Healthy lifespan inequality across Europe

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Extended Abstract:

Living long *and* healthy lives is among the most highly valued and universal human goals. Thus, the proper monitoring of population health has become one of the top priorities for researchers and policy-makers all over the world. Despite its popularity, the indicator of 'life expectancy' (LE) – which measures the average number of years individuals are expected to live under prevailing mortality conditions – ignores two crucial dimensions of health: 'quality' (e.g. how healthy are individuals?), and 'equality' (e.g. are some individuals living much longer than others?). To answer the first question, scholars have promoted the creation of 'health expectancy' measures (HE) that count the average number of years individuals are expected to live in 'good health'[3,4,5] under prevailing mortality and morbidity conditions. For the second one, researchers and policy-makers are urged to quantify the amount of 'lifespan inequality' (LI) existing in the age-at-death distributions[6,7,8,9]. Surprisingly, key insights and contributions from these important research avenues have barely influenced each other over the years. While HE indicators have made the important distinction between 'quantity' and 'quality' of years of life and LI measures have separated 'efficiency' (i.e., average achievement) from 'equality', these two analytical axes have never been considered *simultaneously*. As shown in the following examples, the incorporation of only one of these perspectives at a time generates an incomplete picture of the distribution of health in a population, which, in turn, can be nicely complemented when the other is also taken into consideration.

To illustrate the limitations of currently existing population health measures, let us consider three hypothetical population health distributions. Curves A and B show the density functions of the distribution of ages at which individuals start developing chronic disabling diseases in two hypothetical societies (see left panel in Fig 1). While populations A and B have 70 years of healthy life expectancy at birth – so they are indistinguishable for any HE indicator – the extent of health inequality in B is much larger than in A. Therefore, the proportion of individuals developing chronic diseases before the retirement age of 65 is much larger in B than in A – a piece of information that is potentially useful for the elaboration of employment and retirement policies. Consider now a third hypothetical society C in which all individuals die when they approach the age ω, but in which one half of its members enjoy a perfect health until they die and the other half spends the first half of their lifetime in perfect health and the remaining half in very limiting health conditions (see right panel in Fig 1). Despite the rampant health inequalities, current LI measures would conclude that length-of-life inequality in such society would be close to zero.

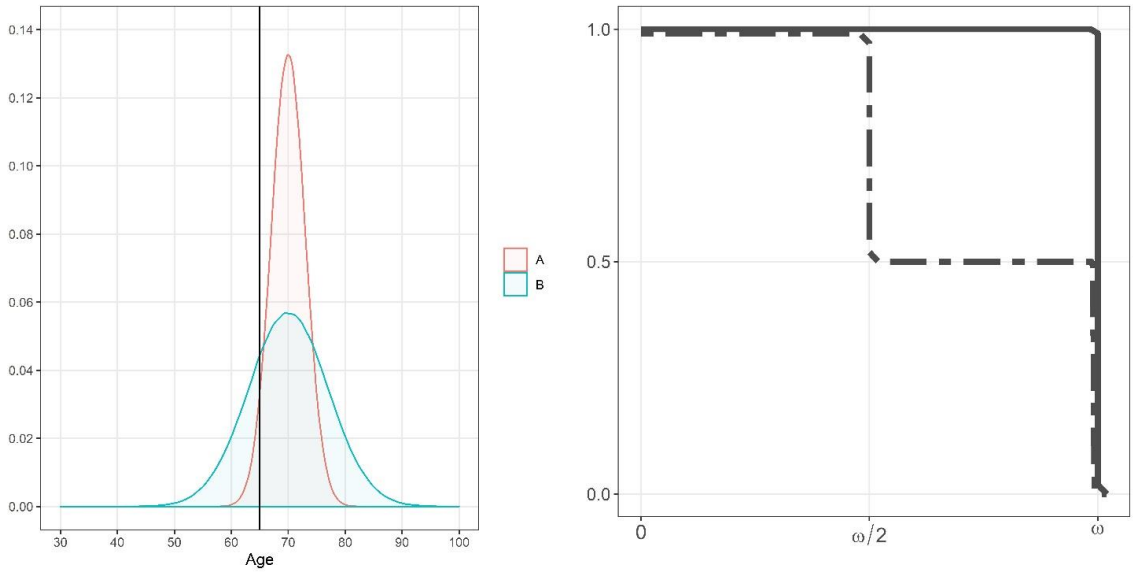

Figure 1. Hypothetical health distributions. Left Panel: Age at morbidity onset distributions for populations A and B; Right Panel: Survival curves of mortality and morbidity (in continuous and dashed lines, respectively) for population C. Source: Authors' own elaboration.

