>C33–C34</td>
</tr>
<tr>
<td>Chronic liver disease and cirrhosis</td>
<td>0–74</td>
<td>571</td>
<td>571</td>
<td>K70, K71.7, K73–K74, K76.0</td>
</tr>
<tr>
<td>Motor vehicle accident</td>
<td>0–74</td>
<td>E810–E823</td>
<td>E810–E825</td>
<td></td>
</tr>
</tbody>
</table>

Note: In Australia, the 8th Revision of the International Classification of Disease (ICD-8) was used to code deaths registered between 1968 and 1978, ICD-9 for 1979–98, and ICD-10 for deaths registered from 1999 onwards.
from the analysis. The mean population size (people under 75 years) of the SLAs was 12,564 (min = 4, max = 238,518; interquartile range = 2,231–11,236).

Analysis

To broadly describe mortality trends by SES for each time period, we aggregated SLAs into quintiles, each containing approximately 20% of the population. Rates were directly standardized for age (using 5-year age groups) and sex using 2001 Australian population data. They were not analysed separately by age group and sex in order to maximize statistical power and simplify the presentation of results. Incidence rate differences (RD) and rate ratios (RR) were calculated to describe the change in rates between 1986 and 2002 and the difference in rates between the lowest (Q1) and highest (Q5) quintiles in each year.

To investigate our hypotheses regarding trends in avoidable compared with non-avoidable mortality by SES, we performed pooled cross-section trend analysis using the SLA-level data. We used two models. The first model examined relative inequalities, and the second, absolute inequalities. For both models, we assumed deaths were Poisson distributed within an area; however, to allow for random variation in rates between areas we modelled for over-dispersion. Prior to the modelling procedure, we used indirect standardization to calculate the expected deaths for each SLA in each year using the age and sex-specific rates for 2002 as the standard. The observed and expected deaths for each SLA in each year were then used in the analysis.

The measure of SES included in these models was the cumulative proportion of the population in the area (SLA), ranked from lowest to highest SES (i.e. the fractional rank). Advantages of this SES measure are that it includes all the available data, allows the SES data to be treated as continuous and avoids the problem of changing socioeconomic group sizes over time. The coefficient for this SES measure is used to calculate the relative index of inequality (RII) (Model 1) and the slope index of inequality (SII) (Model 2). Originally described by Pamuk,18 and later modified by Mackenbach and Kunst,19 the RII is the ratio of the rate of mortality that is predicted for the lower end of the socioeconomic continuum to the rate of mortality for the higher end. In Model 1, it is equal to the exponential of the negative regression coefficient for SES.20 Similarly, the regression coefficients for SES from Model 2 were used to estimate the SII which can be interpreted as absolute differences in standardized mortality ratios predicted for the lower and higher ends of the socioeconomic continuum. To represent the SII’s on a rate scale, we multiplied the coefficients by the 2002 national rates for avoidable and non-avoidable mortality.

For both the relative (Model 1) and absolute (Model 2) models, we modelled avoidable and non-avoidable mortality separately. In Model 1, we used negative binomial regression to model the annual rate of mortality decline by SES by regressing observed deaths on the covariates using a log link, with the log of expected deaths as an offset. The covariates included Year (modelled as a continuous variable) and SES; we also included an SES × Year interaction term to examine change in inequality over time. We compared the change in inequality for avoidable mortality with that for non-avoidable mortality by comparing the SES × Year coefficients from the avoidable and non-avoidable models using the seemingly unrelated estimation (SUEST) procedure in STATA.21 For Model 2, we used an identity link, weighting by the expected number of deaths. We used quasi-likelihood estimation for Poisson regression with a scale parameter to model for over-dispersion as we were unable to use an identity link and incorporate weights to model rates using negative binomial regression.

We used Stata 9.0 statistical software for all analyses except for the absolute models, which were fitted in R version 2.3.0 using the GLM function.

Results

Descriptive statistics

Avoidable and non-avoidable mortality rates by SES quintile for each year are shown in Table 2. Across the four time periods, there was a steady decline in avoidable and non-avoidable mortality rates in every quintile, with the exception that non-avoidable mortality rates changed very little between 1986 and 1991 and actually rose during this time in Q1 (low SES).

