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World of Labor
Evidence-based policy making

Do schooling reforms improve long-term health?

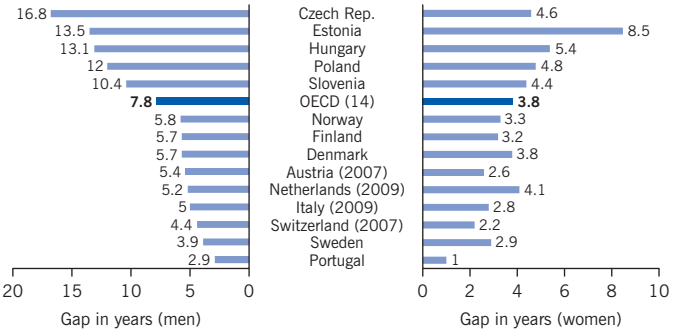
It is difficult to find consistent evidence that schooling reforms provide health benefits

Keywords: schooling reform, long-term health, local treatment effect

ELEVATOR PITCH

A statistical association between more education and better health outcomes has long been observed, but in the absence of experimental data researchers have struggled to find a causal effect. Schooling reforms such as raising school leaving age, which have been enacted in many countries, can be viewed as a form of natural experiment and provide a possible method of identifying such an effect. However, the balance of evidence so far is that these reforms have had little impact on long-term health. Thus, policymakers should be cautious before anticipating a health effect when introducing reforms of this nature.

Gap in life expectancy by education, 2010 (or nearest year)



Note: Gap in expected years of life remaining at age 30 between adults with tertiary and below upper secondary education.

Source: OECD, Health At A Glance, 2013. Online at: https://www.oecd.org/els/health-systems/Health-at-a-Glance-2013.pdf

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KEY FINDINGS

Pros

- Compulsory schooling reforms provide opportunities to measure the causal links between education and health outcomes such as reduced mortality and morbidity.
- Some studies suggest that schooling reforms have provided additional health benefits in some cases.
- Early research using country-level variation in the introduction of compulsory schooling laws shows a causal effect from education to health, possibly arising from delaying engagement in hard physical labor.
- There is evidence of an effect of compulsory schooling reforms on cognitive functioning, which may be reflected in reduced incidence of dementia.

Cons

- More sophisticated research designs with better quality data suggest no causal link from schooling reforms to health.
- The conditions required to achieve health benefits from compulsory schooling reforms may no longer be present in most developed countries.
- If compliance with the reform is weak, then only modest health effects can be expected.
- The impact of reforms appears to be local and context specific, which delimits the generalizability of any observed effects.
- Existing evidence is ambiguous enough that it cannot be assumed that educational reforms will have positive health effects.

AUTHOR'S MAIN MESSAGE

Changes in compulsory schooling laws allow to investigate causal relations between education and health. Results have varied, however, with some studies showing a causal link between such reforms and subsequent health outcomes such as improved longevity and reduced dementia and others showing no causal link at all. Results appear to be sensitive to when the reforms were implemented, the use of individual versus aggregate data, and the type of research design adopted. The lack of uniformity in results suggests that it cannot be guaranteed that compulsory schooling reforms will necessarily have health benefits.

MOTIVATION

There is considerable evidence linking education (whether measured by years of schooling, or highest level of education attained) with a variety of health outcomes such as improved longevity and lower incidence of conditions such as obesity [1]. However, the situation is unclear because such evidence is consistent with alternative pathways: (i) greater education causes better health, (ii) better health causes greater education, or (iii) a third unknown factor simultaneously affects both health and education. In order to isolate a causal link from education to health, researchers have attempted to identify truly exogenous changes in education and then examined their effect upon health. One set of such exogenous changes is the educational reforms enacted in the 20th century, most of which involved increases in compulsory education.

The identification of a causal link between education and health has important policy implications. As well as providing benefits in terms of improved educational outcomes, there would be a double-dividend with improved health outcomes. Ultimately, it could prove to be the case that educational reforms might be the most cost-effective method of improving health outcomes. Thus, it is important to assess carefully the evidence concerning such a link.

