Education and mortality in three Eastern European populations: findings from the PrivMort retrospective cohort study

ABSTRACT

Objectives. To describe changes in mortality among men and women with different levels of education in three Eastern European countries undergoing major political change (1982-2013).

Methods. Data were collected as part of the PrivMort retrospective cohort study. Participants in Russia, Belarus and Hungary provided information on the educational attainment, health-related behaviors, and vital statistics of their close relatives (n=179,691). Odds ratios (OR) for mortality and relative indices of inequality (RII) were estimated for individuals aged 20-65 between 1982 and 2013, comparing those with university, secondary and less than secondary education attainment.

Results. Those in lower educational groups were significantly more likely to die in most time periods and subgroups. The RII increased over time in all countries and both genders, except Hungarian men. Alcohol consumption and smoking have increasingly contributed to educational inequalities in mortality during this period.

Conclusion. Educational inequalities in mortality in these Eastern European countries have continued to grow during recent decades.

BACKGROUND

The collapse of the Soviet Union and subsequent political changes in Eastern European countries in the late 1980s and early 1990s were some of the most significant political and economic events of the twentieth century, with profound consequences for health.[1]. This period of rapid change brought new social and wealth inequalities. In the Soviet system, even those with minimal qualifications or skills would be in employment, which itself could provide a degree of protection for health, beyond any effect on income. However, the introduction of a market economy meant that this was no longer the case [2] as a combination of factors, including high unemployment, breakdown of public services, withdrawal of price controls on food and rent, and a decline in purchasing power, created many winners, but also many losers.

Despite everyday experience of how health inequalities widened in post-communist societies, empirical evidence on their scale and nature remains scarce. What research exists, using individual level data, has shown that education offered some protection against premature death in the post-transition period[3-9]. However, most of these studies examined a relatively short period of time, typically focusing on the first decade after the transition. Few considered the changing composition of the population[10] and the possibility that the relationship between education and mortality might have changed since the exceptional period in the early 1990s. Moreover, although there is now extensive research on the determinants of the post-Soviet mortality crisis, [13] and in particular the role of proximal risk factors such as hazardous drinking and smoking,[14] their contribution to health inequalities remains understudied.

After nearly 30 years since the transition, it timely to revisit educational inequalities in health in this region during the years of rapid social and economic change. This paper uses data from the PrivMort retrospective cohort study[15] to measure educational attainment and mortality of individuals over the last three decades using a validated indirect method of measuring mortality. Our aim was to track mortality trends across educational groups, among men and women, in three Eastern European countries (Russia, Belarus and Hungary) between 1982 and 2013, a much longer period than has been covered so far in the literature. We also examined the extent to which alcohol consumption and smoking contributed to educational inequalities identified during this period.

METHODS

Study sample and data collection

The PrivMort study was established to examine potential effects of privatization on individual-level mortality in three Eastern European countries (Russia, Belarus and Hungary) during the years of political transition in the 1990s. A detailed description of the study sample selection and data collection process has been published previously[15]. Briefly, data collection took place between January 2014 and December 2015 in 102 middle-sized towns in Belarus, Hungary and the European part of the Russian Federation. The towns included had populations of between 5,000 and 100,000 people, and were outside the catchment area of the capital cities.

Individual-level data were collected from randomly selected inhabitants in the included towns. All respondents were born before 1972 and at least one of their family members lived in the same settlement during the 1990s (overall response rate 58%). They provided information on their socio-economic circumstances, employment history, drinking and smoking. The highest level of education was classified as followed: (1) incomplete elementary education; (2) incomplete secondary education with complete elementary education; (3) complete academic secondary education; (4) complete vocational secondary education with diploma; (5) complete vocational secondary education without diploma; (6) incomplete higher education; (7) complete vocational higher education; (8) complete academic higher education. Consistent with earlier studies [8,9], we re-categorized the participants into three groups: less than secondary (original categories 1 and 2); secondary (3, 4, 5); and higher education (6, 7, 8). In addition to the respondents themselves, all the above information was also collected from their deceased and living relatives (mothers, fathers, up to two siblings and partners of female respondents). Questions on the vital status of relatives, including the year of their birth and death (if not alive), were also asked. This indirect demographic data collection technique allows us to estimate mortality rates similar to a cohort study, albeit retrospectively. In previous research, it was used successfully to assess mortality trends in Russia[8,16].

