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Driving Longevity through Educational Attainment – A Literature Review

By
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Abstract	**Résumé**
This paper is based on a literature review of 42 papers, all of which comment on the connection between educational attainment and longevity. Unfortunately, only the paper by Willson (2009) and some of the OECD analysis used any Canadian data. This review finds a very strong correlation between educational attainment and life expectancy. Educational attainment affects and, in some cases, effects many other socioeconomic traits, such as income, smoking habits, obesity, tensions around employment and income security.	Ce document est basé sur une documentation de 42 articles, tous commentant le lien entre le niveau de scolarité et la longévité. Malheureusement, seul l'article de Willson (2009) et quelques analyses de l'OCDE utilisent des données canadiennes. Cette documentation constate une très forte corrélation entre le niveau de scolarité et l'espérance de vie. Le niveau de scolarité affecte et, dans certains cas, a un impact sur de nombreux autres traits socio-économiques, tels que le revenu, les habitudes tabagiques, l'obésité, les tensions autour de l'emploi et la sécurité du revenu.
The first segment of the paper provides support for educational attainment being a driving force behind longevity. The second segment shows how this actually "works". The paper then provides some data analysis to support the overall thesis. It closes by looking at some public policy implications of the findings.	Le premier segment du document soutient que le niveau de scolarité est un moteur de la longévité. Le deuxième segment montre comment cela « fonctionne ». Le document fournit ensuite une analyse des données pour appuyer la thèse globale. Il se termine en examinant certaines implications des résultats pour les politiques publiques.

Key Words

Educational attainment
Longevity
Socioeconomic characteristics

1. Introduction

A Thermos will keep coffee hot on a cold winter's day

And lemonade cold on a hot summer's day

The question remains: How does it know?

This paper is essentially a literature review. The purpose of the paper is to determine and analyze what it is that "drives" longevity.

Early literature using demographic decomposition techniques to determine underlying variables that are highly correlated with longevity was formalized and generalized by Kitagawa (1955).

In reviewing the literature, one finds that there is general agreement that population educational attainment is the number one driver of longevity.

Among the many who have taken this position, we would cite: Pappas et al. (1993), Preston and Elo (1995), Sorlie et al. (1995), Kallan (1997), Rogers et al. (1999), Vaillant and Mukamal (2001), Jemal et al. (2008), Rogers et al. (2010), James et al. (2017), Murtin et al. (2017), Case and Deaton (2021) and Loures and Cairns (2020).

Three papers state that the education–mortality association is predominantly causal (Link et al., 2008; Lleras-Muney, 2010; and Hummer and Hernandez, 2013). But the strongest analysis showing a link between educational attainment and life expectancy is a recent paper by Case and Deaton (2021). They find that there are significant differences in life expectancy between those with a college degree (generically referred to as a BA) and those without, and that the gap is widening. Since 2010, those with a BA continued to see increases in life expectancy but those without saw declines.

Social science and epidemiological research have increasingly pointed to education as an *upstream* factor associated with exposure to a variety of factors related to mortality rates and life expectancy (Hummer and Hernandez, 2013).

The strength and consistency of the inverse relationship between educational attainment and mortality risk over time, across different places and among individuals in different demographic groups suggest that education is a "fundamental cause" of health and mortality (Hummer and Lariscy, 2011).

Rogers et al. (1999) state that the continuous inverse relationship between education and mortality is robust to controls for age, sex, race, marital status, cigarette smoking, adequacy of housing and income.

Education is one possible measure of socioeconomic status. Deaton and Paxson (1999) show that at the individual level, both income and education are separately protective against mortality. However, Vaillant and Mukamal (2001) suggest that education is a more significant cause of differential mortality than other differences in socioeconomic status. In comparing college students and core-city youth over a long period, they found that the core-city men who had completed 16 or more years of education had very similar health to the college cohort.

Preston and Elo (1995) also consider education to be advantageous relative to occupation and income.

The level of education can also affect the cause of death. Kallan (1997) found that education affected every cause of death in the younger age group, but particularly those having a large behavioural component.

When Lutz and Kebede (2018) put wealth and education into the same mathematical model, they found that differences in education closely predicted differences in life expectancy, while changes in wealth barely mattered. They argue that because schooling happens many years before a person has attained their life expectancy, this correlation reflects cause: better education drives longer life. It also tends to lead to more wealth, which is why wealth and longevity are also correlated. But what is important, say Lutz and Kebede, is that wealth does not seem to be driving longevity, as experts thought; in fact, education is driving both of them. Finally, they state that extreme examples are telling: "Cuba is dead poor but has a higher life expectancy than the US because it is well educated." Meanwhile in oil-rich but poorly educated Equatorial Guinea, people rarely reach 60 (p.99).

One innovative study by Montez and Hayward (2014) found that even after they accounted for childhood socioeconomic and health characteristics, they discovered a very strong association between educational attainment and mortality for both women and men.

One reason for selecting education as the most relevant "conditioning" variable is that the risk of "reverse causality" is weaker when looking at the relationship between adult health and education compared to the two-way relationship between health and income, for instance. However, relationships between education and longevity are complex and are also related to the skills gained at early stages of life. These skills not only largely predetermine occupation, income and other socioeconomic characteristics at later stages of life, but also contribute to individual health-related lifestyles, disease risk profiles and psychosocial characteristics (Murtin et al., 2017).

One piece of evidence that somewhat contradicts this general consensus was work done by Cairns et al. (2019). Studying Danish mortality rates for males, they found that at both lower and higher ages affluence was a much stronger discriminator than education. This part of the final paper was never published because of a decision by the journal editor.

The lifelong correlation of education with health and longevity is striking, and there is reason to believe that these socioeconomic status variables collectively may be "fundamental causes" of these disparities.

2. Upon Further Analysis, How Educational Attainment Drives Longevity

A Thermos bottle does not cause coffee to stay hot or lemonade to stay cold. It is its design properties (e.g., non-conduction of heat) that creates this end result.

So it is with education. While education may not "cause" longevity directly, its properties inevitably lead to enhanced life expectancy.

According to the theory of fundamental causes, an important reason that socioeconomic status is related to multiple disease outcomes through multiple pathways that change over time is that individuals and groups deploy resources to avoid risks and adopt protective strategies. Key resources such as knowledge, money, power, prestige and beneficial social connections can be used no matter what the risk and protective factors are in a given circumstance. Consequently, fundamental causes affect health even when the profile of risk and protective factors and diseases changes radically (Link and Phelan, 1995).

Rogers et al. (1999) state that not only does education affect mortality through its link to employment, income generation and information gathering, it also affects mortality by influencing health behaviour and the use of health services. This would support Kallan's (1997) finding that education particularly affected the causes of death having a large behavioural component. Among all sociodemographic characteristics, education is the only one that correlates positively and consistently with health-enhancing behaviours (Hummer and Lariscy, 2011).

Lantz et al. (1998) also found that the distribution of four behavioural risk factors (cigarette smoking, alcohol drinking, sedentary lifestyle and relative body weight) significantly varied by educational attainment. Case and Deaton (2021) found that Americans without a BA have seen rising mortality from drugs, suicide, and alcoholic liver disease—deaths of despair. The reduction in deaths from cardiovascular disease, which was the driving force of mortality reduction in the last third of the last century, has slowed for everyone but has stopped and reversed among those without a four-year degree. Deaths from smoking-related diseases continue to be important, especially among White women without a BA.

