



Research Article

Dynamic Association between Completion of Post-secondary Education and Female Life Expectancy in Developed Countries

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Abstract

Purpose: To investigate the relationship between changes in educational attainment and improvements female life expectancy across a range of high income countries. **Method:** We examined changes in female life expectancy between 1980 and 2007 using data on life expectancy from the Human Mortality Database collaboration between the Max Planck Institute for Demographic Research and the University of California, Berkeley. Changes in educational attainment for the same years were obtained from the Educational Testing Service report on the American Skills Challenge. **Results:** Using country as the unit of analysis, increases in educational attainment were strongly correlated ($r=0.85$) with increases in female life expectancy. Each 16% increase in the proportion of the female population with a post-secondary degree results in a one-year increase in female life expectancy. **Conclusions:** At the aggregate level, increases in educational attainment are strongly correlated with improvements in female life expectancy. Investments in public education may be an important companion to health care for achieving improved population health. However, establishing the causal relationship between education and health remains a significant methodological challenge.

Keywords: Educational attainment; Life expectancy; Demography; Population health; International health

Introduction

Over the last several decades the United States has systematically lost ground in life expectancy gains in relation to other developed countries [1]. Although life expectancy for Americans has increased since 1980, the rate of increase lags behind that of other developed countries. A recent report by the National Research Council suggested that American life expectancies, which were close to the middle of the distribution among rich countries three decades ago, are now the lowest among comparison countries [2].

A wide variety of studies show a systematic relationship between years of education completed and life expectancy [3-5]. These relationships are particularly strong among women. However, establishing a causal relationship between education and life expectancy has been elusive.

This note considers the relationship between improvements in educational attainment and improvements in life expectancy across a sample of high-income countries. Because the effect is most pronounced for women, we focus on female life expectancy.

Method

Data on female life expectancy between 1980 and 2007 were obtained from the human mortality database (<http://www.mortality.org>). Comparison countries were selected to match those used in the National Academies report on life expectancy across countries [6] with the addition to South Korea. South Korea was added because it has gained significant attention for demonstrating large increases in post-secondary education. To estimate changes in educational attainment, we used data

reported in the Educational Testing Services *American Skills Challenge* which was published in early 2015 [7]. The report considered the proportion of each population that had earned a post-secondary degree in two age groups: 55-64 years and 25-34 years. Although the analysis was cross-sectional, the increase in post-secondary degrees in the younger age group represents a change in higher education attainment over one generation.

Results

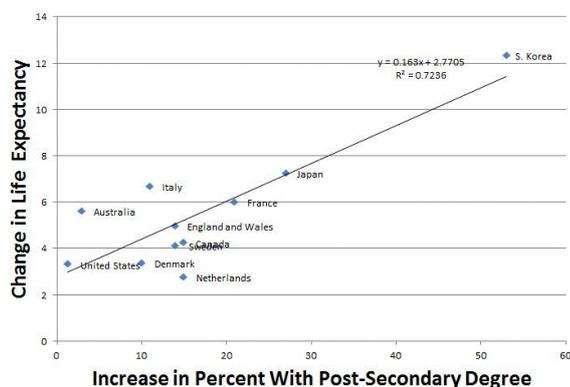
Across all comparison countries, the mean percentage of the population with a post-secondary degree was significantly higher for the 25-34 year old members of the populations (44.30, SD 16.2) in comparison to the 55-64 age group (27.55, SD=19.09) ($P<0.05$). The percentage with a post-secondary degree in the 55-64 age groups varied from 10% (Italy) to 41% (Canada and US tied). In the younger age group, the percentage with a post-secondary degree ranged from a low of 21% (Italy) to a high of 65 (South Korea) in 1980.

The US showed the smallest difference between older and younger post-secondary degree holders (1.3%), suggesting that degree attainment did not change across generations. At the other end of the continuum, South Korea witnessed a 53% difference between older and younger citizens in post-secondary degree completion.