The present analyses used data on relatives only to produce unbiased estimates. They were included in the study if they were aged between 20 and 65 years at any point during the observational period, between 1982 and 2013, or at the time of their death, and had no missing

data on vital status, sex, education attainment, frequency of alcohol intake and smoking. After these exclusions, 179,691 individuals (57,560 Russians, 50,426 Belarusians and 71,705 Hungarians) were included in the analysis.

Statistical analysis

Death rates in the three educational categories were calculated using a discrete-time survival analysis method[17], with changes in mortality over time estimated separately in four distinct time periods: (1) 1982-1989; pre-transitional, (2) 1990-1997; immediate post-transitional, (3) 1998-2005; second financial crisis, (4) 2006-2013; period of relative stability. In the analyses, individuals who were between 20 and 65 years at any stage in each time period were included. Follow-up time in each period was the number of years an individual spent in the specified age range (20-65) between the first and last year of that period or the year of death, whichever came first. Life-years outside this range did not count towards the follow up time.

Death rates in the four time periods were calculated separately by sex and country. In model 1, odds ratios (OR) were adjusted for age, type of relation to respondent and sex of respondent. The latter two variables were used to control for any potential inaccuracies in reports by proxy informants.[16] In model 2, the ORs were further adjusted for smoking (never smoker; ex-smoker; regular smoker) and frequency of alcohol intake (never drinker; quit drinking; drinks few times a year; drinks 2-4 times a month; drinks daily or several times a week). The relative index of inequality (RII) was also calculated with these two models to estimate the extent of inequality in mortality by education and how it varied between countries and over time. [18-20]. One important advantage of this measure is that it takes into account the proportion of individuals in the various categories, thus eliminating any variation due to changing educational composition of the population in temporal comparisons.

All statistical analysis was carried out with the statistical software STATA 13.1 (StataCorp, Texas, US).

RESULTS

Table 1 presents the number of participants in the different educational groups by time period, country and sex. Consistent improvement in educational attainment over time is apparent; the

proportion of people with higher education increased and those with less than secondary education decreased steadily across the four time periods in all three countries and both genders. The prevalence of higher education seems to be considerably lower in Hungary compared to Russia and Belarus, which could be the result of the differences in the structure of vocational training systems between these countries.

The table also shows the proportion of individuals who drank alcohol or smoked regularly within each group. In most time periods and subgroups, the prevalence of regular alcohol consumption and smoking was lower in those with higher education but there were some cases where the gradient was unclear.

Table 2 shows the OR of mortality across educational groups, separately by time period, country and gender, with higher education as the reference category. In line with expectations, mortality rates were significantly higher in lower education groups in most time periods and subgroups. The difference between higher education (reference category) and both secondary and less than secondary education categories increases over time. Although these trends were broadly similar in all countries, there were also some notable differences. For example, we found no clear gradient in mortality across educational groups during the first and first two time periods in Russia and Belarus, respectively. Also, in contrast to the other countries and genders, ORs remained relatively stable across the four time periods in Hungarian men.

As expected, while smoking and alcohol consumption explained some of the mortality differences between educational groups in men there was very little effect among women. The reduction of ORs in model 2 (after adjusting for these lifestyle factors) increased over time, particularly among men. For example, in Russian men during the first time period (1982-1989), the odds ratio for secondary and less than secondary education groups, compared with the higher education group, fell by 31% and 33%, respectively but the gap widened to 52% and 46% in the last (2006-2013) period.

