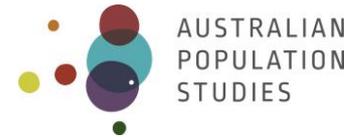


## Fifty years of plummeting cardiovascular death rates and implications for the individual



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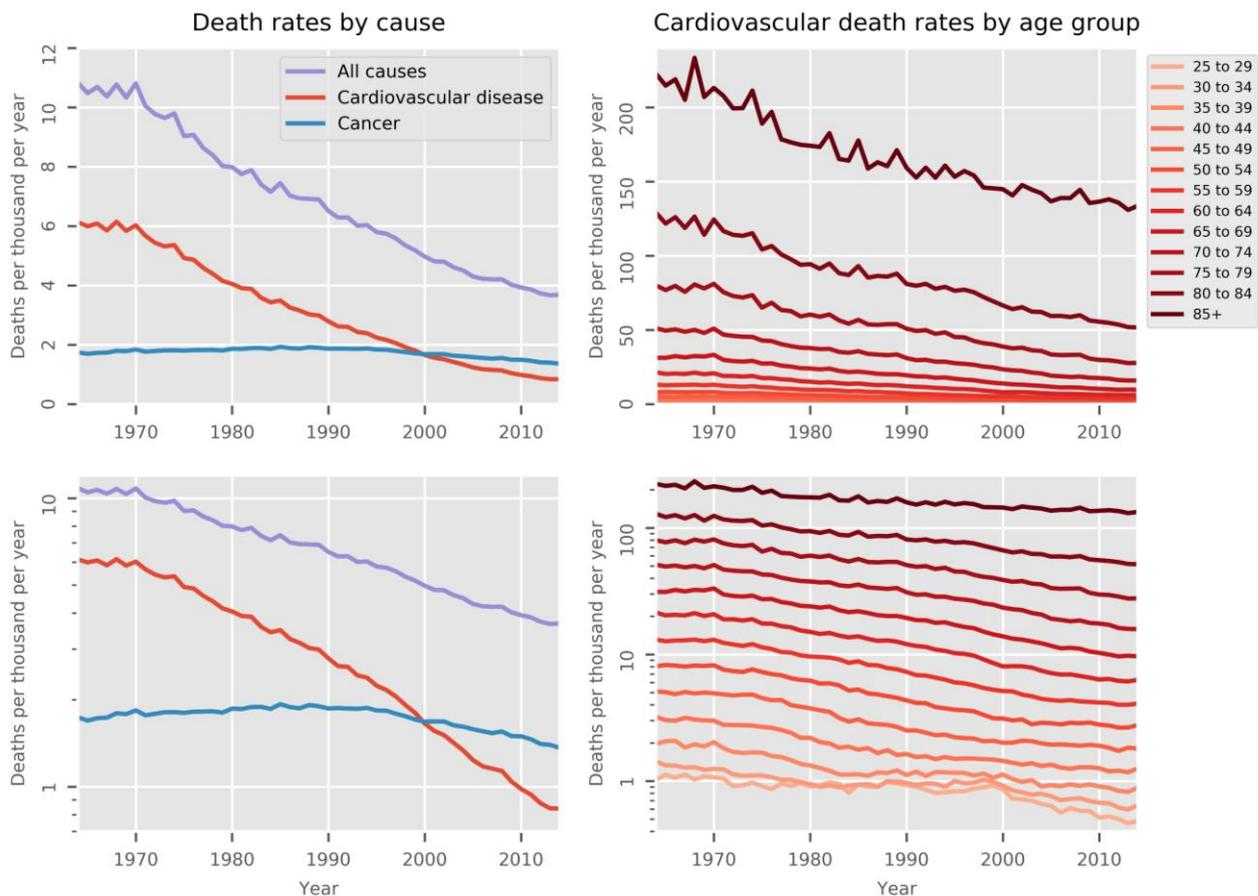
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Mortality rates have been reliably reported for many decades and provide important insights into major changes in disease burden or ‘epidemiological transitions’ (Freak-Poli, Bi and Hiller 2007; Omran 1977). Here we present illustrations of the dramatic shift from cardiovascular disease to cancer as the leading cause of death in Australia and highlight the significance of these changes for individual Australians.

