1 Longevity trends

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This chapter discusses recent trends in longevity in order to provide background and context to the discussion around the development of mortality assumptions and the modelling of mortality. It highlights the differences in patterns across population groups and presents evidence of the drivers of the high-level trends observed.

While the global gains in life expectancy over the last century have been impressive across the board, closer inspection reveals patterns that differ across countries, periods, genders, age groups, and socio-economic groups. Identifying these trends and their drivers can not only help to improve the modelling of mortality, but also help to identify circumstances that may shape these trends going forward and change future patterns relative to what has been observed in the past.

This chapter discusses recent trends in longevity in order to provide background and context to the discussion around the development of mortality assumptions and the modelling of mortality. The first section presents the high-level trends in life expectancy across countries and their drivers, and identifies some of the differences across countries, genders, and age groups. The second section looks at the trends in the distribution of life spans, which can provide richer insight into longevity patterns compared to looking only at life expectancy. The third section discusses trends in the inequalities in life expectancy within populations. The final section discusses the implications that these trends have for modelling future improvements in mortality.

1.1. Global trends and drivers of life expectancy improvements

Life expectancies in most OECD countries have been on a continuous upward trend since the mid-twentieth century. Since 1990 alone, males in OECD jurisdictions have gained on average 7.4 years in life expectancy at birth, and females 5.7 years (OECD, 2022[1]).[1] Gains at age 65 have also been impressive, at 4.1 and 3.7 years for males and females, respectively (OECD, 2022[2]). The large relative gain at older ages – upwards of a 20% increase at age 65 compared to less than a 10% increase at birth – are reflective of the acceleration of mortality improvements towards older ages observed in recent decades (OECD, 2014[3]).

OECD jurisdictions that previously lagged behind have gained remarkable ground over the last decades. In 1960, life expectancy at birth in Türkiye was well below 50, while that in South Korea and the current members from Latin America had life expectancies below age 60 (the exception being Costa Rica, where life expectancy was close to 60). This compares to a then-OECD average life expectancy of around 70. In 2019, life expectancy in South Korea exceeded the OECD average of 81, while Chile and Costa Rica fell just under the average.[2] Türkiye, while lower at 78.6, still gained more ground in total. Mexico started off in line with Chile and has also experienced large improvements, but following a stagnation in life expectancy since the 2000s finds itself a bit further behind, with a life expectancy at birth of around 75 (OECD, 2022[1]).

In addition to Mexico, there are a few other exceptions to the continuous upward trend for life expectancy. Denmark experienced a stagnation of life expectancy in the 1980s. The Czech Republic, Hungary, Poland, and the Slovak Republic only saw life expectancy start to improve substantially since the mid-1990s, while the Baltic countries of Estonia, Latvia, and Lithuania actually saw life expectancy decline in the 1970s, and again more substantially in the 1990s. More recently, the United States has also been experiencing a stagnation in life expectancy.

