35 Socioeconomics and the Macro- and Micro-level Determinants of Global Health Inequality

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Contents

Abstract

Living long and healthy lives is among the most highly valued and universal human goals. Therefore, the unprecedented increases in life expectancy that have been observed all over the world during the last decades should be welcomed as a

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major social achievement. However, at the same time, differences in health and mortality between low and high socioeconomic groups are becoming increasingly large. To acquire a proper understanding of the present and future dynamics in human health and mortality, scholars have recently started paying attention to inequality within socioeconomic groups. This chapter starts off by proving a short summary of differential health studies performed at the micro and macro level before presenting several approaches to measure health inequalities. The authors then provide empirical evidence at the macro level for associations between socioeconomic development indicators (GDP per capita and education) and life expectancy for most countries in the world as well as between life expectancy and lifespan variability. For 29 European countries the bivariate associations between life expectancy and healthy life expectancy (according to sex) is also investigated as well as between healthy life expectancy and the two socioeconomic indicators. The findings reported in the chapter suggest that the world is facing a new challenge: As mortality retreats to increasingly older ages, the surviving population becomes increasingly heterogeneous (i.e., mixing frail and strong individuals), a key issue that should be taken into consideration by policy-makers and health planners around the world in the coming decades.

Keywords

Socioeconomic status · Health inequality · Mortality · Healthy life expectancy · Lifespan

Introduction

This chapter addresses the relationship between socioeconomic status and health differences. Socioeconomic status (SES) refers to the position on the social ladder according to level of education, income, type of occupation, or a combination these. Life at the bottom of the social ladder is correlated with poor health status (Hertzman 2001). This is because health-damaging exposures and health-enhancing opportunities are socially patterned. Moreover, social gradients in health exist at any life stage and even have their origins before birth (Barker 1995). For instance, mothers from lower socioeconomic status backgrounds are known to give birth to babies of lower weight (Chevalier and O'Sullivan 2007). Subsequently, children living in adverse social circumstances are more likely to have a poor diet and fewer educational opportunities (Ben-Shlomo and Kuh 2002). Risk factors at different life stages may then accumulate over time because of "chains of risk" where one adverse (or beneficial) exposure or experience tends to lead to another (ibid.).

Not surprisingly, just as social status and health are closely related at the individual level, so too are more economically developed societies healthier than lesser economically developed ones. Behind the vast improvements in life expectancy during the course of last century through better nutrition, sanitation, housing, and immunization was economic growth. But while economic growth has allowed the majority of the population to obtain some minimal material standard, at the same time, both material and non-material resources and rewards are unequally distributed within a population, resulting in healthy lifestyles being disproportionally adopted by the higher-educated (Wardle and Steptoe 2003). This has led to increasing inequalities between socioeconomic groups in health and survival. A well-known example is the increase in the all-cause mortality of lower-educated middle-aged white non-Hispanic men and women in the United States since the turn of the century (Sasson 2016). Although studies carried out in European countries have reported increases in longevity across all social groups, in general, the socially advantaged have benefited more than the rest (see Permanyer et al. (2018) for an overview).

While researchers have long focused their attention on the study of socioeconomic mortality and morbidity gradients across socially salient groups (e.g., educational attainment groups, income quantiles), there has also been a growing interest in the study of within-group lifespan variability – an interest spurred by equity concerns together with the increasing availability of data permitting such analyses to be conducted. In this chapter, an overview will be provided of some of the main findings in this burgeoning field of research.

This chapter begins with a short background on differential health studies performed at the micro and macro level. Section "Measuring Health Inequalities" presents different approaches to measure health inequalities. Section "Life Expectancy" provides empirical evidence at the macro level for associations between socio-economic development indicators and life expectancy. Section "Lifespan Inequality" analyses lifespan inequalities across and within countries and section "Health Expectancies" considers health expectancies.

Background

The sustained increases in life expectancy observed in most of the world and its regions – particularly during the second half of the twentieth century (Wilson 2011) – have led some scholars to ponder whether the extra years of longevity enjoyed by the average individual were also spent in good health. For that reason, traditional life expectancy indicators were complemented with measures of "healthy life expectancy," that is, indices counting the average number of years individuals are expected to live in good health assuming the current mortality and morbidity conditions prevail over time. In the late 1970s and early 1980s, a debate started regarding the relationship between life expectancy and healthy life expectancy, although at that time, the debate was predominantly theoretical, with little data to prove or disprove theories. The three main competing theories that emerged (and that continue to dominate the debate currently) are the so-called morbidity compression, morbidity expansion, and dynamic equilibrium hypotheses – even though the compact expression "compression versus expansion of morbidity debate" is often used as shorthand.

In 1980, James Fries introduced the morbidity compression hypothesis (Fries 1980). He proposed that the increases in life expectancy would be accompanied by a shortening of the length of morbid life, that is, individuals are expected to (i) live longer lives, and (ii) spend an increasingly shorter period of those lives in morbid states (i.e., in "less than good" health). Fries suggested that the forces that resulted in decreased mortality would be the same ones lowering the incidence of chronic disease and a higher age of onset of chronic disease. Stated in more technical terms, the morbidity compression hypothesis claims that the so-called rectangularization of the survival curve (one of the key analytical frameworks in mortality and morbidity research) will go in tandem with the rectangularization of the curve of onset for chronic disease or an increase in the age of onset of chronic disease (Crimmins and Beltrán-Sánchez 2011). While the theory originally proposed by Fries assumed that there was a fixed upper limit to human life expectancy (set approximately at 85 years of age), the assumption was gradually relaxed to incorporate eventually increasing upper bounds. In more recent versions of the theory (e.g., Fries et al. 2011), life expectancy is allowed to increase above the previous threshold, so what matters is the relative rate of decrease of morbidity vis-à-vis mortality.

Other scholars were less optimistic and believed that the decline in mortality from chronic disease would be met with increased disease prevalence. This is the so-called morbidity expansion theory proposed by Gruenberg (1977). He did not believe that the decrease in mortality would arise from lowered disease incidence rates, but rather from the survival of people with health problems, resulting in more disease in the population – a gloomy scenario he colorfully termed the "failure of success." Gruenberg (1977) and Kramer (1980) predicted a pandemic of chronic diseases – or expansion of morbidity – through the progress in medical care extending the life of those already with disease and disability, as well as life expectancy increasing to the ages at which disease and disability are most likely (Robine and Jagger 2005). A third intermediate scenario, known as the "dynamic equilibrium hypothesis," was proposed by Manton (1982). This scenario highlights the significance of delay in the intermediate stages of the progression from less severe to more severe disease states. It is possible that people with chronic degenerative disease are living longer because the rate of progression of their disease slows down. According to the dynamic equilibrium hypothesis, severe disability decreases, but mild and moderate disability increases as life expectancy increases (Graham et al. 2004; Manton 1982).

So while death is the result of biological processes, there is, unlike the case with fertility, no choice in the matter as everyone eventually dies. However, differences exist in the timing, because the genetically determined rates of functional loss can be accelerated (e.g., by the effects of smoking on pulmonary function) or slowed down (e.g., the effects of restricting fat intake on atherosclerosis) by changes in behavior (Manton et al. 1991). These changes are, in turn, strongly influenced by socioeconomic factors.

Socioeconomic Differences at the Individual Level

It is therefore not surprising that over the last half a century there has been a growing body of research on so-called socioeconomic determinants of health. In empirical studies on socioeconomic differences in health most attention was initially paid to the influence of social position and related differential exposures in adulthood, but there is now a growing amount of literature on how unfavorable social environments in early life (even before birth) affect health in adulthood. For instance, Barker's "foetal origins of adult disease" hypothesis proposes that early life stages, including the environment during foetal and infant life, program people from socioeconomically unfavorable backgrounds to be at an elevated risk of adult ischemic heart disease (IHD), for instance, as a result of higher blood pressure and glucose intolerance that was due to under-nutrition during gestation (Barker 1995). Evidence is also mounting that social inequalities do not decline but rather persist throughout old age due to a progressive accumulation of disadvantages at the social, behavioral, and biological level (Stolz et al. 2017).

A number of researchers have therefore taken a more holistic approach by emphasizing a greater range of biological and social experiences in childhood, adolescence, and early adulthood, which combine to influence adult disease risk (e.g., Ben-Shlomo and Kuh 2002). This framework of reasoning is usually referred to as the life course approach. It proposes that socioeconomic factors affect the risk of disease throughout life as health-damaging exposures and health-enhancing opportunities are socially patterned. This also includes an individual's response to health-damaging exposures or health-enhancing opportunities that may modify their impact or alter the risk of future exposures, as this is powerfully affected by the social and economic experience of the individual (ibid.).

In epidemiological studies, health inequalities have been abundantly studied using various socioeconomic indicators, such as education, occupational social class, income, ownership and wealth, and deprivation. While health research in the USA has often relied on education, studies carried out in Europe tended to focus more on occupational social class (see Lahelma et al. [2004] for references). Studies examining the associations of each socioeconomic indicator with morbidity or mortality have repeatedly shown consistent gradients, with lower SES being linked to higher morbidity and mortality, although these associations are considered indirect through more specific (direct) determinants of disease (Davey Smith et al. 1994).

While different SES indicators have common traits and thus tend to be highly correlated (e.g., higher educated individuals generally occupy higher status and better remunerated jobs and accumulate more wealth), each is also distinct in its own way. For instance, educational attainment is usually acquired by early adulthood and therefore does not change over time (unlike the other SES indicators). Its level is therefore not dependent on the current economic context. Moreover, in epidemiological studies it is information that is usually available for all individuals and not only the economically active (important when studying women; Permanyer et al. 2018). It also tends to be more accurately reported than income or wealth and less susceptible to missing data (Hummer and Lariscy 2011). Although still scarce, since the 1990s mortality records linked to population databases with deaths and population not only broken down by age and sex but also by educational attainment have become available for the USA and a selection of Western European countries (see, e.g., Majer et al. 2011; Permanyer et al. 2018; Sasson 2016). As a final point, regarding its association with health, education is not just an indicator of employment status, occupational class, and income but also of the acquired knowledge and other nonmaterial resources that are likely to promote healthy lifestyles (Lahelma et al. 2004).

