Educational gradients in all-cause mortality in two cohorts in the Czech Republic during the early stage of the postcommunist transition

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ABSTRACT

Objectives We investigated whether social gradient in all-cause mortality in the Czech Republic changed during the postcommunist transition by comparing two cohorts, recruited before and after the political changes in 1989.

Methods Participants (aged 25–64 years) in two population surveys (n=2530 in 1985, n=2294 in 1992) were followed up for mortality for 15 years (291 and 281 deaths, respectively). Education was classified into attainment categories and years of schooling (both continuous and in tertiles). Cox regression was used to estimate HR of death by educational indices in each cohort over a 15-year follow-up.

Results All three educational variables were significantly associated with reduced risk of death in both cohorts when men and women were combined; for example, the adjusted HRs of death in the highest versus lowest tertile of years of schooling were 0.65 (95% CI 0.47 to 0.89) in 1985 and 0.67 (95% CI 0.48 to 0.93) in 1992. Adjustment for covariates attenuated the gradients. In sex-specific analysis, the gradient was more pronounced and statistically significant in men. There were no significant interactions between cohort and educational indices.

Conclusions The educational gradient in mortality did not differ between the two cohorts (1985 vs 1992), suggesting no major increase in educational inequality during the early stage of postcommunist transition. Further research is needed to understand trends in health inequalities during socioeconomic transitions.

WHAT IS ALREADY KNOWN ON THIS SUBJECT

⇒ Previous studies reported an increase in social inequalities in mortality during the early stage of postcommunist transition. However, there has been less evidence from Central Europe, especially based on individual-level (linked) data. There has also been a lack of studies assessing educational gradients for men and women separately.

WHAT THIS STUDY ADDS

⇒ Although the educational gradient in mortality existed before as well as during the political transition, there was no evidence for the expected steeping of the gradient in our study. Our results suggested that the educational gradient in mortality was substantially stronger among men than in women. Further research is needed to understand trends in health inequalities during socioeconomic transitions emphasising the differential patterns between sexes.

INTRODUCTION

The inverse association between educational attainment and health, including all cause and cause-specific mortality, has been long established.[1–3] However, the educational gradient differs over time and between populations. For example, analysis of official data from 22 European countries found considerable differences in the magnitude of educational inequalities between countries.[4] This suggests that sociopolitical context plays an important role in shaping social inequalities in health.[4 5]

A relatively recent example of rapid societal change is the postcommunist transition in Central and Eastern Europe and the former Soviet Union. Macroeconomic data suggest a rapid increase in income inequalities, reappearance of unemployment and falls in living standards in the early stages of the transition.[6 7] With democratic reforms in Central and Eastern Europe, the importance of education as a route to higher income rapidly increased, contributing to increase in income inequality by education.[8] Published studies suggest that social inequalities in mortality in the former Soviet Union and the Baltic countries increased considerably after 1990,[9–11] but there is less evidence from Central Europe, where the transition was less dramatic than in the former Soviet Union. Geographical studies in Hungary and the Czech Republic suggest increasing socioeconomic inequality in mortality after 1990.[12] Estimates based on official unlinked data on death registration with census data in the Czech Republic and the Baltic states also show a short-term increase in all-cause mortality after 1990.[13–15] In most reports, the educational inequalities increased very quickly, over only a few years. However, as most of available studies used unlinked routine data, the numerator-denominator bias makes them less reliable.[16]

In this paper, we analysed data from two Czech cohorts using identical protocol established in 1985 and 1992 to assess changes in educational inequalities using individual-level (ie, linked) data. We hypothesised that the educational gradient would become steeper in the later cohort and this would be apparent in both men and women.

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METHODS

We used data from the 1985 and 1992 population studies conducted as part of the WHO MONICA Project[17] in a 1% random age-sex-stratified sample of men and women aged 25–64 in of six Czech districts (more detail is available elsewhere[18]). In total, 2573 and 2353 participants were recruited in 1985 and 1992 (response rate 84% and 73%), respectively. Participants with missing data on education, marital status and cardiovascular risk factors were excluded, leaving 2530 and 2294, respectively, in the analytical sample.