We obtained data on the total number of deaths and population size for the period 1907–2014 in Australia from the General Record of Incidence of Mortality (GRIM) books (Australian Institute of Health and Welfare 2017) and used this information to calculate death rates overall and by age group attributable to all causes, cardiovascular disease and cancer. The small proportion of deaths (generally <0.1%) for which age group was missing were assumed to be distributed as for the deaths for which age group was known. These calculated death rates were used to construct life tables, under which the complement of the all-cause mortality rate for each year was used to determine the number of persons surviving to the following year. As the data are grouped into five-year age groups, Karup-King interpolation (Siegel and Swanson 2004) was used to obtain smoothed estimates for each year of age in the construction. Full methods are presented as publicly available Python 2.7 code at <https://github.com/jtrauer/demography>.

We observed dramatic falls in cardiovascular mortality, with cancer overtaking cardiovascular disease as the leading cause of death category at the start of this century (Figure 1, left panels). The fall is even more impressive when presented on a log-scale, because the steady absolute decrease represents a greater proportional decrease as rates decline. Cardiovascular death rates are steadily falling across all age groups, although the youngest age brackets have the greatest variation due to the noise associated with these very low rates (Figures 1, right panels). While the initial reduction in cardiovascular mortality was attributable to reductions in death rates in young adults and middle age, increasingly the falls in death rates are occurring in older age groups. Although the fall appears less impressive in the oldest age bracket (85 years and above), this is attributable to the decline in death rates being offset by an increase in the age distribution of this age group.



**Figure 1:** Death rates by cause and cardiovascular death rates by age group from 1964–2014 in Australia

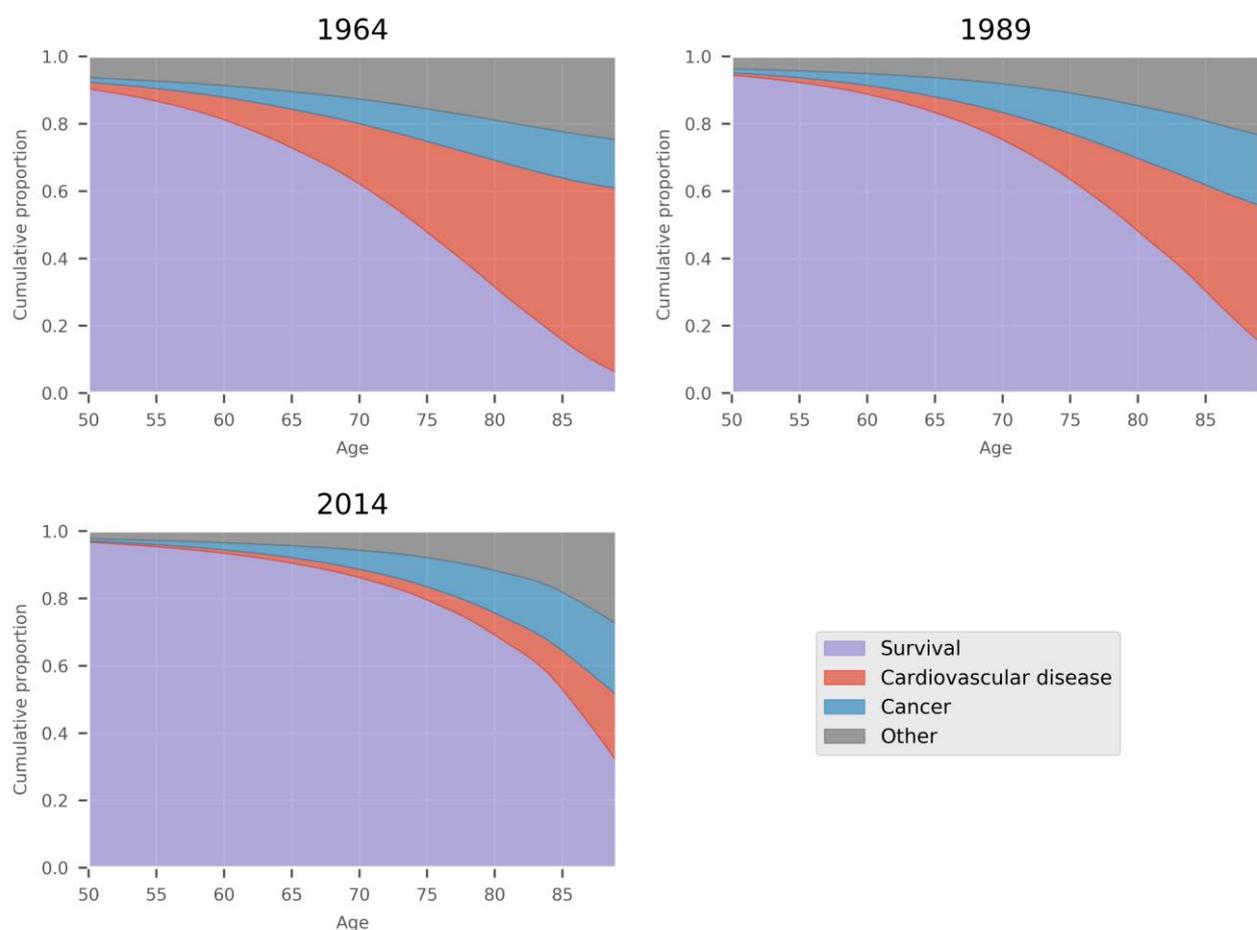
*Source:* Australian Institute of Health and Welfare (2017). *Notes:* Left two panels show death rates standardised to the age structure of the Australian Bureau of Statistics standard Australian population 2001. Right two panels show age-specific death rates attributable to cardiovascular disease.