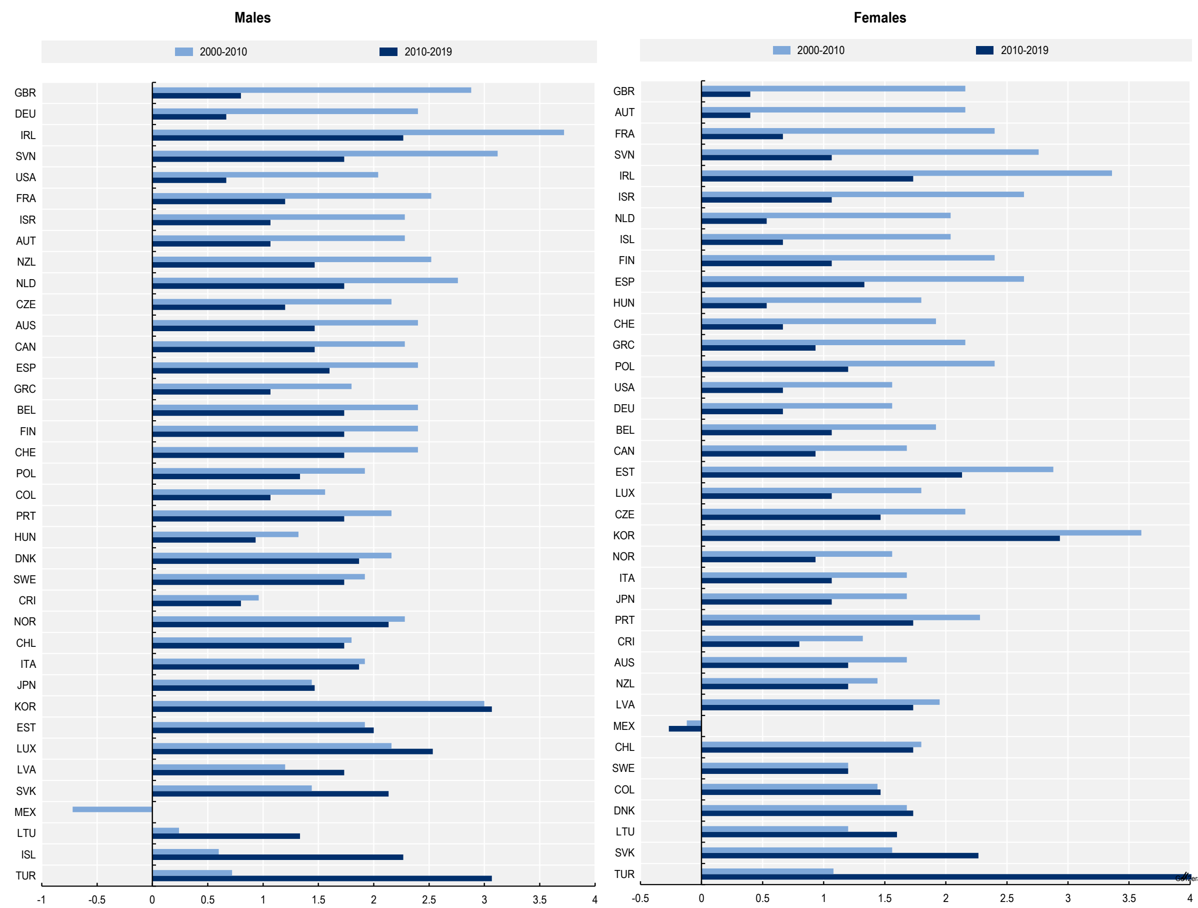
The drivers of these different trends across jurisdictions relate to medical, behavioural and societal factors. For most rich western countries, advances in the treatment of cardiovascular disease have been a main driver of the significant gains in life expectancy over the second half of the twentieth century. Health reforms in Chile contributed to it catching up with other developed countries, as did lower levels of infectious diseases in both Chile and Costa Rica (Alvarez, Aburto and Canudas-Romo, 2019[4]). In Denmark, stagnation in the 80s followed from a high prevalence of smoking (Rosenskjold and Kallestrup-Lamp, 2017[5]; Christensen et al., 2011[6]). Stagnation and decreases in life expectancy in the Central European and Baltic countries were due to these countries not being able to take advantage of the advances in cardiovascular medicine, and also experiencing high rates of deaths linked to accidents as well as smoking, alcohol and drugs (Meslé and Vallin, 2017[7]). Life expectancy significantly improved for these countries following the collapse of the Soviet Union, though in the Baltic States things got worse before they began to improve only in the mid-90s. The stagnation of life expectancy in Mexico is due primarily to high rates of violence and homicide, particularly among mid-life males. This problem contributes to the lack of convergence of life expectancy in Latin America towards that of other developed countries (Alvarez, Aburto and Canudas-Romo, 2019[4]; García and Aburto, 2019[8]). In the United States, the recent stagnation seems to be a result of cumulating trends of reductions in improvements from cardiovascular disease as well as a sharp increase in deaths related to liver disease, suicide and drugs (Chen, Munnell and Sazenbacher, 2017[9]; Case and Deaton, 2015[10]).

Even where life expectancy has not stagnated, smoking prevalence has a large influence on the observed longevity trends. Indeed, smoking can have a dramatic effect on the longevity improvements experienced for smoking cohorts. One study on a cohort of male British doctors showed that improvements in life expectancy accrued only to the non-smokers, with smokers effectively demonstrating zero improvements in mortality. Lifetime smokers had a life expectancy ten years lower than lifetime non-smokers, though this loss of life expectancy could be reduced by stopping smoking at earlier ages (Doll et al., 2004[11]). In the United States, observed cohort effects in mortality are largely attributable to controllable causes linked to lifestyle, and smoking in particular (Lourés and Cairns, 2019[12]). This demonstrates that the ongoing reduction in smoking prevalence can be expected to contribute significantly to improvements in life expectancy for the whole population.

Smoking prevalence has also been a key driver for gender differences in life expectancy. In most countries women took up smoking later than men, and so there is an observed lag in the effects this has had on their mortality. Females in the United States have experienced lower increases in life expectancy at age 50 since the 1980s, which is likely due in part to smoking, as deaths from lung and respiratory diseases have increased since then (Preston, Glei and Wilmoth, 2011[13]). The impact of smoking on mortality for men in the United States began to decline since the 1990s, whereas this occurred for women only a decade later (Chen, Munnell and Sazenbacher, 2017[9]). In addition to Denmark and the United States, smoking has also had a significant impact on female mortality trends in Canada (Preston, Glei and Wilmoth, 2011[13]). Similarly, high smoking rates for female cohorts born around 1925 have led to worse improvements in life expectancy in England and Wales since 1970 relative to 22 high-income countries (Leon, Jdanov and Shkolnikov, 2019[14]). These patterns have led to a reduction in the difference in life expectancy between genders in many countries, particularly at older ages.