These examples suggest the need to complement currently existing measures of population health with indicators that simultaneously account for the 'quality' (i.e. health status) of life years *and* the extent to which these years are equally distributed across individuals (i.e. 'inequality'). The main aim of this article is to bring together these ideas into a coherent whole by creating a new class of population health measures, referred to as 'healthy lifespan inequality' (HLI) indicators. Rather than looking at the distribution of *complete* lifespans (as done by LE and LI indicators), the new indicators fill an important gap investigating the extent to which *healthy* lifespans are unequally distributed across population members.

There are many reasons why healthy lifespan inequality can be considered a fundamental quantity in health research that should be reported alongside other well-known mortality and morbidity summary indicators. Population health means more than simply averting death, and societies are concerned not only about average levels of disease and/or disability, but also in the ways in which the latter are distributed. Larger levels of HLI indicate greater heterogeneity in underlying population health, an issue that can have implications both at the micro and at the macro level. At the individual level, HLI indicators measure uncertainty in the timing of disease, disability or physical limitation onset – the latter being key events with a strong and enduring impact on individuals' well-being – with potentially important effects on individuals' decision-making. At the macro level, HLI are appealing, simple measures of population health that might arguably be more meaningful than their LI counterparts: while the former look at the distribution of a normatively desirable quantity ('years spent in good

health') the latter complicate matters by including quantities that might not be universally desirable (e.g., 'years spent in very bad health').

To compute the new HLI indicators we combine information on mortality, obtained from the Human Mortality Database (HMD), and morbidity, with data from the European Union Statistics on Income and Living Conditions (EU-SILC). We proceed in two steps. First, we estimate the distribution of age-at-disability onset for the population under study by applying the Sullivan method'[10]. Disability is measured by the Global Activity Limitation Index (GALI)[11]. Second, we measure the amount of inequality in such distribution. More detailed information on the method and date used will be described in the full paper.

In Figure 2, we show the values of the different population health indicators discussed so far across 30 European countries around 2005 and 2015, for women and men separately. As is well known, higher levels of life expectancy are strongly associated with lower lifespan variability, and women are more longevous and experience less uncertainty in the ages at which they die than men[6,7,8] (see upper panels). Yet, such advantage disappears when the indicators we compare are health expectancy and healthy lifespan inequality (see bottom panels). That is, the expected number of healthy years lived and the variability in the distribution of those healthy years is roughly similar when comparing women and men. Interestingly, the variability in the ages at which physical activity limitations start (HLI) tends to be substantially larger than the variability in the ages at which individuals die (LI), both for women and for men, and the differences between both measures tend to increase over time. The newly proposed HLI indicators are, on average, around 60% higher than their LI counterparts for men, and around 90% higher for the case of women (i.e. for women, the variability in the age-at-morbidity-onset distributions almost *doubles* the variability in the distributions of ages at which they die). Thus, the new indicators are uncovering substantially large layers of inequality that are not observable with currently existing methods.

The historically strong, well-documented and generally negative relationship between longevity and lifespan variation[6,7] (see upper panels) weakens considerably when inspecting the 'health corrected versions' of those indicators (i.e., when comparing health expectancy with healthy lifespan inequality indicators; see lower panels). The correlation between LE and LI equals -0.92 for men and -0.61 for women, and the correlation between HE and HLI equals -0.45 for men and -0.27 for women. This means that increases in the average number of years individuals are expected to live in good health are not necessarily accompanied by a compression in the distribution of healthy lifespans. In addition, while it is clear that life expectancy (resp. lifespan inequality) tends to increase (resp. decrease) over time, both for women and for men, the trends are not so clear when inspecting the trends in health expectancy and healthy lifespan inequality, which exhibit more erratic patterns – specially for the case of women.