Hummer and Lariscy (2011) state that a higher level of educational attainment helps individuals acquire better and more stable employment, increase their earning power, develop effective agency and beneficial social connections, and attain a greater sense of personal control over their lives. These resources can help more educated people earn and accumulate more money, work in stable and creative jobs, live a healthier lifestyle, live in a safer environment and experience less stress and more social support than less educated people. This conceptualization emphasizes that education provides resources well beyond increased income. Compared to less educated individuals, highly educated individuals are also more likely to exercise, abstain from tobacco use, maintain a healthy body weight and incorporate new health knowledge into their lives. In short, education enables people to coalesce health-producing behaviours into a coherent lifestyle that improves health. These positive influences of education persist throughout the life course, long after the formal completion of schooling.

As mentioned above, Rogers et al. (1999) state that education affects mortality through its link to employment, income generation and information gathering. Let us look at these one at a

time. Being more highly educated means it is easier to get employment and less easy to be unemployed. This in itself is a great stress reliever. Of course, being educated and being employed mean that you earn more income, which generally means you live in a safer neighbourhood, eat better food and have much lower financial stress. Having a higher educational attainment means you gather information more effectively and efficiently. That, in turn, means you probably know more about nutrition and you understand the health care delivery system better and take better advantage of it.

Education exerts its direct beneficial effects on health through the adoption of healthier lifestyles, a better ability to cope with stress and more effective management of chronic diseases. However, the indirect effects of education through access to more privileged social positions, better-paying jobs and higher income are also profound (Olshansky et al., 2012).

Bucher and Ragland (1995) also found that those with less education had higher risk factors. Moreover, education is established early in life and can place people on differential health trajectories that have implications for well-being in old age, as well as mortality (Rogers et al., 2010).

More educated people have greater social psychological resources for dealing with their environment, which may lead to better health and survival. Education is perhaps most important for increasing agency and personal control (Mirowsky and Ross, 1998), which leads individuals to believe that they can effectively alter their surroundings and will therefore seek information to guide their lives, know more about health and adopt a lifestyle that enhances their health outcomes. More highly educated individuals may have access to other highly educated individuals and professionals who can provide advice, and who can effectively and directly intervene in a crisis. Those with higher levels of education may also encounter fewer non-health stressors, such as marital and family problems, conflicts with friends and neighbours, legal hassles and on-the-job troubles, which results in health benefits and lower mortality risks (Rogers et al., 2010).

People with more education have a lower prevalence of dementia, more years of cognitively healthy life and fewer years with dementia. Change in the distribution of educational attainment has played a major role in the reduction of life with dementia in the overall population (Crimmins et al. 2018). Differences in the burden of cognitive loss by education point to the significant cost of low social status both to individuals and to society (Crimmins et al., 2018). This could have a significant impact on long-term care costs.

Olshansky et al. (2012) found that in 2008, US adult men and women with fewer than 12 years of education had life expectancies not much better than those of all adults in the 1950s and 1960s. When race and education are combined, the disparity is even more striking. In 2008, White US men and women with 16 years or more of schooling had life expectancies far greater than Black Americans with fewer than 12 years of education: 14.2 years more for White men than Black men and 10.3 years more for White women than Black women. These gaps have widened over time and have led to at least two "Americas", if not multiple others, in terms of life expectancy, demarcated by level of education and racial-group membership.

Socioeconomic inequalities in mortality are increasing rapidly due to continued progress by educated White and Black men and White women, and stable or worsening trends among the least educated (Jemal et al., 2008).

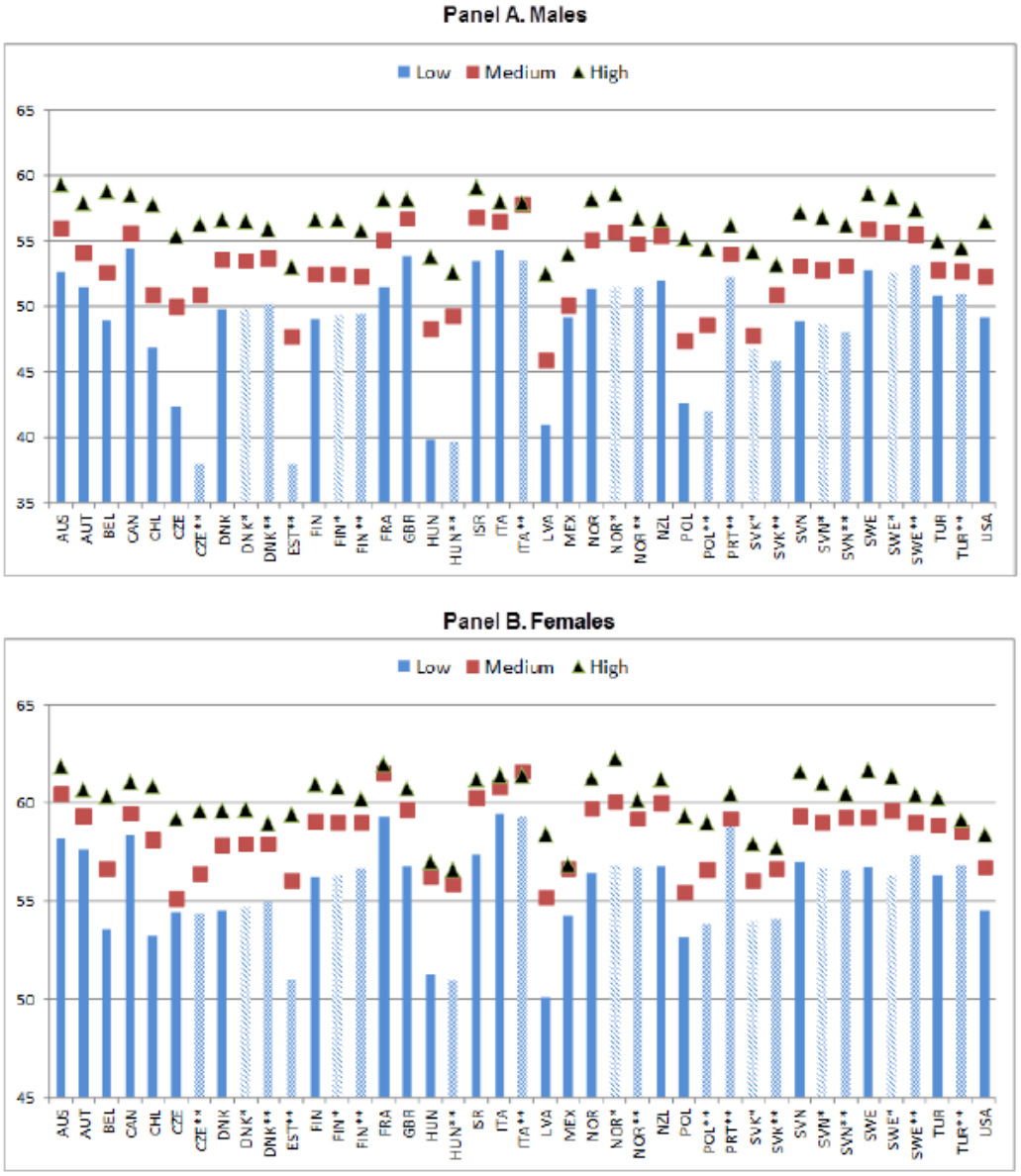
Moreover, more highly educated individuals not only live longer lives on average than less educated individuals, but also live a greater proportion of their lives in good health than do less educated persons (Hummer and Lariscy, 2011).