More recently, a widespread slowdown in improvements has been observed in many Western countries, most notably since 2010-11. Among OECD jurisdictions, the largest slowdown in improvements in life expectancy at birth comparing the period 2010-19 to 2000-10 occurred in the United States, the United Kingdom, and Ireland for males, and Ireland, Estonia, and Iceland for females. At age 65, the largest slowdown occurred in the United Kingdom, Germany, and Ireland for males and in the United Kingdom, Austria, and France for females (Figure 1.1).[3] The slowdown has generally been stronger for females in absolute terms. A separate analysis by the Office for National Statistics in the United Kingdom looking at mortality experience from 2000 to 2016 showed slightly different results in terms of country ordering, but all results consistently show that the United Kingdom has experienced one of the strongest recent slowdowns observed internationally. In both the United Kingdom and the United States, the slowdown was most significant at ages 65-79, and the United States was the only country of 20 that actually experienced an increase in the age-standardised death rates for ages 40-64 (Office for National Statistics, 2018[15]).[4] For females in the United Kingdom, life expectancy at age 75 has even declined over certain periods (Hiam et al., 2018[16]). Most countries experienced a slowdown in mortality improvement for ages over 80, with the exception of Japan (Office for National Statistics, 2018[15]).

Figure 1.1. Annualised increase in life expectancy at age 65 in OECD jurisdictions (in months)



Note: For Latvia, the increase is shown for 2002-10 rather than 2000-10. The scale is truncated at four months.
Source: Own calculations based on data from OECD (2022[2]), "Life expectancy at 65, https://dx.doi.org/10.1787/0e9a3f00-en.

While the observed slowdown in most countries has occurred in the last decade, the slowdown in the United States began earlier. This seems to be mainly driven by an upward trend in the mortality of middle-aged whites since 1999, particularly ages 49-54 (Case and Deaton, 2015[10]). Total average mortality improvement in the United States was 1% over the period 1999-2018, but was only 0.2% over the period 2013-18 (Holman, MacDonald and Miller, 2020[17]).

Behavioural trends such as obesity are another factor in the slowdown of life expectancy improvement across countries. For example, in the United States the life expectancy gains from reduced smoking have largely already been realised by 2005, so rising obesity is now contributing to slowed improvements (Chen, Munnell and Sazenbacher, 2017[9]). Other countries can expect to follow this pattern as smoking rates have declined and obesity rates continue to grow (OECD, 2019[18]; 2017[19]).

Another key driver in this slowdown in many countries seems to be linked to reduced mortality improvements from cardiovascular disease. Improvements for cardiovascular disease have slowed by over 50% in many OECD countries compared to the previous decade (OECD/The King's Fund, 2020[20]). This is partly linked to the behavioural factors of increased obesity and diabetes, which would also offset some of the ongoing gains linked to reductions in smoking. Reduced improvements in circulatory disease have driven reductions in improvement for age 50-89 in the United Kingdom since 2011 (Office for National Statistics, 2018[21]). In the United States, improvements from heart disease have been falling since 2008 (Holman, MacDonald and Miller, 2020[17]).

At the oldest ages, dementia may be a factor in stalling improvements or even increasing mortality. Mental illness and dementia have contributed to the rising mortality for ages over 90 in the United Kingdom since 2011 (Office for National Statistics, 2018[21]). A 41.8% increase in mortality from dementia from 2001 to 2016 has resulted in a loss of 0.15 years of life expectancy at birth in British Colombia, Canada – a notable decrease at birth particularly as these deaths occur primarily in the oldest ages (Ye et al., 2018[22]).

Another worrisome trend is the increase in deaths due to drugs and suicide, the so-called 'deaths of despair'. This has been a major contributor to the stalling longevity improvement in the United States, and to a lesser extent also in Australia, Canada, Ireland, and the United Kingdom (Case and Deaton, 2017[23]). Through 2015, the mortality attributed to deaths of despair increased the most for Whites aged 45-54, and in particular women (Case and Deaton, 2017[23]). While some have attributed this trend to economic hardship and austerity following the Global Financial Crisis, particularly in Europe, the pattern of these trends has varied across countries and regions, and additional research is still needed to better understand the actual reasons behind them.

Drug overdoses have been a particularly harmful problem. In the United States, deaths from drug overdoses more than doubled between 2000-15, and more specifically deaths from opioid overdoses more than tripled. This has resulted in an overall loss in life expectancy at birth of 0.28 years, of which 0.21 years attributed to opioids (Dowell et al., 2017[24]). But older people are also affected. Ages 64-74 experienced the highest annual increase in opioid deaths in 2018, and this sharp increase extended to males aged 65-84 (Holman, MacDonald and Miller, 2020[17]). In British Colombia, Canada, increased drug overdoses over 2014-17 have reduced overall life expectancy by 0.15 years (Ye et al., 2018[22]). Over the period 2011-16, opioid-related death rates more than tripled in Türkiye, and more than doubled in the Czech Republic and Sweden (OECD, 2019[18]).

Suicides are also experiencing an upward trend in several countries, potentially linked to economic hardship and unemployment. In the United States, suicides have increased annually since 2006, even for older ages (Holman, MacDonald and Miller, 2020[17]). However, several studies demonstrate a link between economic hardship and increased suicides only for those under 65. In Europe, a 1% rise in male unemployment during the recession of 2007-11 implied a 0.94% increase in suicide, and a 1% increase in indebtedness increased suicides by 0.54%. These factors did not have a significant impact on suicides for ages over 65 (Reeves et al., 2014[25]). A longer study showed that a 1% increase in unemployment in the European Union between 1970 and 2007 was associated with a 0.79% increase in suicides below the age of 65. However, the strength of this association varied significantly by country and is even negative in some, and investment in labour market programmes had a mitigating effect (Stuckler et al., 2009[26]).