SES in relation to occupation indicates the status and power associated with the occupation and reflects the material conditions related to paid work (Lahelma et al. 2004). Although no standard form of social stratification is applied to occupation, a frequent distinction is made between manual and nonmanual labor, while additional occupational classes are sometimes also distinguished. For example, in Britain, the Registrar General's social class scheme has historically been used in official statistics. It groups a large number of occupations into five levels, from professional to unskilled occupations, whereby the third social class, skilled occupations, has been split into nonmanual and manual (Butler and Watt 2007). The well-known Whitehall studies use five different social grades of civil servants (Marmot et al. 1984), all of whom are nonmanual workers. In some instances, similarities in social standards and behavior are also taken into account, as in the Erikson-Goldthorpe-Portocarero scheme (Vågerö and Erikson 1997). These and more recent studies (e.g., Van Raalte et al. 2018) confirm the existence of an occupational mortality gradient, that is, the lower on the social scale, the higher the mortality. When farmers were included in such studies, they usually showed lower levels of all-cause mortality than manual workers, but higher levels than the white collar workers in a given period (e.g., Valkonen et al. 1993).

The association between income (either individual or household or both) and health has also been the subject of epidemiological studies. Income provides individuals and families necessary material resources, determines their purchasing power, and thereby contributes to the resources needed in maintaining good health (Lahelma et al. 2004). Studies focusing on individual health differences within wealthy nations have consistently demonstrated a strong and consistent positive gradient between income and health, although the association is curvilinear, that is, there is less improvement in health per unit of rising income. However, when health inequalities according to relative income are analyzed, according to one European study (Eikemo et al. 2008), countries with an Anglo-Saxon welfare state regime (in particular the UK) observed the highest income-related inequalities in health. This is an unsurprising result given that they are also the most unequal Western countries in terms of income inequality and operate the least generous social safety net. On the other hand, Scandinavian countries did not exhibit the expected smallest health inequalities but rather held an intermediate position, despite upholding a relatively egalitarian income distribution. Social exclusion, particularly of immigrants, was provided as a possible explanation. However, it should be noted that the absolute inequalities in health are quite small and that health across the Scandinavian populations is generally better than elsewhere in Europe (ibid.).

While education, occupation, and income are often analyzed separately, these socioeconomic indicators are also interrelated and have a clear causal order as determinants of health. For instance, over the life course education is typically acquired first and subsequently contributes to occupational class position and through this to income (Lahelma et al. 2004).

Socioeconomic Differences at the Macro Level

When the association between socioeconomic factors and health or mortality is studied at the aggregate level, for instance, between a selection of countries, per capita gross domestic product (GDP) is often used as in indicator of living standards. GDP is an aggregate monetary measure of the economic output of a country that comes from production and services and GDP per capita is sometimes referred to as the average level of income or wealth in a country. When reference is made to a region, per capita Gross Regional Product is used. A well-established fact is that the association between GDP and health and life expectancy is positive, as individuals from high-income countries are more willing and able (also due to availability) to consume commodities (of better quality), in particular, housing, clothing, food, and health care, which have a direct impact on health. However, and analogous to the micro level, the association between GDP and health is nonlinear, as growth in income has more impact on poor populations because additional resources allow more of these basic necessities to be acquired, which for wealthier populations are taken for granted. The World Bank estimated based on data from 1995 that the effect of doubling income from $1000 to $2000 in purchasing power parity (PPP – used to adjust for different price levels) corresponded with an 11-year higher life expectancy. On the other hand, a doubling of PPP from $4000 to $8000 only resulted in a gain of 4 years (Hilderink 2000). Wilkinson (1992) even suggests that the international relation between GDP and life expectancy has not only grown progressively weaker as countries get richer, but has disappeared altogether among the richest countries. A changing state in the economy of a poorer country will therefore affect the health of its population, but after a certain point of economic development further improvements in material standards has much less influence on health. This empirical cross-sectional relationship of diminishing returns, also known as the Preston curve, was first analyzed on a world scale by Samuel Preston in 1975 (although it should be acknowledged that a decade earlier Stolnitz (1965) already suggested a lack of relationship between mortality change and economic development among less developed countries after a certain level of life expectancy was reached). According to Preston (1975) mortality had become increasingly dissociated from economic level during the course of last century in wealthy countries because of a diffusion of medical and health technologies, facilities, and personnel that occurred, in large part, independently of economic level. Empirical findings (see section "Life Expectancy") still show life expectancy improvements after annual per capita GDP reach a moderately high level (in 2018 a GDP per capita of $40,000 was associated with a 3-year higher life expectancy at birth compared to a GDP of $20,000).

This does not mean that there are no important differences in life expectancy among affluent nations. On the contrary, quite acute differences in life expectancy are still observed in the West. Perhaps the best-known outlier is the USA: one the wealthiest nation in the world, yet with a life expectancy that is comparable with much poorer countries such as Lebanon and Cuba (UNDP 2019). Similarly, mortality rates of southern European countries caught up or even surpassed most other countries of Western Europe during the last three decades of last century, even though in terms of economic development absolute differences remained remarkably consistent (Spijker and Van Wissen 2010). A possible explanation is that confounding factors obscure the mortality lowering effects of high living standards. Other factors besides absolute wealth, namely differences in the quality of medical care, environmental pollution, the political system, psychosocial stress, and diet have been considered potential explanations for the mortality differences, including those observed between western and eastern European countries during the latter decades of last century (Bobak and Marmot 1996).

The lack of return in terms of life expectancy after a certain level of wealth has led researchers to search for explanations. Wilkinson (1992) propositioned on the ground of empirical evidence that in high-income countries changes in relative rather than absolute income are related to changes in life expectancy. A subsequent collection of several dozen articles on this topic that further contribute to this argument can be found in Kawachi et al. (1999). However, almost a decade later Lynch et al. (2001) casted doubt on Wilkinson's (1992) initial results by demonstrating that the association between relative income and life expectancy disappeared after including more countries in the same analysis. Another potential explanation for these diminishing returns with growing income is the effect of confounding factors which negate the positive bivariate association between GDP and mortality. Upon testing the absolute and relative income hypotheses for a selection of European countries Spijker and Van Wissen (2010) therefore controlled for potentially confounding exogenous factors, including secondary sector employment, unemployment, and smoking. They also advocated for several methodological considerations when conducting this type of analysis, including empirically testing the covariates for time lags on mortality (based on a theoretical range to account for a plausible latency period). Results showed that absolute per capita GDP remained a significant variable in explaining total and cause-specific mortality differences and changes over time among western and eastern European countries (which were analyzed separately). Relative income (Gini coefficient) was also tested, but only proved significant for those causes of death known to be associated with psychosocial factors, namely respiratory system diseases, chronic liver disease and cirrhosis, and suicide. The authors argued for analyzing besides total mortality also causes of death because they better isolate the effect of macroeconomic indicators. Also important to note is that a specific disease determinant does not necessarily have the same effect on each disease or cause of death. Alcohol consumption, for instance, may alleviate the risk of ischemic heart disease (IHD) in the long term (Rimm et al. 1996), but augment the risk of stroke (Hart et al. 1999) and sudden IHD if it concerns heavy drinking (Britton and McKee 2000), and certain, but not all types of cancer (Clinton et al. 2000).

Another important consideration when studying mortality differences at the regional or national level is that aggregated data or indicators are usually used as accurate individual-level income or educational attainment for both the numerator (i.e. linked to mortality) and denominator is hard to come by. Such studies are therefore of ecological design, which implies that no causal relationship may be inferred at the individual level from the association that is established between the variable and the mortality outcome (Valkonen 1993). Nevertheless, the direction of a found association is expected to be in line with what has been documented at the individual level. Notwithstanding, as macro studies obviously have their limitations, in an editorial by Mackenbach (2002) it was suggested that a better understanding of the potential importance of contextual factors for population health may come from data on mortality that permit a simultaneous analysis of effects of income on mortality at the individual and aggregate level.

Measuring Health Inequalities

Measuring Health

"Health" is a multidimensional and fuzzy concept whose measurement can be operationalized using several health outcomes. The simplest, and perhaps least controversial one, is the status of being "dead" or "alive." Simply looking at the number of years individuals live can give much information about the health status of populations: Healthier individuals tend to live longer than those who are unhealthy, so length of life is a simple yet powerful indicator that can be used to assess health inequalities around the globe. The indicator that is more commonly used to assess population health is life expectancy, which measures the average number of years individuals are expected to live under current mortality conditions.

Despite its popularity, life expectancy has two important shortcomings. On the one hand, its definition only takes into consideration the mortality of individuals, thus ignoring the health status of those who remain alive. On the other hand, life expectancy is simply an average that does not explain how the length of life is distributed across the members of a given population. To address these limitations, two important research avenues have evolved during the last decades. The first one has promoted the creation of "health expectancy indicators" that measure the number of years that individuals are expected to live in "good health" under prevailing mortality and morbidity conditions. These measures combine not only the quantity but also the quality (in terms of health) of the years of life individuals are expected to live. The second one urges researchers and policy-makers alike to look beyond averages and assess how "unequal" or "disperse" length of life distributions are, that id, to quantify the amount of "lifespan inequality" existing in the ages-at-death distributions across the members of a population.

Measuring Health Expectancy

The calculation of life expectancy, healthy life expectancy, and the difference between the two (which is interpreted as the average number of years of healthy life lost to poor health) has often been used as a direct and simple method to explore the relationship between mortality and morbidity changes, and to test the abovementioned competing hypotheses. Healthy life expectancy is defined as the average number of years individuals are expected to live healthily assuming the prevailing mortality and morbidity conditions remained constant over time. There are several ways in which healthy life expectancy can be calculated. The "Sullivan method" is perhaps the most widely used and requires life tables and information on the age-specific proportions of the population in the different states one is interested in (Sullivan 1971). These proportions pertain to the prevalence of the health status of interest (e.g., "healthy") of a real population that are then used to divide the years lived in the life table population into healthy and unhealthy years.

