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

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ABSTRACT

Background. The aim of the study is two-fold. Firstly, it attempts to investigate the potential impact of major political and economic changes on inequalities in all-cause mortality among men and women with different levels of education in three Eastern European countries. Secondly, to identify changes in contribution of smoking and drinking to educational differences in all-cause mortality. Study covers the period from 1982 to 2013.

Methods. Data were collected in 2013-2014 as part of the PrivMort retrospective cohort study. Participants in Russia, Belarus and Hungary provided information on their 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, stratifying by three levels of educational attainment: higher, secondary and less than secondary education.

Results. Those in lower educational groups were significantly more likely to die, through most time periods and subgroups. The RII increased over time in all countries and both genders, except for 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 increased during recent decades. Smoking and alcohol consumption, two major health-related behaviors, made a significant contribution to these increases in inequality.

Key Words: mortality inequalities, education, alcohol consumption, smoking, Eastern Europe

INTRODUCTION

The collapse of the Soviet Union and subsequent political and economic changes in Eastern European countries in the late 1980s and early 1990s were some of the most significant geopolitical events of the twentieth century, and are known to have had some 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 often provided some direct protection for health, beyond any effect acting through 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 the purchasing power of national currencies, created many winners, but also many losers.

Despite anecdotal experience of how health inequalities widened in post-communist societies, direct empirical evidence on their scale, nature and influence in the health sphere remains scarce. The existing research using individual level data, however, has shown that education offered some protection against premature death in the post-transition period.[3-9] Nonetheless, 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 and the possibility that the relationship between education and mortality might have changed further since the abrupt shocks of the early 1990s.[10,11] Moreover, although there is now a wide range of research on the post-Soviet mortality crisis,[12] and in particular on the role of proximal risk factors such as hazardous drinking and smoking,[13] their contribution to educational inequalities in mortality remains unclear. In fact, we are not aware of any studies addressing this question in the context of Eastern Europe.

As the 30th anniversary of the abrupt changes approaches, there exist sufficiently long time-series to go beyond the early shocks and examine the longer-term changes through a period of continuing social and economic change. Our aim was to investigate inequalities in all-cause 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 and particular way in which alcohol consumption and smoking may have mediated the effect of educational inequalities on health through this period.

METHODS

Study sample and data collection

This paper uses data from the PrivMort retrospective cohort study[14] to measure educational attainment and mortality of individuals over the last three decades using a validated indirect method of measuring mortality, so called Brass technique, where demographic and socioeconomic characteristics of individuals are obtained from surviving relatives. 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.[14] 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. The country-specific response rates were 48%, 39% and 85% in Russia, Belarus and Hungary, respectively. These large differences in response rates are largely responsible for the differences in samples sizes between countries.

Participants provided information on their socio-economic circumstances, employment history, drinking and smoking. The highest level of education was classified as follows: (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 strata: less than secondary (original categories 1 and 2); secondary (3, 4, 5); and higher education (6, 7, 8). This is not highly precise and attainment probably enters in grossly, non-exclusively and categorically only at the stratum transition, but such measures are practical and unambiguous in interpretation and widely used. In addition to the respondents themselves, all the above information was also collected on 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 in ways similar to a cohort study, albeit retrospectively. In previous research, it was used successfully to assess mortality trends in Russia.[8,15,16]

The present analyses used data on relatives only. 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 with complete information on key variables (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 odds ratios for mortality over time estimated separately in the following four distinct time periods of equal length to afford some leverage on linearity of trend: (1) 1982-

1989; pre-transitional, (2) 1990-1997; immediate post-transitional, (3) 1998-2005; second financial crisis in Russia, (4) 2006-2013; period of relative stability. In the analyses, only working age population, i.e. 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 else the year of death, whichever came first. Life-years outside this range did not count towards the follow up time.

Odds ratios of death, stratified by educational category 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, due to a random error or bias, 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 calculated with the same set of control variables 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 in STATA 13.1 (StataCorp, Texas, US).

RESULTS

Tables 1 and 2 show the odds-ratio (OR) for 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 ORs between higher education (reference category) and both secondary and less than secondary education categories increased over time. Although these trends were broadly similar in all countries, there were also some notable differences. For instance, 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 for Hungarian men.