Education was assessed by two indices. First, educational attainment was reported in categories, which were classified into primary, secondary and university education. Second, participants reported how many years they spent in education; this information was used both as continuous variable (years of schooling) and classified in tertiles by cohort. Covariates (potential confounders or mediators) included marital status (recoded into binary variable married vs single/widowed/divorced), ever smoking cigarettes (yes vs no), height (metres), body mass index (BMI, calculated as kg/m^2), high-density lipoproteins cholesterol (mmol/L), total cholesterol (mmol/L), high blood pressure (yes vs no; greater than or equal to 140 mm Hg/90 mm Hg or current treatment with antihypertensive medication).

Deaths among study participants were ascertained via linkage with the national mortality register. For the present analysis, the follow-up time was restricted to 15 years for each cohort (ie, until 31 December 2000 for the 1985 cohort and until 31 December 2007 for the 1992 cohort). Cox proportional hazard regression was conducted to determine the association between education and all-cause mortality in each cohort in both sexes combined and separately for men and women. Age-adjusted models were estimated first, followed by multivariable models adjusted for covariates (age, BMI, height, cholesterol, high blood pressure, smoking status and marital status). The HRs along with their corresponding 95% CIs were estimated using Cox regression. Terms of interaction between educational variables (one per model) and cohort were fitted to assess whether the educational gradient differed between cohorts. All analyses were performed in Stata software (V.16.1).

RESULTS

The descriptive statistics of the characteristics of the combined analytical sample and stratified by sex are reported in table 1. Over 15-year follow-up, there were 291 deaths in the 1985 cohort and 281 deaths in the 1992 cohorts. There were only minor differences in covariates between the two cohorts. However, the numbers and proportions of deaths during follow-up were substantially lower in the 1992 vs the 1985 cohort.

Table 2 presents the age-adjusted and fully adjusted HRs of all-cause mortality for both sexes combined and separately for men and women. For both sexes combined, the gradient in all-cause mortality by all educational indices was significant in age-adjusted models in both cohorts. Each additional year of schooling was associated with reduction in mortality risk by 6% (HR 0.94, 95% CI 0.90 to 0.98) and 7% (HR 0.93, 95% CI0.90 to 0.97), respectively. After adjustment for covariates, the HRs were attenuated and only the association of years of schooling remained significant in both cohorts. When data were analysed separately by sex, a clear educational and statistically significant gradient was only seen in men. Crucially, the gradients, in both sexes, were similar between the cohorts, and there was no suggestion that the gradient became steeper in the 1992 cohort. None of the interactions between cohort and any educational indicators were statistically significant (all $p>0.5$, not shown).

Table 1 Descriptive characteristics of the analytical sample, stratified by sex and cohort

	Men		Women	
	1985	**1992**	**1985**	**1992**
No of individuals	**1237**	**1111**	**1293**	**1183**
Age group				
25–34	24.4% (302)	21.8% (242)	24.7% (319)	21.6% (256)
35–44	23.4% (289)	31.3% (348)	26.1% (337)	29.5% (349)
45–54	27.2% (336)	27.1% (301)	25.7% (332)	25.9% (306)
55–64	25.1% (310)	19.8% (220)	23.6% (305)	23.0% (272)
Marital status				
Married	86.3% (1,068)	83.7% (930)	81.9% (1,059)	80.5% (952)
Single/widowed/divorced	13.7% (169)	16.3% (181)	18.1% (234)	19.5% (231)
Education				
Primary	63.3% (783)	61.8% (686)	68.1% (880)	58.7% (694)
Secondary	28.1% (347)	26.8% (298)	27.2% (351)	35.5% (420)
University	8.7% (107)	11.4% (127)	4.8% (62)	5.8% (69)
Years of schooling				
(Median)	12	11	11	11
High blood pressure	25.9% (320)	25.7% (286)	33.3% (430)	26.6% (315)
Ever smoking	44.8% (554)	39.5% (439)	23.8% (308)	23.3% (275)
BMI mean (SD)	27.04 (3.92)	27.09 (3.83)	27.31 (5.37)	26.87 (5.36)
Cholesterol mean (SD)	6.21 (1.28)	5.98 (1.28)	6.17 (1.24)	5.95 (1.28)
Height mean (SD)	1.74 (0.07)	1.75 (0.07)	1.61 (0.06)	1.62 (0.06)
HDL mean (SD)	1.35 (0.36)	1.32 (0.36)	1.57 (0.36)	1.52 (0.38)
Deaths during follow-up	15.0% (185)	16.5% (183)	8.2% (106)	8.3% (98)