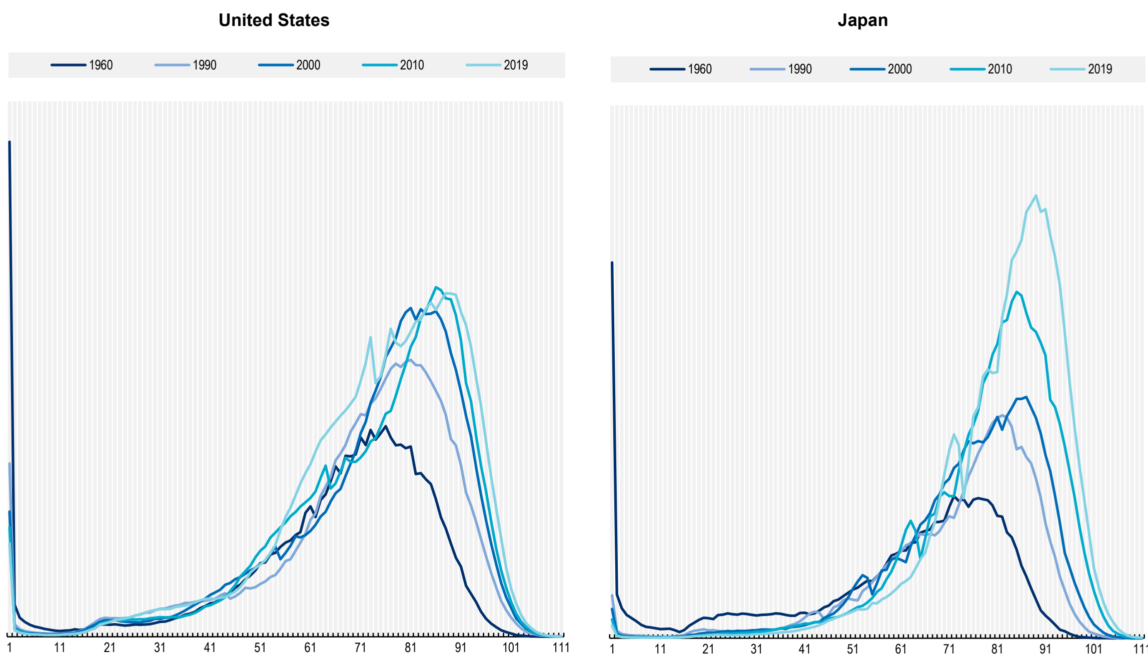
1.2. Patterns in the distribution of lifespans

The patterns of life expectancy and mortality improvements provide only part of the story of the evolution of longevity. The interpretation of changes in life expectancy is difficult, as it remains a summary measure reflecting the average, and is much more sensitive to the mortality at ages nearer to the age at which it is calculated. As such, life expectancy at birth is less sensitive to changes occurring at older ages. Combining life expectancy with analysis of mortality improvement by age can provide further insight as to changes by age, but this still provides an incomplete picture as to the distribution of mortality across ages.

Analysing changes in the distribution of lifespans is useful to complement an analysis of changes in average life expectancy and mortality as it can show how lifespans are converging and/or expanding to older ages for the whole population, not just on average. This can highlight age groups where high mortality may be particularly problematic (which is not observed with an average life expectancy figure), the extent to which people are increasingly living to very old ages in general and not only on average, and any tendency towards a reduction in lifespan inequalities, particularly in old age. A decrease in the variance of the distribution of lifespans indicates a decrease in lifespan inequalities, and a rightward shift of the distribution shows that more people in the whole population are living longer.

To aid in the visualisation of these patterns, Figure 1.2 shows the distribution of lifespans in the United States and Japan in selected years between 1960 and 2019. In both countries, there has been a massive reduction in infant and child mortality since 1960, and a dramatic improvement in adult mortality in Japan. The surprising increase in deaths in the United States for many ages under 70 could potentially be linked to the opioid crisis, but part of this increase is also likely linked with the high numbers of baby boomers that would result in higher deaths regardless, as these distributions do not adjust for population composition. Both countries also demonstrate a shift in the mode of the distribution to higher ages each consecutive year, showing that more and more people are living to older ages. There is also a rightward shift in the distributions themselves, particularly in Japan, showing that the maximum age that people are living to continues to increase.[5] The remarkable difference between these two graphs is that the distribution narrows significantly more in Japan around the modal age at death, whereas the distribution of deaths in the United States demonstrates higher variance, an indication of higher longevity inequalities.

Figure 1.2. Distribution of the age at death, 1960-2019



Note: Distributions are not adjusted for population composition, and the maximum age is capped at 110.
Source: Data from the Human Mortality Database: www.mortality.org.