DISCUSSION OF PROS AND CONS

The existence of a correlation between health outcomes and education has been known since at least the early 1970s, when differences in mortality by educational categories in the US were observed for both genders. This finding has been echoed in many other studies for other countries and time periods [1]. Theoretical support for this empirical regularity was also provided by an early influential contribution to the literature that developed a model whereby health and education were both dimensions of human capital and which predicted a correlation between the two [2]. In this model, health is regarded as both a consumption and a capital good. It is a consumption good in that good health (or the absence of bad health) is valued in its own right; it is a capital good in that good health enhances productivity in the labor market.

However, the observed correlation between health and education is consistent with a number of potential pathways. Causality can run from education to health if more educated people are more efficient at using existing health inputs, or if they choose a more efficient set of health inputs, in areas such as diet and exercise. Higher-educated people will also, on average, have higher incomes and thus may be able to purchase more and better-quality health inputs, such as high-quality food and gym membership. However, a case can also be made for causality from health to education, particularly health in childhood and adolescence. Since important educational decisions are typically made at these ages, poor health may lead to lower investment in education. If poor health in childhood is correlated with poor health in adulthood, then a correlation between health and education will be observed. In particular, specific health interventions/programs may have quite substantial effects on school enrollment and subsequent labor market outcomes [3].

It is also possible that there is no direct causal link between health and education; instead, a third, perhaps unobserved factor may simultaneously influence them both. Perhaps the most common suggested third factor is time-preference, or patience, referring to an individual's willingness to incur costs now (e.g. investing in education and health) in

order to receive benefits in the future. In turn, time-preference itself may be influenced by education and/or health. More-educated people can expect higher incomes later in life and so may be inclined to weight the future more heavily. Similarly, healthier people, who can anticipate living longer, may place a higher weight upon the future than those whose life-expectancy is lower [4].

Thus, a complex pattern of relationships between health, education, and other factors exists, with causality potentially running in a number of different directions. One way of disentangling this pattern is to identify a clearly exogenous source of change in education or health.

This challenge has also arisen in research into the financial returns to education; one approach that has been applied in this area is to exploit changes in compulsory schooling laws, which have been implemented in a number of countries, many of them during the expansion of the welfare state in the aftermath of World War II. These changes often involved increasing the earliest age at which a child could leave school, and since the changes were compulsory, they cannot be regarded as having been chosen by the affected individuals or their families. Research in this area of financial returns to education indicates that this approach was effective in terms of isolating an exogenous change in education. It can thus also be applied to the question about the potential effects of education on health, since these reforms should not be correlated with other decisions that might also affect one's health and hence a causal effect of education upon health can be inferred. Moreover, since these changes were imposed by the government and were compulsory, it seems reasonable that compliance would have been high.

It is important to note that this article focuses on identifying the consequences of a specific type of educational reform, namely, the possible causal effects of one or two extra years of compulsory education in a child's early to mid-teen years. While this can provide highly useful information, it represents a relatively narrow range of potential schooling reforms, and is thus one piece of a much larger puzzle.

Exploiting compulsory schooling laws

How might compulsory schooling laws be employed to identify a causal effect from education to health? Perhaps the ideal research design to examine the effect of extra schooling on health would be a randomized controlled trial, where some children (chosen at random) were exposed to an extra year of schooling and others were not. It seems clear that it is neither practical nor ethically acceptable to carry out such a trial, and hence, researchers are faced with the challenge of isolating a form of randomization via what is sometimes called a "natural experiment."

The intuition behind using compulsory schooling as a natural experiment to identify a causal effect is that such schooling (or the extra schooling entailed by the reform) is not a choice consciously made by an individual, but rather is exogenously imposed upon them. Many studies approach this by examining the correlation between health and a measure of schooling, where instead of using actual years of schooling they use predicted schooling, taking into account the extra schooling imposed by a reform. This measure of schooling (known as the instrumental variable, IV) is designed to produce a measure of schooling that is truly exogenous and outside the choice of the individual, and hence, a correlation between a health outcome and this schooling measure can be viewed as causal.

