How much are educational differences contributing to total lifespan inequality?

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Objective

We aim to quantify the contribution of educational differences in mortality to total lifespan inequality in 11 European countries.

Background

Death rates are systematically higher in groups of lower socioeconomic status, albeit the magnitude of these differences varies across countries [1]. Meanwhile, the average difference in age at death between individuals (regardless of socioeconomic status) varies from roughly 7.4 to 10.5 years for males or 6.3 to 8.8 years for females in countries with advanced economies[1]. Yet how much of this total dispersion in lifespan can be explained by socioeconomic inequality to date remains unknown.

A few previous studies were made with regards to morbidity. Wagstaff and van Doorslaer [2] quantified that between-group income inequality in health accounted for 26 percent of total adult health inequality in Canada (measured by the McMaster Health Utility Index). Similarly they found between-group consumption inequality in Vietnam to account for 23 percent of total inequality in child's height-for-age percentile score. Using the same methods, Asada [3] found socioeconomic inequalities in health (using income and education as proxies) to account for between 31 and 34 percent of total health inequality in the United States, as measured by the Health and Activity Limitation index.

These results are striking, both in terms of the substantial amount of total inequality in health status that they can account for and in terms of the similarity of the contribution of socioeconomic inequality to population health in three different settings (between 23 and 36 percent). This leads us to the following research questions.

Research Questions

1. Is socioeconomic inequality (using educational differences as a proxy) as quantitatively important to lifespan inequality as it is to measures of inequality in morbidity?

[1] Based on calculations of the absolute inter-individual difference for each gender and country of the Human Morality Database, accessed 01/09/2008

2. Is the contribution of socioeconomic inequality to total inequality in lifespan similar in different European countries?
3. Are there any differences in the contribution of socioeconomic inequality to total inequality in lifespan by gender?

Data

We use data assembled and harmonised as part of the Eurothine project, which includes census-based data from a wide range of European countries, with a large territorial coverage. The Eurothine project contains sex-specific data on average age at death grouped in five year intervals, from ages 30 to 85+. Deaths were aggregated into four categories of the International System of Classification of Educations (ISCED): primary or no education; lower secondary education; higher secondary education; and tertiary education. Specific information on the dataset can be found at www.eurothine.org. National mortality data comes from the Human Mortality database, www.mortality.org.

Methods

Transforming data

The Eurothine dataset is aggregated into 5 year age intervals, from ages 30 to 85+. In order to have a more continuous age at death distribution, we apply the proportions found by age and education category to the corresponding national data from the Human Mortality Database. As a result, we end up with death rates by single year of age (30-110+). These death rates are then used to construct life tables, resulting in comparable death densities by education groups.

Construction of life tables above age 30 was done following the methods of life table construction as outlined in the methods protocol of the Human Mortality Database [4]. A Kannisto model was fitted to ages above 80 [5].

Computing and decomposing inequality

Economists have used subgroup decomposition as a tool to quantify the amount of total inequality that can be explained by inequality between subgroups. In health and morbidity research, to date only the Gini coefficient has been applied by Wagstaff and Van Doorslaer [2] and Asada [3, 6] in their decompositions of health inequality. One of the drawbacks to decomposing the Gini coefficent is the presence of a residual or overlap term, present whenever rankings among different subgroup distributions overlap. Wagstaff and Van Doorslaer [2] showed that as the number of subgroups increased, the contribution of between-group inequality also changed slightly, alongside the expected increases in the overlap term and reductions in the within-group inequality. Thus while the overlap term can be useful in terms of examining the degree of stratification between subgroups, the contribution of subgroup inequality to total inequality is at best a close estimate.

The alternative is to use an additively decomposable inequality measure. Given requirements of scale independence and population-size independence Shorrocks [7, 8] showed that only the single parameter Generalised Entropy family can meet this condition, of which Theil's index (*T*) is best known. Although Theil's index is difficult to interpret in precise demographic terms, it is highly correlated with other inequality measures, including the Gini coefficient and Keyfitz' entropy measure.

Shkolnikov et al. [9] showed that *T* (in our case conditional upon survival to age 30) can be reasonably estimated from single year life tables according to,

$$T = \frac{1}{l_{30}} \sum_{x=30}^{\omega} d_x \left[\left(\frac{\bar{x}_x}{e_{30}} \right) \ln \left(\frac{\bar{x}_x}{e_{30}} \right) \right], \qquad (1)$$

where 30 and ω are respectively the youngest and oldest age intervals taken from the life table, l_{30} is the radix of the population (taken to be the initial subgroup population size), d_x and $\bar{x}_x$ are respectively the life table number of deaths and the average age-at-death in the age interval x to $x+1$, and e_{30} is the average remaining life expectancy at age 30 for the life table population.

We then decompose the index into its between- and within-group components. Calculating between-group inequality can be done by assuming that everyone in subgroup *i* has that group's mean age-at-death weighted by the subgroup's population share (w^i).

$$BG = \sum_{i=1}^{n} \left[w^i \left(\frac{e_{30}^i}{e_{30}^t} \right) \ln \left(\frac{e_{30}^i}{e_{30}^t} \right) \right]. \qquad (3)$$

In this case n is the number of subgroups, e_{30}^i refers to the average remaining life expectancy at age 30 for subgroup i, and e_{30}^t is the average remaining life expectancy at age 30 for all education groups combined. Within-group inequality is a weighed average of the inequality levels present within each subgroup calculated by,

$$WG = \sum_{i=1}^{n} \left[w^i T^i \left(\frac{e_{30}^i}{e_{30}^t} \right) \right] \qquad (5)$$

where T^i is the subgroup i Theil index of inequality. The contribution of educational inequalities to the total lifespan inequality thus becomes simply *BG/T*.

Results

The results can be obtained by the authors upon request, at vanraalte@demogr.mpg.de.

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