Demographers have coined several terms for these types of observations. The most notable of these terms are: rectangularisation, or the convergence of lifespans to a single maximal age; compression, or the reduction in the variance around the modal age at death; shifting/delay, or the increase in the modal age at death; and extension, or an increase in the maximal age. Rectangularisation implies a limit to life expectancy, while extension implies that ultimate ages are still being pushed upward. Compression and rectangularisation both imply a reduction in longevity inequalities. Shifting would generally be expected to coincide with increasing life expectancies.

However, these terms can be vague and are at times conflicting definitions of these phenomena. Following this observation, Borger et al. (2018[27]) developed a framework to define and calculate the indicators in a precise manner that allows for the identification and classification of the trends observed over time. These indicators explain more precisely the phenomenon being observed, and allow for any combination of patterns:

- Shift – increase/decrease of the modal age at death
- Extension/Contraction – increase/decrease of the upper bound of the death curve
- Compression/Decompression – increase/decrease in the difference of the area between the actual distribution and a flat distribution (i.e. degree of inequality)
- Concentration/Diffusion – more/fewer deaths around the mode

Application of this framework to 34 countries shows some interesting patterns (Genz, 2017[28]). The modal age at death began its upward trend from the 1970s for the majority of countries, except for several countries in Eastern Europe where this trend only started in the 1990s. Countries have differed more substantially as to when the upper bound of the death curve began to increase. Regional patterns with respect to the upper bounds of the curve are less clear, but most countries have been experiencing an increasing trend since the 1990s. Most countries have also experienced mortality compression since 1920, though there are a number of exceptions, and much of Eastern Europe was neutral or in decompression over the 70s and 80s. Similar patterns are observed for the concentration around the mode. However, when conditioning on survival to age 60, most countries do not experience compression until around the 90s and many Eastern countries demonstrate neutral or decompressing patterns.

Another study looks to analyse more closely the point at which countries transition from a period of compression (decreased variance, in this case) towards a period of mortality delay (i.e. an increase in the modal age at death) (Janssen and de Beer, 2019[29]). It finds that this transformation occurs in stages. The first stage is a compression resulting from reduced mortality at young ages. Compression then slows down because gains at early ages have been largely realised. Delay then becomes the main trend as modal age increases and compression affects different age groups in different ways until delay dominates as adult mortality significantly declines and decompression occurs because of mortality improvements for old ages. The authors find this transition occurred for females nearly a decade earlier than for males, likely due in part to different smoking patterns between genders. The United States was the first to transition from 1950, followed by Northern and Western Europe from the mid-50s through the 60s and Southern Europe in the early 70s. For Eastern Europe, the transition only began in the 90s and is still ongoing.

1.3. Trends in longevity inequalities

The extent to which the distribution of lifespans is compressing or decompressing can also indicate to what extent longevity inequalities exist for a population. If there were no inequalities, everyone would die at the same age. Compression of mortality with more deaths around the modal age implies a reduction in longevity inequalities.[6]

Looking across the entire lifespan, inequalities have decreased in most of the world as life expectancies have increased. This has mainly been driven by the sharp reductions in infant and child mortality, meaning that the left tail of the distribution has been shrinking (Permanyer and Scholl, 2019[30]).

However, this picture changes when truncating the distribution to exclude the younger ages. Reductions in inequality have been much slower when focusing only on adult mortality, and has even increased in Central Asia during the 1990s. When looking only at ages over 65, lifespan inequalities have actually increased in all countries and regions. Latin American countries have among the highest levels of inequalities at older ages by this measure (Permanyer and Scholl, 2019[30]).

Furthermore, the evolution of the distribution of lifespans has not been the same for all groups of the population. Significant inequalities exist across socio-economic groups within countries, and the reduction in the variance of lifespans has occurred primarily for the most advantaged groups. In Finland, the lifespan variation has been stagnant for manual workers while decreasing for non-manual classes (van Raalte, Martikainen and Myrskylä, 2013[31]). In the United States, the lifespan variability has increased for high school educated whites (Sasson, 2016[32]). Higher variation in lifespans for less affluent groups is also observed in Denmark (Alvarez et al., 2020[33]).

The relationship between increasing inequalities and increasing life expectancies is not always intuitive. Improvements in mortality beyond a certain threshold age mechanically increase inequality, as they extend the distribution of lifespans to the right. Indeed, higher mortality improvements at older ages have partly driven the increases in inequality since 1960, particularly in Eastern and Central European as well as Nordic countries, where mortality patterns have differed significantly by age (Aburto et al., 2020[34]). However, the threshold age also increases along with life expectancy, so the age dynamics and link between life expectancy and lifespan equality can change over time.

In order to better understand the implications of longevity inequalities for different population groups, in particular across socio-economic groups, it is necessary to also look at the trends in mortality rates and life expectancy of these groups. Variability in the lifespan can only provide an indication that inequalities may exist, however this cannot explain to what extent inequalities across specific groups translate into differences in average lifespans.