Trends in the relative index of inequality reveal that inequality in mortality among educational groups has grown considerably over the last three decades (figures 1 and 2). Except for Hungarian men, where temporal change in the extent of inequality was not obvious, the relative index of inequality has increased considerably since the early 1990s in other countries and

among women. Similar to the results of the survival analysis, smoking and alcohol consumption explained larger proportion of the inequality in men compared to women, and the reduction of RII after adjusting for these lifestyle habits seem to have increased over time.

DISCUSSION

Main findings

Using data from a large retrospective cohort study in three Eastern European countries over a 32-year period we showed that, after the socio-political changes of the early 1990s, inequalities in mortality have increased substantially among educational groups in Russia, Belarus, and Hungary. This occurred in parallel with significant improvements in educational attainment without which the observed divergence would probably have been even more prominent. The link between health-related behaviors and education is well established in literature. Therefore, if all else was equal, it is intuitive that increasing average levels of education in a society would lead to a reduction in risk factors, such as smoking or drinking, within the population. Although alternative explanations, due to the limitations of our study design, cannot entirely be excluded, these results also suggest that the extent of which unhealthy lifestyle factors, such as alcohol consumption and smoking, contribute to the educational inequalities in mortality has also increased over the last three decades.

Interpretation of results

Our results support previous findings which showed increasing social inequalities in health within Eastern European countries during the 1990s[6,8,22]. Moreover, the current study is the first one to confirm that health inequalities have continued to widen in all three countries in the decades since the political transition. The estimated ORs and relative indices of inequality are somewhat lower than in other studies [6, 23,24] which may reflect measurement bias related to the method of indirect data collection. Nevertheless, the direction of the association between education and mortality and the changes in these figures over time are consistent with previous estimates.

Despite considerable similarities in patterns of inequality across countries and genders, some notable differences between these subgroups were also observed. The diverging trends in mortality between educational groups were found to be more pronounced and consistent in Russia than Belarus and Hungary. This might be because socio-economic changes in the early/mid-1990s were more dramatic in Russia than in the other two countries, and policies which aimed to reduce social inequalities during the recovery years have been probably the least effective here. For example, other research showed that Belarus managed to retain better access to health care than other post-Soviet countries, including Russia.

The results also point to a role for smoking and alcohol consumption in the educational differentials in male mortality and, in fact, it seems that their contribution have grown over the last few decades in these countries. Although this finding is consistent with previous researchs[9], we cannot exclude the possibility that measurement bias also contributed to the observed time trend. As the data on smoking and drinking relate to what survivors are doing now and what those who died were doing just prior to death, it is possible that in the last periods the experience of survivors and decedent were better matched, which could potentially explain this finding. Further research, potentially using more diverse measures of drinking patterns (i.e.: binge drinking, type of alcohol), would be needed to clarify how the contribution of these lifestyle factors to social inequalities changed in Eastern European countries.

Strengths and limitations

Potential limitations of this study need to be considered when interpreting the results. Firstly, our samples are not nationally representative. It is possible that the distribution of drinking and smoking among educational groups observed in European part of Russia deviate to certain extent from the national level. However, in Belarusian and Hungarian sample towns were more equally distributed across countries so we expect bias to be smaller. Also, all interviews were carried in industrial towns with 5,000-100,000 inhabitants, so our findings cannot necessarily be generalized beyond such settlements.

The second potential source of bias arises from the process used to recruit relatives as informants. Our indirect estimation technique allows us to account only for a respondent's relatives who lived long enough to get married and have children, missing individuals who died

prematurely and childless. The never-married population, which could be under-represented in the survey, especially men, are believed to experience a higher risk of premature death than their married counterparts. Moreover, mortality of family members tends to follow similar patterns, so mortality among respondents' relatives is likely to be lower than in the whole population.