An alternative approach to using compulsory schooling laws to identify a causal effect is where there is a clear discontinuity in schooling laws (e.g. when a strict cutoff separates children into groups, such as by year or month of birth). Presuming there is a large enough sample, then in looking at health outcomes for individuals on either side of this discontinuity, it is reasonable to assume that all other factors that might affect health (apart from schooling) are equal between the two groups. This is known as a regression discontinuity (RD) approach and is generally considered to be one of the most robust approaches to identifying causal effects, in the absence of a randomized trial.

Studies exploiting compulsory schooling changes

Studies in a variety of countries have exploited changes in compulsory schooling laws and produced mixed results, possibly due to differences among a number of key dimensions. For instance, the date of introduction of schooling reforms has ranged from the 1920s (the Netherlands) up to the 1970s (Denmark, England and Wales), or even later. Thus, reforms introduced in the 1970s or later have only been able to test for mortality effects up to around age 55 and it is possible that this is too early an age to see the benefits of extra education in terms of longevity. Studies have also differed in terms of health dimensions, with some studies focusing on mortality, and others looking at specific conditions or health behaviors, such as smoking, diet, and dementia. The majority of studies have used individual-level data, though in some cases cell level data, that is, data based on averages of small groups or cells of people, has been used. Finally, the research design employed to detect the health effect has differed, with some approaches relying upon stronger statistical assumptions than others, and hence not being quite so robust.

Can any discernible pattern be detected from this variety of results? Some factors do appear to be associated with whether or not a causal effect is obtained. First of all, earlier reforms seem to have produced greater health effects. One of the most comprehensive studies looks at the Dutch schooling reform introduced in 1928 [5]. This study has the advantage of a large sample size, though owing to data issues it is only possible to detect mortality effects after age 80. However, it seems arguable that the results obtained act as a lower bound, since, at worst, no effects would be found for ages below 80, even if the full data were useable. The study finds that for men surviving to age 81, an additional year of schooling reduces the probability of dying before age 89 by nearly three percentage points, compared to a baseline probability of 50%. These are substantial effects, although the aforementioned data limitations imply that effects can only be detected for those who survive up to age 80. However, the authors point out that greater effects might be found with a younger sample, and this study is one of the more convincing ones that finds a causal effect from a compulsory schooling reform to health.

Another study finds that a 1936 reform in Sweden, which was introduced over a 12-year period, led to discernible reductions in mortality before the age of 30, and the effect grew in magnitude up to age 60 [6]. These effects are arguably implausibly large. However, this study did not use individual-level data, a point returned to below.

Many of the reforms in compulsory schooling happened in the years immediately following World War II; in general, studies of these reforms find little or no causal effect. It is possible that no effect has been found because the people affected by these reforms would have been in their 60s around the time the studies were carried out, and it is possible that the health benefits of extra education, such as increased longevity or reduced incidence

of dementia do not appear until older ages. One counter-example to this is a study of changes in German compulsory schooling laws applied between 1949 and 1969; it finds that additional schooling decreased the risk of long-term illness and disability for men aged between 40 and 70 [7].

A study for France looked at two different educational reforms, one implemented in the 1930s and the other in the 1960s; the first reform raised the school leaving age to 14, while the subsequent reform raised it to 16 [8]. For the first of these reforms, mortality until age 80 is analyzed, while mortality up to age 50 is analyzed for the second reform. This study employs a credible research design, yet it fails to find any influence from either educational reform on mortality.

Evidence regarding cognitive functioning has been used to support the possibility that the health effects of post-war schooling reforms have not yet been seen. As societies in Europe age, it is likely that diminishing cognitive function will be associated with increased incidence of dementia. Many of the compulsory schooling laws were enacted in the years following World War II and hence the cohorts affected by these reforms are now at risk of dementia. Research examining the effect of compulsory schooling laws for a variety of European countries (Austria, Czech Republic, Denmark, France, Germany, and Italy) finds positive causal effects of these laws on some aspects of cognitive functioning such as better memory and verbal fluency [9]. Effects appear to be stronger for men than women, leading to speculation that the protective effect of education on cognition for men works via an increased probability of being employed and also delayed retirement. For women, it may work via higher rates of marriage and fertility, which are both more likely for women who receive more schooling. If so, then the compulsory schooling laws of the post-war period may act to reduce the incidence of dementia in coming years.

