



An education gradient in health, a health gradient in education, or a confounded gradient in both?



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ABSTRACT

There is a positive gradient associating educational attainment with health, yet the explanation for this gradient is not clear. Does higher education improve health (causation)? Do the healthy become highly educated (selection)? Or do good health and high educational attainment both result from advantages established early in the life course (confounding)? This study evaluates these competing explanations by tracking changes in educational attainment and Self-rated Health (SRH) from age 15 to age 31 in the National Longitudinal Study of Youth, 1997 cohort. Ordinal logistic regression confirms that high-SRH adolescents are more likely to become highly educated. This is partly because adolescent SRH is associated with early advantages including adolescents' academic performance, college plans, and family background (confounding); however, net of these confounders adolescent SRH still predicts adult educational attainment (selection). Fixed-effects longitudinal regression shows that educational attainment has little causal effect on SRH at age 31. Completion of a high school diploma or associate's degree has no effect on SRH, while completion of a bachelor's or graduate degree have effects that, though significant, are quite small (less than 0.1 points on a 5-point scale). While it is possible that educational attainment would have greater effect on health at older ages, at age 31 what we see is a health gradient in education, shaped primarily by selection and confounding rather than by a causal effect of education on health.

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1. Introduction

More educated adults enjoy better health. At every age, adults with higher degrees or more years of education have fewer health risk factors, lower incidence of disease, lower mortality (Link and Phelan, 1995; Mirowsky and Ross, 2003), and are more likely to rate their health as “excellent” or “very good” rather than “fair” or “poor” (Bauldry, 2014).

The association between education and health is subject to varying interpretations. The popular terminology *an education gradient in health* suggests a *causal* account in which education affects health (Mirowsky and Ross, 2003; Ross and Wu, 1995). Yet we also can describe the association as a *health gradient in education*, implying a *selection* account in which adolescents with good health are more likely to pursue and complete higher levels of

education (S. A. Haas and Fosse, 2008; Palloni, 2006). Alternatively, the association might be a *confounded gradient*, in which both education and health are affected by prior advantages such as psychological strengths or family background (Conti et al., 2010). To avoid choosing an explanation prematurely, in much of this paper we use direction-neutral terminology such as the *education-health gradient* (Conti et al., 2010), or simply *the gradient*.

Causality, selection, and confounding are not mutually exclusive explanations; it may be that all three play some role in explaining the gradient. That is, it may be that adolescents with prior advantages tend to become both educated and healthy (confounding); and still, net of confounding, especially healthy adolescents tend to become more educated (selection); and still, net of confounding and selection, higher levels of education tend to improve health in adulthood (causation). Yet we should not let this possibility lead us to think that all three processes are equally important. The relative importance of confounding, selection, and causation must be assessed empirically.

It is important for several reasons to understand the relative importance of causation, selection, and confounding. First, these

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processes are fundamental to understanding social stratification—helping to clarify whether health is stratified by education, whether education is stratified by health, or whether health and education are stratified by prior advantages early in the life course. Second, explaining the gradient can help to evaluate the potential of policies that are designed to reduce inequalities in health or educational opportunity. For example, if we find that education has a large causal effect on health, then policies that encourage high school and college completion might be expected to improve population health and reduce the cost and burden of chronic disease (Cohen and Syme, 2013; House, 2015). On the other hand, if education has little effect on health but health predicts education net of confounders, then policies designed to improve the health of poor children might be expected to substantially improve academic performance and persistence (Campbell et al., 2014; Case et al., 2005).

In this article, we review theoretical mechanisms that might explain the education–health gradient. We then review and assess the promise of different research designs for evaluating whether the gradient is due primarily to selection, causation, or confounding. Finally, we conduct a new longitudinal study which tracks changes in educational attainment and self-rated health (SRH) within a nationally representative sample of youth followed from age 15 to age 31. Our study asks the following questions:

1. Do healthier adolescents tend to complete higher levels of educational attainment?
 - a. If so, can the higher educational attainment of healthier adolescents be explained by confounding advantages?
 - b. Or does health continue to predict higher educational attainment even after confounders are controlled (selection)?
2. Net of selection and confounding, how large is the causal effect of educational attainment on health?