As with all self-reported measures, it is possible that some bias has occurred due to the moderate response rate and measurement error, including errors in reporting of deaths[15]. Testimonies of respondents reporting on year of birth and death of their relatives may not always be accurate. It is also likely that data from more recent time periods are more accurate than for the 1980s, potentially influencing the apparent change in OR over time. However, the reported educational attainment is likely to be reliable even for those who died long time ago, so this bias is more likely to affect the data on smoking and alcohol consumption. On the other hand, this study is the first to investigate changes in educational inequalities in life expectancy in Russia, Belarus and Hungary over an extended period of 32 years, from 1982 to 2013. The large sample size and the multiple indicators to estimate educational inequalities in mortality are further advantages of our analysis.

Public health implications

Our research confirms that higher education has a significant protective effect on mortality during times of instability and economic fluctuations, and that, as expected, alcohol and smoking contribute to educational inequalities in mortality.

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Competing interests

None declared.

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TABLES

Table 1. Number of individuals in the different education groups and the proportion of regular smokers and alcohol drinkers amongst them by time period, country and sex

Sex	Country	Education group	1982-1989				1990-1997				1998-2005				2006-2013			
			n	(%)	% regular smoker	% regular alcohol drinker[1]	n	(%)	% regular smoker	% regular alcohol drinker[1]	n	(%)	% regular smoker	% regular alcohol drinker[1]	n	(%)	% regular smoker	% regular alcohol drinker[1]
MALES	Russia	Higher	10,460	(35)	48	11	10,212	(38)	48	11	8,968	(43)	48	10	6,874	(47)	48	9
		Secondary	11,557	(39)	62	17	10,878	(40)	62	16	9,185	(43)	62	16	6,674	(45)	61	14
		Less than secondary	7,813	(26)	62	18	5,843	(22)	62	19	3,035	(14)	63	20	1,122	(8)	63	19
	Belarus	Higher	10,080	(39)	44	8	10,135	(43)	45	7	9,072	(48)	45	7	7,190	(52)	45	7
		Secondary	8,162	(32)	60	12	8,108	(34)	60	12	7,081	(37)	60	12	5,484	(40)	60	12
		Less than secondary	7,302	(29)	57	13	5,501	(23)	57	13	2,811	(15)	57	14	1,34	(8)	59	19
	Hungary	Higher	3,377	(10)	23	12	3,225	(11)	22	11	2,704	(11)	21	10	2,050	(12)	21	10
		Secondary	20,100	(56)	38	21	18,786	(60)	38	20	15,652	(65)	37	20	11,600	(68)	38	18
		Less than secondary	12,243	(34)	45	29	9,141	(29)	44	28	5,915	(24)	45	26	3,356	(20)	49	25
FEMALES	Russia	Higher	7,002	(33)	4	1	6,692	(37)	5	1	5,817	(45)	5	1	4,404	(54)	6	1
		Secondary	6,351	(30)	5	1	5,753	(32)	5	1	4,609	(36)	6	1	3,074	(37)	8	2
		Less than secondary	8,051	(37)	2	1	5,514	(31)	2	1	2,416	(19)	3	1	766	(9)	7	2
	Belarus	Higher	7,068	(37)	4	0	7,096	(43)	4	0	6,501	(52)	4	0	5,289	(61)	5	0
		Secondary	4,064	(22)	4	1	3,929	(24)	5	1	3,464	(27)	5	1	2,569	(29)	6	1
		Less than secondary	7,628	(41)	1	0	5,414	(33)	1	0	2,625	(21)	2	1	828	(10)	4	1
	Hungary	Higher	1,705	(7)	13	1	1,795	(8)	13	1	1,662	(10)	13	1	1,373	(12)	13	1
		Secondary	8,844	(33)	15	2	8,675	(39)	16	2	7,498	(45)	17	2	5,882	(52)	19	1
		Less than secondary	16,082	(60)	12	2	11,852	(53)	15	2	7,448	(45)	19	2	3,985	(36)	26	3