While smoking and alcohol consumption explained some of the mortality differences between educational groups in men there was very little attenuation in odds ratios among women when smoking and drinking were added to the model. The percentage attenuation in the ORs (AOR%), for educational level, between model 1 (m1) and model 2 (m2) (i.e. after adjusting for health-related behaviors) was calculated as follows:

$$AOR\ \% = OR_{m1} - OR_{m2} / (OR_{m1} - 1)$$

AOR% 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 30.8% and 33.3%, respectively, after controlling for smoking and drinking. The attenuation of odds ratios due to the two major health behaviors increased to 52.3% and 46.1% in the last (2006-2013) period.

Among women, the attenuation of odds ratio is much smaller, and time trend unclear, suggesting different mechanisms responsible for the increase of inequalities than among men. Out of three countries, the highest values of AOR% can be observed among Hungarian women, due to the highest prevalence of smoking in this group (Table S1, available online).

Trends in the relative index of inequality for mortality show that this inequality in mortality among educational groups has grown considerably over the last three decades (figures 1 and 2). Except for Hungarian men, where any temporal change in the extent of inequality was less obvious, the relative index of inequality has increased considerably since the early 1990s in other countries and among women. As in proceeding analyses, smoking and alcohol consumption explained larger proportion of the inequality in men compared to women. Among women, RII values for both model 1 and model 2 (adjusted for smoking and alcohol consumption) are similar, and educational gradients in mortality seem to be somewhat steeper than among men. However, the 95% CIs for RII scores among women are wider than among men, reflecting smaller sample size, which makes an unambiguous interpretation of the steeper rate of increase among women difficult.

Supplementary Table S1 (available online) gives the number of relatives of participants in the different educational groups by time period, country and sex. There is a consistent improvement in educational attainment over time; the proportion of people with higher education increased and those with only primary 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 than in Russia and Belarus, which may relate to differences in the structure of the respective vocational training systems.

The table also shows the proportion of individuals who drank alcohol or smoked regularly within each group. In most time periods and subgroups in men, the prevalence of regular alcohol consumption and smoking was lower in those with higher education. In women, where the absolute rates of smoking and drinking are low, the gradient was less clear.

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, according to education, have continued to grow in Russia, Belarus, and Hungary. The results also suggest that the extent to which unhealthy lifestyle factors, such as alcohol consumption and smoking, contribute to the educational inequalities in mortality, particularly among men, has also increased over the last three decades.

Interpretation of results

Our results showed increasing social inequalities in health within Eastern European countries during the 1990s. This was a period of major political, economic and social changes, including marked increases in income inequalities and, in some countries, dramatic fall in mean income.[21] These macro-economic changes were associated with pronounced changes in national mortality rates,[22] and several studies have suggested that social inequalities within countries have also increased.[7-10,23,24] The current study is the first to show that health inequalities have continued to widen in the three examined countries over the decades since the socio-political transition. In fact,

despite the relative stability of the late 2000s – early 2010s, this unfavorable trend did not reverse but rather intensified. The overall estimated ORs and relative indices of inequality are somewhat lower than in other studies[6,25,26] which may reflect measurement error 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 similarities in influences of inequality across countries and genders, some notable differences between these subgroups were also observed. Among men, the diverging trends in mortality between educational groups were found to be more pronounced and consistent in Russia than in Belarus or 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 probably been less effective there. For example, Belarus managed to retain better access to health care than other post-Soviet countries, including Russia.[27] Moreover, the ways in which each country embraced a free-market economy varied significantly which probably led to between-country differences in health inequalities.

The results point to a role of smoking and alcohol consumption in the educational differentials, particularly in male mortality. The data suggest that their contributions have grown over the last few decades in these countries. Increasing role of risk-factors, combined with shift towards higher education in all three populations, may have contributed to marginalisation of the less-than-secondary group and rise of educational gap in mortality. Our findings also indicate that educational inequalities increased over time, even after controlling for these lifestyle (model 2), which suggests that other factors, for example psychosocial stress, might have also played a role in the growing mortality gap.

