Education and Mortality: Evidence from Historical Compulsory Schooling Laws in Canada

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A large literature across the social sciences documents the well-known positive correlation between educational attainment and health outcomes. Whether or not the relationship is causal is subject to considerable debate. A number of studies (e.g. Lleras-Muney, 2005; Oreopoulos, 2006; Mazumder, 2008; Meghir, Palme and Simeonova, 2012; Clark and Royer, 2013; Gathmann et al. forthcoming) use compulsory schooling laws as a source of exogenous variation in educational attainment and find mixed results. Lleras-Muney (2005) and Oreopoulos (2006) find large effects of attained schooling on adult health and mortality. On the other hand, Mazumder (2008), Meghir, Palme and Simeonova (2012) and Clark and Royer (2013) find that extra schooling induced by compulsory education laws has little impact on adult health and mortality. However, and importantly, very little evidence exists on the pathways through which eduction might improve health.

This study makes two major contributions. First, it uses abrupt, unexpected changes in Canada's compulsory schooling laws early 20th Century to estimate the relationship between schooling and age-specific mortality throughout the life course. This approach is attractive given both the substantial changes in educational attainment under the laws and the unusually high importance of education for health in pre-epidemiological transition populations (like the historical Canadian context). By mandatorily changing maximum school entry age (eg. from 6 to 7 years old) and minimum school leaving age (eg. from 14 to 15 years old), these compulsory schooling laws forced individuals at schooling age to get more schooling than they would have chosen otherwise. Previous work has shown that individuals affected by these laws have higher income in adulthood (Oreopoulos, 2005).

Second, it uses a novel approach to distinguish the importance of economic and non-economic channels through which education may improve survival. By also estimating variation in the economic return to education across geographic and demographic groups, we are able to then test for comparable patterns of heterogeneity in population health improvement - separating the role of economic and non-economic channels (like efficiency in absorbing health related information from one's environment in the wake of new health knowledge produced by the Bacteriological Revolution).

We use the 1941 Canadian Census (restricted use) to obtain individual educational attainment. We focus on cohorts born 1959-1916 in eight Canadian provinces: Ontario, British Columbia, Prince Edward Island, Nova Scotia, New Brunswick, Saskatchewan, Alberta and Manitoba. We use the number of years one spent in school to measure educational attainment. Our analysis sample is by birth province and birth cohort. Years of schooling at the province-birth cohort level ranges from 0 to 16. To examine the effect of education on adult mortality, we also obtain vital statistics at the province-birth cohort level from 1921-1997 from the Canadian Human Mortality Database. We can also look at education and mortality by gender.

In our empirical analysis, we use the change in the minimum school leaving age as the instrument for years of schooling. For example, when the minimum school leaving age was increased from 14 to 15 in British Columbia in 1921, individuals born in 1907 or later had to stay in school until 15 to drop out, while those born in 1906 or earlier were able to drop out at 14. We then track birth cohort in the vital statistics data from 1921-1997 to estimate the effect of extra schooling on overall mortality and age-specific mortality (e.g., under 50, 50-60, 60-70, 70-80). Moreover, we explore the mechanisms through which education affects mortality. We take advantage of the heterogeneity in the effect of education on labor market outcomes by gender and geographical location. If the income channel plays an important role, one would expect larger mortality effects where the return to education in higher.

Our preliminary findings are presented in Table 1. We find that a law that required students to stay in school until age 15 (rather than 14) increased the total years of education for the affected birth cohorts by 2.2 years. The first stage is precisely estimated. In the second stage, we find that extra schooling induced by these compulsory education laws significantly reduced mortality rates over age 50. One additional year of schooling decreased the mortality rate in the 50-60 age group by 0.0002 percentage points. Relative to the average mortality rate of 0.01 at age 50-60, this effect is equivalent to a 2% decrease in mortality in this age group. The effect of schooling on mortality is larger in older age groups. We found a 3% decrease at age 60-70 and a 1.8% decrease at age 70-80. Moreover, we find that the effect of education on reducing mortality is larger for men than for women.

Turning to mechanisms, we find that extra schooling significantly improved labor market performances. In the 1941 census year, one more year of schooling increases the probability of being employed, hours of work and weekly wage. Returns to education in the labor market are larger and more precisely estimated for men than for women. To better understand the mechanisms, we are further exploring the heterogeneity in return to education by geographical location, as well as heterogeneity in other relevant outcomes, e.g. marriage market sorting and fertility choices.

Our study complements the existing literature in several ways. First, it is the first study to use the historical compulsory laws in Canada to study adult mortality. Different from previous studies that used more recent laws and found no or negligible effects (Mazumder 2008, Meghir, Palme and Simeonova, 2012, and Clark and Royer, 2013), our study shows that compulsory school laws in the early 20th Century had significantly reduced adult mortality in Canada.

Second, one unique feature of our mortality data is that we had records of mortality rates for each birth cohort over a total of 76 years, which allowed us to continuously track birth cohorts as they age. Observing mortality rates for birth cohorts year by year not only increase the robustness of the analysis, but also enable us to generate a set of results with time trends. Different from Meghir, Palme and Simeonova (2012) which finds a short-live gain in expected years of life in 45-50 but a shift in mortality in 50-55, our findings show that, over age 50, extra schooling consistently reduces mortality as people age.

Lastly, our study will shed light on the mechanisms through which education affects mortality, such as labor market performances, marriage market and fertility, etc. These findings will help to disentangle the direct resource channels from non-economic and cognitive channels.

References

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Table 1: **Effects of education on mortality rate**

	All Ages	below 30	30-40	40-50	50-60	60-70	70-80
Panel A: OLS							
$\bar{yrsch}$	-0.0004	0.0002	0.00005	0.00005**	-0.00007**	-0.0001*	-0.0004***
	(0.0008)	(0.00005)	(0.00003)	(0.00002)	(0.00003)	(0.00006)	(0.0001)
Panel B: 2SLS (instrument: dropout age at 15)							
			Second-stage				
$\bar{yrsch}$	-0.001	0.0005***	0.0001*	0.0001***	-0.0002***	-0.0006***	-0.001***
	(0.0008)	(0.00007)	(0.00005)	(0.00003)	(0.00005)	(0.0001)	(0.0001)
			First-stage				
dropout age = 15	2.21***	0.945***	1.39***	1.88***	2.25***	2.33***	2.33***
	(0.20)	(0.11)	(0.13)	(0.18)	(0.20)	(0.21)	(0.21)
Panel C: Reduced Form							
dropout age = 15	-0.002	0.0004***	0.00015*	0.0002***	-0.0005***	-0.001***	-0.002***
	(0.002)	(0.0001)	(0.0001)	(0.00006)	(0.0001)	(0.0002)	(0.0004)

Notes: Estimation uses the observations who were born between 1859 and 1916. The dependent variable is mortality rate in gender-age-birth cohort-province cells. The independent variable, $\bar{yrsch}$, is the average years of schooling of each gender-birth cohort-province cell. All regressions control for birth cohort dummies, provinces, and gender. Standard errors are clustered by birth cohorts.