The required health data is usually obtained from cross-sectional health or disability surveys. The method is very flexible and can be adapted to incorporate multiple unhealthy states. The only requirement is to partition the population into pairwise disjoint and exhaustive groups. Perhaps the most common way healthy life expectancy is captured is through the self-reported survey question where respondents are asked to evaluate their general state of health as being "very good," "good," "fair," "bad," and "very bad," whereby the first two categories are combined to form the "healthy" state. A conceptually related measure is "happy life expectancy," which is derived from questions on level of "happiness" or "life satisfaction." A second approach to operationalize health is according to the level of disability. Using the same method, this generates the well-known health expectancy measure "Disability-free life expectancy" (DFLE). Data permitting, this measure can be applied to the whole age range, allowing the calculation of DFLE at birth. Conversely, particularly utilized in the assessment of health at older ages are the self-care scales "Activities of Daily Living (ADL)" and "Instrumental Activities of Daily Living (IADL), which are measures of performance of essential daily activities for an independent life at older ages. ADLs include activities such as eating, dressing, toileting, bathing, or walking inside home and IADLs include being able to prepare own meals, use the telephone, shop for personal items, manage medication, or manage money (Saito et al. 2014). Within a similar framework, the Euro-REVES network put forward a more general measure of disability, namely the "Global Activity Limitation Index (GALI)." GALI measures the extent to which adult individuals' daily activities have been limited by health problems and is now regularly included in the EU Statistics on Income and Living condition (EU-SILC) questionnaires, allowing it to be used for comparative analysis across most EU countries (Jagger et al. 2010). It is important to note, however, that there is still a need for caution when comparing the level of the GALI across EU countries as well as over time. Despite a major revision of the translations of the GALI question into EU languages in 2008, cultural understanding and differences in reporting may also threaten its (cross-national) validity. Outside the EU, cross-national comparability of health expectancies (based on any specific indicator) is even more limited as they rely on different measures (Berger et al. 2016).

No matter how they are defined, health expectancy measures are independent on the size of the population and of their age structure. Hence, whenever they focus on the same health outcome and are constructed with the same methodology, health expectancies provide a direct comparison of the different groups that make up populations. Nevertheless, there are several issues that might complicate the comparison of health expectancy measures across time and/or space. On the one hand, they are highly dependent upon the specific operationalization of health one adheres to, and they might be sensitive to the specific wording implemented during the questionnaire design (an issue that might difficult comparisons across countries speaking in different languages). In this line, cultural traits might make some groups more prone to declare higher disability levels than others under broadly similar objective conditions. On the other hand, technological change can improve the living conditions of individuals experiencing disease or disability (e.g., they might become more autonomous and less prone to declare disability than before) – an issue that could complicate the determination of morbidity trends (Crimmins and Beltrán-Sánchez 2011). Lastly, the fact that (i) the share of institutionalized populations varies substantially across countries, and (ii) such populations are not usually covered by household health surveys, can pose an additional challenge to international comparisons.

Measuring Lifespan Variability

Life expectancy is a summary indicator that measures the *average* number of years individuals of a given population are expected to live. Thus, it ignores the extent of variability in the corresponding age-at-death distribution. However, over the last couple of decades, the study of lifespan variability has attracted a lot of attention from demographers and other social scientists (Edwards and Tuljapurkar 2005; Van Raalte et al. 2018). Results have shown that the variation in length of life is one of the most fundamental inequalities in human populations: living long and healthy lives is among the most highly valued and universal human goals. This implies that the existence of very unequal length of life distributions goes beyond purely natural causes and is indicative of an unfair state of affairs in which some population groups might be disadvantaged or discriminated against. In addition, higher levels of lifespan inequality imply higher uncertainty in the timing of death – an issue with enduring impact on individuals' well-being and influencing important decisions during their life courses –, for instance in terms of investing in higher education, when to have children, applying for a mortgage, contracting or upgrading a health insurance policy, or saving for retirement (Edwards 2013).

Studying variations in age at death is important both for theoretical and practical reasons. From a theoretical perspective, the study of lifespan inequality is fundamental for a proper understanding of the present and future dynamics in human mortality. From a practical perspective, even if group differences in life expectancy constitute the primary and most commonly reported form of lifespan inequality, they do not explain the whole story because they fail to explain variations within groups. From a policy point of view, larger lifespan inequality might be indicative of a worsening state of affairs across or within socially relevant groups – a cause of legitimate ethical concern, especially when the social patterning in health is attributable to preventable causes.

Importantly, studying trends in lifespan inequality differs, both conceptually and empirically, from comparing life expectancy differentials across socioeconomic groups. While somewhat related, the two approaches are fundamentally different: the latter compares levels of expected longevity across a closed list of prespecified groups, and the former investigates variability in length of life distributions across individuals. These approaches echo a debate of the early 2000s, when the World Health Organization recommended going beyond group-based mean comparisons and incorporate individual-based data in the analysis of health inequalities (Gakidou et al. 2000). Since the turn of the century, the concept of interindividual inequality has gained traction, thus favoring the spread of a bourgeoning literature on lifespan inequality. This section reports the evolution of lifespan inequality measures (i) across virtually all countries around the globe during the last decades, and (ii) across socioeconomic groups for a selected number of countries.

Measuring Inequalities

The debate on whether health inequalities should be measured using absolute or relative indices is long and unsettled (Mackenbach 2015). While there is a long tradition in using relative inequality measures (partly driven by their widespread use among economists because of their ability to compare income distributions expressed in different currencies), there is no theoretical reason why one should disregard the use of absolute measures when exploring differences in health. The choice between absolute and relative measures can be problematic when assessing trends because the corresponding results do not necessarily coincide – an issue that is partly attributable to the explicit dependence of relative measures to the values of the mean, which tend to change over time (Lambert and Zheng 2011). Very often, relative measures might show declines because the mean has increased, while absolute measures might remain unaffected. Since the choice between both kinds of measures is purely normative (Atkinson 2013) and no clear consensus seems to be in place, in this chapter both absolute and relative inequality measures are used.

The specific inequality measures chosen to present the findings are the Theil index (a relative inequality measure) and the Variance (an absolute one). These measures have been chosen for being additively decomposable (i.e., their values can be neatly broken down into a within-country and between-country components – see below). Assuming they have a certain distribution $(y_1, \cdots, y_n)$ (where y_i is a non-negative real number corresponding to observation i), the Theil index and the Variance are defined as

$$T(y_1, \cdots, y_n) = \frac{1}{n} \sum_{i=1}^{n} \frac{y_i}{\mu_y} \ln \left(\frac{y_i}{\mu_y} \right) \tag{1}$$

$$V(y_1, \cdots, y_n) = \frac{1}{n} \sum_{i=1}^{n} \left(y_i - \mu_y \right)^2 \tag{2}$$

where μ_y represents the mean of the distribution.

In the remaining part of this chapter, the empirical relationship between socioeconomic status and differences in health outcomes is explored on the basis of the aforementioned three health indicators, both across and within world countries.

Life Expectancy

Life expectancy is a group-based measure, that is, it is an aggregate measure that summarizes the mortality experience of a whole population. How does life expectancy covary with respect to other indicators measuring those populations' socioeconomic attainment?

Differences in Life Expectancy Across Countries

Figure 1 is a scatterplot that compares world countries' GDP per capita in the horizontal axis against the corresponding levels of life expectancy, both in 1990 and in 2018. On top of each scatterplot the best fit logarithmic curve – also known as "Preston curve" (see Preston 1975) – is superimposed and illustrates the general relation between life expectancy and national income. At low-income levels, life expectancy tends to be low as well, but the latter increases rapidly with income. At higher-income levels, the curve flattens and the relationship becomes much weaker (i.e., further increases in income are not strongly related to improvements in life expectancy). Interestingly, at relatively low-income levels, there is a lot of variation and countries with either low or quite high life expectancies can be identified. As shown in Fig. 1, such relationship can be observed both in 1990 and 2018. When moving from one year to another, the vast majority of countries shift upwards and to the right, that is, they tend to become richer and their residents longer lived.

Another indicator that is commonly used to assess countries' socioeconomic development is the corresponding level of education. In Fig. 2, the relationship between countries' "Mean years of schooling for the population 15+" and the corresponding life expectancy is plotted. As discussed in the theoretical section, in those countries where individuals spend more years at school there are many reasons to expect that their inhabitants will tend to live for a longer time, as is indeed the case for the countries shown in Fig. 2. There is perhaps more variation in life expectancy at low educational attainment levels, and somewhat less at higher education levels. The relationship between both variables looks rather similar in 1990 and in 2018. When moving from the former to the later, the relationship becomes a bit flatter, and most countries shift upwards and to the right, that is, their inhabitants tend to spend more years in education and their residents tend to live more years.

If the observed relationship between life expectancy and these socioeconomic indicators would continue over time, one should expect a convergence in life expectancy levels across world countries. Have poorer countries indeed made greater strides in life expectancy than their richer counterparts? This important question is investigated in Fig. 3. Countries are ordered according to their 2010

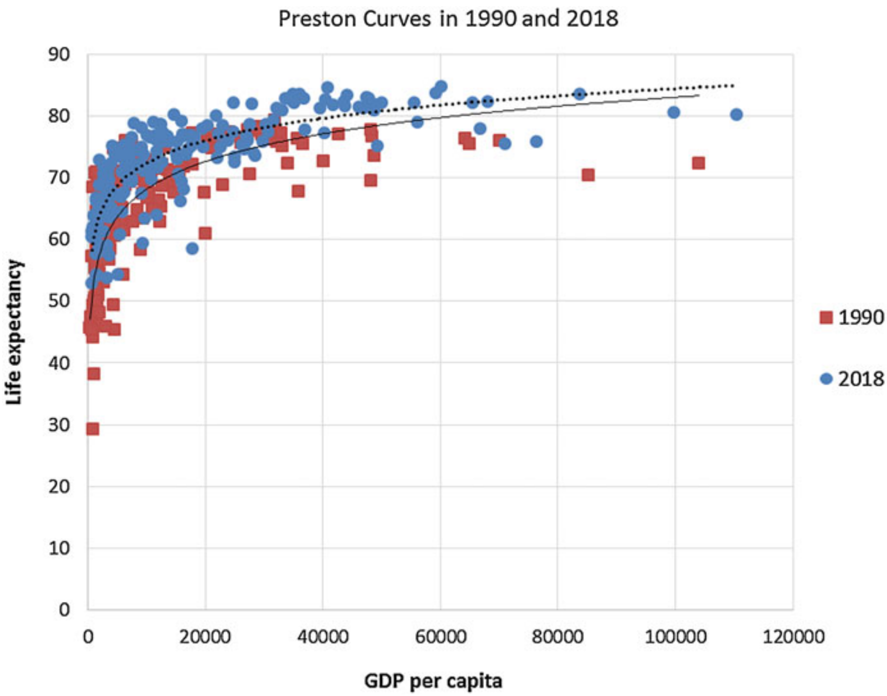

Fig. 1 Scatterplot comparing countries' GDP per capita in current US$ (horizontal axis) against life expectancy around the world, years 1990 and 2018. Best fit logarithmic curves shown for each year. (Source: Authors elaboration based on the publicly available database from the United Nations Development Programme (UNDP) (2019))

