The educational shock: a natural experiment enlightening mechanisms behind educational inequalities in young-adult mortality between the 1990s and the 2000s in Belgium

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Introduction

Population health has made remarkable steps forward in the last century in most industrialised countries. Driven by improved living conditions and lifestyles, medical breakthroughs and rising levels of education, life expectancy rose at an inconceivably fast pace, with a mean age of 77.5 years for men and 83.1 years among women in the EU28 in 2012 (Eurostat 2014). Despite this general progress strong health inequalities still exist, and the Black Report (Townsend, Davidson & Whitehead, 1992) gave the initial impetus to unravel social determinants in morbidity and mortality (Braveman, Egerter & Williams 2011; WHO, 2013}. An opposing mortality trend is observed: while absolute mortality differences have declined in the last decennia, relative differences remain high (Mackenbach et al., 2014).

These persisting inequalities are in conflict with conventional wisdom concerning the positive effects of educational expansion in the last decades, including improving the economic welfare and health situation (Hannum & Buchmann, 2005). A gradual expansion of schooling has been taking place in the twentieth century, supported through a set of reforms on different levels of the educational system (Walters, 2000), with the implementation of compulsory education as one of the most important acts to educate the total population. Belgium was one of the latest European countries to implement compulsory education in 1914. This meant being obliged to attend school between the ages of 6 and 14, and was gradually implemented in the subsequent years (Garrouste, 2010). Belgium finally extended the compulsory age from 14 to 18 in 1983, which was quite unique compared to other European countries, generally not extending it above the age of 15/16 (Fort, 2006; Brunello, Fort & Weber, 2009).

In most countries educational attainment increased substantially after these implementations (Fort, 2006; Clark & Reyer, 2013). After World War II enormous expansion of higher education began both in the United States as in Western Europe {Hurn 1978}. There is a general consensus on the positive effects of compulsory education on educational attainment (Gathmann, Jürges & Reinhold 2014). The direct positive impact it has had on health and mortality is however still debated, with some studies finding strong influences on mortality (Lleras-Muney, 2005; Van Kippersluis, O'Donnell & van Doorslaer, 2011), while others only find negligible effects (Clark & Reyer, 2013; Albouy & Lequien, 2009; Gathmann et al., 2014). Regional differences, time-specific circumstances and different data sources obscure a correct comparison. Gathmann et al. (2014) is closest to overcoming these shortcomings through country-comparisons with the same data source. None of these studies, including Gathmann et al.

(2014), however made use of individually-linked mortality data of the total population, which can overcome shortcomings of earlier studies.

We put to test if the 1983 educational reform in Belgium influenced the educational distribution and the young-adult mortality rates with census data individually linked to death and emigration records. Young adults who attended school prior to the reforms are selected in the 1991 census, while the same age group in the 2001 census is selected and experienced the last educational reform. We analyse the trends in educational inequalities in mortality between these two cohorts through mortality follow-up in 1991-1995 and 2001-2005.

Data & Methods

Data are derived from two Belgian censuses linked to death and emigration records of the national registry. These sources provide exhaustive information on the official population living in Belgium at the time of each census collection (01/03/1991 and 01/10/2001). Follow-up is possible due to linkage with national register data on deaths and emigrations for the respective periods 01/03/1991-01/03/1995 and 01/10/2001-01/10/2005. These data overcome common numerator-denominator problems (Clark & Royer, 2013) and other biases from research using compulsory education reforms (Gathmann et al., 2014). The cohort is semi-closed; no new entries (immigration or birth) are taken into account.

We restrict analyses to young adults born between 1959 and 1968 for the 1991 census and young adults born between 1969 and 1978 in the 2001 census. As Albouy & Lequien (2009) put forward, the effect of compulsory education can be verified best for birth cohorts close to the reform. The first birth cohort affected by the 1983 reform was born in 1969. Those born between 1959 and 1968 (aged 22-32 years in the 1991 census), were all enrolled in the old system with compulsory education until the age of 14, while the birth cohorts of 1969 until 1978 (aged 22-32-year in the 2001 census) became 14 after the implementation of the reform. This makes these groups ideally suited to discern the effect of the educational reform. In order to evaluate the additional impact of the introduction of compulsory education until the age of 18 compared to the general effect of the democratisation of education, older adults in both periods are selected and their mortality compared. These older adults are corresponding to birth cohorts of 1949-1958 (aged 32-42 in 1991 census) and 1959-1968 (aged 32-42 in 2001 census) and all obtained their educational degree before the 1983 reform.

