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Socioeconomic inequalities in all-cause mortality in the Czech Republic, Russia, Poland and Lithuania in the 2000s: findings from the HAPIEE Study

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ABSTRACT

Background Relatively large socioeconomic inequalities in health and mortality have been observed in Central and Eastern Europe (CEE) and the former Soviet Union (FSU). Yet comparative data are sparse and virtually all studies include only education. The aim of this study is to quantify and compare socioeconomic inequalities in all-cause mortality during the 2000s in urban population samples from four CEE/FSU countries, by three different measures of socioeconomic position (SEP) (education, difficulty buying food and household amenities), reflecting different aspects of SEP.

Methods Data from the prospective population-based HAPIEE (Health, Alcohol, and Psychosocial factors in Eastern Europe) study were used. The baseline survey (2002–2005) included 16 812 men and 19 180 women aged 45–69 years in Novosibirsk (Russia), Krakow (Poland), Kaunas (Lithuania) and seven Czech towns. Deaths in the cohorts were identified through mortality registers. Data were analysed by direct standardisation and Cox regression, quantifying absolute and relative SEP differences.

Results Mortality inequalities by the three SEP indicators were observed in all samples. The magnitude of inequalities varied according to gender, country and SEP measure. As expected, given the high mortality rates in Russian men, largest absolute inequalities were found among Russian men (educational slope index of inequality was 19.4 per 1000 person-years). Largest relative inequalities were observed in Czech men and Lithuanian subjects. Disadvantage by all three SEP measures remained strongly associated with increased mortality after adjusting for the other SEP indicators.

Conclusions The results emphasise the importance of all SEP measures for understanding mortality inequalities in CEE/FSU.

INTRODUCTION

The rise in mortality seen in Central and Eastern Europe (CEE) and the former Soviet Union (FSU) in the aftermath of the political transformations of the 1980s and 1990s has attracted considerable attention.[1–6] The mortality increase was largest in Russia and other FSU countries. The increase in deaths was largest in working-age men, although it also took its toll on women.[2 3 6 7] Currently, the mortality profile of CEE/FSU is still adverse, relative to Western Europe.[8] Yet there is substantial heterogeneity between CEE/FSU countries,[1 6 8 9] with the Czech Republic doing particularly well and Russia performing particularly badly. For example, in 2011, male life expectancy at birth was 75 years in the Czech Republic versus 63 years in the Russian Federation (WHO data). In general, CEE countries have a better health status than FSU countries. Although it is difficult to identify the main cause for this divergence, differences in socioeconomic conditions, health behaviours (smoking, alcohol), diets and healthcare systems are likely to play a role.[1 6]

National mortality trends conceal marked and persistent within-country differences.[10–12] An inverse association between socioeconomic position (SEP) and mortality has been demonstrated in Western and Eastern Europe.[13–17] However, the description of mortality inequalities in CEE/FSU remains fragmentary.[13] Published reports suggest relatively large socioeconomic gradients in CEE/FSU mortality[14 15] and a rapid rise in the magnitude of inequalities in recent decades.[18 19] Yet most studies examined educational inequalities[14 15 19 20] and used unlinked vital statistics data, in which information on mortality is derived from one data source, and population data, such as number of person-years, from another source.[20 21] Unlinked data, although valuable, suffer from numerator-denominator bias, which may seriously affect the estimates of the magnitude and trends in inequalities.[20 21]

The fact that previous studies mainly focused on educational differentials is an important limitation for several reasons. First, there is no single best indicator of SEP. Education measures only one part of socioeconomic stratification, and other dimensions are important as well. The use of various SEP indicators provides a broader perspective of inequalities. Different SEP parameters convey divergent information on inequalities and, hence, may shed light on the causal mechanisms at stake.[22–24] Second, because of the rapid rise in income inequalities in CEE/FSU after the societal transformations of the 1980s and 1990s,[25] it is particularly important to investigate the role of material deprivation in this region.