An additional factor that appears to exert some influence upon results is whether the unit of observation is an individual person or the average from a small group of people (a cell). Results for cell-level data generally show more of an effect [1], [6], but these are ecological inferences, that is, inferences about individual behavior drawn from data on aggregates, even if there may be quite a high degree of disaggregation. Such studies can, however, be susceptible to an ecological fallacy, a form of aggregation bias whereby if an effect is observed for a group, it is assumed that it also holds for the individual.

A study that examined the England and Wales schooling reforms of 1947 and 1972 (the first of which raised the school leaving age from 14 to 15 and came into effect on April 1, 1947, and the second of which raised it to 16 and came into effect on September 1, 1972), employed an unusually precise RD approach [10]. Since the authors had information on month of birth, this offered a very sharp discontinuity between those affected (the treatment group) and not affected (the control group) by the reform. Thus, treatment and control groups were born only one month apart, and so would almost certainly have been subjected to the same set of contemporaneous factors affecting health. Using a combination of individual- and cell-level data, the authors find no effect of the reforms on mortality.

An alternative research strategy to the IV or RD approaches is the use of twin studies. In these studies, the effects of educational differences within twin siblings on subsequent mortality are examined. Analysis within twin pairs controls for early environmental factors for non-identical twins and in addition for genetic factors in the case of identical twins. Evidence using Danish registry data for same-sex twin pairs born between 1921 and 1950

finds very little effect of educational differences on mortality, with the exception of males born between 1921 and 1935 [11]. This may be evidence of an incarceration effect (see below).

Of the studies that appear to have the strongest research design, two studies find no effect [8], [10], while another finds quite a strong effect on mortality, though only for older men [5]. However, within this category of older men, the study with the tightest RD design finds no effect [10]. It is also noteworthy that an influential US study, which found large mortality effects using cell-level data and an IV strategy, failed to find effects using individual-level data and the more robust RD approach [1]. Thus, for those studies with the most robust research design, the balance of evidence is for little or no effect of educational reforms upon health.

Finally, for those studies that do find a causal effect, it appears that the effects may not be homogenous across gender and socio-economic status. For example, the Dutch and German studies find effects for men only [5], [7], while there is evidence for Sweden that effects are greater for lower socio-economic groups [12]. This reflects a more general point, which is that different compulsory schooling laws may have affected different groups at different times. Thus, even if convincing evidence could be found that a specific reform did produce health benefits, that is no guarantee that such a result could be replicated elsewhere.

Making sense of conflicting evidence

The evidence is so far conflicting with respect to the presence of a causal effect from education to health, though there do seem to be some common factors where effects are found. Is it possible to come to a coherent conclusion in the face of these seemingly contradictory results? First of all, each of these schooling reforms, and their effect upon health, must be seen as context dependent, that is, they must be evaluated in terms of the specific local circumstances in which they were applied at the time. This may explain why earlier reforms find effects, and why such effects are found more often for men. Earlier reforms typically had high compliance, and in some cases the reforms increased schooling by more than a year. Since men in that era typically had greater labor market opportunities outside of school it is likely that schooling reforms forced more men to stay on at school than would have been the case for women, more of whom would have voluntarily stayed on.

Earlier reforms may also have been effective due to an "incarceration effect." For example, earlier reforms in countries such as the Netherlands had the effect of keeping young males in school for longer periods, and thus away from the alternative, which was often tough physical labor, all the more so for males of lower socio-economic background. This can be viewed as a (benign) form of incarceration, and may also explain why the UK reforms of 1947 and 1972 show less of an effect, since the alternative to not being in school in those cases may have had less severe health consequences than in the Netherlands example. The phenomenon of an incarceration effect is also consistent with the fact that for some school reforms, there was little or no change in the curriculum [6], reducing the possibility that extra education led to increased knowledge, which, in turn, might have led to health benefits. This is also supported by the relative lack of an effect of compulsory schooling reforms on health behaviors (such as smoking).

However, if the effects that have been discovered so far are due to an incarceration effect and the removal of young men from physically demanding labor, then the policy implication is that health benefits of further compulsory schooling laws are unlikely to be seen for advanced industrialized countries, where heavy physical labor in areas such as agriculture has all but vanished. For developing countries, however, compulsory schooling may yet bring health benefits.

