Educational inequalities in healthy longevity by race in the United States

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Abstract

Substantial disparities in longevity and health exist among different educational groups in the US population. However, current research has not fully disentangled the determinants of these inequalities. Utilizing data from the US Health and Retirement Study (HRS), we estimate cohort life expectancy (LE) and disability-free/disabled life expectancy (DFLE/DLE) by educational groups for the Black and the White by sex. This intersectional approach provides further insights into how educational attainment translates into health inequality among different population subgroups. We decompose these healthy disparities by education and examine whether the educational disparities in later-life disability are primarily due to unequal functional health at the onset or if they stem from divergent patterns of functional decline during older age. Our findings indicate these disparities are primarily driven by differences in the transitions between disability states and mortality. By decomposing educational levels, we highlight key factors contributing to gaps in life expectancy (LE) and disability-free life expectancy (DFLE) between college graduates and those without a high school diploma. The impact of education varies significantly by race and sex across U.S. birth cohorts, advancing the debate on how early-life education affects health disparities in later life.

Keywords: health, education, racial inequality, mortality

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Introduction

Health and well-being among older Americans are known to be substantially patterned by sociodemographic factors. Social inequalities in health in the US are pervasive. Women are known to live longer than men but live a higher proportion of their remaining years subject to poor health and disabling conditions (Read and Gorman 2010), and these gaps have grown over time (Freedman et al. 2016). Whites generally live longer and with fewer years subject to poor health, as compared to Blacks, and racial gaps in disability-free LE have widened over time (Solé-Auró et al. 2015; Hayward and Heron 1999; Phelan and Link 2015). Inequalities in life expectancy (LE) by education have also increased over time (Hendi 2015; Sasson 2016; Shen and Payne 2023), and extensive prior research has found substantial, and growing, gaps in longevity and healthy life expectancy between individuals with high and low levels of education (Chiu et al. 2019; Chiu et al. 2016; Crimmins and Saito 2001; Molla et al. 2004; Shen and Payne 2023; Meara et al. 2008).

Significant inequalities in healthy and longevity exist across different social groups in the United States, particularly in terms of education or race (Olshansky et al. 2012; Solé-Auró et al. 2015; Payne 2022). Despite this considerable study on patterns of healthy longevity among different groups, little prior research has investigated the intersection of these changes. In particular, relatively little research has explored how educational inequalities in healthy longevity may differ by racial groups. Educational inequality in healthy and total life expectancy may operate differently by sex, or within different racial groups. In other words, certain level of educational attainment could translate more to the healthy inequality for some subpopulations but not the others (Hayward et al. 2015).

Focusing on education is crucial, as the educational landscape in the U.S. has shifted significantly in recent years. A much larger share of older adults now holds a bachelor's degree or higher, yet a persistent racial gap remains. Between 2010 and 2020, the percentage of white adults over 45 with a bachelor's degree rose from 28% to 35%, while the proportion of black adults in the same age group increased from 18% to 26% (US Census Bureau 2010, 2020). Notably, the sex distributions of these figures differ by race. Among the older white population, males tend to be more educated about 37% with a bachelor's degree in 2020, while the proportion of Black females with a bachelor's degree at these ages is slightly higher than Black males, especially in 2020 reaching 28%. The link between health and education are rather well studied (Ross and Wu 1995; Lynch and von Hippel 2016; Montez and Berkman 2014;

Shkolnikov 2006), it is hence worth to investigate the interplay between racial and educational difference by sex.

To better understand how these inequalities emerge, shift, and potentially grow over the life course, it is crucial to investigate whether social inequalities in healthy longevity are derived from less advantaged populations reaching older ages with worse health, or result from differences in patterns of onset and recovery from poor health. Previous studies on health expectancy inequalities have not been able to identify the relative importance of these two factors in producing inequalities in later life health expectancies. Recent advances in multistate decomposition now offer greater insight into the role these components play in shaping inequalities. This methodological progress allows us to identify the relative importance of these factors in producing inequalities in later life health expectancies, a capability that has been lacking in previous studies on health expectancy inequalities across education and racial groups.