3. Some Data Reinforcement

Murtin et al. (2017) find that on average, across the countries covered in their analysis, the gap in life expectancy at age 25 between high and low educational groups is eight years for men and five years for women. At the age of 65, these gaps are 3.5 years for men and 2.5 years for women, implying that *relative* inequalities in longevity increase with age.

Inequalities in longevity by education are lower, in absolute terms, when observed at higher ages; however, this is a mechanical consequence of the fact that longevity decreases as people age. When the longevity gap between people with different education is expressed as a share of the life expectancy of people with higher education, the opposite conclusion emerges; i.e. *relative* differences in longevity by education are larger at age 65 than at age 25 (18.1% versus 13.6% for men, and 10.5% versus 7.6% for women) (Murtin et al., 2017).

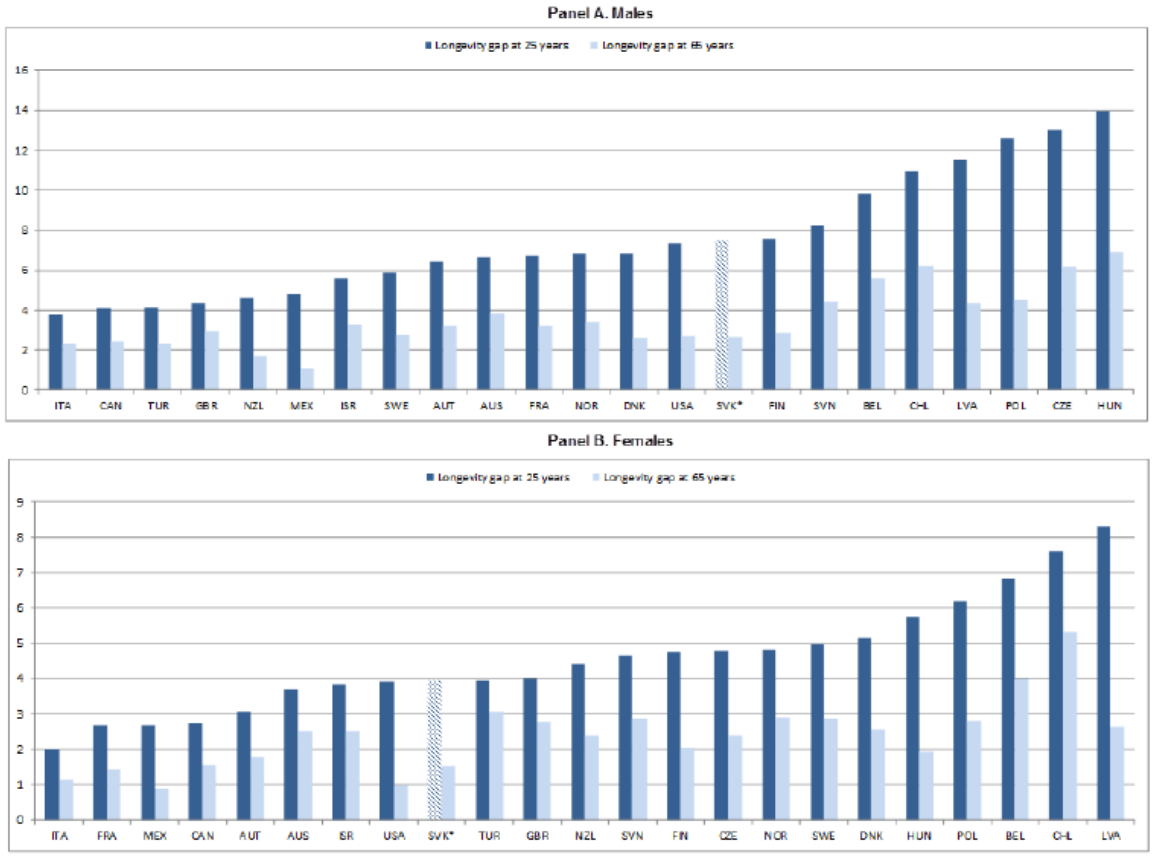
Figure 1 – Life expectancy at age 25 by education around 2011, by gender



Note: Countries without an asterisk correspond to estimates based on the country-data gathered for this paper and on authors' calculations. Estimates for the Slovak Republic (denoted with an asterisk *) are based on authors' calculation based on detailed Eurostat data; ** denotes Eurostat data and calculations.

Source: Murtin et al., 2017

Figure 2 – Life expectancy gap between the highest and lowest educational groups at the age of 25 and 65



Note: Countries without an asterisk correspond to estimates based on the country-data gathered for this paper and on authors' calculations. Estimates for the Slovak Republic (denoted with an asterisk (*) are based on authors' calculation based on detailed Eurostat data.

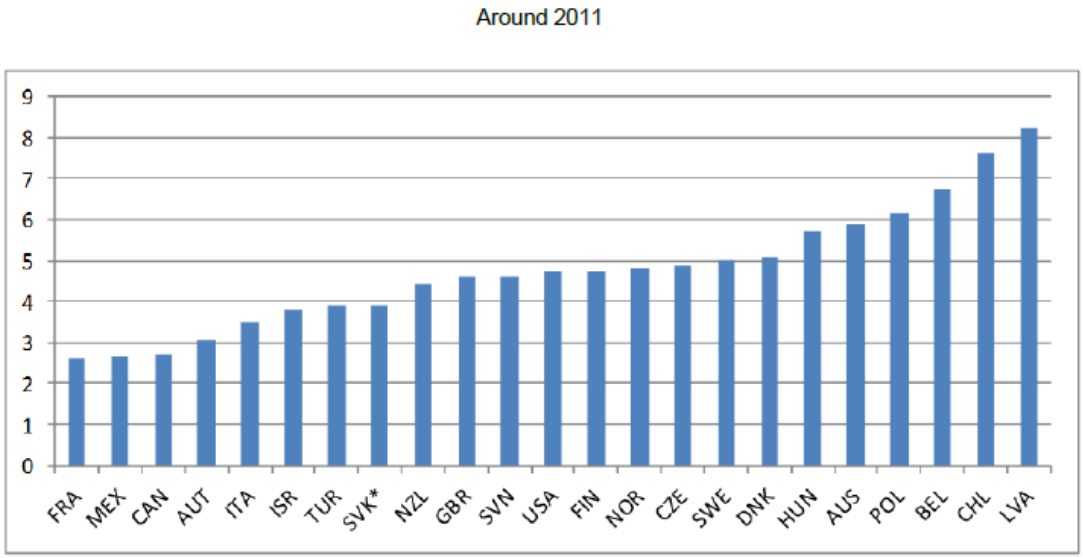
Source: Murtin et al., 2017

Other measures of inequalities in longevity by education (such as country averages of age-standardized mortality rates and the slope index of inequality) do not significantly change the assessment relative to one based on life expectancy measures (Murtin et al., 2017).

