Mortality inequalities around the world (1950-2022): Is there a stall in convergence?

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Introduction

Under the umbrella of the demographic transition theory, and the epidemiological transition theory, the convergence of mortality has been earnestly examined. The epidemiological transition (sometimes referred to as a health transition) foresees populations converging through a shift in mortality towards control over infectious diseases, with low related mortality, and increases in the relative share of non-communicable diseases (Omran 1971). This idea prevailed in the 1960s and 1970s, and was supported by rapid gains in survival in developing countries at the end of the WWII, thanks to the spread of medical progress against infectious diseases.

However, rather than convergence, various periods marked by divergence in mortality trends have been identified. Some authors even claimed that progress in reducing mortality differences between populations slowed down in the late 1980s and early 1990s, and that the global convergence in life expectancy at birth switched to divergence (Moser et al. 2005). In Latin America, high levels of external mortality (homicide, accident and suicide related deaths) were found to be an obstacle for countries in the region to converge towards high-income countries' mortality regime (Alvarez et al. 2020). The health crisis in eastern Europe, whereby communist regimes lacked resources to run efficient health systems to deal with chronic diseases and lost out in a cardiovascular revolution of the 1970s, also sparked a period of divergence, contesting the idea of a fourth stage of delayed degenerative diseases in the health transition which should have applied everywhere (Olshansky and Ault 1986). In sub-Saharan Africa, in the 1990s and 2000s, countries diverged widely from a general world-wide convergent trend in mortality due to the HIV/AIDS epidemic (Gabrielli et al. 2021; McMichael et al. 2004; Neumayer 2004), challenging the stages of the epidemiological transition (Caselli et al. 2002; Vallin and Meslé 2004).

In an attempt to explain cases of stagnation, reversal, or divergence from declining mortality trends, trajectories of life expectancy have been grouped into "convergence clubs" (Mayer-Foulkes 2001). These convergence clubs maintain the idea behind the epidemiological transition – mortality decline can be expected, just with the right development policies, adapted to each club. Similarly, convergence in life expectancy has been suggested to be bimodal, with a group of unhealthy high-mortality countries and a group of health low-mortality countries (Bloom and Canning 2007). During the process of convergence, some high-mortality countries may make a rapid transition to low, while other

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countries may be stuck in a "mortality trap" with persistent high mortality. This mortality trap suggests that large efforts are needed for some countries to pass a threshold to transition smoothly to lower mortality.

In aiming to reach a low level of mortality, will inequalities persist? Will sub-Saharan Africa remain divergent? Previous research has focused almost exclusively on convergence in life expectancy and/or child mortality. Yet, if we rely solely on these indicators, we are at risk of missing a more comprehensive picture. First, child mortality has benefitted from targeted interventions that are also likely to encourage convergence. The evolution of global inequalities in survival could look very different beyond age five. Second, in high-mortality countries, life expectancy will be highly sensitive to child survival, and will change rapidly as age-specific mortality rates decline. In more advanced countries, deaths are more concentrated in specific age groups, constraining progress in life expectancy. Convergence is somehow "built in" this metric. We therefore turn to age-disaggregated measures: age-specific mortality rates to consider the trends in declining mortality, and the possibility of convergence.

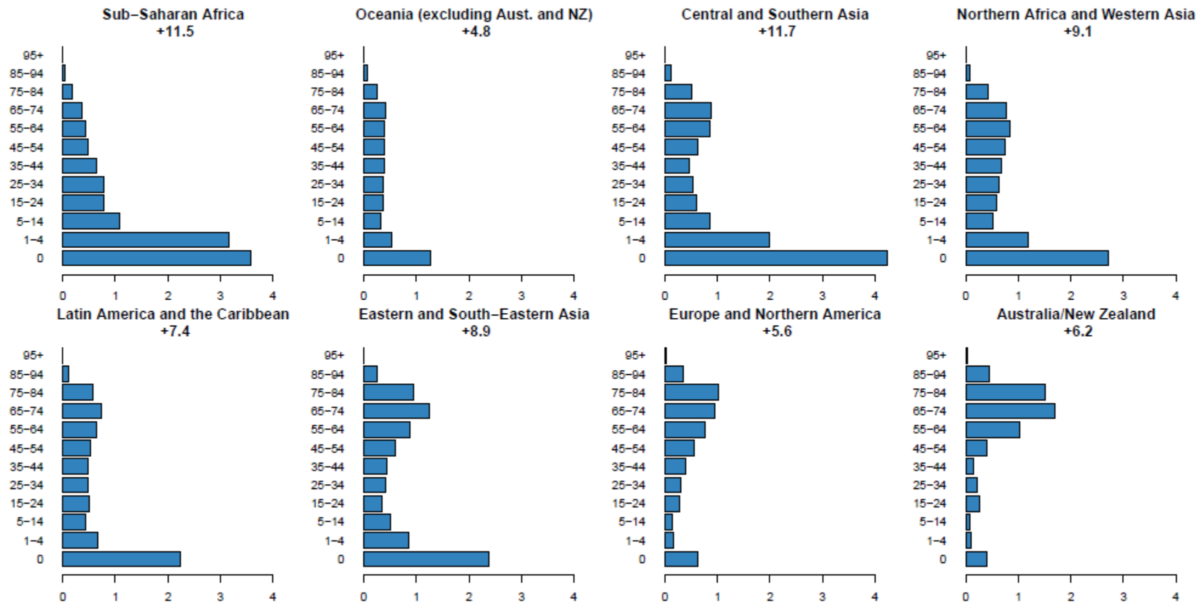
Data and methods

We use estimates of age-specific mortality rates from the 2022 UN World Population Prospects (Gaigbe-Togbe et al. 2022), covering eleven age groups from birth to age 95, between 1950 to 2022. To examine convergence, we rely on two metrics: the Dispersion Measure of Mortality (DMM), as proposed by Moser et al. (2005), and the Gini Index. The DMM measures the degree of dispersion in mortality, and as calculated as the average absolute inter-country mortality difference weighted by population size, between every pair of countries (Moser et al. 2005). Declines in DMM indicate convergence. The Gini Index is a widely used and intuitive coefficient, measuring the inequality in distribution, where zero reflects equality – or convergence, and one maximal divergence (inequality between values). We employ two measures to identify convergence and divergence to ensure that our conclusions are not dependent on the measure we use, since they capture slightly different things.