Educational level is categorised in three groups, following the ISCED-classification (UNESCO, 2011): 1) up to lower secondary education (LOW; isced 0-2), 2) upper secondary education (MEDIUM; isced 3-4) and 3) tertiary education (HIGH; isced 5+). Missing values on education are included as separate categories in the analyses.

Both relative and absolute inequalities in mortality are calculated. We computed *age-standardised mortality rates* (ASMRs) per 100,000 person years, using the 2001 Belgian population as standard population. Absolute mortality decline is calculated. Subsequently, relative mortality decline is calculated by dividing the absolute mortality decline in the 2000s by the ASMR in the 1990s. To identify which share of the

differences between mortality rates in 1991-1995 and 2001-2005 is attributable to differences in the educational distribution of the young population in 1991 and 2001, the decomposition technique was used, analogous to Preston, Heuveline and Guillot (2001) and first applied by De Grande, Vandenheede & Deboosere (2014).

The following equation is calculated:

$$\Delta = ASMR^{1991} - ASMR^{2001} =$$

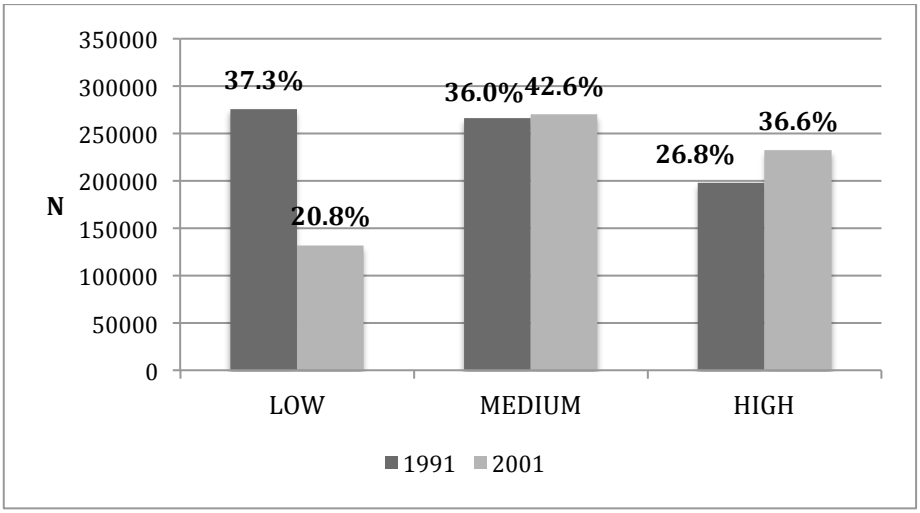
$$\sum_i (C_i^{91} - C_i^{01}) \times \left[\frac{M_i^{91} + M_i^{01}}{2}\right] + \sum_i (M_i^{91} - M_i^{01}) \times \left[\frac{C_i^{91} + C_i^{01}}{2}\right]$$

with C_i as the proportion of each educational level (i) per period and M_i as the corresponding age-specific mortality rate of each educational level for both periods . This corresponds to the difference in educational composition multiplied by the weighted average of age-specific mortality plus the differences in mortality rates multiplied by the weighted average of the educational composition. The first part of the equation represents the contribution of educational compositional differences, while the second part indicates the contribution of change in education-specific mortality rates over time. Dividing these contributions by the total difference in mortality between the two periods gives us the proportion of difference attributable to a change in educational distribution and the proportion of difference attributable to an overall change in mortality. The distribution of educational levels in the young population was calculated exclusive of missing values on this variable.