One of the largest challenges in assessing trends in life expectancies across socio-economic groups – apart from a lack of data – is identifying definitions for the groups that correlate strongly with differences in life expectancy. Socioeconomic indicators used include education, occupation, income, wealth, and other economic indicators of relative disadvantage. Box 1.1 discusses the advantages and disadvantages of various definitions to assess longevity differences across socio-economic groups over time.[7]

By many measures, differences in life expectancy across socio-economic groups have widened over time. Those in the higher educational quartile in the United States have experienced higher mortality improvements over the last century (Chen, Munnell and Sazenbacher, 2017[9]). Considering absolute levels of education, mortality rates for the White population without a college degree have actually increased in more recent years, while mortality continues to decrease for those with a college degree and for the Black and Hispanic populations (Case and Deaton, 2017[23]).

Increases in the difference in life expectancy across occupational groups has occurred in England and Wales, in France, and in the Netherlands though there are some differences in this pattern across genders. In England and Wales, differences in life expectancy at birth across occupations has increased over the period 1982-86 to 2007-11 by 1.1 years for males and 1.5 years for females, though the difference has declined for males since 1997-2001 (Office for National Statistics, 2015[39]). In France, a divergence across occupational groups has been observed for males over the period of 1980 to 2011, though the difference across groups remains more stable for females (Insee, 2016[40]). Data for Dutch Olympic athletes over the period 1900-2012 indicates that the differences in life expectancy between low and high socio-economic groups, as measured by their occupations before or after the Olympic Games, has increased for subsequent birth cohorts (Kalwij, 2019[41]).

Box 1.1. Socioeconomic indicators for assessing longevity trends

Educational attainment is the most common indicator available to assess differences in mortality across socio-economic groups. It has the benefit of being a clear measure that is determined early in life, and is also a widely available statistic. Nevertheless, most countries have experienced a large compositional shift in the level of educational attainment of their population, making education a poor measure to assess relative disadvantages over time. As fewer people now have very low levels of education, those who do are likely to be more disadvantaged today than they might have been a few decades ago. Some studies have nevertheless overcome this barrier by assessing changes in life expectancy of different groups based on relative educational attainment rather than absolute measures.

Occupation is another indicator linked to socio-economic groups that statistical agencies commonly collect. This measure has the advantage of having a direct influence on the day-to-day physical environment as well as social and behavioural factors that can be associated with different mortality levels. Nevertheless, categorisation can be a challenge, particularly for intermediate groups. While there tends to be a clear difference in life expectancies between those in manual work and those having managerial roles, the hierarchy of occupation and mortality is less clear, for example, for agricultural workers or small employers. In addition, occupation can change over the lifetime, making classification for assessing trends more difficult.

Income is more directly related to socio-economic status than either education or occupation. Lifetime income is likely to be a better indicator of socio-economic status than income at a single point in time, as it is less affected by temporary changes to an individual's situation.

Wealth is arguably better at capturing the socio-economic status by household, and tends to be a more stable measure. However, it is rather difficult to measure and data on wealth linked to mortality is not widely available. In England, some studies have found wealth to be a better predictor of mortality than other commonly used measures, likely due to the fact that it better reflects an accumulation of disadvantage over time (Demakakos et al., 2015[35]).

Several researchers have sought to overcome the shortcomings of individual measures by using indices combining multiple measures of socio-economic status. Cairns et al. (2019[36]) developed an 'affluence index' combining income and wealth measures for the Danish population. This composite index demonstrated much higher predictive power than either wealth or income measures alone, particularly for higher mortality groups. In England, the regularly published Index of Multiple Deprivation provides an alternative basis for classifying socio-economic status. In addition to income and education, this index includes indicators for employment levels, crime, health, barriers to housing and services, and living environment for small geographic regions. Wen (2019[37]) finds that income, unemployment, average number of bedrooms, housing quality, crowding, education, and rural areas are particularly relevant for assessing differences in mortality.

Note: The OECD Business and Finance Outlook (2016[38]) assesses evidence of the differences in life expectancy for each of these indicators.

Income and wealth measures show increasing disparities for adult and older adult mortality in Canada, Finland, Denmark, and New Zealand. In Canada, inequalities across pension levels over the period 1990-2016 have increased particularly for ages 65-75 (Wen, Kleinow and Cairns, 2020[42]). In Finland, the gap in life expectancy at age 35 between the lowest and highest income quintiles increased by 5.1 years for men and 2.9 years for women over the period 1988-2007 (Tarkiainen et al., 2011[43]). In Denmark, improvements over the period 1985-2012 have been largest for the most affluent and at younger ages, with the gap in life expectancy at age 67 between the highest and lowest affluence deciles increasing by

1.3 years for men. However, the lowest group did improve at a slightly faster rate than the adjacent lower groups (Cairns et al., 2019[36]). Observations were slightly different for females, however, with the decline in life expectancy largest for the low-middle and middle socio-economic groups, who contributed most to the stagnation of life expectancy. The lowest groups actually experienced large positive improvements at ages 80-95 (Rosenskjold and Kallestrup-Lamp, 2017[5]). In New Zealand, the difference in life expectancy at age 65 between highest and lowest tertile of income increased by 1.5 years for males and 1.1 years for females between 1981 and 2001 (Carter, Blakely and Soeberg, 2010[44]).