Both absolute declines (RD) and relative declines (RR) in avoidable mortality rates were much greater than in non-avoidable rates. Percentage declines over time showed a socioeconomic gradient for both avoidable and non-avoidable mortality, ranging from 44% in the lowest quintile (Q1) to 55% in the highest (Q5) for avoidable mortality, and 8% (Q1) to 23% (Q5) for non-avoidable mortality. This pattern of greater percentage declines in avoidable than non-avoidable mortality is also reflected in the decline in avoidable mortality rates as a proportion of total mortality for each SES quintile, as shown in Figure 1.

The RD and RRs comparing Q1 with Q5 in each year show significant absolute and relative socioeconomic inequality, respectively, in both avoidable and non-avoidable mortality. Rate differences show that absolute inequality in avoidable mortality rose between 1986 and 1991 before falling thereafter. A similar pattern was seen for non-avoidable mortality. In contrast, relative inequality in avoidable mortality rose steadily over time, with RRs ranging from 1.31 in 1986 to 1.63 in 2002. For non-avoidable mortality, RRs increased between 1986 and 1991 from 1.23 to 1.45, with little change thereafter, the rise in the RR in 1991 being driven by the rise in non-avoidable death rates in Q1 (with rates remaining stable in the other quintiles).

Modelled trends in avoidable and non-avoidable mortality

The results of Model 1 (Table 3) show that at the lower end of the SES continuum avoidable mortality rates declined annually by 3.47% (95% CI: 3.15–3.80%) and non-avoidable rates by 0.80% (0.43–1.17%). At the higher end of the continuum, avoidable rates fell by 5.03% (4.73–5.33%) per annum, while non-avoidable rates fell 1.50% (1.17–1.83%). At both ends of the SES continuum avoidable mortality rates declined annually by 3.47% (95% CI: 3.15–3.80%) and non-avoidable rates by 0.80% (0.43–1.17%). At the higher end of the continuum, the declines in avoidable mortality rates were greater than in non-avoidable mortality rates (P < 0.001 for both).
was 50% higher than at the higher end (RII ¼ 0.45; 0.43–0.47).

Similarly, the declines in non-avoidable mortality were greater at the higher SES end (P ¼ 0.027), with inequality in non-avoidable mortality rates rising over time [RII in 1986 ¼ 1.55 (1.45–1.66); in 2002 ¼ 1.74 (1.68–1.80)]. However, the SUEST procedure comparing the SES $\times$ Year interaction terms across the models showed that the rise in relative inequality in avoidable mortality was significantly greater than that for non-avoidable mortality (P ¼ 0.036).

The results of the model of absolute rates (Model 2, Table 4) show that at the lower end of the SES continuum avoidable mortality fell by 8.38 (7.87–8.90) deaths/100 000 per year and non-avoidable mortality by 1.71 (1.22–2.20). At the upper end, avoidable mortality fell 3.73 (3.69–3.76) deaths/100 000/year and non-avoidable mortality fell 2.15 deaths (1.69–2.61).

Comparing trends at the two ends of the SES continuum showed the decline in avoidable mortality/100 000 population was significantly greater at the lower than the higher end, as shown by the positive SES $\times$ Year interaction (P ¼ 0.021). Consequently, there was a decrease in absolute inequality in avoidable mortality over time, with the SII in 1986 of 97.75 (95% CI: 87.60–107.91) deaths/100 000 falling to 81.51 (74.55–88.47) deaths by 2002. In contrast, the trends in non-avoidable mortality over time were similar at the lower and higher ends of the SES continuum (P ¼ 0.295), with the SII in 1986 equal to 60.00 (51.00 to 69.04) deaths/100 000 and

Table 2 Avoidable, non-avoidable and total deaths by year, and age- and sex-adjusted mortality rates by year and SES quintile (Q), for Australian population aged <75 years