In this paper, we use data from the US Health and Retirement Study (HRS 2024) to explore educational inequalities in later life disability. Our paper presents the life expectancies by disability status for four educational groups, both sexes, and two main races with an intersectional approach. This approach offers a more targeted understanding of the educational inequality in health longevity among different subpopulations. Furthermore, we aim to determine whether these disparities are primarily driven by different health statuses upon reaching older age or by divergent patterns of functional loss across older ages. We identify the major factors contributing to widest gaps in healthy and total life expectancy between individuals with a bachelor's degree and those without a high school diploma. By applying these advanced decomposition methods, our research seeks to provide a more nuanced understanding of the mechanisms behind health inequalities, potentially informing more effective policies and interventions to promote health equity across diverse populations.

Data and Method

Data

Data for this study is drawn from the US Health and Retirement Survey (HRS), a biennial national longitudinal survey (Sonnega et al. 2014). Our analysis utilized the RAND HRS Longitudinal File 2020 (V2) (HRS 2024). We focused on data from 1998 to 2020 to estimate cohort life expectancy across different educational groups for three birth cohorts—1938-1947, 1928-1937, and 1918-1927—who were, on average, 55, 65, and 75 years old in 1998,

respectively. The estimated cohort life expectancy should not exceed 22 years given the time range of the observation period.

Educational attainment was categorized into four levels: less than a high school diploma (<HS), high school graduate including GED (HS), some college (Col), and bachelor's degree or higher (Bac). The analysis also considered two primary racial groups: non-Hispanic White and non-Hispanic Black. Health was assessed based on disability, defined as difficulty in performing basic daily activities as measured by the Activities of Daily Living (ADL) scale (Katz et al., 1963), including tasks such as bathing, dressing, eating, transferring in and out of bed, and walking across a room. Individuals with no limitations were classified as "disability-free (DF)," while those with one or more limitations were classified as "disabled (D)."

Model

We use a three-state multistate life table model to estimate population-based partial cohort life expectancy (LE), as well as disability-free and disabled life expectancies (DFLE/DLE). The exact age of death is obtained from HRS data, assuming individuals who die between survey waves remain in their last observed state until death. The multinomial model incorporates a range of covariates, including age, age-squared, sex, birth cohorts, educational attainment, race, and interaction terms among these factors. All coefficients within the models are statistically significant. The product of two weights is applied in the regressions. The sample weight, available in the HRS dataset, person-level analysis weight. To address potential bias from differential attrition, we apply an attrition weight, which uses inverse probability weighting to adjust for individuals who do not drop out, considering their age, race, education, and disability status (Dugoff et al. 2014; Payne 2022).

The modeled coefficients are then used to generate transition probabilities for each demographic group by age, which serve as inputs for a microsimulation-based multistate life table model (Cai et al. 2010; Shen and Payne 2023). 95% confidence intervals (CIs) are derived through 500 bootstrap resamples from the original dataset. The final point estimates presented in the results are based on the complete dataset.

Decomposition

Using this procedure, we calculate life expectancy (LE), disability-free life expectancy (DFLE), and disabled life expectancy (DLE) by educational attainment for four subpopulations: non-Hispanic White males, non-Hispanic Black males, non-Hispanic White females, and non-

Hispanic Black females, across three birth cohorts. We then decompose the widest health gap between the most educated (those with a bachelor's degree) and the least educated (those without a high school diploma), stratified by sex, race, and birth cohort. This gap is further broken down into three gaps of the neighboring education group: between those without a high school diploma and high school graduates, high school graduates and those with some college, and those with some college and bachelor's degrees. Utilizing the multistate life table decomposition method (Shen et al. 2023), we attribute these differences in life expectancies to initial health structures and transition probabilities. All analyses are conducted using R software (R Core Team 2024).

Results

Figure 1 illustrates life expectancy data across different cohorts, demographic groups, and education levels, revealing significant disparities based on race and education. Consistently across all cohorts, White individuals demonstrate higher life expectancy compared to Black individuals, with this gap being more pronounced at lower education levels. Education plays a crucial role in increasing life expectancy for all groups, but its impact is more substantial for White individuals. The most striking contrast is observed between White individuals with bachelor's degrees, who consistently have the highest life expectancy, and Black individuals with less than high school education, who generally have the lowest. The largest gaps are usually to be found between high school graduates and without. However, there is an education gradient in health, where total and DFLE and LE is generally higher with more years of education.