Consistent with other studies on England and Wales, analysis based on other indicators of disadvantage also show a widening of differences in life expectancies across socio-economic groups. Assessing mortality based on the Index of Multiple Deprivation, which includes among others regional employment and housing indicators, finds that differences in life expectancy across the top and bottom deciles have increased over 2001-17 (Wen, Cairns and Kleinow, 2020[45]).

While relative inequalities have increased over time, there is also some evidence that absolute inequalities in age-standardised mortality rates have decreased. This was the case over the period 1990-2010 for Finland, Norway, Sweden, Scotland, England and Wales, France, Switzerland, Spain (Barcelona), Italy (Turin), Slovenia, and Lithuania based on measures of education and occupation (Mackenbach et al., 2016[46]). In Japan, absolute inequalities have decreased for both genders, while relative inequalities have increased only for specific sectors, such as male service workers (Tanaka et al., 2017[47]). Similarly, in Canada absolute differences between the highest and lowest income quintiles decreased significantly for males over the period 1991-2011, though they seem to have increased since 1996 for women. The difference in relative terms increased significantly for both genders over the period (Marshsall-Catlin, Bushnik and Tjepkema, 2019[48]).

The composition of the population may affect the extent to which differences across socio-economic groups are observed, depending on the socio-economic indicator used. There is some evidence of a 'healthy immigrant effect', where the immigrant population tends to be in better overall health relative to the average native population. The typical measures of socio-economic status may not accurately capture these differences. For example, in Canada a study of the mortality in the CPP and QPP based on pension levels shows that the mortality of the lowest group of males eventually becomes lower than the mortality of the middle groups, and the CPP demonstrates lower levels of inequality than the QPP. One reason for this could be the higher levels of immigration outside of Quebec. The pension level of immigrants would not necessarily be reflective of their socio-economic status, as they may be entitled to a lower pension simply because they have contributed for less time (Wen, Kleinow and Cairns, 2020[42]). The healthy migrant effect is also observed in Barcelona, Spain. Despite the stabilised socio-economic inequalities in mortality in the Spanish-born population, one study found no inequalities between neighbourhoods for foreign-born men and women (Rodríguez-Sanz et al., 2019[49]).

1.4. Drivers of longevity inequalities

The drivers of these longevity inequalities are largely the same as the drivers of the observed slowdown in increases in life expectancy in many countries, and are primarily due to deaths that could be avoided. Avoidable deaths can be classified into two overlapping categories of preventable and amenable deaths. Preventable deaths are those that can be linked to controllable factors. These include deaths related to smoking, alcohol, drugs, obesity, and suicide. Amenable deaths are those that could be effectively treated with the appropriate health interventions. The majority of these types of deaths in the OECD and Europe are linked to cardiovascular disease (OECD/European Union, 2018[50]).

Amenable causes of death are one factor increasing longevity inequalities across socio-economic groups. Those with higher education have experienced faster relative mortality declines for amenable causes of death than those with low education in Europe over the period 1980-2010 (Mackenbach et al., 2017[51]).[8]

Increased health expenditure has been successful in stabilising absolute inequalities, however, and improvements in mortality from cerebrovascular disease have actually contributed to reductions in inequalities in Japan (Mackenbach et al., 2017[51]; Tanaka et al., 2017[47]).

The amenable drivers of mortality inequalities tend to also be largely preventable. The slowdown of mortality improvements for cardiovascular diseases is partly due to risk factors such as increased obesity and diabetes, which can have more impact on disadvantaged groups of the population, resulting in large inequalities in cardiovascular deaths (OECD/The King's Fund, 2020[20]).

Indeed, preventable deaths seem to be the largest contributing factor to longevity inequities. Risk factors linked to preventable deaths tend to be correlated with socio-economic position (Chen, Munnell and Sazenbacher, 2017[9]; Demakakos et al., 2015[35]). In England and Wales, excess mortality inequalities linked to causes of death with controllable risk factors has been growing since 2001, linked to a widening gap in the prevalence of factors such as smoking, alcohol, unhealthy diet and low physical activity. Limited inequalities are observed for causes of death with no obvious controllable factors (e.g. breast and prostate cancer) (Cairns, 2019[52]). In Finland, growing inequalities are a result of a stagnation in improvements for the lowest income groups due especially to alcohol-related deaths, but also cancer deaths (particularly lung cancer) and slower declines from heart disease (Tarkiainen et al., 2011[43]). Deaths linked to smoking contributed to the slowdown in life expectancy improvements for less affluent females in Denmark (Rosenskjold and Kallestrup-Lamp, 2017[5]).

Drugs are also a preventable driver in life expectancy inequalities. Drug overdoses are a major contributor to widening inequality among Whites in the United States, with opioids accounting for a significant part of this for ages between 25 and 64 (Geronimus et al., 2019[53]). Deaths due to drug overdoses are three times higher for low socio-economic groups compared to high socio-economic groups in British Colombia, Canada (Ye et al., 2018[22]).