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<tr>
<td>1986</td>
<td>14 914 474</td>
<td>34 757</td>
<td>23 407</td>
<td>58 164</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1991</td>
<td>15 737 506</td>
<td>31 715</td>
<td>25 825</td>
<td>57 540</td>
<td>–</td>
<td>0.98 (0.95–1.01)</td>
<td>0.98 (0.95–1.01)</td>
</tr>
<tr>
<td>1997</td>
<td>17 574 653</td>
<td>27 877</td>
<td>27 295</td>
<td>55 172</td>
<td>0.75 (0.72–0.78)</td>
<td>0.98 (0.95–1.01)</td>
<td>0.98 (0.95–1.01)</td>
</tr>
<tr>
<td>2002</td>
<td>18 501 662</td>
<td>23 847</td>
<td>26 417</td>
<td>50 264</td>
<td>0.88 (0.86–0.91)</td>
<td>0.98 (0.95–1.01)</td>
<td>0.98 (0.95–1.01)</td>
</tr>
</tbody>
</table>

Figure 1 Avoidable deaths as a proportion of total deaths by year for each SES quintile (Q)

Comparing trends at the two ends of the SES continuum showed the declines in avoidable mortality were greater at the higher than the lower end, as revealed in the negative SES $\times$ Year interaction (P < 0.0001). This resulted in a rise in relative inequality over time: at the start of the period, in 1986, the avoidable mortality rate at the lower end of the continuum was 50% higher than at the higher end (RII ¼ 1.54; 1.46–1.63) and by 2002 it was twice as high (RII ¼ 2.00; 1.95–2.06).
rather than as a continuous variable. Models 1 and 2 when year was modelled as indicator variables for IHD separately. All three categories of death given that ischaemic heart disease (IHD) accounts for 40% of all deaths with non-avoidable mortality were similar for both those with non-avoidable mortality and those with avoidable mortality. We performed three subanalyses. First, to examine any possible effect modification by sex, we repeated Model 1 separately for males and females (standardizing only by age) and compared coefficients across the models. While there was greater inequality in both avoidable and non-avoidable mortality in males than females, the SEX × YEAR interaction was not significantly different across sexes for either avoidable (P = 0.557) or non-avoidable (P = 0.736) mortality, indicating that trends over time in inequality were similar for males and females. Second, we investigated whether or not the patterns of increasing relative inequalities in avoidable mortality compared with non-avoidable mortality were similar for both those conditions that are treatable (MCI) and those conditions that are largely avoidable through primary prevention only (HPI). Given that ischaemic heart disease (IHD) accounts for approximately half of the total MCI deaths, we also calculated the RIIs for IHD separately. All three categories of death showed similar patterns, however the rise in relative inequality over time in mortality rates was lower for MCI than for IHD and HPI (P < 0.001 for both comparisons).

Finally, we also re-analysed the data including only those people who lived within capital city statistical subdivisions (63–64% of population in each year; number of SLAs ranged from 525 to 585) because of the potential for confounding due to remoteness. The pattern of results for the city sub-sample is similar to those for the entire sample, although the rise in inequality over time in avoidable mortality, while significant (P = 0.014), was lower than for the total sample (while non-avoidable mortality trends did not differ significantly between city and total sub-samples).

Discussion
Our findings indicate that individuals across the socioeconomic spectrum have benefited from health care, as shown by the greater declines in avoidable mortality than in non-avoidable mortality over time at both the low and high ends of the spectrum. However, the declines in avoidable mortality (compared with non-avoidable) were greater at the higher end of the SES spectrum resulting in increasing relative inequality. This suggests that, of those in need of health care, higher SES individuals were more likely to have benefited from it than those of lower SES. Although methodologies and time periods vary considerably, the findings from our study are generally consistent with those reported for other countries. At the same time, absolute declines in avoidable mortality were greater at the lower end of the spectrum resulting in decreasing absolute inequality over time, reflecting the greater need for care in this population. Thus, while there is evidence of inequality in the individual benefits of health care, the overall population impact in terms of improved survival is greater at the lower end of the socioeconomic spectrum.