Another way of describing the higher inequality between educational groups consists of calculating the gain in life expectancy (conditional on survival to age 25) that would be realized if all people were subject to the same survival rates; this benchmark can conveniently be chosen as those of highly educated women, the group that records the highest life expectancy in all countries.

On average, if all individuals had the same vital characteristics as highly educated women, the potential gain in life expectancy would be 4.8 years on average, ranging between around 2.6 years in France and 8.0 years in Chile and Latvia (Murtin et al., 2017, Figure 3).

Figure 3 – Potential gain in life expectancy at age 25 when assuming longevity of highly educated women for entire population



Note: countries without an asterisk correspond to OECD data and calculations; *denotes OECD calculations based on Eurostat data.

Source: Murtin et al., 2017

Across the whole set of 23 Organisation for Economic Co-operation and Development (OECD) countries analyzed, men record a level of longevity at age 25 of 48.9 years for people with low education, 52.6 years for those with medium education and 56.6 years for those with tertiary education. The corresponding values for women are 55.5 years, 58.3 years and 60.1 years. These results suggest an absolute gap of 7.7 years, on average, between high- and low-education men, and of 4.6 years for women (Murtin et al., 2017).

At age 65, men experience a life expectancy of 15.8 years for those with low education, 17.1 for those with medium education and 19.2 years for those with high education. The corresponding values for women are 19.6, 20.8 and 21.9 years. These values imply that the gap between high and low educational groups at age 65 is 3.5 years for men and 2.3 years for women. Similar gaps are observed when analyzing differences in life expectancy across gender for each educational group. Among people with low and medium education, women live 3.8 years longer than men, while for those with higher education the gap is 2.7 years (Murtin et al., 2017).

Murtin et al. (2017) note that differences in life expectancy between people with low and high education account for about 10% of overall inequalities in ages at death. Life expectancy inequalities are larger within low-education groups than within high-education groups, and mainly reflect higher premature mortality. Lastly, cardiovascular problems explain the bulk of mortality differentials between high- and low-education people (43% for men and 51% for women).

Over the past 25 years, life expectancy has been rising in the United States at a slower pace than has been achieved in many other high-income countries. Consequently, the United States

has been falling steadily in the world rankings for level of life expectancy, and the gap between the United States and countries with the highest achieved life expectancies has been widening. International comparisons of various measures of self-reported health and biological markers of disease reveal similar patterns of US disadvantage. The relatively poor performance of the United States with respect to achieved life expectancy over the recent past is surprising given that it spends far more on health care than any other nation in the world, both absolutely and as a percentage of gross national product (Crimmins et al., 2011).

Life expectancy at birth in the United States for both sexes combined ranked 35th in the world in 2018 (United Nations Development Program, 2019, as found on Wikipedia).

As noted, differences in longevity between groups with low and high educational attainment account, on average, for around 10% of overall inequalities in ages of death; this implies that eliminating average differences in longevity across groups with different education does not imply eliminating all differences in mortality across people. Also, within-group inequality in ages at death is larger among low-education people than among highly educated people, mainly reflecting higher premature mortality. Because of this pattern, reducing premature mortality, especially among men with low educational attainment, holds the promise of raising both overall longevity and reducing inequality in ages at death.

Some of the papers also identified increases in educational differentials in recent years. Pappas et al. (1993) found that absolute death rates declined for people of all educational levels, but the reduction was greater for those with more education than for those with less, highlighting an increasing disparity in mortality rates for those of different education levels.

The extent of basic education has been shown to be more highly correlated with mortality than that of more advanced education. The effect of the difference between a middle education and a low education is greater than that between a high education and a middle education (Table 9.3 in Crimmins et al., 2011).

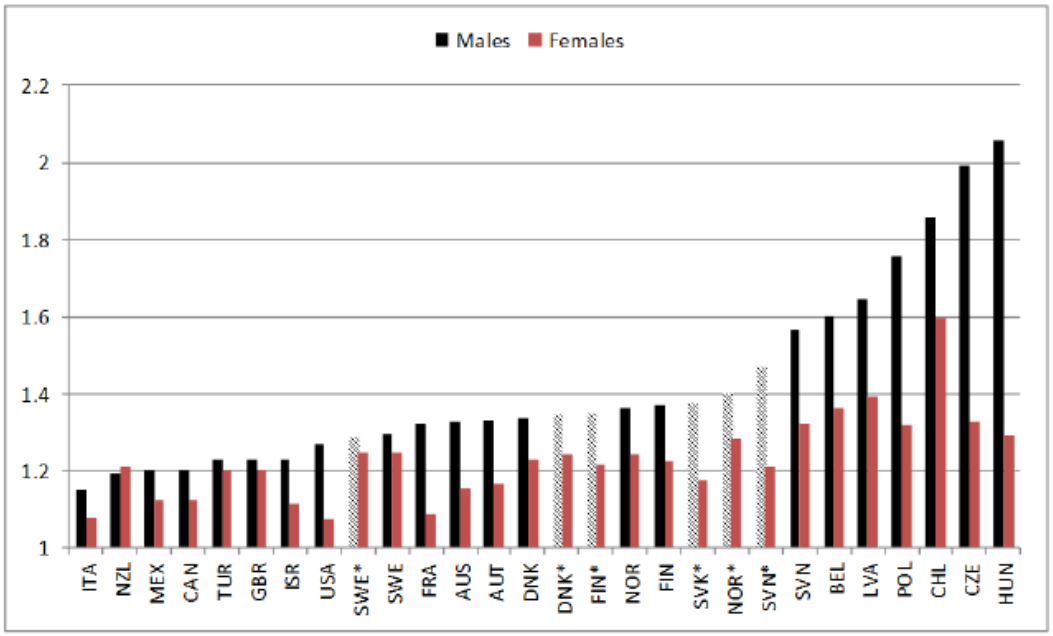
The measures of inequality in longevity described above (life expectancy at age 25 and 65) have two specific features that may affect cross-country comparisons:

- First, life expectancy is especially affected by mortality rates at very young ages; in other terms, a reduction in mortality rates among the elderly will, by construction, have a smaller impact on life expectancy than a similar reduction in mortality rates of young people.
- Second, measures of life expectancy by education are also affected by differences across countries in the share of high- and low-education people among the deceased. These differences are a potential source of bias when measuring inequalities of longevity, as people with low educational attainment may disproportionally include people with special disadvantages (e.g. learning or health problems at a young age) in countries where medium and higher education is the norm, as compared to countries where very few people pursue studies until a higher age (Murtin et al., 2017).

In other terms, countries with a high ratio in average age-standardized mortality rates (relative inequality) also have a high difference in these age-standardized mortality rates (absolute inequality). This is because cross-national differences in the average mortality rate almost

entirely reflect cross-country differences in mortality among the less educated, while mortality rates of the highly educated people are rather similar among countries (Murtin et al., 2017).