GDP per capita levels in the horizontal axis, and the corresponding levels of life expectancy in the periods 1950–55 and 2010–15 are shown in the vertical axis. As can be seen in the upper panel of Fig. 3, poorer countries have made larger improvements than richer ones in terms of life expectancy at birth (albeit starting at a lower level), leading to a convergence across countries (the slope of the best-fit line declines from 0.132 in 1950–55 to 0.083 in 2010–15, a statistically significant difference). The fact that poorer countries are catching up in basic health indicators like life expectancy has been facilitated by (a) the ample room for improvement of poorer countries as regards child mortality, (b) the fact that countries at later stages of the epidemiological transition can only experience increases in life expectancy by further delaying the ages at death among the eldest, a more expensive and difficult task to accomplish.

What conclusions would be reached if, rather than looking at life expectancy at birth (as has been done so far), life expectancy at a given adult age is considered (i.e., the expected years of life for those who survived up to a certain age)? When considering international differences in mortality after age 15, that is, a threshold that separates child from adult mortality, the results are slightly different to those

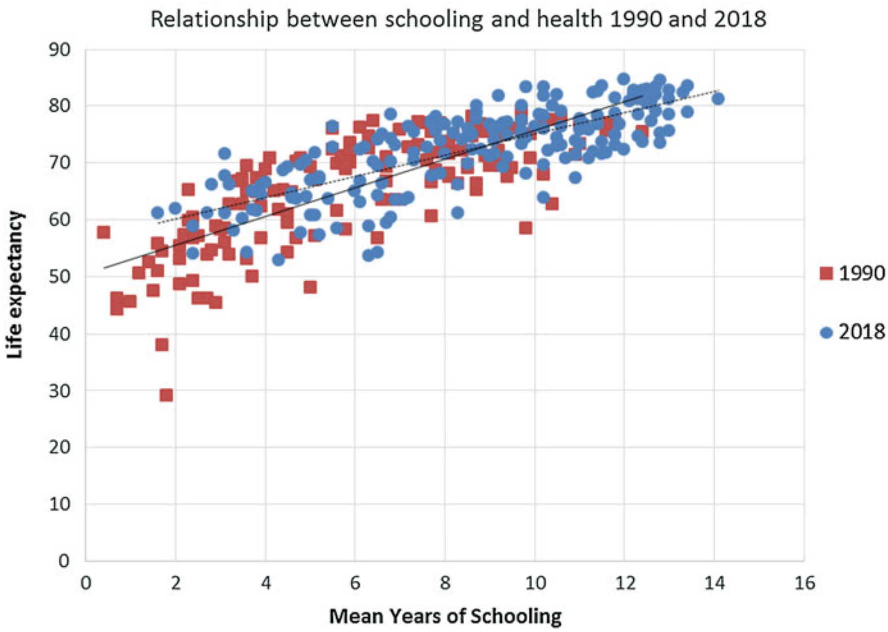

Fig. 2 Scatterplot comparing countries' mean years of schooling (horizontal axis) against life expectancy around the world, years 1990 and 2018. Best fit regression lines shown for each year (solid line for 1990, dashed line for 2018). (Source: Authors elaboration based on the publicly available database from the United Nations Development Programme (UNDP) (2019))

shown before (see middle panel in Fig. 3). Here, all countries increase their average length of adult life by approximately the same amount – irrespective of their economic level in 2010 – so neither convergence nor divergence is observed (the slope of the best-fit line goes from 0.18 in 1950–55 to 0.16 in 2010–15, a statistically insignificant difference). This suggests that the health gradient across countries is the same, so that countries' differences in adult mortality have not narrowed down. If the same exercise is repeated for remaining life expectancy at age 65 (to take the standard retirement age in many high-income countries as the lower age bound), a readily apparent trend is that richer countries have increased their average length of remaining life more than their poorest counterparts (see lower panel of Fig. 3). This implies an international divergence in longevity gains among older ages (the slope of the best-fit line increased from 0.38 in 1950–55 to 0.52 in 2010–15, a statistically significant difference).

Thus, whether or not poor countries benefit more than richer countries from generalized longevity gains crucially depends on the part of the age-at-death distribution one is looking at. While an international convergence in life expectancy at birth can be observed, new layers of inequality are arising at older ages (i.e., differences are widening across countries as regards the longevity prospects of the population at typical retirement age). These remarkable trends have also been highlighted in the

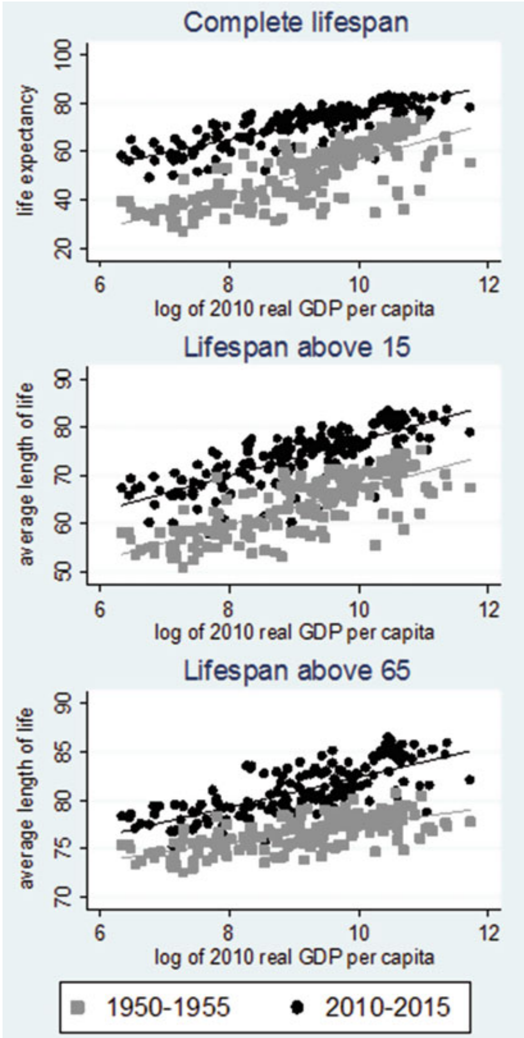

Fig. 3 Scatterplot with countries' GDP per capita in 2010 versus life expectancy at birth (upper panel), average length of life above 15 (middle panel) and above 65 (lower panel) for the years 1950–55 and 2010–15. Best fit regression lines shown for each cloud of points. (Source: Authors' elaboration based on UN data)

2019 Human Development Report, where its authors conclude that "A new generation of inequalities is emerging, with divergence in enhanced capabilities, despite convergence in basic capabilities" (UNDP 2019: 7).

Differences in Life Expectancy Within Countries

So far, life expectancy differences between countries in the world and over time and its association with socioeconomic factors have been analyzed. What could be said about the differences in life expectancy across socioeconomic groups within those countries? Unfortunately, there is much less empirical evidence to address this kind of questions, and for good reasons. Very often, mortality registers do not include socioeconomic information from which to infer the corresponding life expectancies, although the situation is gradually changing over time. More and more studies have recently investigated group-specific life expectancy levels and trends, typically in high-income country settings. For instance, Majer et al. (2011) investigated life expectancy at age 65 by education in 10 European countries between 1996 and 2001. Steingrímsdóttir et al. (2012) and Deboosere et al. (2009) explored longevity differentials by educational attainment in, respectively, Norway (from 1961 to 2009) and Belgium (from 1991 to 2004). Analogously, Tarkiainen et al. (2012) and Brønnum-Hansen (2017) report differences in life expectancy for different income quantiles in, respectively, Finland (from 1988 to 2007) and Denmark (from 1986 to 2014). In a recent study for Spain, Permanyer et al. (2018) assess differences in life expectancy by education from the 1960s to 2012−15. Other studies from the USA have reported life expectancy differentials across education (Sasson 2016) and income quantile groups (Chetty et al. 2016). The case of Finland has also been investigated in Van Raalte et al. (2018), where SES is operationalized using education, type of work, and income quintiles and Asaria et al. (2019) identify gradients in life expectancy in India across wealth quintiles using data for 2011–2015.

Even if the evidence is not extremely abundant (and all too often restricted to high-income countries), it points toward the expected direction: the socially advantaged groups tend to live longer than its disadvantaged counterparts do. In addition, these studies invariably report diverging trends across groups, that is, the longevity differences across the most and the least socially advantaged groups tend to increase over time. Inspecting the results for women and men separately, one observes that, while the levels of life expectancy differ across the sexes (with women systematically living longer than men), the trends go exactly in the same direction. Interestingly, while the European studies report increasing life expectancies over time across *all* SES groups, the studies for the USA indicate that the most disadvantaged groups have experienced sustained declines in life expectancy during the last decade (Sasson and Hayward 2019). Despite the different SES definitions and nonidentical associations with mortality, an approximation of SES differences in longevity for, respectively, the USA and Europe can be schematically illustrated in the following manner (Fig. 4).