Thus, while some studies show effects, it seems fair to say that the case so far is unproven. However, the evidence reviewed in this article has referred to the possible causal effect of a fairly specific educational reform, that is, the effect of one or two extra years of compulsory education in early to mid-teens. The absence of clear evidence for a health benefit of such a reform does not imply that extra education at other stages of the life-cycle would not have positive health benefits. For example, it is quite plausible that increased tertiary education may lead to greater efficiency in both the choice and use of health inputs. It may also enhance qualities such as patience, which in turn may lead to greater health investments.

LIMITATIONS AND GAPS

Empirical results show that it is still not entirely clear-cut as to whether there is a causal effect from education reforms to health. Even in those cases where an effect has been observed, there is still some ambiguity as to the precise mechanism underlying the effect. For instance, most of the reforms that have shown effects included relatively little change in the educational curriculum, suggesting that the observed effects are unlikely to be related to the specific knowledge that students gain while in school. Hence, it may be that simply staying in school reduces an individual's exposure to adverse health shocks and conditions. It may also be that the extra years of education enable the existing curriculum to be covered in greater depth or detail. Lack of the precise mechanism at work constitutes a clear knowledge gap on the subject.

An implication of this knowledge gap is that the general applicability of these policies is reduced. Confusion over why reforms may (or may not) provide health benefits increases the risk associated with implementing such a policy, though of course there may be non-health benefits associated with the policy, and indeed, these will likely be the principal reason for introducing this type of policy in the first place.

A further limitation involves the frequency of and scope for schooling reforms such as raising the school leaving age. Unlike more conventional policies, which may be changed on a year-to-year basis, changes in compulsory schooling laws are typically only introduced at long and infrequent intervals, and ultimately there is a limit to their introduction, since it is not plausible that students be compelled to stay in school indefinitely. Most countries in western Europe introduced one, or at most two, such reforms in the last 100 years. Thus, these reforms are not part of the conventional toolkit that policymakers have at their disposal.

Finally, the research design employed in most of these studies is IV or RD. This implies that whatever effects are detected will only be for those actually affected by the reform, that is, those who would have dropped out of school earlier had the reforms not been introduced. This effect (the local average treatment effect, LATE) will typically differ from the average effect, since the latter also includes individuals who would have stayed on in

school, regardless of the reform, although in the case of the UK reform of 1947, the two effects will be close, since it affected such a large portion of the population [10]. In general, it appears that those most affected by compulsory schooling reforms are individuals with high rates of time-preference, since individuals with low rates of time-preference (i.e. more forward-looking people) would probably have stayed on voluntarily anyway [13].

SUMMARY AND POLICY ADVICE

Overall, the results from using compulsory schooling reforms as a means of identifying a causal effect from education to health are ambiguous. Effects are found in some cases, but not in others. After trying to adjust for the quality of data and research design, the evidence, on balance, seems to be tentatively against such a causal effect. There are some factors that appear to be correlated with the presence of health benefits, such as the timing of their introduction, with early reforms showing most effectiveness, but overall results appear to be time, country, and context specific.

The fact that results appear to be so context specific poses problems for policymakers. If they hope to bring about an improvement in health via an educational reform that increases schooling years, they need to be very careful with respect to the setting in which the reform will be implemented. In some cases, for simple historical reasons it may not be possible to replicate optimal conditions from earlier times, since it may already be the case that most individuals are staying in school up to age 16 and beyond, and labor market conditions outside of school are no longer so unhealthy. For many countries, it may be that the low-hanging fruit, so to speak, has already been picked, and further compulsory schooling reforms would be unlikely to provide additional health benefits. This is less likely to be the case for low-income countries, where modest educational attainment levels and less healthy labor market conditions seem to allow for a greater chance of receiving a health dividend from educational reforms.

For other countries, the safest conclusion is that policymakers would be unwise to expect an automatic accrual of health benefits from educational reforms, especially when considering compulsory reforms that increase the quantity of schooling. If such reforms are to be introduced in middle- and high-income countries, the decision to do so should be based on their educational, as opposed to their health, merits.

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Competing interests

The IZA World of Labor project is committed to the *IZA Guiding Principles of Research Integrity*. The author declares to have observed these principles.

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