Figure 4 – Ratios of age-standardized mortality rates between high- and low-education groups



Note: Mortality rates are age-standardised based on WHO European Population structure (old standard) and standardization method.

Source: Murtin et al., 2017

It is also interesting to look at the pairwise correlations, across countries, between several measures of inequality in longevity by education: the (absolute) difference and (relative) ratio of life expectancy at age 25 between high- and low-education people; and the (absolute) difference and (relative) ratios in average age-standardized mortality rate between the same two groups. The correlation tables show that all measures of inequality in longevity are highly correlated across countries, with pairwise correlations above 0.96 for men and 0.88 for women. This implies that countries rank more or less similarly in terms of longevity inequalities by education whatever the measure used. Thus, accounting for differences in the size of the various educational groups does not significantly change the assessment of countries' rankings (Murtin et al., 2017).

Intuitively, this suggests that much of the cross-country differences in longevity (at national or at subgroup levels) are explained by premature mortality or mortality at the younger ages (Murtin et al., 2017).

The large inequality in ages at death observed among low-education people mostly reflects a higher degree of premature mortality among this group. Differences in the modal age at death between educational groups are significantly smaller than differences in life expectancy (or average life expectancy). While the gap in life expectancy at age 25 between high- and low-education people is around eight years for men and five years for women, the corresponding

gaps in modal age of death are 4.9 and 2.3 years respectively. This suggests that about half of mortality inequalities between educational groups are explained by deaths occurring before the modal age.

The above remarks suggest that both the average longevity and the inequality in life expectancy are disproportionately affected by premature mortality. In other terms, premature mortality lowers life expectancy and raises longevity inequality (Murtin et al., 2017).

This indicates that life expectancy inequality is larger within groups with lower education than within highly educated groups (Murtin et al., 2017).

Smoking is a very important risk factor for cardiovascular diseases. According to Mackenbach (2016), smoking accounts for up to half of the observed inequalities in mortality in some European countries; while its contribution to inequalities in longevity has decreased in most countries for men, it has increased among women. In almost all countries analyzed by Mackenbach, prime-age people, both men and women, with lower education are more likely to smoke than those with a medium or higher education. On average, 45% of low-education men aged 18–64 smoke daily or occasionally, as compared to 23% of highly educated men. The educational gradient of smoking prevalence disappears after age 65, reversing in some countries. This suggests that part of the education gradient of mortality is explained by differential smoking prevalence before age 65. In this regard, when analyzing the contribution of smoking to socioeconomic inequalities in mortality among 14 European countries between 1990 and 2004, Mackenbach found that smoking-related mortality represents a larger fraction of total mortality for people with a lower level of education than for those with higher education, especially for men. In 2000–2004, the contribution of smoking to mortality differentials between low- and high-education groups varied between 19% and 55% for men and between nil and 56% for women. Since the early 1990s, the contribution of smoking to inequalities in mortality by education has fallen in most countries for men but increased for women.

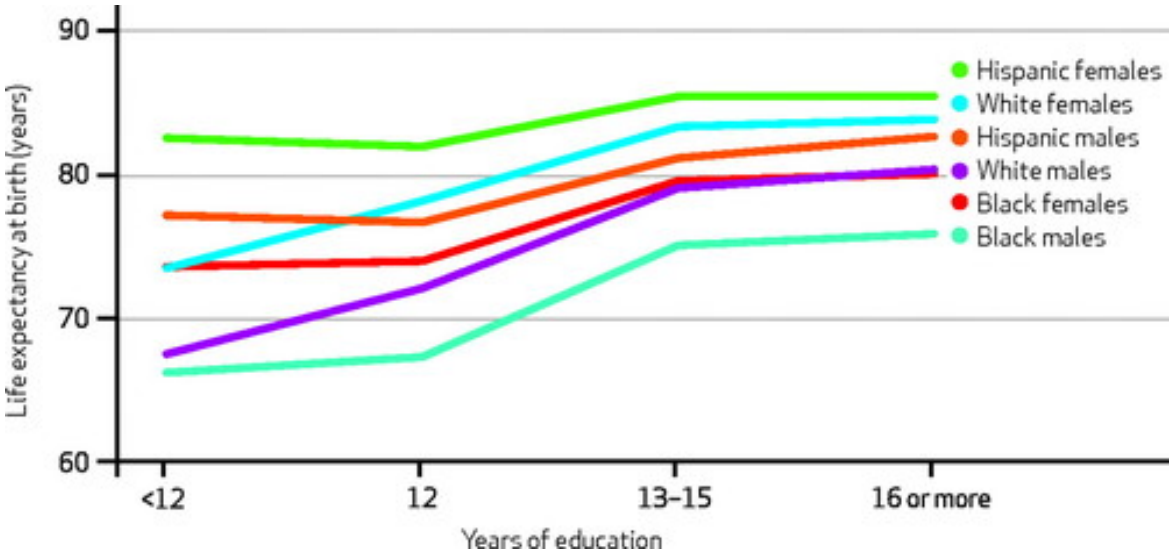
American men with less than a high school education are 2.5 times more likely to currently smoke and 1.5 times as likely to ever have smoked as those who have completed college. The current smoking prevalence among US women with low education is 2.25 times higher than among the high-education group (Crimmins et al., 2011).

In a review of the literature, James et al. (2017) and Murtin et al., (2017) conclude that, in most OECD countries where country-level data are available, the longevity gap between high- and low-education people has remained constant or slightly increased over the last decade. Over the longer term, country-specific evidence yields similar findings. For instance, the longevity gap has increased by three years among Norwegian men and by almost one year among women over the 1971–2009 period (Murtin et al., 2017). Similar findings for France are reported (ibid).

Olshansky et al. (2012) found that on average, Black people and Hispanic people with 16 or more years of education lived 7.5 years and 13.6 years longer, respectively, than White people with less than 12 years of education. This is a clear demonstration of the profound influence that education and its correlates have on length of life expectancy (based on US data).