Results

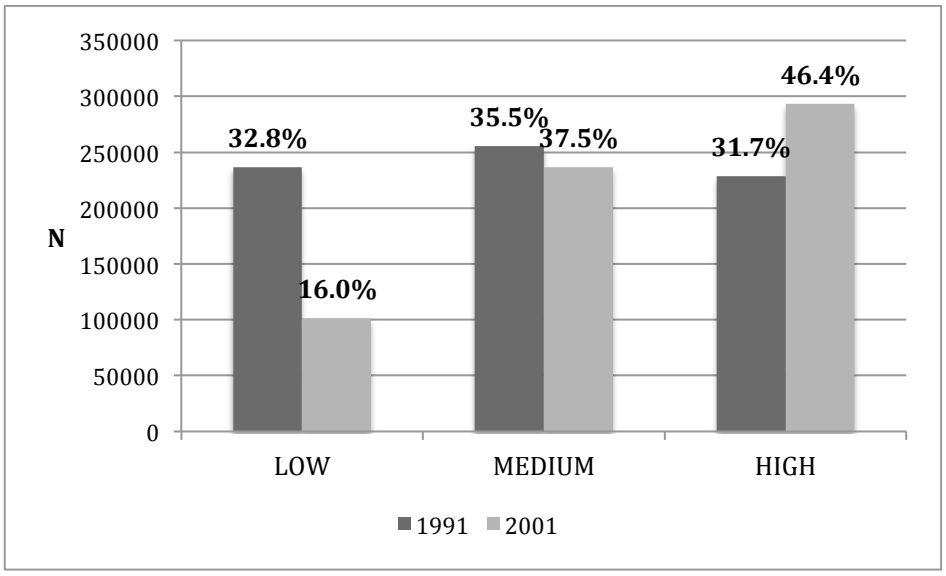
The major shift in educational attendance is illustrated by the increased proportion of young adults at least finishing upper secondary education (Figure 1A&B): from two thirds in 1991 to four fifths in 2001. A higher percentage pursued higher education: from 26.8% in 1991 to 36.6% in 2001 for men (Figure 1A), and an increase towards 46.4% among women (Figure 1B).

Figure 1A: Number (N) and distribution (%) of young MEN per educational category in 1991 and 2001



$N_{total\ 1991\ men}$= 740,326 (1959-1968 birth cohorts); $N_{total\ 1991\ men}$= 634,147 (1969-1978 birth cohorts), excluding missings on education

Figure 1B: Number (N) and distribution (%) of young WOMEN per educational category in 1991 and 2001



$N_{total\ 1991\ women}$= 719,991 (1959-1968 birth cohorts); $N_{total\ 1991\ women}$= 631,172 (1959-1968 birth cohorts), excluding missings on education

Young-adult mortality decreased considerably over time, both among men and women. There was an overall relative decrease in mortality of 21,6% among men and 21,3% among women. The absolute mortality difference over time was highest among men (28,8 deaths per 100,000 compared to 11,3 among women). Mortality among men is 2,5 times higher than among women in both periods. After decomposition, we found that 47% of the mortality decline was attributable to a change in educational composition, while the remaining 53% was due to declines in mortality per educational category, both in men and women.

The overall improvement in mortality is not translated towards a similar mortality decline for all educational groups (Table 1). Absolute mortality declines were observed in all educational levels. Relative mortality declines were however highest among the highest educated (e.g. -43.8% among higher academic educated men and -32.6% among women). A clear and pronounced gradient in young-adult mortality remains among men and women: as educational level increases, mortality decreases.

Table 1: Age-Standardised Mortality Rates (ASMR) per 100,000 person years (PY) of young adults (22-32 yrs) according to educational level, absolute and relative mortality difference between 1991 and 2001 and decomposition measure

		1991-1995			2001-2005			Difference$_{2001-1991}$		Decomposition	
		PY	ASMR	CI	PY	ASMR	CI	Abs.	Rel.	C	M
MEN	LOW	1,092,655	175.9	[168.0-183.8]	522,231	158.6	[147.7-169.5]	-17.3	-9.8		
	MEDIUM	1,059,232	113.4	[106.8-120.1]	1,072,961	102.4	[96.4-108.5]	-11.0	-9.7		
	HIGH	779,425	71.0	[64.8-77.2]	915,872	46.7	[42.3-51.1]	-30.5	-43.8		
										0.47	0.53
WOMEN	LOW	936,849	65.8	[60.6-71.1]	402,159	60.9	[53.1-68.6]	-4.9	-7.4		
	MEDIUM	1,016,839	47.0	[42.5-51.4]	941,991	40.0	[35.9-44.0]	-7.0	-14.9		
	HIGH	901,975	39.6	[32.3-40.8]	1,157,798	28.0	[24.9-31.1]	-11.6	-29.3		
										0.47	0.53