Among women, smoking and alcohol consumption played only a marginal role in explaining the educational differences in mortality. This also points towards other causes of the rising inequalities, potentially including psychosocial, lifestyle or material factors. Another possible explanation is that education became increasing discriminating determinant of mortality over time, via its increasing importance for determining individual's occupation, income or other aspects of social status.

Further research, potentially using more diverse measures of drinking patterns, would be needed to clarify how the contribution of these lifestyle factors to social inequalities changed in Eastern European countries. Psychosocial aspects of the new politico-economic order, such as an awareness of injustice, status anxiety or a serious shortage of social capital[28] are also likely to contribute to the rise of health inequalities and future studies should pay more attention to these factors.[29]

Strengths and limitations

Potential limitations of this study, as noted previously,[14] include limited representativeness of the sample. It is possible that the distribution of drinking and smoking among educational groups observed in the European part of Russia deviate to a certain extent from the national level. However, in Belarus and Hungary, sample towns were more equally distributed across countries so we expect bias to be smaller. Also, all interviews were carried out 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 those respondent's relatives who

got 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 an absolutely 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. However it is not clear whether and how this underestimation would seriously perturb the effects and associations shown.

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.[14]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. The reported educational attainment is likely to be unbiased even for those who died long time ago, but such an underestimation is quite likely to occur in smoking and alcohol consumption data.

Finally, by using the conventional difference method in the mediation analysis, we are unable to control for additional confounders in the association of smoking and frequency of alcohol consumption with mortality,[30] what may lead to overestimation of contribution of these risk factors to growing educational inequalities in mortality.

Despite these possible limitations, this study is the first to investigate mortality in several European countries within the same framework from before the major changes of 1989-91 up to the second decade of this century including the role of educational inequalities. The large sample size and the multiple indicators to estimate these educational inequalities in mortality speak to high generalizability of the results.

COMPETING INTERESTS

None declared.

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KEY POINTS

- Educational inequalities in all-cause mortality have continued to grow over last three decades, past the initial shock of economic and political transition in Eastern Europe
- Health-related behaviors, such as smoking and alcohol consumption, continue to have a major influence on educational differences in mortality, particularly among men
- The contribution of smoking and drinking to differences in mortality between educational groups has been increasing over time
- Policies aiming to reduce both absolute mortality levels and social inequalities in health should consider societal measures in the educational sector as well as interventions and economic measures to reduce tobacco and alcohol consumption, particularly in groups characterized by low education levels and other markers of socioeconomic disadvantage.

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Table 1. Odds ratios of mortality in males, between the different education groups by time period and country.

		1982-89					1990-1997					1998-2005					2006-2013				
Country	Education	m1		m2			m1		m2			m1		m2			m1		m2		
		OR	(95%CI)	**OR**	(95%CI)	**AOR%**	**OR**	(95%CI)	**OR**	(95%CI)	**AOR%**	**OR**	(95%CI)	**OR**	(95%CI)	**AOR%**	**OR**	(95%CI)	**OR**	(95%CI)	**AOR%**
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)	30.8	**1.32**	(1.19-1.47)	**1.19**	(1.06-1.33)	40.6	**1.43**	(1.27-1.61)	**1.25**	(1.12-1.40)	41.9	**1.44**	(1.26-1.63)	**1.21**	(1.06-1.39)	52.3
	Less than secondary	**1.36**	(1.18-1.57)	**1.24**	(1.05-1.46)	33.3	**1.50**	(1.33-1.70)	**1.32**	(1.13-1.53)	36.0	**1.82**	(1.66-2.00)	**1.52**	(1.35-1.72)	36.6	**1.89**	(1.57-2.27)	**1.48**	(1.24-1.77)	46.1
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)	28.1	**1.23**	(1.07-1.42)	**1.09**	(0.96-1.24)	60.9	**1.18**	(1.05-1.32)	**1.05**	(0.94-1.17)	72.2	**1.25**	(1.08-1.43)	**1.07**	(0.91-1.27)	72.0
	Less than secondary	**1.32**	(1.13-1.54)	**1.19**	(1.02-1.39)	40.6	**1.21**	(1.11-1.31)	**1.03**	(0.97-1.11)	85.7	**1.41**	(1.27-1.58)	**1.20**	(1.08-1.33)	52.5	**1.75**	(1.43-2.14)	**1.40**	(1.16-1.69)	46.7
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)	16.7	**1.70**	(1.46-1.97)	**1.52**	(1.31-1.76)	25.7	**1.55**	(1.33-1.81)	**1.36**	(1.17-1.59)	34.5	**1.51**	(1.34-1.70)	**1.33**	(1.17-1.51)	35.3
	Less than secondary	**1.94**	(1.61-2.33)	**1.75**	(1.46-2.10)	20.2	**2.11**	(1.84-2.42)	**1.79**	(1.55-2.07)	28.8	**2.02**	(1.70-2.39)	**1.65**	(1.38-1.97)	36.3	**1.88**	(1.64-2.16)	**1.52**	(1.31-1.76)	40.9