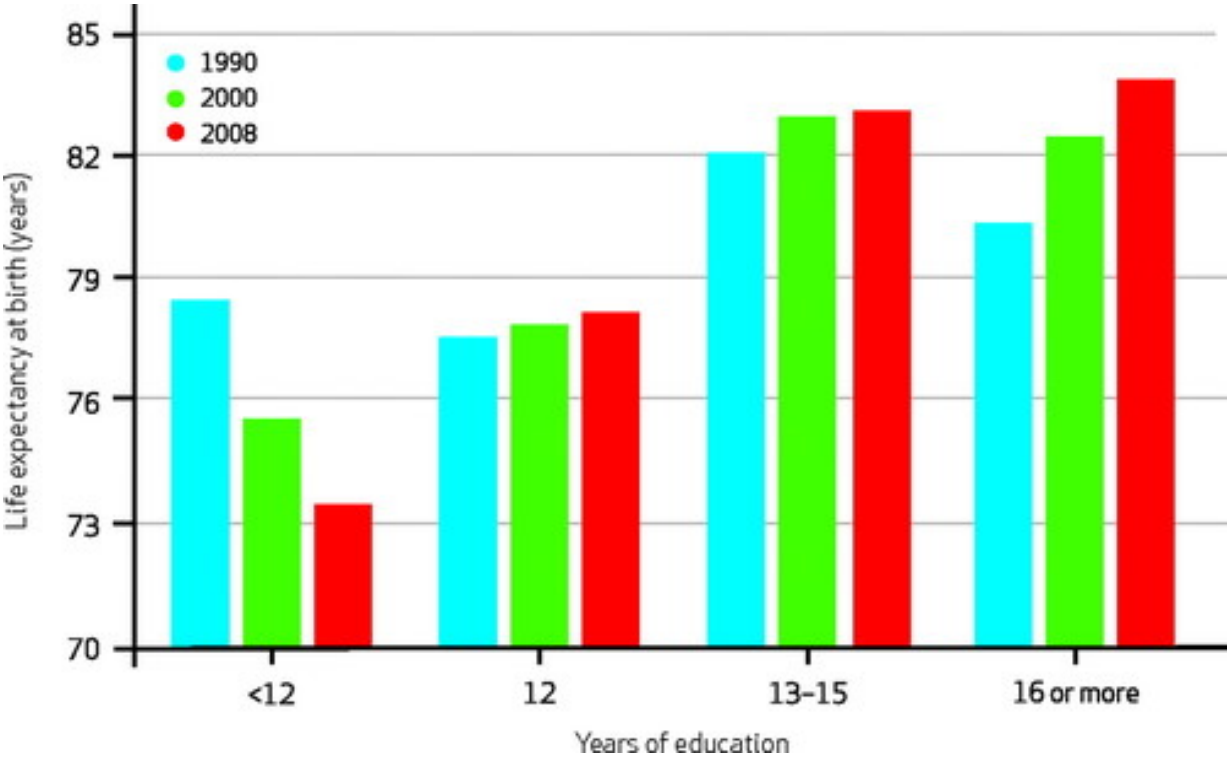
For all racial and ethnic groups, having an additional four years of education beyond high school yields a pronounced longevity advantage. Having a postgraduate degree produces an even greater advantage (Olshansky et al., 2012).

Figure 5 – Life expectancy at birth, by years of education at age 25, by race and sex, 2008



Source: Olshansky et al., 2012

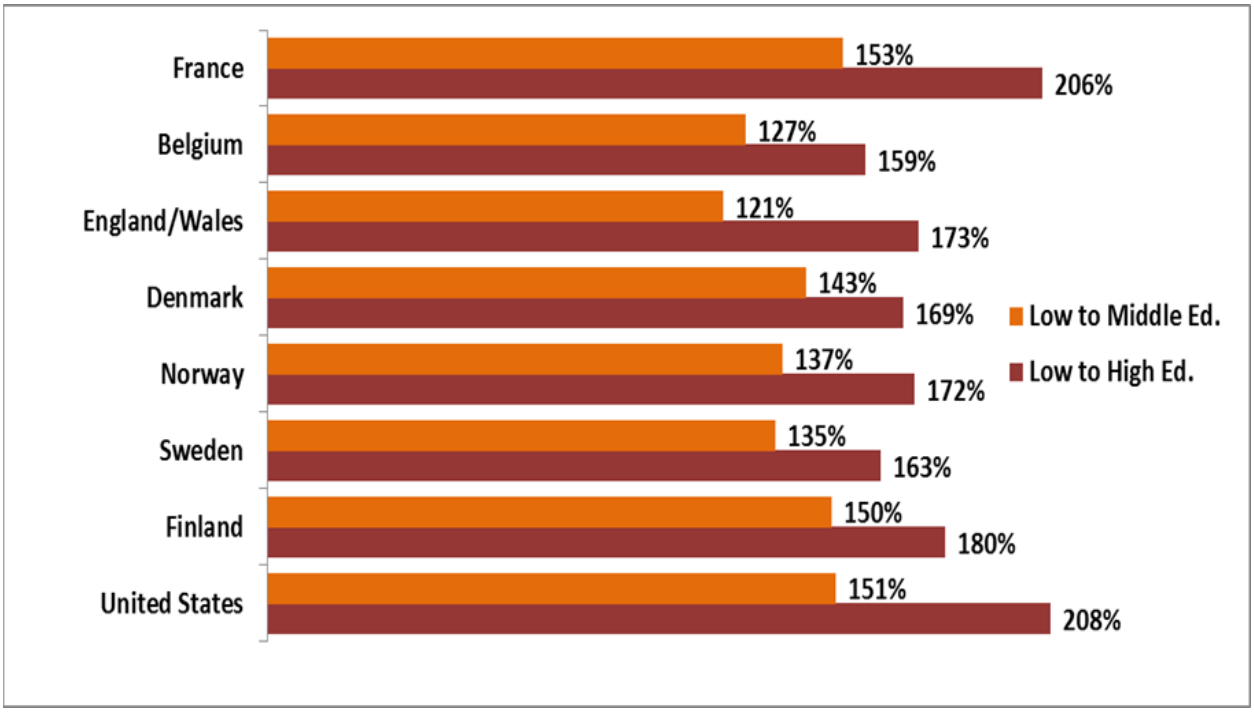
Figure 6 – Life expectancy at birth, by years of education at age 25 for White females, 1990–2008



Source: Olshansky et al., 2012

As mentioned above, the extent of basic education has been shown to be more highly correlated with mortality than that of more advanced education. For example, Figure 7 indicates the effect of middle or higher education relative to a lower level of educational attainment. The effect of the difference between a middle education and a low education is greater than that between a high education and a middle education (Crimmins et al., 2011).

Figure 7 – Effect of education on relative mortality for selected developed countries



Source: Adapted from Crimmins et al. (2011, Table 9.3)