Educational level: low (primary education + lower secondary education), medium (upper secondary education), high (tertiary education)
CI: 95% confidence interval
Decomposition: C is proportion change attributable to change in educational composition, D is proportion change due to general mortality decline

The increasing educational attainment clearly influenced young-adult mortality. The question remains however if the increased compulsory age had an additional impact on top of the on-going larger participation in higher education and of the general trend in improving health? In Table 2 ASMRs for older adults attending school before the educational reform are shown, and shows us that the democratization of education indeed also impacted on mortality before increasing the compulsory school age. We observe a trend towards a higher share with a higher education degree (although less than the younger generation in Table 1), and much lower mortality in the 2000s compared to the 1990s. Decomposition shows that 40% of the mortality decline is due to changes in the educational composition of the adult population over time among men, and 38% among women. Mortality declines among birth cohorts affected by the last educational reform were thus slightly more due to a change in educational composition than before the reform.

Table 2: Age-Standardised Mortality Rates (ASMR) per 100,000 person years (PY) of older adults[1] according to educational level, absolute and relative mortality difference between 1991 and 2001 and decomposition measure

		1991-1995			2001-2005			Difference$_{2001-1991}$		Decomposition	
		PY	ASMR	CI	PY	ASMR	CI	Abs.	Rel.	C	M
MEN	LOW	1,336,872	259.5	[250.6-268.5]	1,002,456	228.3	[219.0-237.5]	-31.2	-12.0		
	MEDIUM	787,810	190.8	[180.5-201.0]	1,053,858	153.1	[145.6-160.7]	-37.7	-19.8		
	HIGH	608,797	126.9	[117.4-136.4]	897,263	84.6	[78.6-90.7]	-42.3	-33.3		
										0.40	0.60
WOMEN	LOW	1,343,549	143.2	[136.6-149.8]	889,494	117.8	[110.7-124.9]	-25.4	-17.7		
	MEDIUM	735,336	109.3	[101.1-117.6]	1,030,727	90.1	[84.3-95.9]	-19.2	-17.6		
	HIGH	589,153	93.4	[84.8-102.0]	1,015,929	63.4	[58.5-68.4]	-30.0	-32.1		
										0.38	0.62

[1] birth cohorts of 1949-1958 (aged 32-42 in 1991 census) and 1959-1968 (aged 32-42 in 2001 census)
Educational level: low (primary education + lower secondary education), medium (upper secondary education), high (tertiary education)
CI: 95% confidence interval
Decomposition: C is proportion change attributable to change in educational composition, D is proportion change due to general mortality decline

Discussion & Conclusion

We observed a general positive trend towards higher educational attainment and substantial lower mortality in the cohort succeeding the educational reform of 1983.

This trend is found in men and women. Mortality did however not significantly decrease in each educational group, with more stable or increasing mortality for the primary and lower secondary educated young adults and strongest declines among the highest educated, leading to persisting inequalities over time. Decomposition showed that around half of the decline is attributable to changes in the educational composition. The other half is due to declines in each educational category, meaning that health in general has improved in all educational groups. Mortality also significantly declined among older generations that did not experience the last educational reform, which demonstrates that the democratization of education in general pays off in terms of health gains. Mortality declines among birth cohorts who had to attend school until 18 years were slightly more affected by the change in educational composition than the older birth cohorts, which might point towards an additional effect of the reform.

The lowest educated become a smaller and more selective group with high mortality risks which calls for the need of increased youth care and support. As Mackenbach (2012) points out, it is likely that the widening or persisting inequalities over time are largely a consequence of the democratization of education. This system helped more students towards higher education and left the lowest educational strata mainly composed of individuals with personal characteristics that increase health risks.