The aim of the present study is to quantify and compare socioeconomic inequalities in all-cause mortality during the 2000s in urban population samples from four CEE/FSU countries (the Czech Republic, Russia, Poland and Lithuania), using three different measures of SEP. Cross-country comparisons of socioeconomic inequalities are likely to improve our understanding of inequality-generating mechanisms. Insofar as inequality patterns differ between countries, country

characteristics are important determinants of inequalities. Based on previous research, we hypothesise that the burden of mortality and, consequently, the absolute inequalities, will be larger in Russia, especially among men.[2–6] The SEP measures considered in this paper are education, difficulty buying food and household amenities. Education is thought to affect health either directly, via knowledge and skills acquired, or indirectly, via its influence on future employment and income.[22–24] The other two SEP indicators—difficulty buying food and household amenities—are markers of material circumstances. The former reflects current material resources and is considered a measure of absolute deprivation, affecting health directly (eg, through malnutrition). The latter captures accumulated wealth through the life course and can be seen as an indicator of relative deprivation, which may influence health indirectly (eg, through reduced participation in society).[22–24 26] As socioeconomic stratification has multiple dimensions, it is hypothesised that each SEP indicator will be independently associated with mortality.

METHODS

Design and study populations

Data from the baseline survey and the mortality follow-up of the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study were used. The study was set up to investigate determinants of health in CEE/FSU following the societal transformations. The HAPIEE study consists of four cohorts in the Czech Republic, Russia, Poland and Lithuania. These cohorts are situated in seven middle-sized towns in the Czech Republic and three leading centres of academic and cultural life (Novosibirsk, Krakow and Kaunas), in Russia, Poland and Lithuania. The cohorts were randomly selected from urban population registers (electoral lists in Russia), stratified by gender and 5-year age groups. In total, 35 992 people aged 45–69 years at baseline participated in the study. The overall response rate was 61%. The baseline survey took place in 2002–2005 in the Czech Republic, Russia and Poland and in 2005–2008 in Lithuania. A more detailed description of the HAPIEE study methodology has been reported elsewhere.[27] The study was approved by the University College London/University College London Hospital ethics committee and by the local ethics committee in each participating centre. All participants gave written informed consent.

Mortality

The outcome variable was all-cause mortality. Deaths in the cohorts were identified through linkage with mortality registers (N=2750). For the Czech Republic and Lithuania, mortality was followed until the end of 2011, for Russia until the end of 2010 and for Poland until 30 June 2009. Median follow-up was 8.1, 6.5, 5.5 and 4.5 years for the Czech Republic, Russia, Poland and Lithuania, respectively. People who were lost to follow-up were censored at their last date of contact (N=1082). The proportion of people lost to follow-up varied considerably by country, ranging from 0.3% in the Czech Republic and Lithuania to 7% in Poland. The high percentage of censored people in Poland is mainly due to withdrawal from the study.

Measurements of SEP

Three indicators of SEP were used. *Education* was defined as the highest level of education completed. To enhance comparability, education was classified according to the International Standard Classification of Education (ISCED), V.2011. Participants were grouped into three levels of education: (1) pre-primary, primary and lower secondary (ISCED 0–2); (2) upper secondary (ISCED 3–4); and (3) tertiary education (ISCED 5–8). Absolute material deprivation was assessed by the question 'How often do you not have enough money for food'. Answers were coded as 'never/rarely' (0) and 'sometimes/often/all the time' (1); the derived variable was called *deprivation*. The number of household *amenities* (microwave, video recorder, colour television, washing machine, dishwasher, freezer, camcorder, satellite TV, telephone and mobile phone), varying from 0 to 10, was divided into country-specific tertiles to represent relative deprivation. The proportion of missing values was 0.4% for education, 0.8% for deprivation and 4.6% for amenities.