2. Theoretical mechanisms and research designs

2.1. Causation: the education gradient in health

Research on the education–health gradient is often motivated by causal theories holding that higher educational attainment helps to maintain or even improve health. In sociology, there are several mechanisms through which the causal effect of education on health is hypothesized to work (Mirowsky and Ross, 2003; Ross and Wu, 1995). According to the economic mechanism, higher education protects recipients from the health risks and dangers of low-skill occupations (such as mining or construction), and provides access to work that is relatively safe and subjectively fulfilling (Mirowsky and Ross, 2003). According to the social-psychological mechanism, higher education increases perceived and experienced social support, which buffers against health insults (Thoits, 1995). In addition, higher education increases “learned effectiveness,” a psychological advantage allowing adults to successfully navigate potential health setbacks without debilitating stress or poor coping skills (Mirowsky and Ross, 2003). According to the “health lifestyle” mechanism, higher education makes adults more likely to engage in healthy behaviors, such as exercise, and less likely to engage in unhealthy behaviors, such as smoking (Ross and Wu, 1995). The theorized effect of education on health lifestyle is attributed partly to increased personal control (Ross and Wu, 1995) and partly to education equipping adults with a better understanding of the health consequences of their behavior (Nayga, 2000).

Outside of sociology, different mechanisms have been proposed for education’s causal effect on health. Physicians and economists emphasize the role of the medical delivery system, pointing out

that more-educated adults have better health insurance, higher-quality doctor’s visits, and greater use of advanced medical technology (Fiscella et al., 2000; Lleras-Muney and Lichtenberg, 2002). Higher education may also increase future orientation, perhaps by increasing income and the prospects for a comfortable old age. Future orientation, in turn, is theorized to increase investments in long-term health (Becker and Mulligan, 1997).

To estimate the causal effect of education on health, some studies use cross-sectional data to regress adult health outcomes on adult educational attainment, with intervening paths to estimate how the effect of educational attainment on health might be mediated by variables such as resources (e.g., income, health insurance), health behaviors (e.g., smoking, exercise), or psychological strengths (e.g., sense of control) (Mirowsky and Ross, 2003). Confounding is addressed by control variables, which can be used as covariates in a regression model (Adler et al., 1994; Kimbro et al., 2008; Mirowsky and Ross, 2003), or to construct propensity scores on which more- and less-educated adults are matched (Schafer et al., 2013).

There are two weaknesses in such research designs. First, the observed control variables may not be adequate to control for unobserved confounding. One way to address the problem of unobserved confounders is to compare twins and ask whether the more educated twin also has better health. Twin comparisons hold constant unobserved genetic and environmental factors that are shared within families. Within twin pairs, the association between education and health can be either larger or smaller than the association in the general population (Amin et al., 2015; Behrman et al., 2015).

A second weakness of many cross-sectional analyses is that they cannot distinguish selection from causation. Although it is common to estimate the causal effect of education on health by regressing health on educational attainment, one could just as easily reverse the paths and regress educational attainment on health. Even some twin studies have this weakness.

Ambiguity of causal direction is especially evident in cross-sectional studies, where it is not clear whether education preceded health or health preceded education. Longitudinal studies have the potential to address the issue of temporal precedence, but only if they stretch back to adolescence or childhood, before education is complete. Unfortunately, many longitudinal studies begin in middle age or later, after education is complete (Lantz et al., 2001; Ross and Mirowsky, 1999). Such studies can only observe changes in health, not changes in education, and therefore they cannot estimate the effect of education on health.

Another approach to estimating education’s causal effect on health is to find an instrumental variable, such as a change in compulsory schooling laws, which affects educational attainment without affecting health through any other path. Instrumental variable studies have arrived at mixed conclusions. Among instrumental variables that estimated the effect of educational attainment on SRH, one estimated that the effect was small and insignificant (Arendt, 2005), but another estimated a large and significant effect (Silles, 2009).

2.2. Selection: the health gradient in education

While causal explanations are the most common interpretation of the education–health gradient, an alternative interpretation is selection. Longitudinal studies have found that healthier adolescents select into higher education; that is, well before education is complete, substantial SRH gaps exist between adolescents who will and will not later complete higher levels of education (Conley and Bennett, 2000; S. Haas, 2007; S. Haas, 2006; Needham et al., 2004). If selection is present, then the gradient is, at least in part, a health

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