Lifespan Inequality

Lifespan Inequality Across Countries

With the unfolding of the demographic (Landry 1934) and epidemiological (Omran 1971) transition theories, the variability of the age-at-death distributions has generally declined in tandem with concomitant increases in longevity (i.e., life expectancy). Indeed, several studies have identified a historically strong and negative

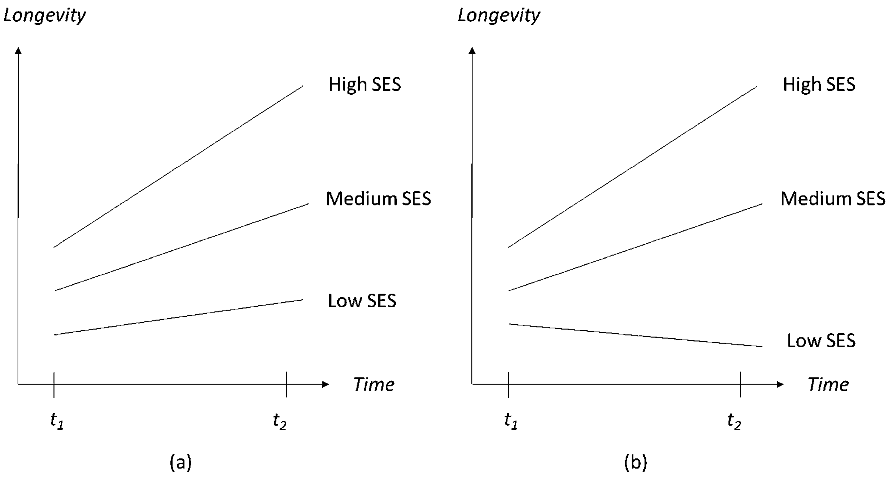

Fig. 4 Within country changes in longevity across SES groups over time. "European" (**a**) and "US model" (**b**). (Source: Authors' elaboration)

association between countries' life expectancy and length of life inequality (e.g., Permanyer and Scholl 2019). No matter if absolute or relative inequality measures are used, one often reaches the same conclusion: increases in countries' longevity tend to be associated with decreases in lifespan inequality. This relationship is illustrated in the different panels of Fig. 5, where the values of life expectancy at birth for virtually all world countries are shown in the horizontal axis and those of lifespan variability in the vertical one (see red squares). In the upper and lower panels, results are shown whereby lifespan variability is measured with a relative and an absolute inequality measure, respectively. In both panels, the results from virtually all world countries from 1950 up to 2015 are pooled using information from the United Nations' World Population Prospects Database (https://population.un.org/wpp/). When using a relative inequality measure like the Theil index, the relationship between both variables is monotonic, but with an absolute measure like the variance, an inverted U-shaped relationship is observed, with a maximum in lifespan variability when life expectancy is around 45–50 years (see lower panel). The changing relationship across absolute and relative measures has been analyzed in previous studies (e.g., Permanyer and Scholl 2019).

The upper and lower panels of Fig. 5 show the relationship between longevity and lifespan inequality when conditioning on survival up to certain ages. More specifically, it contains the results for the "adult" and "elder" age ranges (i.e., from 15 onwards and from 65 onwards, respectively). Interestingly, when focusing on the adult age range, the relationship between both variables is weaker than when considering the whole age range; that is, further increases in adult longevity are also associated with a compression in the distribution of deaths, but the declines in inequality are much smaller than before. Lastly, inspecting the trends among the elder, one is able to observe that further increases in longevity tend to be

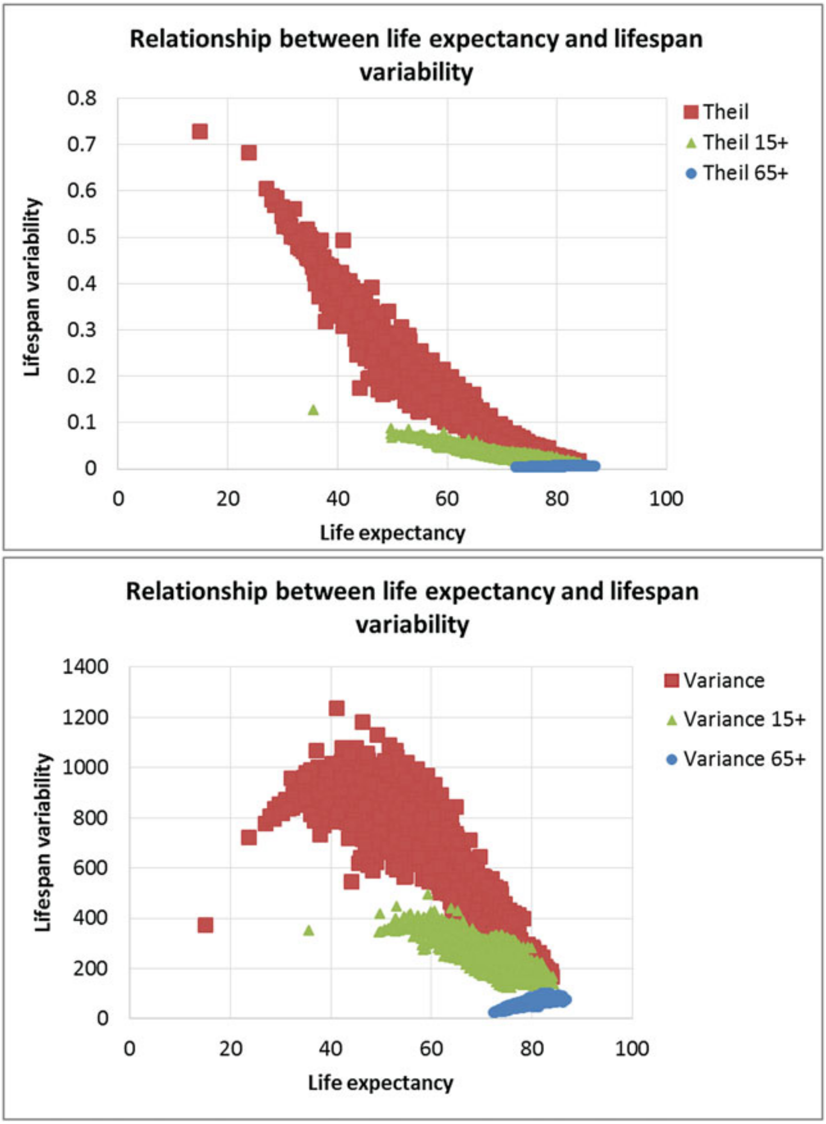

Fig. 5 Relationship between life expectancy and lifespan inequality (measured with the Theil index in upper panel and with the variance in the lower panel) for different age ranges. (Source: Authors' elaboration based on pooled data (1950–2015) from the UN Data Population Prospects)

accompanied by further *increases* in lifespan variability. Thus, as the population beyond standard retirement age tends to survive a higher number of years, it becomes increasingly heterogeneous over time. This suggests that there is an equality-efficiency tradeoff among the elder population around the world upon which it will be necessary to reflect (Permanyer and Scholl 2019).

Lifespan Inequality Within Countries

The main factor that has contributed to reducing countries' lifespan variability is the reduction in infant mortality. This decrease has been extensively documented elsewhere (Liu et al. 2015) and can be largely attributed to the use of cheap and widely available treatments, such as the use of oral rehydration and antibiotics. Among adults and the elderly, within-country disparities in lifespan are often associated with the existence of socioeconomic gradients. While the relationship between life expectancy and lifespan inequality is generally strong across countries, it becomes much weaker when inspecting trends across SES groups within them. The empirical evidence collected so far to track the evolution of SES groups' longevity and lifespan variability is scarce, but it consistently points to the same direction. Van Raalte et al. (2018) investigate trends in lifespan variability across different SES groups in Finland from 1971 to 2010, and Sasson (2016) does the same across education groups in the USA between 1990 and 2010. Brønnum-Hansen (2017) investigate trends in lifespan variability across income quartiles in Denmark from 1986 to 2014, and Permanyer et al. (2018) perform a similar analysis across education groups in Spain from the 1960s to 2012−2015. More recently, Seaman et al. (2019) investigate trends in lifespan variability by area-level deprivation in Scotland from 1981 to 2011. All these studies suggest that (i) there is a negative gradient between SES and lifespan inequality (i.e., lower socioeconomic groups tend to have *higher* levels of lifespan inequality) and (ii) the gradient becomes steeper over time because of the decrease (resp. increase) in lifespan variability among high (resp. low) SES groups (see Fig. 6). Overall, these findings suggest the emergence of divergent health dynamics across SES groups within national borders (at least in the context of high-income countries). Whether these diverging patterns are also taking place in middle- and low-income countries is a matter for future research. The divergent health pathways observed across SES groups within countries are a matter of concern that could hinder the prospects of improvements in overall life expectancy (the recent case of the USA is paradigmatic in this regard) and could lead toward increasingly polarized societies.

Global Lifespan Inequality

Interestingly, the differences in life expectancy across countries discussed in the previous section and the differences in lifespan variability within countries from this section can be seen as the two key ingredients of "global lifespan inequality" – a measure of the extent of variability in the world's age-at-death distribution, which has recently been explored in the study of health inequalities (Permanyer and Scholl 2019). More formally, when using additively decomposable inequality measures, global length of life inequality (i.e., variations in age at death around the whole world) can be broken down into two clearly interpretable components: the inequality observed *within* countries and the component capturing the differences in average attainment *between* countries. That is

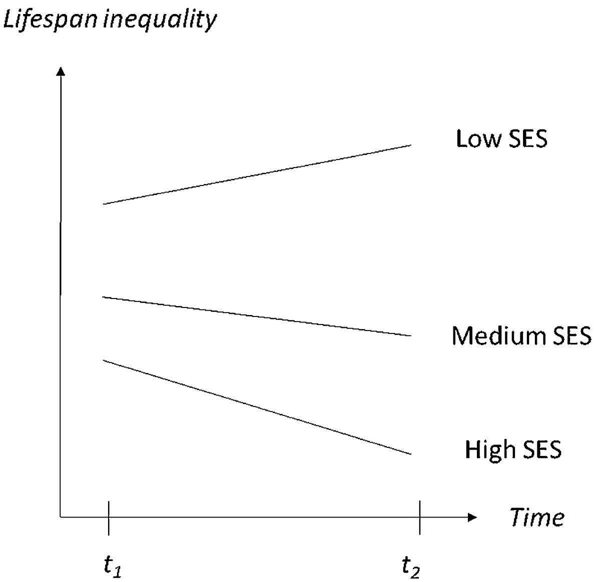

Fig. 6 Within country changes in lifespan inequality across SES groups over time. (Source: Authors' elaboration)

$$I = I_B + I_W$$

In the last equation, I_B represents the inequality that would be observed in a hypothetical distribution where the age at death of each individual corresponds to the average age at death in the corresponding country (i.e., eliminating within-country variations). Thus, this component measures the extent of inequality in life expectancies across countries. The second term is a weighted average of lifespan inequality within countries.