Statistical analyses

As the distribution of SEP indicators differed substantially by country and gender (table 1), we calculated country-specific and gender-specific age-standardised mortality rates (ASMRs), directly standardised to the WHO standard population.[28]

To assess *relative* SEP differences in all-cause mortality, age-adjusted Cox regression models were fitted, with time-on-study as time scale. The *relative* index of inequality (RII) was calculated to measure the magnitude of inequalities in mortality by education.[29 30] First, a country-specific and gender-

Table 1 Distribution of baseline socioeconomic position indicators by country and gender

	Men				Women			
	Czech	Russia	Poland	Lithuania	Czech	Russia	Poland	Lithuania
Number of subjects	4017	4260	5227	3254	4689	5089	5495	3907
Education (%)								
Lower secondary*	6.0	11.2	9.5	11.8	18.1	9.5	13.4	8.7
Upper secondary	76.0	56.8	60.3	55.6	72.0	64.1	59.5	59.2
University	18.0	32.0	30.2	32.6	9.9	26.4	27.1	32.1
χ^2 test	434 (p<0.001)				776 (p<0.001)			
Deprivation (%)								
Yes	11.8	33.1	19.8	6.0	16.1	47.0	27.2	11.4
No	88.2	66.9	80.2	94.0	83.9	53.0	72.8	88.6
χ^2 test	983 (p<0.001)				1700 (p<0.001)			
Amenities (mean)	6.0	4.9	5.9	6.4	5.7	4.5	5.5	6.0
F test	500 (p<0.001)				626 (p<0.001)			

*Pre-primary, primary and lower secondary education.

specific educational rank variable was constructed, ranging from 0 to 1 (highest to lowest end of educational distribution). It was then regressed on all-cause mortality, using age-adjusted Poisson regression.[31] The resulting RII can be interpreted as the rate of dying at the bottom versus the top of the educational hierarchy. As the RII accounts for differences in the distribution of education, it can be used for comparative purposes.[32] In addition to the RII, the slope index of inequality (SII) by education was calculated, representing the *absolute* difference between the predicted mortality rates at the lower versus the higher end of the education distribution.[15]

Despite large relative and absolute differences in mortality inequalities between countries, the direction and graded pattern of the association between SEP and all-cause mortality was similar in all samples. Therefore, data were pooled for further examination of socioeconomic inequalities. Two gender-specific Cox models were fitted: first, a model with age, country and each SEP measure separately; and second, a model with age, country and all three SEP measures simultaneously.

The proportional hazards assumption was checked in all Cox models,[33] indicating no violation of the assumption. To evaluate the robustness of the findings, sensitivity analyses were conducted: (1) different categorisations of SEP variables were used in the models; and (2) the first 2 years of follow-up were excluded, to filter out possible health selection effects. These analyses demonstrated a good consistency and validity of the results.

RESULTS

Table 1 shows the distribution of SEP variables by country and gender. Educational attainment was particularly high in Russia, Poland and Lithuania, mainly because these cohorts are situated in cities with large universities. Absolute and relative deprivation were highest in Russian men and women. Women were generally worse off than men: they were less educated and more deprived.

Large differences in ASMRs were observed across countries and between genders (table 2). In men and women, highest mortality was observed in Russia. Among men, ASMRs ranged from 12.2 (95% CI 11.0 to 13.3) per 1000 person-years in the Czech Republic to 23.6 (95% CI 21.7 to 25.5) in Russia; among women, they varied from 4.7 (95% CI 3.6 to 5.7) per 1000 in Lithuania to 7.1 (95% CI 6.3 to 8.0) in Russia.

Absolute inequalities in mortality

Absolute SEP differences by country and gender are presented in table 2. For *education* and *amenities*, largest absolute inequalities were observed in Russian men. The mortality difference between the bottom and top tertile of amenities amounted to 23.1 per 1000 person-years, and the SII for education to 19.4 per 1000. The largest absolute inequalities for *difficulty buying food* were found in Lithuanian men, with a rate difference of 15.9 per 1000. Although having a high SEP was beneficial in all countries, mortality in Russian men remained high at all levels of SEP. Absolute mortality differentials by all three SEP measures were smaller in women than in men, reflecting lower death rates.

Relative inequalities in mortality

Relative differences by country and gender are presented in table 3. All models were age-adjusted and included only one SEP measure at a time. There was an inverse *educational* gradient in mortality in all countries and both genders. For example, in Czech women, hazard ratios (HRs) were 2.4 (95% CI 1.3 to 4.2) and 1.6 (95% CI 0.9 to 2.7) for women with lower and upper secondary education, respectively, compared with women with a university degree. Largest RIIs were observed among Lithuanian women and Czech men. In the former, RII reached 4.9 (95% CI 2.1 to 11.8), denoting that the rate of dying at the bottom of the educational hierarchy is almost five times the rate of dying at the top of the educational hierarchy. In all countries, people who reported being *deprived* (ie, were short of money for food) died more often. There was an inverse graded association between household *amenities* and mortality: persons who were in the bottom tertile of this variable had the highest mortality, followed by people in the mid tertile. Individuals in the top tertile were best off.