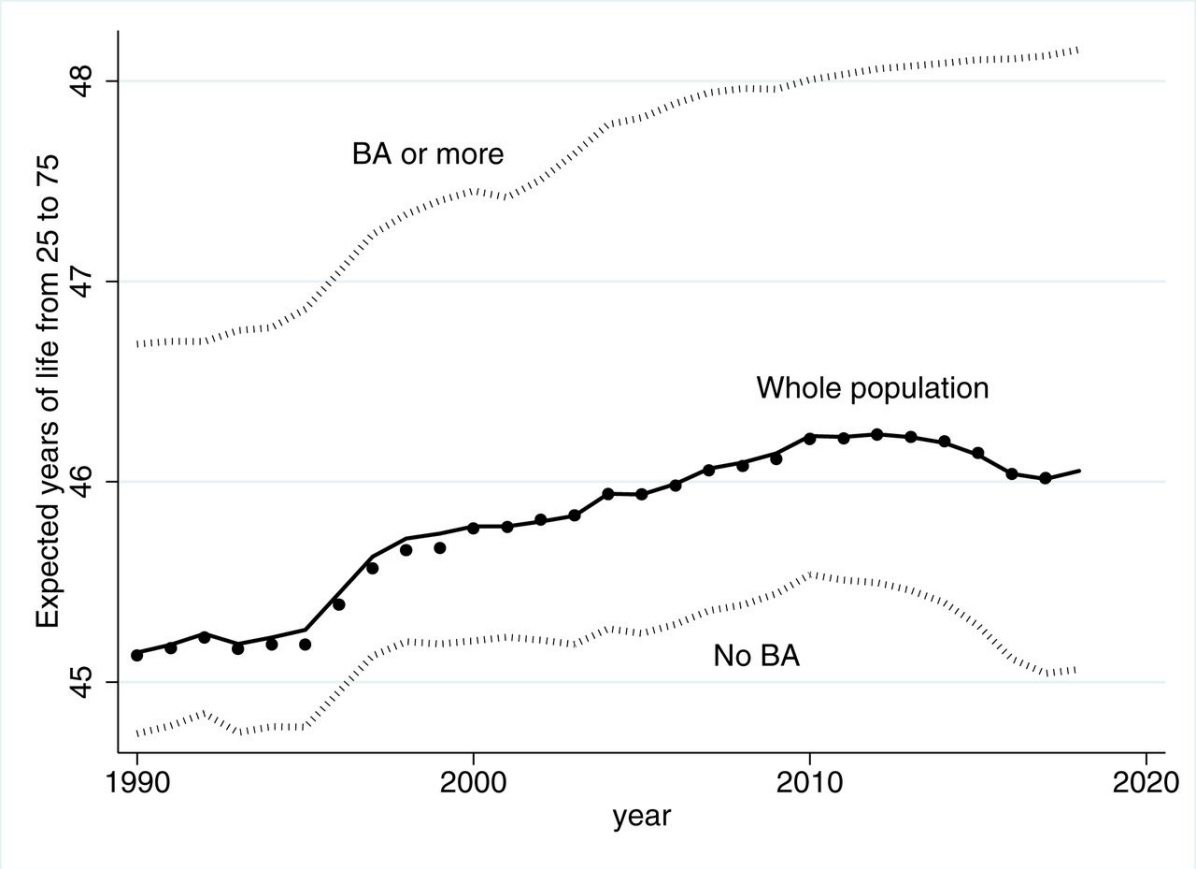
Importantly, both genders generally show larger education-mortality disparities among more recent cohorts. There are several reasons for the higher relative mortality risk for persons with lower levels of education among more recent birth cohorts. First, as larger proportions of the population receive advanced degrees, it becomes increasingly difficult for persons without college or high school degrees to find employment. Second, health and risk behaviours are not evenly distributed across socioeconomic statuses. Indeed, research has shown that innovations in ideas and health-related knowledge are adopted by persons of higher socioeconomic status first, and then diffuse to the rest of the population. In particular, differences in smoking behaviours by education level may be a major force for the larger mortality risk disparity by educational degree among younger cohorts, particularly among males (Rogers et al., 2010).

In Kaplan et al. (2015) educational attainment and follow-up data were available on 29,657 (98%) of the participants. Over 6.3 years of follow-up, 3,673 participants died. There was a monotonically increasing risk of death with lower levels of educational attainment. The same monotonic relationship held with adjustments for age, race, sex, cardiovascular risk factors and health behaviours. The unadjusted hazard ratio for those without a high school education in comparison with college graduates was 2.89 (95% Confidence Interval = 2.64–3.18). Although adjustment for income, health behaviours and cardiovascular risk factors attenuated the relationship, the same consistent pattern was observed after adjustment. The relationship between educational attainment and longevity was similar for Black and White participants. The monotonic relationship between educational attainment and longevity was observed for all age groups, except for those aged 85 or more.

When Crimmins et al. (2011) looked at how mortality rates varied by educational level in Europe and the United States, the international rankings differed at high versus low levels. Among those with a low level of education (equivalent to 11 years or less), the mortality among men and women in the United States, both Black and White, was higher than that in any of the Western European countries. In contrast, among those with the highest level of education—equivalent to a bachelor's degree or higher in US universities—US men fared better, ranking higher than men in three of the eight Western European countries. However, their US female counterparts fared worse than highly educated women in all but Denmark. Mortality levels among highly educated Black people in the United States were higher than those among the highly educated in any other country.

Case and Deaton (2021) looked at expected life years lived between 25 and 75 in the United States by educational attainment. The results of their analysis are captured in Figure 8.

Figure 8 – Expected years of life from 25 to 75 by educational attainment

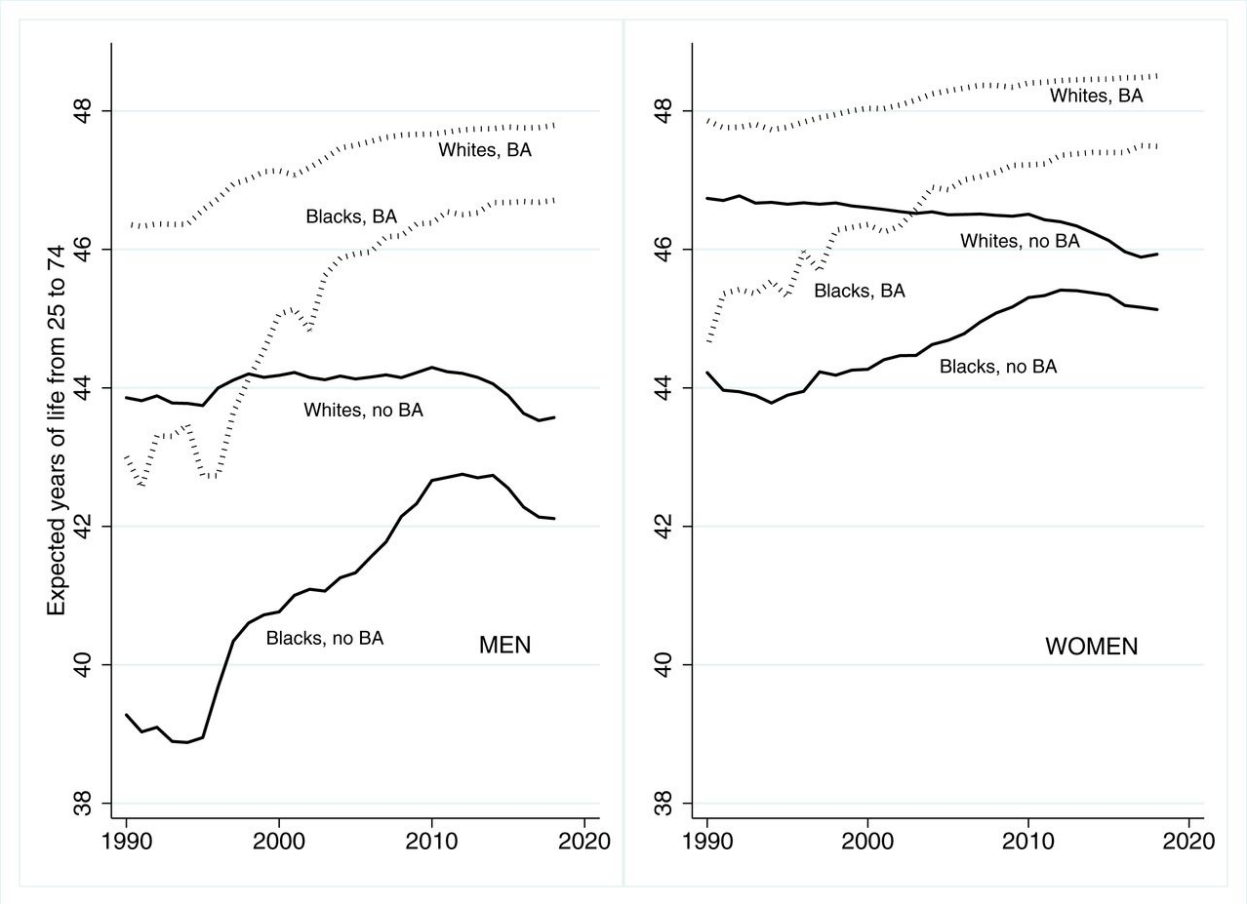


Source: Case and Deaton (2021)

Case and Deaton (2021) state that one reason for this disparity is the fact that there is an earnings premium for a BA degree over high school education that has reached a record 80%. They also state that the biggest step in the increase in expected years of life is between those with "some college" versus those with a four-year degree.