Female life expectancy in 1950 ranged from 55.5 years (South Korea) to 72.44 years (Sweden). By 1980, it ranged from 70.4 years (South Korea) to 79.14 years (Netherlands). In 2007, life expectancy ranged from 80.78 years (US) to 85.98 years (Japan). Between 1980 and 2007, female life expectancy increased by 3.3 years for US women (low end of

range) to 12.33 years in South Korea (high end of range).

Figure 1 summarizes the analysis. The x-axis is the increase in the proportion of each population obtaining a post-secondary degree while the y-axis is the change in life expectancy between 1980 and 2007. The relationship is strong and linear ($r = 0.85$, $p < 0.01$). The analysis suggests that each 16% increase in the proportion of the population with a post-secondary degree results in a one-year increase in female life expectancy. One concern is that South Korea is an outlier that could have inflated the correlation. Removing South Korea attenuated the correlation, but with it removed, the correlation was still strong and linear ($r = 0.66$, $p < 0.01$).



Data on life expectancy from Data from Human Mortality Database (<http://www.mortality.org>). Education data are from educational Testing Service American's Skill Challenge 2015. The X Axis is based on the difference between postsecondary degree holders among those 25-34 years of age and those 55-64 years of age in 2010.

Figure 1: Change in female life expectancy between 1980 and 2007 as a function of increases in the percent of population with a tertiary degree.

Discussion

The relationship between educational attainment and life expectancy is strong and linear. We invest significantly in healthcare with the goal of improving life expectancy. Yet many healthcare investments have only minimal impacts on life expectancy [8]. For example, managing high blood pressure might add only about eight months to life expectancy [9] while mammography screening might add only about one month [10].

One recent meta-analysis of 39 common medical screening tests used to detect 19 diseases suggested that the tests have very little effect on how long people live [10]. Gains in population life expectancy attributable to medical intervention range from about one month to one year [11]. In contrast, the difference between obtaining a graduate degree and having less than a high school education has been estimated to be about 10 years in life expectancy [12].

There are numerous limitations in this analysis. The countries used in the analysis are selected and were chosen because they were used in previous international comparisons (with the exception of South Korea). One of the major challenges is that it is almost impossible to determine whether

the correlation between life expectancy and educational attainment is causal.

Although the analysis is correlational, other arguments hint at a causal connection between educational attainment and life expectancy. This analysis considers dynamic relationships by evaluating changes in life expectancy as a function of changes in educational attainment in wealthy countries. Pickett et al. [13] reviewed the epidemiologic framework for establishing causation in observational studies. The relationship between educational attainment and life expectancy fits a causal pattern for most of these criteria. For example, the relationship is consistent across a wide variety of methodological approaches and geographical settings [14].

The relationship meets a temporality criterion because, as suggested in the current study, gains in life expectancy follow increases in educational attainment. A strength of association criterion is supported by very strong association observed in a variety of studies [15,16]. The dose-response criterion is evidenced by this study, which suggests that greater changes in educational attainment are associated with larger increases in life expectancy.

Another finding in this study suggests that cessation of exposure may have turned off the effect. For example, life expectancy in the United States increased in the first part of the 20th century as educational attainment increased. But, over the last generation, a steady-state in the proportion of the population with a post-secondary degree was associated with very modest changes in life expectancy. The association is also coherent with other evidence.

The association is also consistent with other evidence. For example, greater educational attainment is associated with better numeracy, ability to follow complex instructions [7], and a variety of health habits known to promote health [17]. Although confounding factors such as income and socioeconomic status are strong rival explanations, the association between educational attainment and life expectancy remains after statistical adjustments for demographic factors, income, biologic factors, and health behaviors [18].

It is important to recognize that many other factors may correspond to changes in educational attainment and it is likely that a third variable could explain the increases. Clearly, causation cannot be established in observational studies. But, a plausible argument for causation might be advanced.

Another concern is that the results represent an ecological fallacy in which there is a correlation at the aggregate country level but not within countries. This explanation seems unlikely because a variety of studies show strong correlations between education attainment and life expectancy within countries [3].

In summary, despite clear limitations, the findings suggest that the associations between increased spending on education and improved female life expectancy may be worthy of continuing investigation.

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