Independent effects of SEP measures

When all three SEP indicators were included in one model, HRs were reduced by about a third, but all variables retained strong independent effects (table 4, Model 2). This analysis reveals the importance of each form of inequality. Interaction terms between SEP variables were not statistically significant (results not shown).

DISCUSSION

Summary of findings

In all four countries, we found clear mortality differentials by the three SEP measures. The magnitude of inequalities varied according to gender, country and SEP indicator. The largest absolute inequalities were generally observed among Russian men, while largest relative inequalities were seen among Lithuanian women. For all three SEP indicators, multivariate analyses demonstrated independent effects on mortality.

Limitations and strengths

Several methodological aspects of this study should be considered when interpreting its findings. The HAPIEE samples are predominantly urban, and, hence, are not entirely representative of the populations of their respective countries. It is likely, however, that the socioeconomic characteristics and mortality profiles of the HAPIEE samples reflect those of the urban populations of the Czech Republic, Russia, Poland and Lithuania, respectively.[27]

The generalisability of our results is somewhat restricted by withdrawal from the study and non-response to the baseline survey. The response rates in the HAPIEE study were similar to those in other contemporary studies.[34 35] People who withdrew from the study were likely to be lower educated and more deprived. Consistent with many other studies, HAPIEE non-responders were more likely to be male, younger, lower educated and less healthy than responders.[27] To the extent that the non-responder characteristics differ between countries, cross-country comparisons are problematic. Due to higher mortality rates and a generally less favourable socioeconomic profile among non-responders, within-country analyses are likely to underestimate the burden of mortality and its SEP gradient.

An important strength of this study is the high comparability of measures between countries. Furthermore, to partly account for between-country differences in the meaning and distribution of the amenities variable, country-specific tertiles were derived.

The cohort design of the study minimises the numerator-denominator bias and facilitates the assessment of causality. The association between the SEP variables at baseline and subsequent mortality is unlikely to result from reverse causality. However, some health selection may have occurred, and it may partly account for the observed associations between SEP and mortality.

Table 2 Country-specific and gender-specific numbers of deaths and age-standardised mortality rates (ASMRs) per 1000 person-years by education, deprivation and amenities (HAPIEE mortality follow-up data)