These changes have translated into massive changes in survival and cause of death (Figure 2). For example, a person subject to the age–cause-specific death rates of 1964 would probably be dead before their 80th birthday, with cardiovascular disease the likely cause of death. By contrast, a person subject to the age–cause-specific death rates of 2014 would probably live to celebrate their 85th birthday, and likely die of non-cardiovascular causes before turning 90. Again note that death rates for those aged 85 years and above are considered as a single age group, which was used to calculate survival from 85–89 years. Therefore, our findings emphasise the need for disaggregation of this oldest age group, which has grown from a very small group to a considerable size, and continues to grow.

Past modelling in similar developed country settings suggests that the dramatic reductions in cardiovascular mortality are attributable both to changes in the population prevalence of predisposing risk factors and medical treatments – the latter including both clinical care for episodes of disease and secondary prevention (Capewell et al. 2000; Capewell, Morrison and McMurray 1999). Pharmacological primary prevention has not contributed significantly to these major reductions in the past, although results from large community-based randomised controlled trials into aspirin (ASPREE Investigator Group 2013) and statins (Zoungas et al. 2014) as primary preventive interventions will shed light on this point. However, while intervention studies can quantify the

relative reduction in incident cardiovascular disease, one of the most important issues to address before recommending prevention strategies to individuals is the absolute risk of new cardiovascular disease (Otto 2016). While disease-specific mortality rates do not translate directly to rates of incident disease, the dramatic reductions in cardiovascular death rates over recent decades are likely to reflect decreases in cardiovascular disease to some extent. Therefore, it is essential to ensure guidelines are based on risk assessments that consider modern rates of incident cardiovascular disease by demographic and comorbidity status.

Cancer mortality is presented for comparison as it is the other major disease category responsible for a high proportion of deaths over recent decades. Although cancer mortality appears relatively stable over this period, the aggregate rates mask important underlying trends in cancer types by gender (Freak-Poli, Bi and Hiller 2007). With non-cardiovascular mortality remaining relatively stable, it is clear that the declines in overall mortality directly parallel those in cardiovascular-specific mortality (Figure 1, upper left panel). This highlights how critical these improvements have been in driving Australia's recent improvements in overall life expectancy, to the extent that falling cardiovascular mortality has entirely driven the all-cause mortality decreases.



**Figure 2:** Cumulative outcomes for an Australian living their life with death rates as observed in 1964, 1989 and 2014

*Source:* Australian Institute of Health and Welfare (2017). *Notes:* Survival region represents a life-table, with cumulative contributions of three cause of death categories presented as shaded regions above. Data from five-year brackets are smoothed by calculating yearly estimates using Karup-King interpolation.

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