Figure 7 shows the trends in global lifespan inequality from 1950 to 2010 for different age ranges, using a relative and an absolute inequality measure (the Theil index and the variance). When considering the entire age at death distribution, global lifespan inequality has been declining monotonically since the mid-twentieth century. After six decades, the Theil index and the variance have shrunk considerably, from 0.26 to 0.06 and from 911.5 to 444.1, respectively. The levels of global lifespan inequality for the adult population (i.e., for the ages above 15) are declining as well, but much less than in the previous case. The Theil index (resp. the variance) declines from 0.046 to 0.025 (resp. from 333.2 to 244.7). In both cases, a clear decline between 1950–55 and 1980–85 is observed, followed by a long inequality plateau. In the case of the variance, some slight increases at the turn of the millennium can be detected in the world as a whole. Lastly, for the age-at-death distributions above 65, global lifespan inequality has been increasing monotonically, from 0.0044 to 0.0055 for the Theil index and from 52.6 to 72 for the variance.

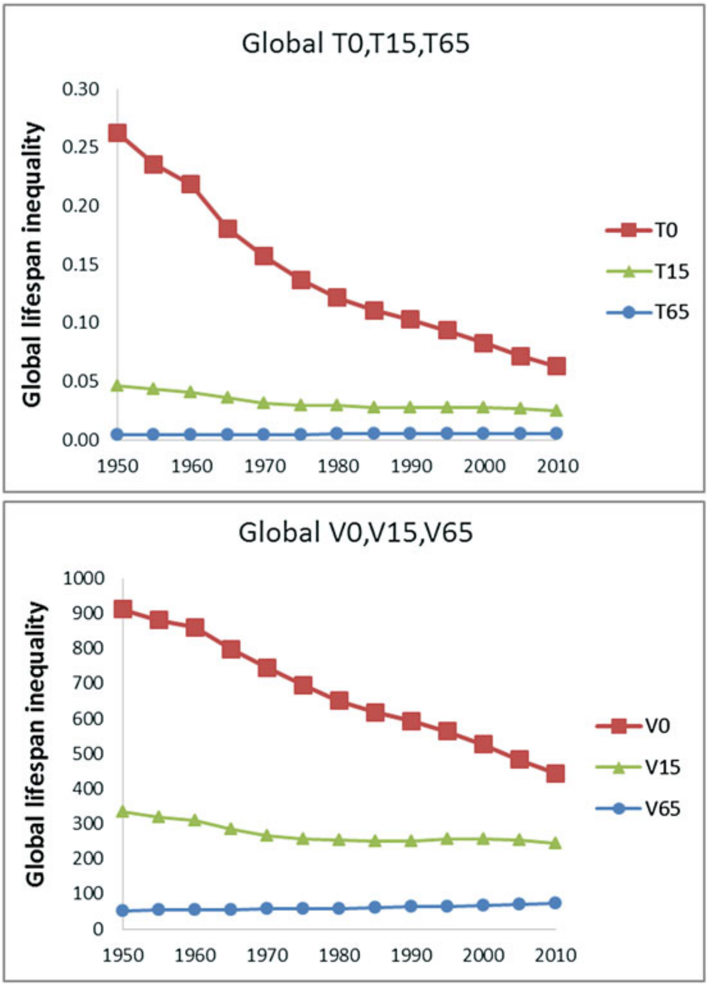

Fig. 7 Trends in global lifespan inequality from 1950 to 2010 according to the Theil index (upper panel) and the variance (lower panel) for different age ranges. (Source: Authors' calculations based on the United Nations' World Population Prospects)

When global lifespan inequality is broken down in its two between- and within-country components, it turns out that the later explains most of the total variation. Approximately, around 10% of global lifespan inequality can be attributable to differences across countries. This means that the country where individuals live only explains 10% of the variability in the ages at which the world citizens die, so that the majority of the variation can be attributable to differences occurring *within* countries; see Permanyer and Scholl (2019) for further details.

Health Expectancies

What about health expectancies? A longer life expectancy does not necessarily imply more years in good health. For a comprehensive assessment of health, in particular gender differences in health, it is important to consider both survival and health, rather than looking at either life expectancy or the health status of the population. For instance, it has been particularly well-documented that despite women's mortality advantage, this advantage in life expectancy disappears when inspecting differences in health expectancies. This is because women report worse self-rated health, more health problems, more frequent disability, and use more health services (Nusselder et al. 2010), although important age- and country-specific variations in this so-called female-male health-survival paradox have been documented. For instance, Ahrenfeldt et al. (2019) found sex gaps to increase with advancing age, women to have more comorbidity than men in Eastern, Southern, and Northern Europe but observed no overall sex difference in comorbidity in Western Europe. In terms of frailty, their study showed women to be frailer than men in all regions, with the largest sex difference in Southern Europe. Dahlin and Härkönen (2013) also found some regional clustering in women's health, as health was poorest relative to men's in Eastern and Southern Europe. The latter result was somewhat surprising as the gender gap in life expectancy (to the disadvantage of men) is known to be average or relatively small in Southern Europe (Jagger et al. 2008; Van Oyen et al. 2013).

For an increasing number of countries (and including regions), health expectancies have also been analyzed, including for Austria (Doblhammer and Kytir 2001), Denmark (Brønnum-Hansen and Baadsgaard 2008), the Netherlands (Groenewegen et al. 2003), the UK (Breakwell and Bajekal 2005), the US (Crimmins and Saito 2001), Japan (Yong and Saito 2009), China (Gu et al. 2009), Hong Kong (Cheung and Yip 2010), South Australia (Banham et al. 2011), and India (Lau et al. 2012). Internationally comparative studies on self-assessed health expectancy among older adults include those by Ofstedal et al. (2004) in six Asian countries and Jagger et al. (2008), Minagawa (2013), and Van Oyen et al. (2013) in different selections of European countries.

Studies have also investigated the differences in health expectancy among SES groups (e.g., Brønnum-Hansen and Baadsgaard 2008; Majer et al. 2011). Since 2004, the European Union has used a health expectancy measure, "healthy life-years" (HLY), defined as the number of years that a person is expected to continue to live in a healthy condition, as one of its structural indicators to monitor, on a yearly basis, the outcomes of healthcare and retirement policies (Jagger et al. 2008; Salomon et al. 2012). Similarities or differences between groups of Member States in HLY have also been shown to correlate with macro-level factors that cover broad areas of wealth and expenditure, including GDP, poverty risk, inequality of income distribution, expenditure on elderly care, labor force participation (employment rate of older at age 55–64 years, long-term unemployment rate, mean exit age from labor force), and level of education (life-long learning, low education attainment) (Jagger et al. 2008).

Results from the latter study was based on data from the 2005 sample of the EU Statistics on Income and Living conditions (EU-SILC) survey. Since then, survey information from EU-SILC, the European Community Household Panel (ECHP), the European Social Survey (ESS), and the Survey of Health, Ageing and Retirement in Europe (SHARE) have all been integrated in the European Health & Life Expectancy Information Systems (EHLEIS) by the European Health Expectancy Monitoring Unit (EHEMU) and EHLEIS project (Robine et al. 2013). Their information system, available through the website www.eurohex.eu, provides a central facility for analyzing life expectancies and different types of age- and sex-specific health and disability-free expectancies for each EU Member State going back to 1995.

The Association Between Life Expectancy and Healthy Life Years at the Country Level in Europe

These databases have been used to compare "life expectancy" (LE) against "healthy life-years" (HLY) and other socioeconomic indicators, like the GDP per capita or mean years of schooling. Like Jagger et al. (2008) HLY is operationalized here as the expected number of years of life lived disability-free that is based on the GALI indicator. Likewise, for comparative purposes, the situation for 50-year-olds is reported and is done so separately for men and women. Figure 8a and b shows the association between LE and HLY at age 50 for men and women for the years 2008 and 2016. An earlier year was not analyzed because of comparability issues (see the section "Measuring Health Inequalities"). As can be observed, in all 29 European countries, in 2008 50-year-old women were expected to live a further 18.1 years in a healthy state, that is, 54% of their remaining life free of activity limitations (see also Table 1). In the case of men, this was respectively 17.5 years and 62%. Eight years later, both proportions were virtually identical and corresponded to a HLY of, respectively, 18.6 and 18.3 years. In other words, on the whole, European women have, besides a higher LE also slightly higher HLY than men, although the HLY/LE proportion is slightly lower. There are, however, quite large country differences: in 2016 the range in HLY for men was 16.4 years (10.7 years in Latvia; 27.1 years in Iceland). Regarding women, the range was 15.7 years (12.0 years in Latvia; 27.7 years in Sweden). In both cases, the minimum-maximum difference is similar to 2008 (a notable exception being that in 2016 Slovakia was no longer the country with the lowest HLY). The Pearson correlation coefficient (R^2) between LE and HLY is quite moderate in both years in the case of men (0.57 in 2008 and 0.52 in 2016), which can be explained by the East-West divide. The exception is Slovenia, which is similar to Portugal, Germany, and Austria (specific countries are not labeled in the figures, only a distinction is made between Western and Eastern European countries). Among women, the HLY range and East-West pattern is similar but country

Fig. 8 Life expectancy (LE) and healthy life years (HLY) at 50 years of age for 29 European countries in 2008 and 2016 by sex. (Source: www.eurohex.eu. For the list of countries and notes, see Table 1. Best fit regression lines and fit (R^2) shown for each year)