	Men								Women							
	Czech		Russia		Poland		Lithuania		Czech		Russia		Poland		Lithuania	
	Deaths	ASMR (95% CI)	Deaths	ASMR (95% CI)	Deaths	ASMR (95% CI)	Deaths	ASMR (95% CI)	Deaths	ASMR (95% CI)	Deaths	ASMR (95% CI)	Deaths	ASMR (95% CI)	Deaths	ASMR (95% CI)
Whole sample	452	12.2 (11.0 to 13.3)	671	23.6 (21.7 to 25.5)	406	13.1 (11.9 to 14.5)	199	12.7 (10.8 to 14.7)	255	5.9 (5.1 to 6.7)	277	7.1 (6.3 to 8.0)	208	6.4 (5.6 to 7.4)	94	4.7 (3.6 to 5.7)
Education																
Lower second*	59	33.7 (23.7 to 43.8)	120	34.6 (25.8 to 43.4)	55	18.7 (13.3 to 24.1)	46	12.5 (8.2 to 16.8)	75	8.9 (6.6 to 11.1)	61	12.4 (5.1 to 19.7)	62	15.4 (10.6 to 20.2)	22	5.4 (2.9 to 8.0)
Upper second	334	11.9 (10.5 to 13.2)	396	25.8 (23.2 to 28.4)	272	15.0 (13.2 to 16.8)	108	14.1 (11.3 to 16.9)	164	5.6 (4.7 to 6.4)	164	7.0 (5.9 to 8.1)	101	5.4 (4.3 to 6.4)	54	4.9 (3.5 to 6.3)
University	53	7.7 (5.5 to 9.8)	155	16.4 (13.7 to 19.1)	79	8.1 (6.3 to 9.9)	41	7.5 (4.9 to 10.1)	14	3.2 (1.5 to 4.9)	52	5.6 (4.1 to 7.2)	44	5.3 (3.8 to 6.9)	15	2.7 (1.3 to 4.2)
p for trend		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001
SII		14.3		19.4		11.7		13.7		5.3		5.5		6.1		6.2
Deprivation																
Yes	82	22.1 (17.2 to 27.1)	296	31.3 (27.3 to 35.4)	111	20.5 (16.7 to 24.3)	23	27.6 (15.2 to 40.0)	64	10.3 (7.8 to 12.9)	163	8.6 (7.1 to 10.0)	79	9.6 (7.5 to 11.7)	24	9.8 (5.4 to 14.2)
No	359	10.8 (9.6 to 11.9)	375	20.1 (18.1 to 22.2)	295	11.6 (10.3 to 13.0)	170	11.7 (9.7 to 13.7)	182	5.0 (4.2 to 5.7)	114	5.9 (4.8 to 7.0)	119	5.5 (4.5 to 6.4)	67	3.9 (2.9 to 5.0)
Amenities																
Bottom tertile	144	19.5 (15.7 to 23.4)	261	41.2 (35.0 to 47.4)	82	29.9 (22.7 to 37.2)	47	22.8 (13.0 to 32.6)	88	8.3 (6.2 to 10.4)	138	10.1 (7.9 to 12.2)	57	15.8 (11.1 to 20.5)	37	7.6 (4.1 to 11.1)
Mid tertile	146	11.1 (9.2 to 13.1)	154	23.8 (19.6 to 28.0)	135	13.8 (11.3 to 16.4)	70	12.7 (9.3 to 16.2)	91	5.7 (4.4 to 6.9)	68	7.0 (5.2 to 8.8)	82	6.0 (4.6 to 7.4)	31	4.3 (2.6 to 6.0)
Top tertile	96	8.3 (6.6 to 10.0)	251	18.1 (15.9 to 20.3)	175	10.7 (9.0 to 12.3)	75	10.5 (8.0 to 13.0)	39	4.2 (2.8 to 5.5)	71	5.4 (4.1 to 6.7)	62	4.6 (3.4 to 5.7)	23	3.5 (2.0 to 4.9)
p for trend		<0.001		<0.001		<0.001		<0.01		<0.001		<0.001		<0.001		<0.01

*Pre-primary, primary and lower secondary education.
HAPIEE, Health, Alcohol and Psychosocial factors In Eastern Europe; second, secondary; SII, slope index of inequality.

Table 3 Age-adjusted country-specific and gender-specific hazard ratios (HRs) and 95% CIs by education, deprivation and amenities (HAPIEE mortality follow-up data)

	Men				Women			
	Czech	Russia	Poland	Lithuania	Czech	Russia	Poland	Lithuania
Education								
Lower second*	3.4 (2.3 to 4.9)	2.0 (1.6 to 2.5)	2.1 (1.5 to 2.9)	2.6 (1.7 to 3.9)	2.4 (1.3 to 4.2)	2.0 (1.4 to 2.9)	2.2 (1.5 to 3.3)	3.6 (1.8 to 7.0)
Upper second	1.6 (1.2 to 2.1)	1.5 (1.3 to 1.9)	1.8 (1.4 to 2.3)	1.7 (1.2 to 2.4)	1.6 (0.9 to 2.7)	1.2 (0.9 to 1.7)	1.0 (0.7 to 1.4)	1.9 (1.1 to 3.4)
University	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)
p for trend	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RII	3.9 (2.4 to 6.1)	2.4 (1.8 to 3.2)	2.6 (1.8 to 3.9)	3.3 (1.9 to 5.8)	2.6 (1.6 to 4.4)	2.3 (1.4 to 3.7)	2.8 (1.6 to 4.9)	4.9 (2.1 to 11.8)
Deprivation								
Yes	1.9 (1.5 to 2.5)	1.5 (1.3 to 1.8)	1.8 (1.4 to 2.2)	2.3 (1.5 to 3.5)	2.0 (1.5 to 2.7)	1.4 (1.1 to 1.8)	1.7 (1.3 to 2.2)	2.8 (1.7 to 4.4)
No	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)
Amenities								
Bottom tertile	2.2 (1.7 to 2.9)	2.0 (1.7 to 2.4)	2.5 (1.9 to 3.3)	1.9 (1.3 to 2.7)	1.8 (1.2 to 2.7)	1.8 (1.3 to 2.4)	2.8 (1.9 to 4.0)	2.2 (1.3 to 3.8)
Mid tertile	1.4 (1.1 to 1.8)	1.3 (1.0 to 1.5)	1.2 (1.0 to 1.5)	1.1 (0.8 to 1.5)	1.4 (1.0 to 2.1)	1.30 (0.9 to 1.8)	1.4 (1.0 to 2.0)	1.1 (0.6 to 1.9)
Top tertile	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)
p for trend	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