Gender differences are also evident, with females typically enjoying higher life expectancy than males across all race and education categories. The positive effect of education on life expectancy appears more pronounced for females. Additionally, the proportion of healthy years to unhealthy years tends to be higher for more educated groups and for White individuals compared to Black individuals, suggesting that education not only extends life but also improves its quality. While education positively impacts life expectancy for all groups, it does not fully eliminate racial disparities. The gap between White and Black life expectancy narrows somewhat at higher education levels but remains persistent. These patterns are consistent across different cohorts.

[Figure 1 about here]

To better explore the educational inequality in health, we illustrate the gap between education groups in Figure 2. Across all educational group comparisons, the gap in DFLE is consistently positive, while the gap in DLE is generally negative. The educational gradient in health is particularly evident in the DFLE. As mentioned, the differences between high school graduate (HS) and those achieve less than high school (<HS) usually contribute the most to the gap between the most and the least education (i.e., Bac-<HS). However, most variations between subgroups emerge if we explore the second largest gap.

For White individuals, particularly males, achieving a bachelor's degree correlates with significant increase in both disability-free and decrease in disabled life expectancy, suggesting a compression of morbidity with higher education. In contrast, Black individuals show minimal health advantages from higher education beyond some college, with life expectancy—both disability-free and disabled—remaining largely unchanged. This disparity indicates that the health benefits of education observed in White populations may not apply uniformly across races. However, a notable exception emerges among younger Black males with bachelor's degrees, who experience extended disability-free life expectancy. This trend is not statistically significant for younger Black females. Overall, these findings challenge the assumption that higher education universally translates to better health outcomes across all demographic groups.

The lack of changes between college graduate and some college among the Black may be explained by frailty if we focus on the mortality or the total life expectancy. The classical model of frailty centers on the concept of selective survival (Lynch et al. 2003; Vaupel et al. 1979). This theory posits that Black individuals, as a group, experience higher overall mortality rates, which acts as a stronger selective pressure. Consequently, Black individuals who survive to old age represent a particularly robust subset of their original cohort, whereas the elderly White population includes a broader spectrum of health conditions from their initial group. The similar argument on selection based on socioeconomic factor also presents, where more educated groups include frailer individuals at older ages (Hoogendijk et al. 2014; 2017). However, if we look beyond mortality, frailty should also manifest in health or healthy life expectancy before ending up in mortality. Therefore, we should expect the frailer group, as in the individuals with bachelor’s degree, show an increase in unhealthy years (DLE) and a decrease in healthy years (DFLE) to achieve the roughly the same life expectancy. However, this is not observed across all cohorts, suggesting that factors beyond mere selection are at play

or the selection take place in even older ages. Further analysis of the decomposition results could shed more light on the underlying mechanisms driving these patterns.

[Figure 2 about here]

Discussion and next step

The preliminary results with the intersectional approach have uncovered compelling health disparities across educational levels among various subpopulations. These findings prompt a deeper investigation into the underlying factors contributing to these differences. In our next phase of analysis, we will employ decomposition techniques to gain a more nuanced understanding of these disparities. This approach will allow us to distinguish between two key components: the cumulative effects of health-related factors in younger ages and the transition probabilities in health status over time in older ages. By examining these components, we aim to elucidate the age-specific patterns that contribute to the health gaps between education groups within each race and sex category. This detailed analysis will provide valuable insights into how educational attainment interacts with race and sex to influence health outcomes throughout the life course. Additionally, we plan to incorporate more theoretical frameworks in our background research to contextualize and interpret our findings. This comprehensive approach will not only help explain the observed patterns but also contribute to the broader discourse on social determinants of health and the mechanisms through which education impacts health outcomes between the Black and the White.