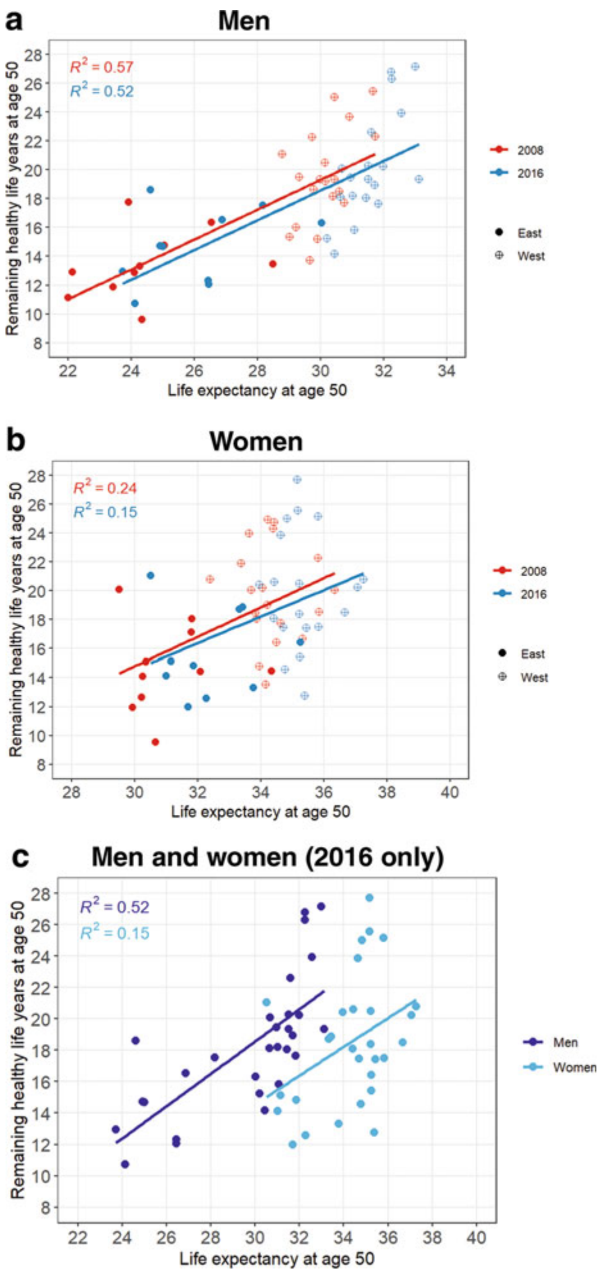

Table 1 Life expectancy (LE) and healthy life years (HLY) at 50 years of age for 29 European countries

	2008								2016							
	Men			Women			GDP per capita	Ave yrs at school	Men			Women			GDP per capita	Ave yrs at school
	LE	HLY	%HLY	LE	HLY	%HLY			LE	HLY	%HLY	LE	HLY	%HLY		
Austria (AT)	29.9	15.2	50.9	34.5	16.4	47.6	51,709	11.5	31.1	15.8	50.9	35.3	15.4	43.7	45,238	12.6
Belgium (BE)	29.3	19.5	66.4	34.1	20.2	59.3	48,107	11.0	31.0	19.5	62.9	35.2	20.5	58.2	42,012	11.8
Bulgaria (BG)	23.9	17.8	74.2	29.5	20.1	68.1	7262	10.5	24.6	18.6	75.6	30.5	21.1	69.0	7469	11.8
Cyprus (CY)[a]	30.6	18.5	60.4	33.9	18.1	53.3	35,391	11.3	31.4	18.1	57.4	34.7	17.5	50.3	24,019	12.1
Czech Republic (CR)	26.5	16.3	61.6	31.8	18.1	56.7	22,699	12.2	28.2	17.6	62.3	33.3	18.7	56.2	18,463	12.7
Denmark (DK)	28.8	21.1	73.2	32.4	20.8	64.2	64,322	12.9	30.7	20.1	65.4	34.0	20.4	60.1	54,664	12.6
Estonia (EE)[a,b]	24.1	12.9	53.4	32.1	14.4	44.9	18,227	12.3	26.5	12.1	45.6	33.8	13.3	39.4	18,237	13.1
Finland (FI)	29.2	16.0	54.8	34.6	17.7	51.2	53,554	12.2	30.6	18.1	59.1	35.4	17.4	49.2	43,777	12.4
France (FR)	30.4	18.2	59.7	36.3	20.1	55.2	45,334	10.7	31.7	19.0	59.8	37.1	20.2	54.6	36,962	11.4
Germany (GE)[c]	29.7	13.7	46.3	34.0	14.8	43.6	45,427	13.7	30.4	14.2	46.5	34.8	14.6	41.9	42,099	14.1
Greece (GR)	30.0	19.4	64.6	34.2	19.0	55.6	31,997	10.1	31.0	18.2	58.7	35.2	18.4	52.1	18,116	10.3
Hungary (HU)	23.4	11.9	50.6	30.3	14.1	46.6	15,753	11.5	24.9	14.7	59.1	31.2	15.1	48.5	12,992	11.8
Iceland (IS)[a]	31.7	25.5	80.4	34.2	24.9	72.8	56,410	10.4	33.0	27.1	82.2	34.8	25.0	71.8	61,758	12.4
Ireland (IE)	29.8	18.6	62.5	33.7	20.0	59.5	61,262	12.0	31.6	22.6	71.6	34.6	23.9	68.9	63,197	12.5
Italy (IT)[a]	30.8	17.7	57.7	35.3	16.7	47.3	40,778	9.5	31.8	17.6	55.4	35.8	17.5	48.8	30,936	10.2
Latvia (LV)	22.0	11.1	50.5	29.9	12.0	39.9	16,377	12.2	24.1	10.7	44.4	31.7	12.0	37.9	14,153	12.8
Lithuania (LT)	22.1	12.9	58.3	30.4	15.1	49.7	14,962	12.2	23.7	13.0	54.6	31.9	14.8	46.5	14,999	12.9
Malta (MT)	29.7	22.3	74.9	33.6	24.0	71.3	21,929	10.0	32.6	24.0	73.6	35.8	25.2	70.2	25,152	11.3
Netherlands (NL)	30.2	19.2	63.6	33.8	18.5	54.5	57,644	12.0	31.5	19.4	61.4	34.4	18.1	52.6	46,008	12.2
Norway (NO)	30.4	25.0	82.2	34.4	24.8	71.9	96,944	12.7	32.3	26.3	81.6	35.2	25.6	72.7	70,461	12.6
Poland (PL)	25.1	14.8	58.9	31.8	17.1	53.9	14,001	11.9	26.9	16.5	61.5	33.4	18.9	56.5	12,432	12.3
Portugal (PT)[a]	29.0	15.4	52.9	34.2	13.5	39.6	24,848	7.8	30.2	15.3	50.5	35.4	12.8	36.0	19,978	9.2
Romania (RO)[d]	24.3	13.3	54.9	30.2	12.7	41.9	10,435	10.6	25.0	14.7	58.8	31.0	14.1	45.6	9567	11.0

Slovakia (SK)	24.4	9.6	39.5	30.7	9.6	31.1	18,677	11.2	26.5	12.3	46.6	32.3	12.6	39.0	16,506	12.6
Slovenia (SI)[d]	28.5	13.5	47.2	34.4	14.5	42.1	27,483	11.9	30.0	16.3	54.3	35.3	16.4	46.6	21,623	12.0
Spain (ES)	30.4	19.4	63.6	35.9	18.5	51.7	35,366	9.2	32.0	20.2	63.2	37.3	20.8	55.8	26,506	9.8
Sweden (SE)	30.9	23.7	76.6	34.4	24.3	70.6	55,904	12.2	32.3	26.8	83.0	35.2	27.7	78.8	51,974	12.4
Switzerland (CH)	31.7	22.3	70.3	35.8	22.3	62.1	72,488	12.9	33.1	19.4	58.4	36.7	18.5	50.5	80,172	13.4
United Kingdom (UK)	30.1	20.5	68.0	33.4	21.9	65.6	47,287	12.8	31.5	20.3	64.3	34.4	20.6	59.8	41,074	12.9
European Average[e]	**28.1**	**17.5**	**61.7**	**33.2**	**18.1**	**54.4**	**37,888**	**11.4**	**29.6**	**18.3**	**61.3**	**34.3**	**18.6**	**54.2**	**33,047**	**12.0**

Source: GDP (World Bank 2020) and years of schooling (United Nations Development Programme (UNDP) 2019); LE and HLY: www.eurohex.eu. LE and HLY data is also available for Croatia but only from 2011. Likewise, Luxembourg was excluded because between 2010 and 2016 female HLE at age 50 reduced by an unrealistic 6 years

GDP per capita in current US$

LE, life expectancy; HLY, healthy life years

[a]2015 (instead of 2016)

[b]2009

[c]2014

[d]2010 (instead of 2008)

[e]Arithmetic average of the 29 countries

differences in LE are smaller. The overall LE-HLY association is also lower than observed for men (R^2 0.30 in 2008 and 0.15 in 2016) given the lower than expected HLY of the Baltic States, Slovenia as well as Portugal, Austria, and Switzerland. This gender difference in the variation of LE between countries in 2016 is clearly shown in Fig. 8c (the results for 2008 are very similar).

Differences in Healthy Life Years Between Countries and Its Association with Socioeconomic Factors

In Fig. 9a and b, we compare countries' HLY vis-à-vis the corresponding GDP per capita levels. The graph also includes a logarithmic curve as a way to assess whether the results follow the Preston curve. Again, the years 2008 and 2016 are analyzed as well as men and women separately (note, however, that GDP and years of schooling are for the total population).

Overall, results detect at most a minor reduction in the increase in HLY as GDP becomes higher. Furthermore, the Preston curve can be less discerned in the more recent period, as observed by the lower R^2 (0.42 in 2008 vs. 0.39 in 2016 in the case of men and 0.33 in 2008 and 0.27 in 2016 in the case of women). There is in fact more evidence for a linear trend for both sexes (R^2 men: 0.49 in 2008 and 0.43 in 2016; women: respectively 0.41 and 0.30). In other words, there is limited evidence that the law of diminishing returns of GDP on HLY holds, particularly with respect to women and in the European context. Moreover, as the linear association increased over time in the case of women, economic development in general appears to be of growing relevance in explaining country differences in female HLY in Europe but still of less relevance than in the case of men. However, looking with more detail at the time trend and given the slight general decline in GDP due to the economic crisis, to obtain the same HLY in 2016 as in 2008 slightly less GDP per capita was required. Nevertheless, this is not an unexpected result as it concurs with earlier established anticyclical association between economic growth and health and mortality trends (Gerdtham and Ruhm 2006; Karanikolos et al. 2013). A final noteworthy result is that there is no association among the Eastern European countries and a small but declining association among the Western European countries (R^2 not shown). This suggests that the association between GDP and HLY among European countries is mainly explained by East-West differences.