Fortunately, the results also underline positive evolutions over time, with an expanding higher educated group showing further declining mortality. This is in line with research conducted in the general adult population (Deboosere et al., 2009), and shows that there is no dilution of education over time. The long-term effects of educational investments cannot be denied. As a recent article on increased participation in higher education concluded (Kulhánová et al., 2014): further improvements in educational attainment are still possible and can lead to substantial health gains.

References

Albouy,V. & Lequien,L. (2009). Does compulsory education lower mortality? *Journal of Health Economics*, 28(1), 155-168.

Braveman, P., Egerter, S., & Williams, D. R. (2011). The social determinants of health: Coming of age. *Annual Review of Public Health*, *32*, 381-398.

Brunello, G., Fort,M. & Weber,G. (2009). Changes in compulsory schooling, education and the distribution of wages in Europe. *The Economic Journal,* 119, 516-539.

Clark,D. & Royer,H. (2013). The effect of education on adult mortality and health: the case of Britain. *The American Economic Review*, 103(6),2087-2120.

Deboosere, P., Gadeyne, S., & Van Oyen, H. (2009). The 1991--2004 evolution in life expectancy by educational level in belgium based on linked census and population register data. *European Journal of Population/Revue Européenne De Démographie*, *25*(2), 175-196.

De Grande, H., Deboosere, P., & Vandenheede, H. (2013). Evolution of educational inequalities in mortality among young adults in an urban setting. *International Journal of Public Health*, *58*(6), 825-835. doi:10.1007/s00038-013-0478-x

Eurostat. (2014). *Mortality and life expectancy statistics*. Retrieved on 2/4/2015 from http://ec.europa.eu/eurostat/statistics-explained/index.php/Mortality_and_life_expectancy_statistic

Fort, M. (2006). *Educational reforms across Europe: a toolbox for empirical research.* Working Paper consulted on 18/08/2014 on http://www2.dse.unibo.it/fort/files/papers/fort_reforms.pdf

Garrouste, C. (2010). *100 years of educational reforms in Europe: A contextual database.* Luxembourg: Publications Office of the European Union.

Gathmann,C., Jürges,H. & Reinhold,S. (2014). Compulsory schooling reforms, education and mortality in the twentieth century Europe. Social Science and Medicine, p1-9 (in press).
Hannum, E. & Buchmann, C. (2005). *Global educational expansion and socio-economic development: an assessment of findings from the social sciences*. World Development, 33(3), 333-354.
Kulhánová, I., Hoffmann, R., Judge, K., Looman, C. W., Eikemo, T. A., Bopp, M., . . . EURO-GBD-SE Consortium. (2014). Assessing the potential impact of increased participation in higher education on mortality: Evidence from 21 european populations. *Social Science & Medicine (1982)*, *117*, 142-9.
Mackenbach, J. P. (2012). The persistence of health inequalities in modern welfare states: The explanation of a paradox. *Social Science & Medicine (1982)*, *75*(4), 761-9. doi:10.1016/j.socscimed.2012.02.031
Marmot, M. (2013). *Review of social determinants and the health divide in the WHO European region: Final report.* Copenhagen: WHO Regional office for Europe.
Lleras-Muney, A. (2005). The relationship between education and adult mortality in the United States. *Review of Economic Studies*, 72, 189-221.
Portal Belgium (2015). The powers of the communities. Retrieved on 2/4/2015 on http://www.belgium.be/en/about_belgium/government/communities/competence/
Townsend, P., Davidson, N., & Whitehead, M. (1992). Inequalities in health: The black report and the health divide. In *Inequalities in health: The black report and the health divide.* London: Penguin Books
Van Kippersluis,H, O'Donnell,O. & Van Doorslaer,E. (2011). Long-run returns to education. Does schooling lead to an extended old age? *Journal of Human Resources*, 46(4), 695-721.
Walters, P.B. (2006). The limits of growth. In: M.T. Hallinan (ed.), *Handbook of the sociology of education*. Boston: Springer US (p241-261).
WHO (2013). *Review of social determinants and the health divide in the WHO European Region: Final report.* Copenhagen: WHO Regional office for Europe