*Pre-primary, primary and lower secondary education.
HAPIEE, Health, Alcohol and Psychosocial factors In Eastern Europe; RII, relative index of inequality; Second, secondary.

The effect of recent health selection is probably rather small, as suggested by the sensitivity analyses: excluding the first 2 years of follow-up did not alter the results substantially. Yet the impact of earlier health selection cannot be completely excluded.

Other methodological strengths are the use of absolute and relative measures of inequality (SII and RII) and of different SEP indicators (education, deprivation and amenities). SII and RII can be used for comparative purposes, on condition that the relationship between the educational rank variable and the outcome (in our case, all-cause mortality) is linear. Despite the fact that the education variable consisted of merely three groups, the assumption of linearity was not violated. As mentioned in the introduction, virtually all previous studies in CEE/FSU used education as the main or only SEP indicator. Assessment of measures of material circumstances adds important new information to the evidence of social inequalities in the region.

The burden of mortality

The absolute mortality rates in the HAPIEE samples were highest in Russia. Despite improvements in the last few years, the long-term mortality trends and mortality rises in the 1990s led to mortality rates that are among the highest in the world.[6 8] Mortality rates in urban Czech, Polish and Lithuanian HAPIEE samples were lower than the national averages and comparable with each other, and with Western European rates.[8] For example, in 2001–2009, Belgian ASMRs were 12.5 (95% CI 12.3 to 12.6) per 1000 person-years for 45–69-year-old men and 6.6 (95% CI 6.4 to 6.7) for 45–69-year-old women (own calculations). The relatively low mortality rates in the Czech, Polish and Lithuanian samples are probably related to the urban character of the cohorts.[36] Contrary to expectations, Lithuanian mortality rates were similar to those in the Czech Republic and Poland, possibly due to a favourable socioeconomic profile of Kaunas.[36] In agreement with other findings,[12] mortality was

Table 4 Age-adjusted and gender-specific hazard ratios (HRs) CIs by education, deprivation and amenities in pooled sample (HAPIEE mortality follow-up data)

	Men		Women	
	Model 1*	Model 2†	Model 1*	Model 2†
Education				
Lower secondary‡	2.2 (1.9 to 2.6)	1.8 (1.5 to 2.1)	2.2 (1.8 to 2.8)	1.8 (1.4 to 2.3)
Upper secondary	1.6 (1.4 to 1.8)	1.4 (1.3 to 1.6)	1.3 (1.0 to 1.6)	1.2 (0.9 to 1.4)
University	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)
Deprivation				
Yes	1.7 (1.5 to 1.9)	1.4 (1.2 to 1.6)	1.7 (1.4 to 1.9)	1.4 (1.2 to 1.7)
No	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)
Amenities				
Bottom tertile	2.0 (1.7 to 2.3)	1.6 (1.4 to 1.9)	1.9 (1.5 to 2.4)	1.5 (1.2 to 1.9)
Mid tertile	1.3 (1.1 to 1.4)	1.2 (1.0 to 1.4)	1.3 (1.0 to 1.6)	1.2 (0.9 to 1.5)
Top tertile	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)

*Model 1: adjusted for age and country.
†Model 2: adjusted for age, country and all socioeconomic position indicators simultaneously.
‡Pre-primary, primary and lower secondary education.
HAPIEE, Health, Alcohol and Psychosocial factors In Eastern Europe.

lower among women, compared with men, in all HAPIEE samples.