Model 1: adjusted for age, relationship with respondent, respondent sex

Model 2: adjusted for all variables in model 1 and alcohol consumption and smoking

AOR%-the percentage attenuation in odds ratio in model 2

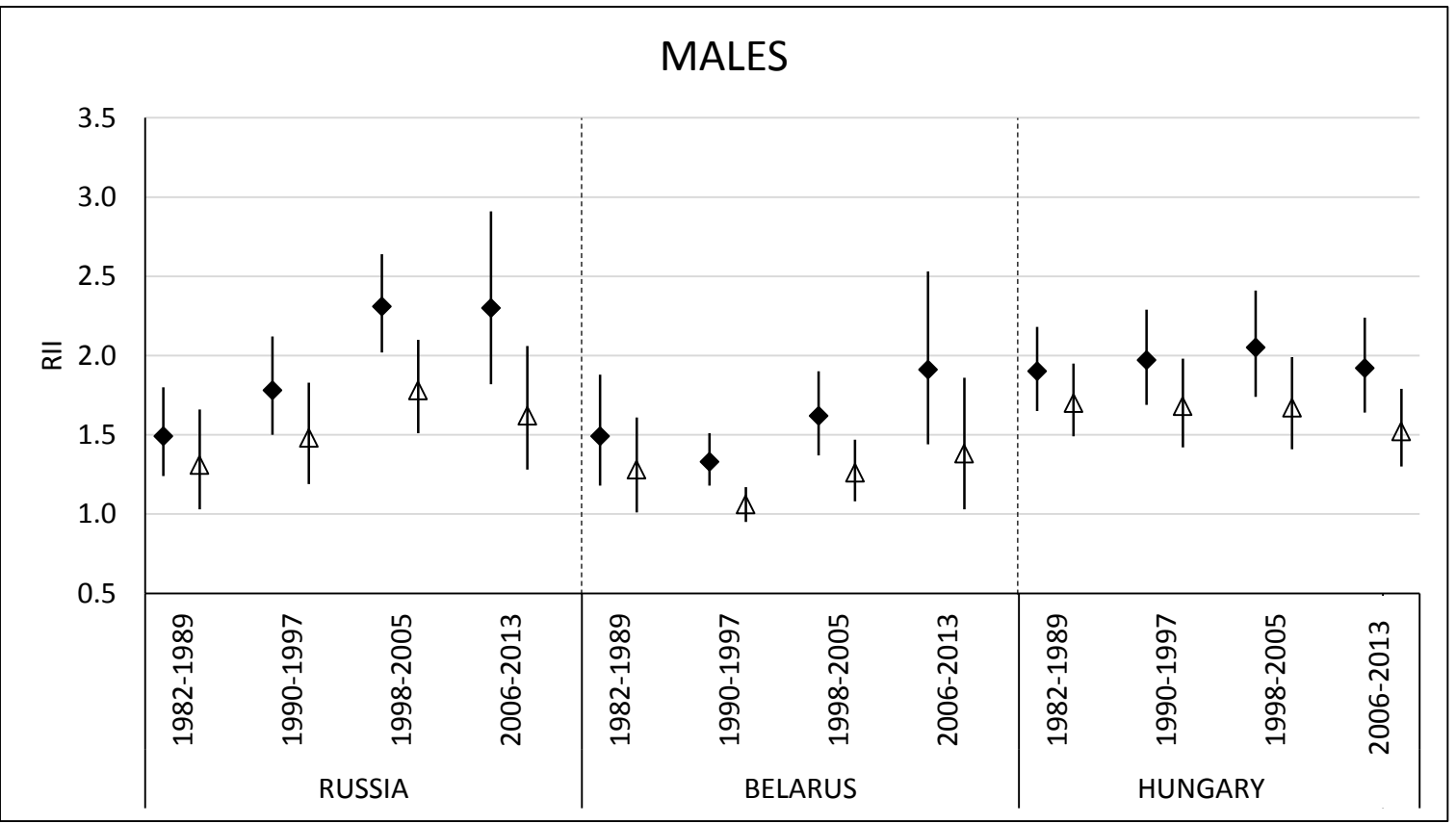
Table 2. Odds ratios of mortality in females, between the different education groups by time period and country.