[1] Drinks/drank alcohol daily or several times a week

Table 2. Odds ratios of mortality between the different education groups by time period, country and sex

Sex	Country	Education	1982-89				1990-1997				1998-2005				2006-2013			
			m1		m2		m1		m2		m1		m2		m1		m2	
			HR	(95%CI)	**HR**	(95%CI)	**HR**	(95%CI)	**HR**	(95%CI)	**HR**	(95%CI)	**HR**	(95%CI)	**HR**	(95%CI)	**HR**	(95%CI)
MALES	Russia	Higher	**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**	
		Secondary	**1.39**	(1.20-1.61)	**1.27**	(1.10-1.47)	**1.32**	(1.19-1.47)	**1.19**	(1.06-1.33)	**1.43**	(1.27-1.61)	**1.25**	(1.12-1.40)	**1.44**	(1.26-1.63)	**1.21**	(1.06-1.39)
		Less than secondary	**1.36**	(1.18-1.57)	**1.24**	(1.05-1.46)	**1.50**	(1.33-1.70)	**1.32**	(1.13-1.53)	**1.82**	(1.66-2.00)	**1.52**	(1.35-1.72)	**1.89**	(1.57-2.27)	**1.48**	(1.24-1.77)
	Belarus	Higher	**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**	
		Secondary	**1.32**	(1.15-1.52)	**1.23**	(1.07-1.40)	**1.23**	(1.07-1.42)	**1.09**	(0.96-1.24)	**1.18**	(1.05-1.32)	**1.05**	(0.94-1.17)	**1.25**	(1.08-1.43)	**1.07**	(0.91-1.27)
		Less than secondary	**1.32**	(1.13-1.54)	**1.19**	(1.02-1.39)	**1.21**	(1.11-1.31)	**1.03**	(0.97-1.11)	**1.41**	(1.27-1.58)	**1.20**	(1.08-1.33)	**1.75**	(1.43-2.14)	**1.40**	(1.16-1.69)
	Hungary	Higher	**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**	
		Secondary	**1.54**	(1.27-1.85)	**1.45**	(1.20-1.75)	**1.70**	(1.46-1.97)	**1.52**	(1.31-1.76)	**1.55**	(1.33-1.81)	**1.36**	(1.17-1.59)	**1.51**	(1.34-1.70)	**1.33**	(1.17-1.51)
		Less than secondary	**1.94**	(1.61-2.33)	**1.75**	(1.46-2.10)	**2.11**	(1.84-2.42)	**1.79**	(1.55-2.07)	**2.02**	(1.70-2.39)	**1.65**	(1.38-1.97)	**1.88**	(1.64-2.16)	**1.52**	(1.31-1.76)
FEMALES	Russia	Higher	**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**	
		Secondary	**1.33**	(0.98-1.81)	**1.33**	(0.97-1.81)	**1.34**	(1.14-1.57)	**1.32**	(1.12-1.54)	**1.16**	(0.93-1.45)	**1.15**	(0.92-1.44)	**1.00**	(0.79-1.28)	**0.94**	(0.74-1.20)
		Less than secondary	**1.23**	(0.99-1.53)	**1.22**	(0.98-1.53)	**1.34**	(1.11-1.63)	**1.32**	(1.09-1.60)	**1.44**	(1.14-1.82)	**1.43**	(1.14-1.80)	**1.93**	(1.39-2.68)	**1.80**	(1.27-2.54)
	Belarus	Higher	**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**	
		Secondary	**1.14**	(0.75-1.74)	**1.12**	(0.73-1.70)	**1.47**	(1.18-1.82)	**1.46**	(1.18-1.81)	**1.19**	(1.03-1.36)	**1.19**	(1.04-1.36)	**1.42**	(1.12-1.79)	**1.40**	(1.10-1.79)
		Less than secondary	**1.20**	(0.86-1.68)	**1.21**	(0.87-1.68)	**1.32**	(1.09-1.58)	**1.32**	(1.09-1.58)	**1.33**	(1.07-1.65)	**1.33**	(1.07-1.65)	**2.22**	(1.73-2.84)	**2.17**	(1.66-2.82)
	Hungary	Higher	**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**	
		Secondary	**1.03**	(0.71-1.50)	**1.02**	(0.70-1.49)	**1.08**	(0.80-1.45)	**1.06**	(0.78-1.44)	**1.18**	(0.84-1.67)	**1.15**	(0.82-1.63)	**1.19**	(0.84-1.69)	**1.15**	(0.82-1.63)
		Less than secondary	**1.38**	(0.97-1.96)	**1.37**	(0.96-1.95)	**1.17**	(0.87-1.59)	**1.14**	(0.83-1.55)	**1.67**	(1.25-2.23)	**1.55**	(1.16-2.08)	**1.81**	(1.30-2.52)	**1.67**	(1.21-2.30)