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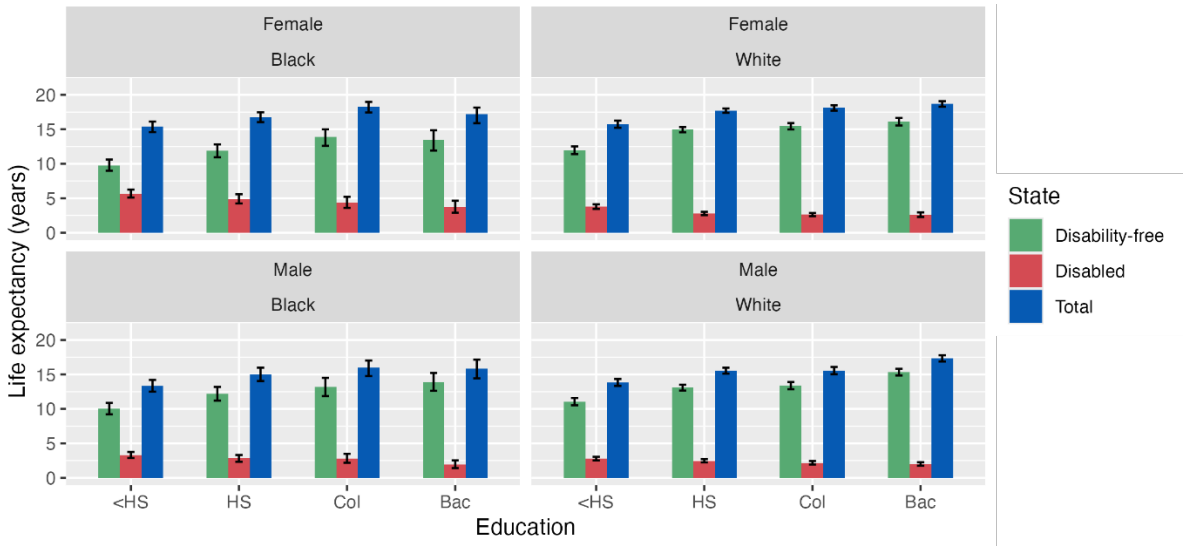

Figure 1. Life expectancies by educational attainment, sex and race (cohorts 1928-1937)

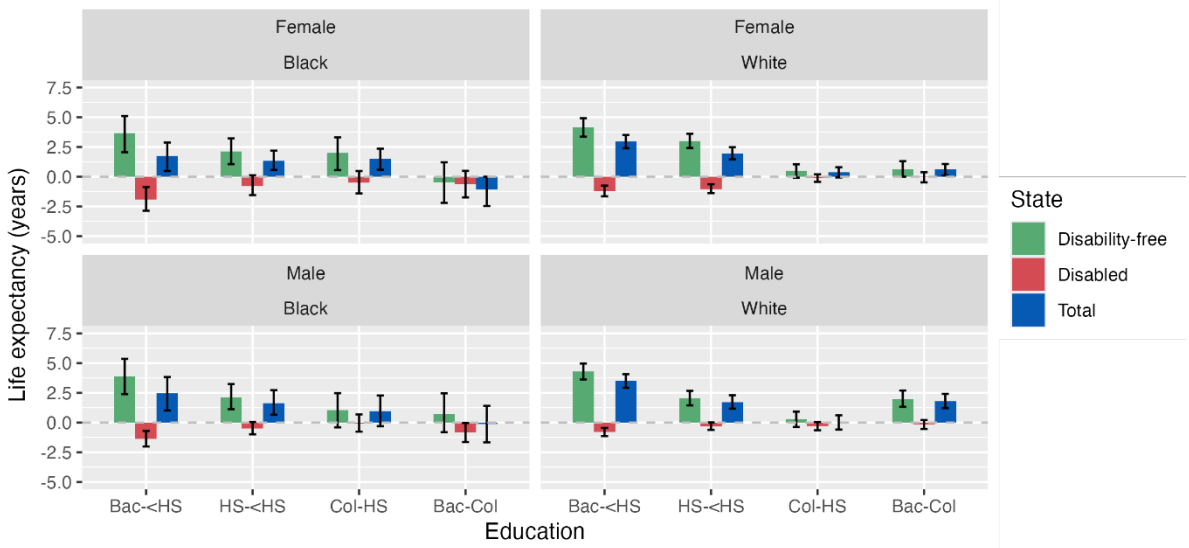

Figure 2. Gap in life expectancies between educational groups by sex and race (cohorts 1928-1937)