BMI, body mass index; HDL, high-density lipoproteins.

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Table 2 Age-adjusted and fully adjusted HRs for mortality by educational variables in 1985 and 1992

	Age adjusted		Fully adjusted*	
	1985	1992	1985	1992
Men and women combined (also adjusted for sex)				
Education				
Primary	1.0	1.0	1.0	1.0
Secondary	0.78 (0.59–1.04)	0.81 (0.62–1.07)	0.81 (0.60–1.08)	0.88 (0.66–1.17)
University	0.61 (0.35–1.05)	0.70 (0.44–1.10)	0.67 (0.39–1.17)	0.80 (0.51–1.27)
P value for trend	0.021	0.051	0.058	0.237
Years of schooling				
Lowest tertile	1.0	1.0	1.0	1.0
Medium	0.92 (0.70–1.19)	0.88 (0.65–1.20)	0.94 (0.72–1.23)	0.91 (0.67–1.23)
Highest tertile	0.65 (0.47–0.89)	0.67 (0.48–0.93)	0.71 (0.51–0.99)	0.76 (0.55–1.07)
P value for trend	0.011	0.018	0.055	0.115
Years of schooling (per year)				
P value	0.94 (0.90–0.98) 0.007	0.93 (0.90–0.97) 0.001	0.95 (0.91–0.99) 0.028	0.95 (0.91–0.99) 0.019
Men				
Education				
Primary	1.0	1.0	1.0	1.0
Secondary	0.78 (0.55–1.10)	0.84 (0.60–1.18)	0.82 (0.58–1.16)	0.86 (0.61–1.22)
University	0.57 (0.31–1.06)	0.67 (0.40–1.12)	0.66 (0.35–1.22)	0.72 (0.43–1.20)
P value for trend	0.033	0.088	0.101	0.159
Years of schooling				
Lowest tertile	1.0	1.0	1.0	1.0
Medium	0.94 (0.67–1.30)	0.83 (0.56–1.23)	0.98 (0.70–1.37)	0.81 (0.55–1.20)
Highest tertile	0.61 (0.42–0.90)	0.66 (0.45–0.95)	0.70 (0.47–1.03)	0.72 (0.49–1.05)
P value for trend	0.016	0.025	0.090	0.068
Years of schooling (per year)				
P value	0.94 (0.89–0.99) 0.012	0.92 (0.88–0.97) 0.001	0.95 (0.91–1.00) 0.058	0.94 (0.89–0.98) 0.008
Women				
Education				
Primary	1.0	1.0	1.0	1.0
Secondary	0.83 (0.49–1.39)	0.76 (0.47–1.23)	0.85 (0.50–1.45)	0.95 (0.58–1.55)
University	0.80 (0.25–2.54)	0.86 (0.31–2.36)	0.87 (0.27–2.80)	1.25 (0.45–3.49)
P value for trend	0.453	0.331	0.572	0.915
Years of schooling				
Lowest tertile	1.0	1.0	1.0	1.0
Medium	0.85 (0.55–1.32)	0.96 (0.60–1.55)	0.86 (0.55–1.34)	1.16 (0.71–1.90)
Highest tertile	0.82 (0.46–1.48)	0.69 (0.33–1.44)	0.88 (0.48–1.62)	0.93 (0.44–1.98
P value for trend	0.408	0.376	0.552	0.890
Years of schooling (per year)				
P value	0.96 (0.89–1.05) 0.367	0.97 (0.89–1.05) 0.460	0.97 (0.89–1.06) 0.514	1.01 (0.93–1.10) 0.799

*Adjusted for age, BMI, height, cholesterol, high blood pressure, smoking and marital status.
BMI, body mass index.