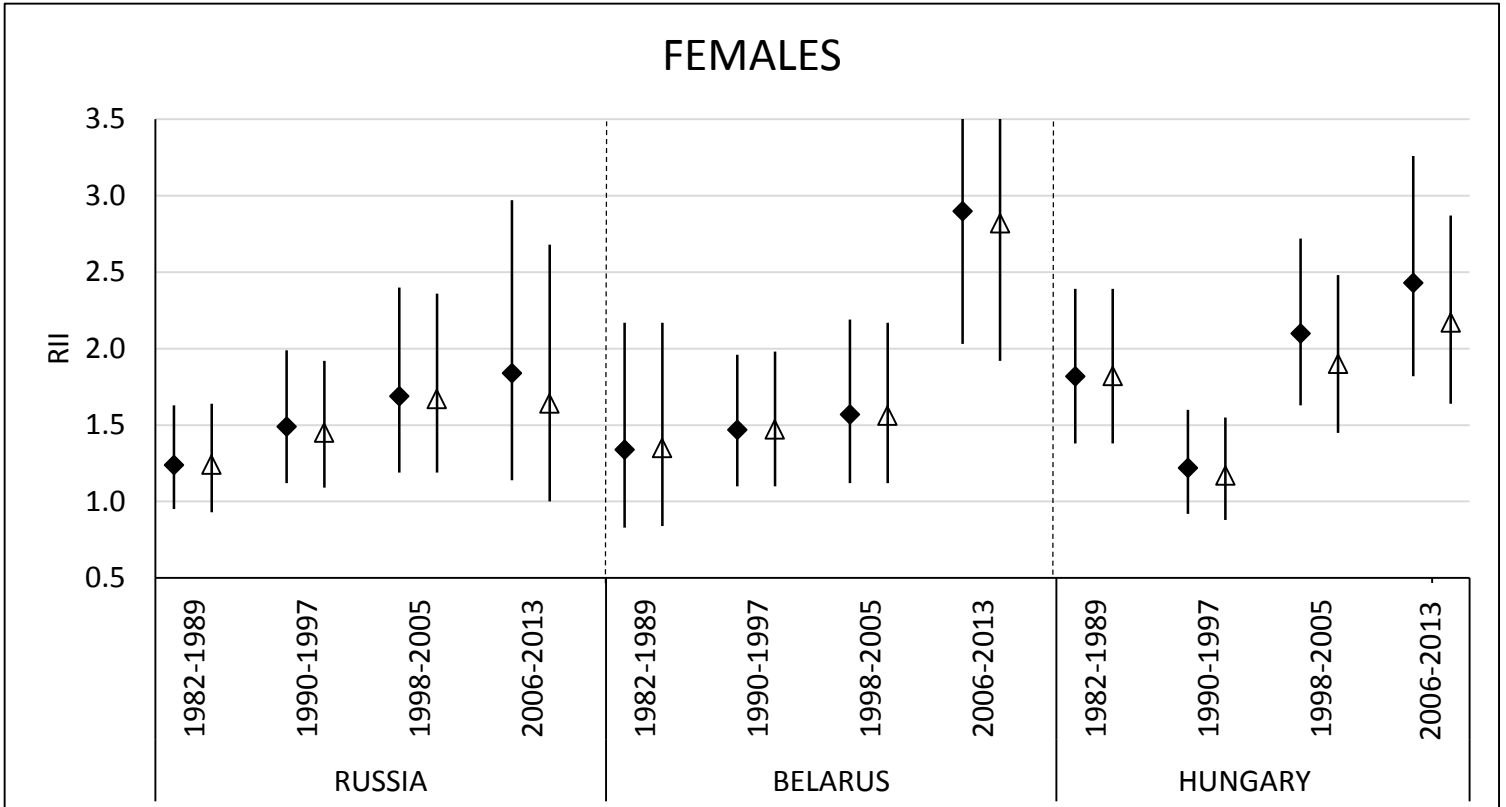
		1982-89					1990-1997					1998-2005					2006-2013				
Country	Education		m1		m2			m1		m2			m1		m2			m1		m2		
		OR	(95%CI)	**OR**	(95%CI)	**AOR%**	**OR**	(95%CI)	**OR**	(95%CI)	**AOR%**	**OR**	(95%CI)	**OR**	(95%CI)	**AOR%**	**OR**	(95%CI)	**OR**	(95%CI)	**AOR%**
Russia	Higher	**1.00**		**1.00**			**1.00**		**1.00**			**1.00**		**1.00**			**1.00**		**1.00**		
	Secondary	**1.33**	(0.98-1.81)	**1.33**	(0.97-1.81)	0.0	**1.34**	(1.14-1.57)	**1.32**	(1.12-1.54)	5.9	**1.16**	(0.93-1.45)	**1.15**	(0.92-1.44)	6.3	**1.00**	(0.79-1.28)	**0.94**	(0.74-1.20)	na.
	Less than secondary	**1.23**	(0.99-1.53)	**1.22**	(0.98-1.53)	4.3	**1.34**	(1.11-1.63)	**1.32**	(1.09-1.60)	5.9	**1.44**	(1.14-1.82)	**1.43**	(1.14-1.80)	2.3	**1.93**	(1.39-2.68)	**1.80**	(1.27-2.54)	14.0
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)	14.3	**1.47**	(1.18-1.82)	**1.46**	(1.18-1.81)	2.1	**1.19**	(1.03-1.36)	**1.19**	(1.04-1.36)	0.0	**1.42**	(1.12-1.79)	**1.40**	(1.10-1.79)	4.5
	Less than secondary	**1.20**	(0.86-1.68)	**1.21**	(0.87-1.68)	NA	**1.32**	(1.09-1.58)	**1.32**	(1.09-1.58)	0.0	**1.33**	(1.07-1.65)	**1.33**	(1.07-1.65)	0.0	**2.22**	(1.73-2.84)	**2.17**	(1.66-2.82)	4.1