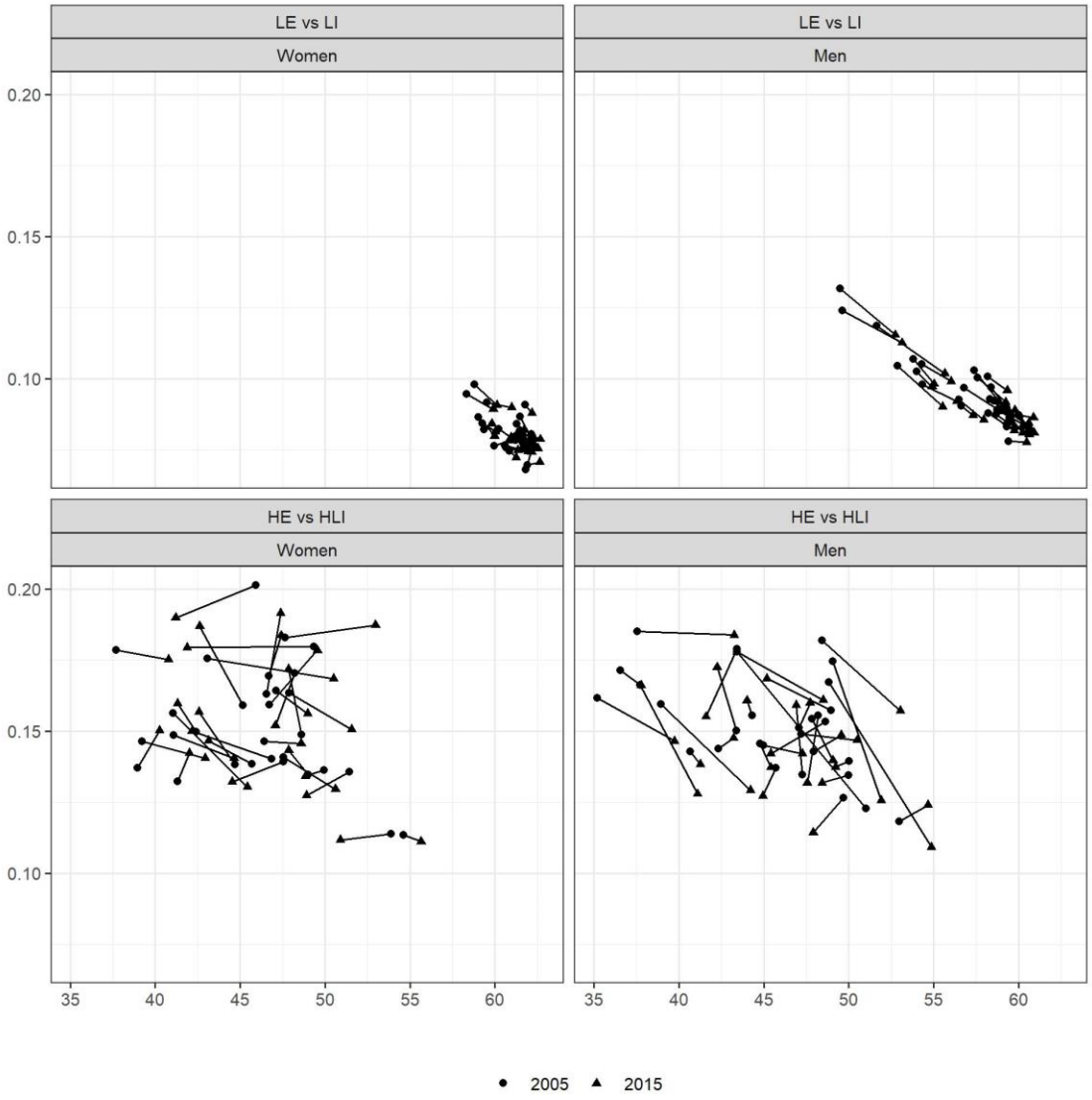

Figure 2. Population health indicators for women and men across 30 European countries circa 2005 and 2015. Top panels: Life expectancy (horizontal axes) vs Lifespan inequality (vertical axes). Bottom panels: Health expectancy (horizontal axes) vs Healthy lifespan inequality (vertical axes). Source: Authors' own elaboration.

The new indices hold promise to be an important complement to traditional LE, HE and LI measures, which, on their own, do not explain the whole story and might lead to the elaboration of unfair or misinformed policies. Inter alia, HLI indicators can be crucial for the design of equitable pension schemes and retirement policies that are sensitive to the underlying heterogeneity in the population, and for the public provision of medical care (especially at advanced ages). From a public health policy perspective, larger HLI might be indicative of a worsening state of affairs across or within socially relevant groups – a cause of legitimate ethical concern, especially when social patterning in health is attributable to preventable causes.

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