Limitations to the study
As has been noted in other studies using the avoidable mortality approach, there are several limitations to consider when interpreting these findings. First, as originally discussed by Rutstein and his colleagues, who introduced the concept of avoidable mortality, the chain of events that leads to death may be long and complex, thus the partitioning of deaths into those that are avoidable, and those that are not, is an inexact science. Second, over the period covered by this study, there were changes in ICD coding that may affect trends. However, the effect of such changes on overall trends have been examined previously and are not expected to have a major impact on this study, particularly given trends in individual causes of death were not examined (with the exception of IHD). Third, as the avoidable mortality concept only captures deaths and not other health outcomes, it offers an incomplete assessment of the benefits of health care. Fourth, there is the criticism that the findings may just reflect differences in incidence. However, avoidable causes are those for which death is largely avoidable once the condition has developed (with the exception of the three HPI causes) and differences in incidence rates also reflect, at least in part, differences in preventive health care and health policy initiatives (HPI).
Other limitations of this study include; first, the potential for biased estimates as the numerator data and denominator data were obtained from different sources—mortality and census data. We attempted to minimize the extent of this bias by selecting years in which data from the two sources used identical SLA coding. Second, with regard to the SES area-based measure used, while such an index is a multidimensional indicator that may measure aspects of SES not captured by individual-level indicators, it is less precise than individual-based measures and is likely to result in an underestimation of the true extent of socioeconomic inequality. Third, to preserve power and simplify the presentation of results, we aggregated results by age and sex. While we adjusted for these factors, the combined results could have potentially obscured important age and sex differences. Nevertheless, a subanalysis showed no effect modification by sex.

Conclusions
The relative inequality in the benefits of health care may be because those of lower SES are less likely to use formal health care services than higher SES individuals with similar needs. There may also be differences in the quality of services provided across SES groups. There is evidence that socioeconomically disadvantaged people in Australia are less likely to attend screening, undergo elective or discretionary surgery, be admitted to a private hospital, or have lengthy general practice consultations, while the findings on frequency of such consultations by SES are mixed. Inequality in avoidable mortality rates may also reflect the differential capacity of SES groups to adapt to new health knowledge, whether this be delivered through formal or informal channels (e.g., getting health care in improving health and creating inequalities cannot be overlooked. Because mass behaviour change may occur in response to information flowing through the mass media, and in an uncoordinated or informal way through health professionals, health care ‘needs to be understood broadly, not just as a domain of professional practice, nor as a bundle of commodities to be “delivered” but rather as an institution in which the whole of society participates’.

The rises in relative inequality over time were larger for conditions avoidable largely through HPI and for IHD than for other treatable conditions (MCI). However, the distinction between categories should be interpreted cautiously and it should not be assumed that non-medical health care is driving the inequalities: declines in HPI deaths may reflect advances in medical care, just as many conditions amenable or preventable through medical care (MCI and IHD) are also preventable through HPI. For example, the declines in IHD reflect health policy interventions through reductions in smoking and dietary risk factors as well as medical care such as management of abnormal blood pressure, emergency department care and surgical coronary artery procedures.

Another example is the reduction in road traffic deaths, which reflect policy initiatives such as national laws regarding seat-belt use and alcohol control, as well as improvements in trauma care for road accident victims. In addition, we cannot rule out inequalities in health care for particular conditions within MCI, as these were not examined separately.

Whether due to direct medical care or HPI, formal or informal channels, health care has clearly benefited people across the socioeconomic spectrum. While the population impact has been largest in those who have the most to gain—those at the lower end of the spectrum—those at the higher end have obtained a disproportionate benefit resulting in widening relative health inequalities. This pattern of inequalities is consistent with the theory put forward by Phelan and Link that inequalities are driven by our increasing capacity to control disease and death in combination with existing socioeconomic inequalities—as we make advances in health care, the benefits are distributed according to SES-related resources such as money and power. The fact that there are inequalities in deaths that are potentially avoidable through health care should be of particular concern. While not all determinants of the distribution of health may be avoidable, the inequitable distribution of health care and health knowledge is one that is amenable to change. While this article does not address what it is about health care in Australia that results in inequalities, it does indicate that having a ‘universal’ system does not guarantee equality in health-care related outcomes. If these outcomes of the less advantaged members of society were to improve to the levels of the more advantaged members, not only would this make for a fairer society, but also it would improve the overall level of the population’s health.

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Conflicts of interest: None declared.

KEY MESSAGES
- Life expectancy has been steadily increasing in Australia, as in other developed countries, which can be partly explained by advances in health care.
- People across the socioeconomic spectrum have benefited from these advances in health care.
- Health care has contributed to decreasing the absolute mortality gap, but advantaged people have obtained a disproportionate benefit, contributing to widening relative health inequalities.
- Having a universal health care system does not guarantee equality in the benefits of health care.
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