DISCUSSION

The main objective of these analyses was to compare educational gradients in all-cause mortality in two cohorts established before and during the early stage of the postcommunist transformation in the Czech Republic. The results suggested that (1) educational gradients in mortality existed in both cohorts, (2) were pronounced only among men and (3) the gradients were of similar magnitude in both cohorts. These data, therefore, do not suggest a major divergence of educational inequalities of mortality.

Some of findings are unexpected. First, the lack of clear gradient in women was surprising, since official statistics have shown educational inequality in mortality in both sexes.[13] The stronger association between educational level and mortality in men might be explained by differences in health behaviours among women and men (men are more likely to follow unhealthy and risky behaviours) that might consequently contribute to higher specific mortality to, for example, accidents, lung cancer.[19]

Second, since the majority of published reports suggest an increase in social inequalities in mortality during the early stage of postcommunist transition,[9 12 15] we expected a similar pattern in these cohorts. However, there was no evidence for the expected steeping of the gradient.

Previous studies in the Czech Republic generally found increase in educational differences in all-cause mortality, despite some exceptions between particular categories for both men and women.[12 13 20] Increasing inequalities were also reported in Poland, Hungary, Estonia and Lithuania from 1990 to 2000,[15] Russia from 1989 to 2001[9] and Estonia from 1989 to 2000,[14] indicating that the postcommunist transition exacerbated educational discrepancies in mortality.

One potential explanation for the unexpected findings may be the numerator–denominator bias. A previous study conducted in Lithuania between 2001 and 2004 revealed an overestimation of the educational gradient in mortality in studies that used unlinked data rather than linked data, due to overreported deaths in lower educational groups and underreporting for those with higher education,[10] although the extent of the bias seems dependent on the context and country.[16] In addition, at least one prospective cohort[21] and one retrospective study,[9] both using individually linked observations, reported diverging mortality inequalities in Russia, suggesting that numerator–denominator bias is not a major alternative explanation.

A second potential reason for our findings may be the lower response rate in the 1992 vs 1985 survey (73% vs 84%). Given this large difference and the literature consistently suggesting that non-respondents tend to be less healthy and more likely socially disadvantaged than respondents, the potential changes in educational gradients between cohorts may be obscured by differential response rate.[22] Lower response rate may partly explain the lower mortality risk in the second study.

Third, the observation period between the two compared cohorts (1985 vs 1992) might be too short (7 years) to distinguish the potential effect of the educational gradient in all-cause mortality. In order to obtain a sufficient number of deaths for the analysis, a 15-year follow-up was used and the calendar years during follow-up, therefore, partially overlap between the cohorts. Restricting analyses to non-overlapping first 5 years of follow-up reduced the number of deaths in the analyses and did not provide any additional clues.

Finally, the sample sizes of the cohorts may have been too small to detect modest changes in associations between education and mortality between cohorts; this is particularly pertinent to women, among whom the lower deaths rates further reduce the statistical power.

CONCLUSION

Notwithstanding these limitations, this first individual-based prospective investigation outside of the former Soviet Union found evidence for an educational gradient in mortality in both cohorts, which was largely driven by gradients among men. However, we found no evidence for the gradient becoming steeper in the later cohort. These findings warrant re-examination of this important question in larger individual-based datasets.

Correction notice This article has been corrected since it first published. In the last row of table 1, 'Deaths during follow-up', data has been corrected. This data has also been corrected in the main text.

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