Socioeconomic inequalities in mortality

In the past, research on socioeconomic inequalities in CEE/FSU mainly used education[14 15 19 20] or area-level data.[13] For the latter, the assumption is that area-level associations between SEP indicators and mortality mirror associations at the individual level.[13] This assumption may often hold, but it could be prone to ecological fallacy. Regarding the former, previous studies have demonstrated educational gradients in all-cause mortality in CEE/FSU countries.[14 19] Our study adds to the literature by also focusing on other individual-based measures of SEP.

To the best of our knowledge, there is only one comparative study on individual-level socioeconomic inequalities, which includes CEE/FSU countries and looks beyond education.[17] Eikemo *et al*[17] have shown that class-related morbidity inequalities in CEE/FSU were comparable with those in the rest of Europe. In line with these findings, our analyses indicate that inequalities exist according to all SEP indicators considered. In other words, education and absolute and relative deprivation all play a part. Our pooled analyses have shown that, despite some overlap between the three indicators, the effects of these SEP measures were largely independent. We were able to demonstrate an important independent role of absolute and relative material deprivation (difficulty buying food and amenities). These material factors mediated some of the effect of education on mortality. On the other hand, education remained important, demonstrating the relevance of other factors for socioeconomic stratification in mortality.

Notwithstanding large similarities in inequality patterns across countries and between genders, country- and gender-specific differences were observed. Relative inequalities were most marked in Czech men and Lithuanian subjects. This finding may partially reflect the relatively small burden of mortality in these groups,[37] but it also supports previous research that found relatively large relative inequalities in Lithuanian mortality.[19] As expected, absolute inequalities were largest in Russian men, and they were larger in men than in women, reflecting the higher absolute mortality rates.[37] The high absolute mortality rates among Russian men in every SEP group suggest that it is the lower-educated and poor men who are affected by the conditions responsible for the high mortality burden, and that these conditions impinge upon all Russian men. On the other hand, absolute inequalities among Russian women are comparable with those in other countries. These findings point at the importance of societal characteristics for understanding SEP inequalities among Russian men. Hence, Russia may benefit the most from prevention programmes, targeting the socioeconomic gradient and the overall high mortality level, and with a specific focus on men.

CONCLUSIONS

This study demonstrates large absolute and relative mortality inequalities according to three different SEP measures (education, difficulty buying food and amenities). In other words, mortality inequalities in CEE/FSU are not an 'either-or' story, but a 'both-and' story: knowledge and skills, absolute and relative deprivation all play a part. The high overall mortality rates in these countries imply the powerful effects of current and past social and economic environment on the health of all societal groups. Differences in the magnitude of SEP inequalities between countries are likely to reflect differences in societal characteristics. The large within-country inequalities in mortality indicate that lower-SEP groups have been disproportionally affected. In addition to promoting and monitoring the health of all, preventive and healthcare policy should pay particular attention to lower-SEP groups, and take into account different dimensions of socioeconomic disadvantage. To further inform policy, future research should investigate inequalities in cause-specific mortality and the intermediary mechanisms linking SEP to mortality.

What is already known on this subject?

Mortality rates are high in Central and Eastern Europe and the former Soviet Union, compared with Western Europe. Yet there is substantial between-country and within-country heterogeneity. Research suggests relatively large socioeconomic mortality differences within countries in this region. However, evidence remains fragmentary, and published reports mainly examine educational inequalities. This study assesses the associations between mortality and absolute and relative deprivation, as well as education, in four countries in this region.

What this study adds?

This study adds to the literature by demonstrating large absolute and relative mortality inequalities by measures of material deprivation (amenities and difficulty buying food) in the Czech Republic, Russia, Poland and Lithuania. These material differences in mortality are relatively independent from educational mortality differences, hinting at the multifaceted nature of socioeconomic inequalities. Preventive and healthcare policies may benefit from taking into account different dimensions of socioeconomic disadvantage.

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