Results

Since life expectancy is a commonly used metric to examine mortality convergence, we firstly decompose the contributions of each five-year age group to gains in life expectancy at birth using the Arriaga method (Arriaga 1984). By doing so we show the differential contribution of gains in life expectancy across regions – due to age-specific declines in mortality (Figure 1). In central and southern Asia and in sub-Saharan Africa, where over 11 years in life expectancy were gained, declines in under-five year olds contributed the most. In Europe, North America, Australia and New Zealand, declines in deaths in older ages (55-84) contributed the most to gains in life expectancy (those these were more moderate). Figure 1 validates the importance of examining convergence within age groups.

Figure 1: Age-specific contributions to gains in life expectancy at birth from 1990 to 2019

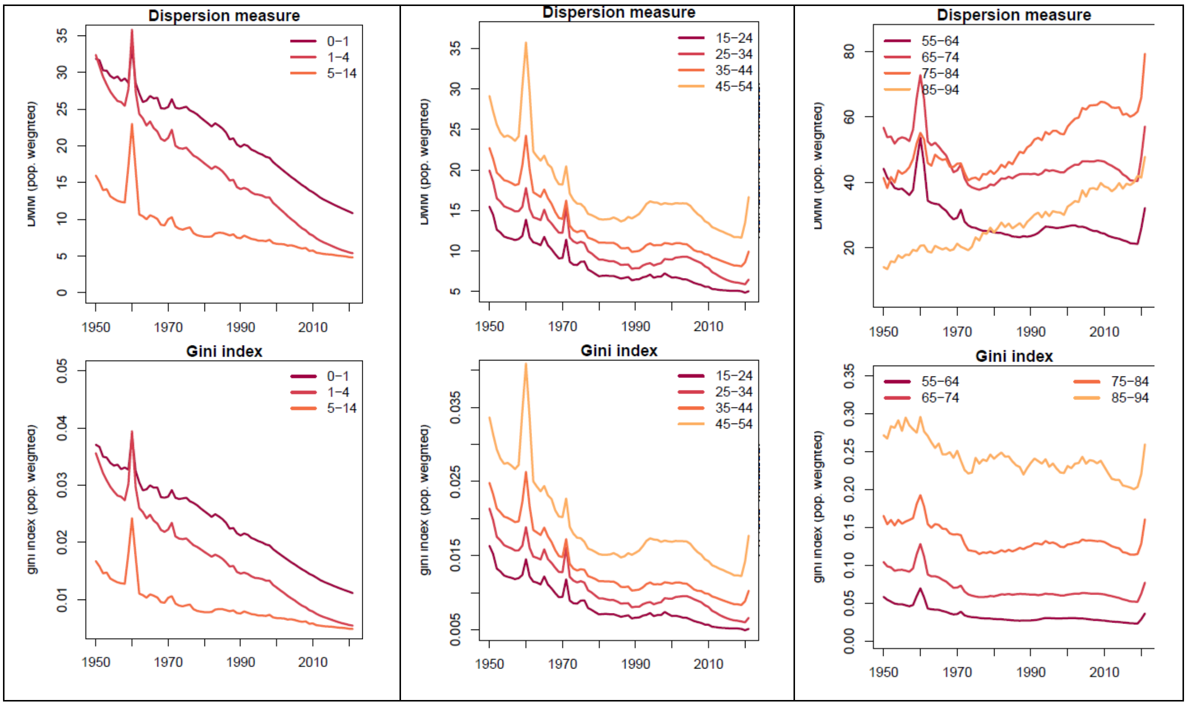


Considering mortality amongst children, we see that over time there has been in decline in the Gini Index from 1950 to 2022 – suggesting greater equity between countries (Figure 2).[2] This decline is particularly steep among 1-4 year olds, and lesser so among 5-14 year olds. These declines are a clear reflection of the success of programmes aimed to reduce mortality in under-five year olds in low- and middle-income countries. We see similar declines in the DMM for these age groups. When we consider adults aged 15-54, we see more moderate declines in both the Gini Index and DMM (and the Gini Index is much higher as compared to <.05 among children), but as we move though the 10-year age groups it is clear that there is more diversity in mortality. In other words, there is an age gradient in convergence. This gradient is also apparent from age 55 to 94, looking at the Gini Index.[3] However, when we consider the DMM, we see that in addition to higher values, declines are not seen from age 75 to 94. We actually see increases in the DMM since 1950 for the oldest age group, and from around 1970 for 75-84 year olds. Further analysis (not shown here) based on projected DMM in life expectancy to 2100 suggests that we can expect to see a divergence in mortality – or at least a stall (if we consider the Gini Index). This reflects changes in the burden of mortality – as it shifts to older ages. Overall, our analysis indicates that with further mortality declines, inequalities between countries will likely

[2] The spike in the indices around 1960 is due to the famine resulting from The Great Leap Forward in China.
[3] The upturn in both measures around 2020 reflects Covid-19 mortality.

increase, unless we work actively to reduce disparities in survival at older ages. The future will be determined by countries in sub-Saharan African in particular, as they begin to age.

Figure 2: Convergence in age-specific mortality using two measures: DMM and Gini Index



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