Case and Deaton also present their results broken down by gender and race, as illustrated in Figure 9.

Figure 9 – Expected years of life from 25 to 75 by gender and educational attainment



Source: Case and Deaton (2021)

Case and Deaton note that the life expectancy turndown is only for those without a BA, one of two main results. The other, perhaps even more remarkable, is that the narrowing of racial gaps that have already been seen has come with a pronounced widening of the gaps between those with and without a BA. Black men and women with a BA, who used to have fewer expected years from 25 to 75 than White people without a BA, now have more expected years. As a result, Black people with a BA are currently closer to White people with a BA than to Black people without a BA, in sharp contrast to the situation in 1990. The same is true for White people with a BA, who are closer to Black people with a BA but much farther from White people without a BA, again something that was not true in 1990.

The widening educational differences have meant that education is now a sharper differentiator of expected years of life between 25 and 75 than is race, a reversal of the situation in 1990.

4. Public Policy Indications

Want to live a long life? Stay in school (Cutler et al., 2008).

Despite increased attention and substantial dollars directed to groups with low socioeconomic status, within race and gender groups the educational gap in life expectancy is rising, mainly because of rising differentials among the elderly. With the exception of Black males, all recent gains in life expectancy at age 25 have occurred among better-educated groups, raising educational differentials in life expectancy by 30% (Cutler et al., 2008). Life expectancy would have increased more rapidly if it had increased in all socioeconomic groups at the same rate as in the highest socioeconomic group (Crimmins et al., 2011).

Differential trends in smoking-related diseases explain at least 20% of this trend. Beyond the differential change in smoking, there is the national trend toward increased obesity. As with smoking, obesity is more common among the less educated than among the better educated. Further, recent research suggests that obesity might contribute to nearly as many deaths as tobacco does. Although the population health consequences of obesity remain controversial, the obesity trends into the future could further widen socioeconomic gaps in health (Cutler et al., 2008).

A country with greater income inequality—with more wealthy but also more poor people—may have worse average health and greater average mortality because the health benefits to the wealthy from their extra income are outweighed by the health deficits experienced by the poor (Crimmins et al., 2011).

Thus, one possible and very straightforward way to reduce educational differentials in adult mortality would be to shift more and more people out of the lower portions of the educational distribution into more advanced educational categories, as was clearly the case across birth cohorts for most of the twentieth century (Hummer and Lariscy, 2011).

Such a policy might be especially important both because educational differences in mortality are widening for younger cohorts and because more than 10% of US young adults continue to have less than a high school degree (Hummer and Hernandez, 2013).

Social policies should focus on keeping everyone in school and on track toward a degree. Moreover, social policies could encourage more individuals to pursue advanced professional degrees (Rogers et al., 2010).

Levering up the skills of individuals increases their employability and productivity. More broadly, cognitive skills of individuals have been strongly associated with economic growth over the last four decades (Hanushek and Woessmann, 2009a). Education has also been associated with entrepreneurship and thus with increasing social mobility (OECD, 2010).

Returns on educational investments are higher in early, primary and secondary education due to their effects on facilitating later learning (Hanushek and Woessmann, 2009b). The substantial long-lasting effects of the early years of education on economic and social outcomes are particularly high for children from disadvantaged backgrounds, whose home environments may not provide them with the foundation skills necessary to prosper at later educational stages.

This is why investing as early as possible in high-quality education for all and in supporting students from disadvantaged backgrounds is a cost-beneficial strategy: it pays off (OECD, 2012).

From a public finance perspective, the benefits of investing in upper-secondary education completion outweigh the costs in all OECD countries. In OECD countries, the public internal rate of return of a man who has accomplished this level of education is very high, accounting to 7.7% (OECD, 2012).

Educational failure also imposes high costs on society. Poorly educated people limit economies' capacity to produce, grow and innovate. School failure damages social cohesion and mobility and imposes additional costs on public budgets to deal with the consequences: higher spending on public health and social support and greater criminality, among others. For all these reasons, improving equity in education and reducing school failure should be a high priority in all OECD education policy agendas (OECD, 2012).

Supporting a good education could counter the fact that the US health care system does a particularly poor job at prevention, an observation that may be especially relevant in the midst of a nationwide obesity epidemic (Crimmins et al., 2011). Education is a preventive action. Lutz and Kebede (2018) suggest that schools may be a better health investment than high-tech hospitals.

As Brown (1999) stated, spending more on health care may not result in better population health if the new funds for that health care spending decrease the government budget for education. The increased longevity from the extra health care spending could easily be overshadowed by the decreased longevity because of the decreased funding for education.

Although living longer than currently expected could also pose financial challenges to national age-entitlement programs such as Social Security and Medicare, the extension of healthy productive life would transform these challenges into opportunities (Olshansky et al., 2012).

Indeed, it has been proposed that social conditions can be "fundamental causes" of health inequalities, which is why interventions based exclusively on modifying biomedical risk factors have not been, and are not likely to be, successful in substantially reducing health disparities (Olshansky et al., 2012).

As reported in Hummer and Hernandez (2013), Steven Woolf et al. estimated whether more lives would have been saved between 1996 and 2002 by equalizing levels of educational attainment so that all US adults would have at least a college degree compared to the number of lives saved from advances in biomedicine over this period. Their estimates indicated that many more lives would have been saved from increasing education levels than from advances in biomedicine. This specific example is not intended to promote a reduction in such medical or public health advances, but rather to highlight the enormous potential importance of educational attainment for population health (Hummer and Hernandez, 2013).

Thus, a growing body of evidence suggests that enhanced investments in education at the population level may also double as investments in the long-term health and longevity of the population (Hummer and Hernandez, 2013).

5. Conclusion

This paper reviewed 42 papers, all of which comment on the connection between educational attainment and longevity. The review found a very strong correlation between educational attainment and life expectancy. While educational attainment may not cause longevity directly, it affects many other socioeconomic traits, such as income, smoking habits, obesity, tensions around employment and income security.

The first segment of the paper reviewed support for educational attainment being a driving force behind longevity. The second showed how this actually "works". The paper then provided some data analysis to support the thesis. Finally, it looked at some public policy implications of the findings.

We would note that the findings in this paper should be of interest to actuaries in the insurance and pension industries who, in their pricing and reserving, need a deep understanding of life expectancy.

Finally, investing in education is a way to improve lifestyle and also improve the longevity of the population—a win for all.

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