Model 1: adjusted for age, relationship with respondent, respondent sex
Model 2: adjusted for all variables in model 1 and alcohol consumption and smoking

FIGURES

Figure 1. Relative index of inequality (RII) in the three countries across the time periods in males.

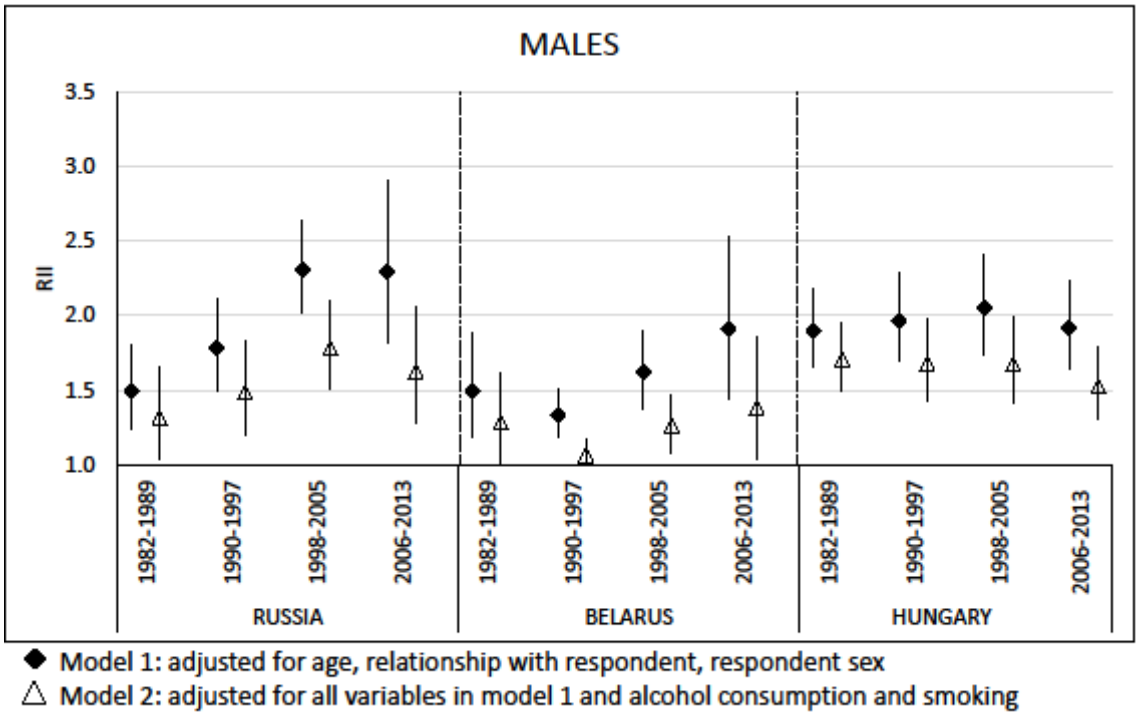

Figure 2. Relative index of inequality (RII) in the three countries across the time periods in females.