The last piece of analysis included in this overview is the association between countries' HLY and the corresponding mean years of schooling (Fig. 10a and b). It is interesting to see that while GDP showed a moderate linear association with male HLY, in the case of education any association is completely absent in both years and for both men and women. A sensitivity analysis confirmed the same results if the sample would be split into Eastern and Western European countries. Considering, therefore, the established educational gradient in HLY from epidemiological research (i.e., based on individual-level data; see "Background" section), the fact that within-country differences do not necessarily convert to an association at the

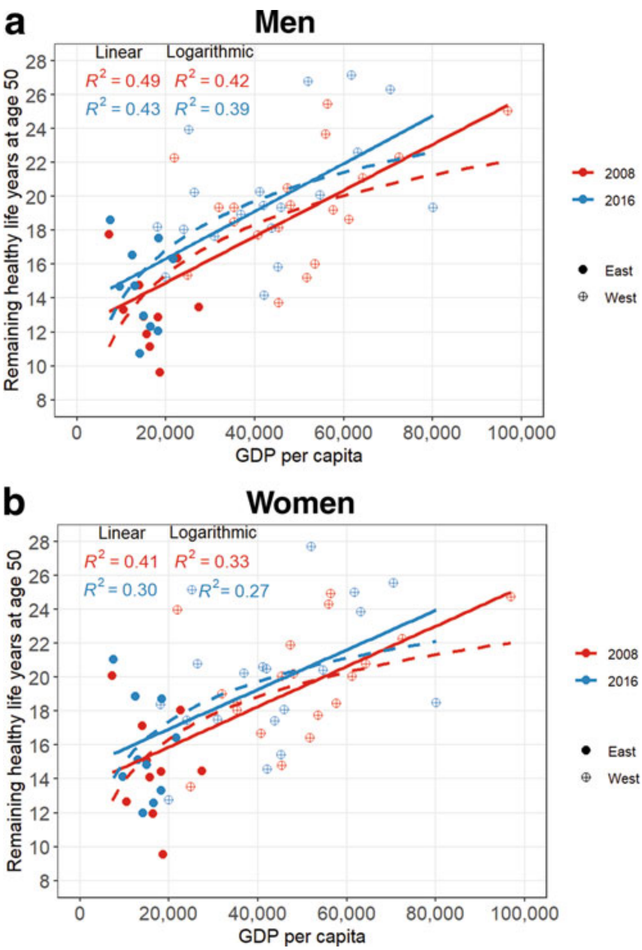

Fig. 9 Healthy life years (HLY) at 50 years of age and GDP per capita for 29 European countries in 2008 and 2016 by sex. (Source: GDP: United Nations Development Programme (UNDP) (2019); HLE: www.eurohex.eu. For the list of countries and notes, see Table 1. Best fit regression lines (linear and logarithmic) and fit (R^2) shown for each year)

country level alludes to the problem of ecological fallacy, that is, the danger of making inferences about the individual from macro-level data.

Conclusion

Living long and healthy lives is among the most widely shared human desires. Thus, when assessing the performance of health systems or when inspecting health trends, it is crucial to incorporate both the “efficiency” *and* “equality” perspectives into the evaluation. In this line, a topic that has attracted the attention of scholars and

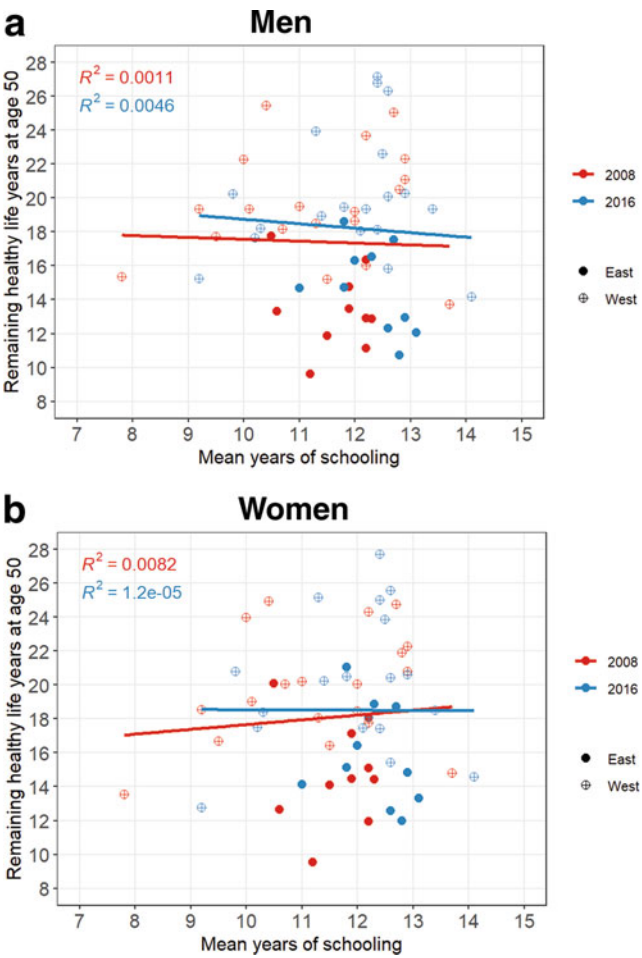

Fig. 10 Healthy life years (HLY) at 50 years of age and average years of education for 29 European countries in 2008 and 2016 by sex. (Source: Education: United Nations Development Programme (UNDP) (2019); HLY: www.eurohex.eu. For the list of countries and notes, see Table 1. Best fit regression lines (linear and log) and fit (R^2) shown for each year)

policy-makers alike for a long time is the relationship between socioeconomic position and health outcomes. To what extent are socioeconomically advantaged individuals or groups performing better than the rest? That is, do we observe health inequalities along socioeconomic lines? These are the main questions we have addressed in this chapter.

The answer to these important questions usually goes in the same direction, that is, socioeconomically advantaged individuals or groups tend to perform better than their less advantaged counterparts do. Yet such relationship can vary depending on (i) the units of analysis (e.g., individuals, socioeconomic groups, countries), (ii) the health indicators we are looking at (e.g., life expectancy, health expectancy, lifespan inequality), (iii) contextual-specific factors (e.g., the societies we are comparing, the years included in the analyses, or the range of ages taken into consideration).

Inspecting the relationship between individuals' socioeconomic status and health/survival outcomes, a clear gradient emerges. Individuals with better jobs, higher educational attainment, income, and/or wealth tend to live longer and experience more favorable health outcomes than their lower SES counterparts. This is a fairly universal pattern that has been documented in a wide range of societies around the world during the last decades.

Moving from individuals to groups, it is also very common to observe a clear gradient between socioeconomically advantaged groups vis-à-vis their less advantaged counterparts. That is, *on average*, highly educated individuals tend to perform better than low educated ones, the outcomes of those with higher occupation class tend to be better than those in the lower classes, and so on and so forth. In addition, many studies suggest that the gradient across socioeconomic groups tends to become steeper over time. This means that, despite the efforts to reduce the health/survival gaps between socioeconomically advantaged and disadvantaged groups, such gaps have very often increased over time.

For a long time, studies of socioeconomic inequalities in health have limited their attention to *between*-group comparisons. Yet, ignoring the differences that might exist *within* groups and focusing on group-specific average levels alone, one might arrive at overly simplistic conclusions. During the last couple of decades, a burgeoning field of research has investigated the extent of variability in health/survival outcomes across *and within* groups. Many of these studies suggest that socioeconomically advantaged groups not only perform better, on average, than their less advantaged counterparts, but also that there is less uncertainty regarding the occurrence of those better outcomes. Symmetrically, the survival/health outcomes of individuals from lower socioeconomic strata tend to be lower on average and be more unequally distributed. Given the higher uncertainty associated with higher variability, some scholars argue that lower SES individuals are thus exposed to a "double burden of inequality." The diverging trends observed across SES groups within countries are a matter of concern that could endanger the prospects of overall improvement (e.g., increasing countries' overall life expectancy levels), and eventually lead toward highly polarized societies.

Exploring the relationship between countries' socioeconomic standing and health/survival outcomes, this chapter documents a variety of results, ranging from popular to perhaps less well-known ones. In general, richer and more highly educated countries tend to live longer. Yet, the relationship becomes considerably weaker at higher income levels: beyond a certain threshold, further increases in countries' GDP per capita are not strongly associated with higher levels in life expectancy. Analogously, the relationship between the average number of years individuals are expected to live in good health (i.e., health expectancy) and countries' socioeconomic performance is not very strong, although it still exists. However, while the relationship is weak when using GDP per capita, especially among women (and, interestingly enough, only among Western European countries), it is nonexistent when using countries' mean years of schooling is used as a factor of socioeconomic standing. Although it is beyond the scope of this chapter, future research should consider performing a cross-national regression analysis similar to Jagger et al. (2008) but with more recent data that includes other potentially explanatory factors such as expenditure on elderly care, poverty risk, inequality of income distribution, unemployment rate, and the mean exit age from the labor force.

Lastly, the chapter also documents important trends in global health inequalities. While we observe that countries worldwide are becoming increasingly similar regarding their levels of life expectancy *at birth*, we observe the opposite trend when conditioning on survival up to typical retirement age (e.g., around 65 years of age). Inspecting the trends in life expectancy and lifespan variability among the elder (e.g., for those who survived up to the age of 65), we observe that (i) countries are diverging over time (i.e., between country inequality is on the rise), and (ii) there is increasing lifespan variability within countries. As mortality retires to increasingly older ages, the surviving population becomes increasingly heterogeneous (i.e., mixing frail and strong individuals), an important issue that should be taken into consideration by policy-makers around the world in the coming decades.

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