While accidents and suicides have been a driver in the overall slowdown increases in life expectancy, they do not appear to be a major factor for increasing inequalities in all countries. Suicide has been a main driver of widening inequalities in Japan for some groups, but it does not seem to be a big contributor to inequalities in the United States (Geronimus et al., 2019[53]; Tanaka et al., 2017[47]). To the contrary, lower rates of homicide and accidents among Blacks in the United States have contributed to the narrowing of the gap in life expectancy between Whites and Blacks (Geronimus et al., 2019[53]).

1.5. Implications of the observed trends for modelling mortality

Understanding the trends in mortality and life expectancy is important to inform decisions regarding the selection and calibration of the model used to determine mortality improvement assumptions. An analysis of past trends can aid in determining the appropriate period over which to calibrate the model to reflect the current and ongoing patterns, and to what extent these patterns will continue in the near term. An analysis of the drivers of these trends can provide a rationale for longer term expectations regarding an acceleration or deceleration of life expectancy improvement.

Historical patterns in mortality are driven by the political and societal contexts, and large changes can result in breaks in the trend that should not be included for the purpose of modelling current expectations of future mortality. For example, the fall of the Soviet Union had a dramatic impact on the trend in life expectancy of Eastern European and Baltic countries. Including data before the 1990s to calibrate a model would therefore result in a significant underestimation of the potential improvements in life expectancy going forward. Including periods of stagnation, such as that observed in Denmark in the 1980s, can also lead to an underestimation of improvements to the extent that the patterns in the drivers of stagnation change. Life expectancy improvements accelerated again in Denmark as the rates of smoking declined.

Patterns in the distribution of lifespans and the extent to which it continues to move rightward can inform expectations as to whether mortality improvements will continue, in particular at high ages. Observations of continued mortality delay and extension combined with limited compression of mortality at old ages indicates that life expectancy will continue to increase, as will the maximum age of survival. The fact that improvements in life expectancy are accelerating again in Japan – who currently has the highest life expectancy in the world – support this hypothesis, as do the continued higher gains in life expectancy for higher socio-economic groups relative to disadvantaged groups.

The rapid increase in life expectancy of less-wealthy nations demonstrates that those currently behind can be expected to catch up with the right conditions. Reductions in infant mortality and deaths from amenable diseases has been a key driver of the dramatic improvements observed in countries such as Chile, Korea and Türkiye, though violence has in some cases tampered the positive effects from improved health, as it has in Mexico.

Nevertheless, the recent slowdown in mortality improvements observed in many countries raises the question as to whether improvements will be lower in the near and longer term. There are many opposing drivers of this trend that could result in a continued slowdown or a return to the trend observed over the past decades. Continued reductions in smoking will contribute to mortality improvements. However, this may be offset by rising obesity, a large risk factor for cardiovascular disease and a key explanation for slowed improvements for this cause of death. Nevertheless, medical advances in the treatment of cancer, HIV, and hepatitis, among others, could boost improvements from other significant causes of death.

Changes in the behavioural trends that are driving both the slowdown in mortality improvements and the increasing inequalities over time will be a key factor determining whether these patterns continue. Preventable deaths linked to smoking, alcohol, drugs, unhealthy diet and low physical activity seem to be driving the increased inequalities at the heart of the slowdown in life expectancy improvements. Reductions in these harmful behaviours, particularly for low socio-economic groups, could be expected to lead to a reduction of inequalities and a return to the 'normal' trend going forward for all groups of the population.

However, the COVID-19 pandemic does not bode well for an improvement in these controllable risk factors driving inequalities. Lockdown measures have increased economic hardship and exacerbated mental illnesses that could perpetuate 'deaths of despair'. It has also introduced many uncertainties regarding the long-term impact on the mortality of COVID-19 survivors. The next chapter will explore in more detail both the direct and indirect effects that COVID-19 has had on mortality.

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Notes

[1] Through 2019, excluding Latvia for whom the historical data series is not complete over this period.

[2] Average life expectancy is not weighted by populations.

[3] Calculated as an annualised change in life expectancy during the specified periods based on OECD statistics, not standardised for population changes.

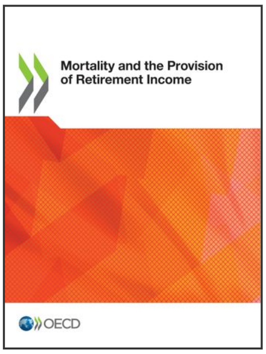
[4] The ONS analysis is based on data from the Human Mortality Database (HMD) and compares improvements in life expectancy over the most recent six years compared to the previous six years.

[5] However, this graph caps the age at death to 110, so does not provide a true picture of the maximal ages reached.

[6] Many studies use the Theil index and Gini coefficient to measure lifespan inequalities, but this chapter focuses on the high-level trends and does not enter into the technical discussion of how to measure inequalities.

[7] Previous reports (e.g. OECD (2016[38]) and OECD (2018[54])) have firmly established the existence of differences in life expectancy across socio-economic groups. This chapter focuses only on how these differences may have changed over time.

[8] This study covered Austria, Belgium, the Czech Republic, Denmark, England and Wales, Estonia, Finland, France, Hungary, Italy, Lithuania, Norway, Poland, Slovenia, Spain, Sweden, and Switzerland.



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