Heterogeneous Effects of Education on Mortality in the United States: Evidence from Within-Twin Pair Comparisons

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BACKGROUND AND RESEARCH QUESTION

There are large educational disparities in mortality in the United States which have, moreover, been growing in recent decades (Hayward & Farina, 2023; Montez & Bisesti, 2024; Sasson, 2016). The association between education and mortality may be partly or entirely due to a causal effect of education on health in line with a "social causation" hypothesis or may merely be a reflection of selection on unobserved confounders as proposed by the "social selection" hypothesis. Several recent studies identify an effect of education on mortality using relatively robust designs such as twin models or instrumental variable models consistent with a causal interpretation of the education-mortality association (Fletcher, 2015; Fletcher & Noghanibehambari, 2024; Halpern-Manners et al., 2020).

Less is known, however, about how the effect of education on mortality varies across subgroups of the U.S. population. It is possible that the benefits that education has for the longevity of individuals differ systematically by gender, race, family socioeconomic background, or across regions. Analyzing how the effect of education on mortality varies across the population has important implications for our understanding of the processes underlying between-group disparities in mortality as well as for policies targeted at reducing lifespan inequality.

A few previous studies examined whether educational gradients in mortality differ by gender and race but those studies are mostly descriptive and did not employ robust

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methodological designs (Hayward et al., 2015; Montez et al., 2009; Sasson & Hayward, 2019; Zajacova & Hummer, 2009). We advance this research by analyzing within-twin pair differences in a nationally representative sample of twins and address the following question: *How does the effect of education on mortality in the United States vary by gender, race, family socioeconomic background, and region?* While subject to certain limitations, the estimation of twin models allows to control for unobserved characteristics of the shared family and social environment during childhood as well as partly, in the case of dizygotic (DZ) twins, or fully, in the case of monozygotic (MZ) twins, for genetic endowments. This substantially increases our confidence that observed within-twin pair differences in longevity associated with more education are not driven by selection.

DATA

Following Halpern-Manners et al. (2020) we analyze linked U.S. Census and administrative mortality data. First, we identify all twins born between 1910 and 1920 in the 1920 IPUMS Full Count Census data (Ruggles, Flood, et al., 2024; Ruggles, Nelson, et al., 2024). The individual-level records in the 1920 Census are then linked to their respective individual-level records in the 1940 Census when they were young adults using the crosswalks provided by the IPUMS Multigenerational Longitudinal Panel (Helgertz et al., 2023) where we observe the years of schooling completed for each twin. The individual-level linkages across censuses have been achieved using supervised machine learning algorithms (Ruggles, Rivera Drew, et al., 2024). Subsequently, we link the linked 1920–1940 Census records to the Social Security Numident file using the IPUMS crosswalks which contains the age at death for all social security registrants that died before 2008 which is the case for the vast majority of individuals in the 1910–1920 birth cohort. The analytic sample consists of approximately 10,000 twin pairs. We employ weights provided by IPUMS in order to adjust for differential linkage probabilities.

METHODS

To estimate how the effect of education on mortality varies by gender, race, family socioeconomic background, and region we estimate the following twin fixed-effects models:

$$\Delta M_j = \beta_1 \Delta S_j \times MOD_j + \beta_2 \Delta S_j + \Delta \varepsilon_j$$

where ΔM_j is the within-twin pair difference in age at death for the twin pair j, ΔS_j is the within-twin pair difference in years of schooling completed, MOD_j is the moderator of interest (alternatively race, gender, family socioeconomic background, or region), and $\Delta \varepsilon_j$ is the within-twin pair difference in the individual-level error term. The primary term of interest is β_1 which represents the coefficient of the interaction of the within-twin pair difference in years of schooling with the respective moderator.

EXPECTED FINDINGS

We expect to find weaker effects of education on longevity for Black individuals compared to White individuals. Systemic racism is likely to lead Black individuals to attend schools with lower school quality (Frisvold & Golberstein, 2013) and to make it more difficult to translate a high educational attainment into a high economic living standard in adulthood. Given the highly gendered distribution of paid and unpaid labor, in particular in the cohort studied, the living conditions of women are likely to be more dependent on their husband's socioeconomic attainment than on their own. We accordingly expect to find weaker effects of education on mortality for women than for men. We are ambiguous with regard to how the effect of education on longevity varies by family socioeconomic background. The theory of "cumulative advantage" (Dannefer, 2003) would propose stronger effects of education for individuals from higher family socioeconomic backgrounds whereas the "resource substitution theory" (Ross & Mirowsky, 2011) would propose stronger effects for individuals from lower family socioeconomic backgrounds. Given large regional differences in local economic opportunity

structures and school quality (Card & Krueger, 1992), we expect the effect of education on longevity to be weaker in the U.S. South compared to other regions.

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