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)	33.3	**1.08**	(0.80-1.45)	**1.06**	(0.78-1.44)	25.0	**1.18**	(0.84-1.67)	**1.15**	(0.82-1.63)	16.7	**1.19**	(0.84-1.69)	**1.15**	(0.82-1.63)	21.1
	Less than secondary	**1.38**	(0.97-1.96)	**1.37**	(0.96-1.95)	2.6	**1.17**	(0.87-1.59)	**1.14**	(0.83-1.55)	17.6	**1.67**	(1.25-2.23)	**1.55**	(1.16-2.08)	17.9	**1.81**	(1.30-2.52)	**1.67**	(1.21-2.30)	17.3

Model 1: adjusted for age, relationship with respondent, respondent sex

Model 2: adjusted for all variables in model 1 and alcohol consumption and smoking

AOR%-the percentage attenuation in odds ratio in model 2


MALES
RII
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1982-1989
1990-1997
1998-2005
2006-2013
RUSSIA
BELARUS
HUNGARY
◆ Model 1: adjusted for age, relationship with respondent, respondent sex
△ Model 2: adjusted for all variables in model 1 and alcohol consumption and smoking


FEMALES
RII
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1982-1989
1990-1997
1998-2005
2006-2013
RUSSIA
BELARUS
HUNGARY
Model 1: adjusted for age, relationship with respondent, respondent sex
Model 2: adjusted for all variables in model 1 and alcohol consumption and smoking