Life expectancy advantages of high education: a comparison between Sweden and Lithuania

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Introduction

The majority of studies on mortality inequalities traditionally focus on unfavorable position of lower socio-economic groups and magnitude of the differences. Numerous international comparative studies confirmed a systematic health advantage of people with higher education against lower education groups (Valkonen, 2001; Mackenbach et al., 2003; Huisman et al., 2005; Mackenbach, 2006; Kohler et al., 2008). The prior findings demonstrate that during the most recent decades, many industrialized countries did not see any reductions in educational inequalities. On the contrary, some countries were experiencing further widening of life expectancy gap between higher and lower education groups (Valkonen, 2001). This is particularly true for the former communist countries of Central and Eastern Europe showing striking levels of educational differentials in the end of the 1990s or beginning of the 2000s (Shkolnikov et al., 2006; Leinsalu et al., 2009).

Importance of improvements in education for life expectancy of entire populations can be addressed in several ways. First, it is obvious that increasing shares of highly educated people with lower mortality also contribute to the gains in overall life expectancy. For example, Shkolnikov et al. (2006) report that improving education partly counter-balanced life expectancy decreases in Estonia and Russia in the 1990s. The only groups experiencing at least some progress in longevity in the two countries were highly educated groups. Due to the fact that mortality situation continued deteriorating further among the lower educated people, the recovery in overall life expectancy in the second half of the 1990s (in Russia up to 1998) can be largely attributed to the health progress among people with higher education (Shkolnikov et al., 2006). Similar changes and compositional effects were also observed for Lithuania (Kalediene & Petrauskiene, 2005; Jasilionis, Jdanov, Leinsalu, 2006; Leinsalu et al., 2009).

Second, highly educated group can be considered as a *vanguard* group showing the pathways for better health for the remaining population. Life expectancy disadvantage of lower education groups can be discussed in the framework of time lag which refer to the years or decades needed to catch up with higher (vanguard) education group. For example, mortality of Finnish males with primary education in 1993-95 was still higher than mortality of Finnish males with higher education in the beginning of the 1970s (Valkonen, 1997). Such time lags may be attributed to numerous factors such as differences in speed of spread of health education across various population groups. There are other advantages related to higher education – such as higher income, safer and more stable occupations, stronger social networks, better control over life, less stressful living environment, and etc. which may be regarded as confounding effects (Evans, Barer, Marmor, 1994; Mirowsky & Ross, 2003).

This study systematically examines similarities and differences in mortality patterns of highly educated people in Lithuania and Sweden. First, we identify age groups and causes of deaths responsible for life expectancy advantages of higher education groups against the remaining populations in both countries. Second, we discuss the potential of higher education group in Lithuania to ensure the further recovery in life expectancy of entire population. In particular, we explore whether premature mortality and specific causes of death such as alcohol-related deaths and external causes of death also play an important role for the differences in life expectancy between the highly educated Swedes and Lithuanians.

Data and methods

Census-linked datasets

Data for both countries come from longitudinal mortality datasets that were based on linkage of death registries to population censuses. The data for Sweden were provided in individual data format (with all original personal identification numbers replaced by special identification codes). Statistics Lithuania provided data in so called frequency format including frequencies of deaths and numbers of person years of exposure by each combination of categories of available socio-demographic variables.

In Sweden, 100% of death records were successfully linked to the census. The corresponding share of the linked death records in Lithuania was 95%. The remaining 5% were included into the analyses by introducing correction factors for census-unlinked (death record based) information. This methodological solution is described in more detail in the previously published article (Shkolnikov et al., 2007).

Data for Sweden cover deaths and person years of exposure for the period from the beginning of 1998 to the end of 2000. The information about education is taken from the 1991 population census. The corresponding period of observation for Lithuania refers to the July 1st 2001 – end of 2004. The Lithuanian data on education of both the deceased and survivors are based on the 2001 population census. For both countries, the data on education refer to the highest attained level of education. We consider only two broad education groups: higher education group (with completed university or higher non-university education) and lower than higher education group (further in the text we also refer to this group as "the remaining population"). Due to higher probability of changes of education in younger ages, we restrict our analyses to the ages 35+. The final distributions of deaths and person years of exposure are shown in Table 1.

We used standard techniques of life table analyses as well as the age and cause decomposition algorithm elaborated by Evgueni Andreev (Andreev, Shkolnikov, Begun 2002).

Table 1. *Distributions of deaths and person years of exposure (in thousands) by educational level.*

	Lithuania		**Sweden**	
	Deaths	Exposures	Deaths	Exposures
MALES				
Higher	5.4	445.9 (*16.1%*)	10.8	1336.0 (*19.4%*)
Lower than higher (incl. unk.)	65.4	2330.1 *(83.9%)*	124.1	5534.2 (*80.6%*)
Total	70.8	2775.9 (*100%*)	134.9	6870.2 (*100%*)
FEMALES				
Higher	3.2	610.6 (16.7%)	6.0	1108.0 (*18.0%*)
Remaining (lower than higher)	62.4	3041.6 (83.3%)	118.9	5033.6 (*82.0*)
Total	65.5	3652.2 (*100%*)	124.9	6141.6 (*100%*)

Data quality issues

Two important data quality issues should be considered before proceeding to the analyses. The first and most serious issue concerns the comparability of cause-specific data due to differences in coding practices. Cause of death validation studies conducted in Lithuania in the end of the 1980s and early 1990s found some over-reporting of cardiovascular diseases and under-reporting of cancers, external causes, and alcohol-related deaths (Petrauskiene et al., 1996; Stalioraityte, Pangonyte, Kazlauskaite, 2005). The probability of such misclassifications increased with age. However, the authors suggested that these biases do not distort the principal cause of death pattern in a significant way (Petrauskiene et al., 1996; Stalioraityte, Pangonyte, Kazlauskaite, 2005). Such validation studies for more recent years are missing. We assume that restricting our analyses to 8 commonly used broad groups of causes of death diminishes such potential bias. Nevertheless, cause-specific results for old age should be treated with caution.

The second potential problem concerns the comparability of educational groups between countries. We focus on two large and well defined *higher* education and *lower than higher* education groups. Therefore, we assume that differences in education systems make no significant effect on the major results of our analyses.

Results

Differences in life expectancy by education within countries

Table 2 shows life expectancy estimates by education for males and females in Lithuania and Sweden. The results point to a remarkable life expectancy advantage of highly educated males against the remaining population in Lithuania: life expectancy for males with higher education was 40.8 years, whereas the corresponding figure for males with lower than higher education was only 33.4 years. Thus, the difference in life expectancy between these two groups exceeded seven years. In Sweden, the difference between the two groups was twice as small (3.7 years). It is also important to note that life expectancy of highly educated Lithuanian males was by almost 2 years lower than among lower educated males in Sweden (Table 2).

The educational gap was considerably smaller among females (Table 2). Life expectancy advantage of highly educated Lithuanian females against the remaining female population exceeded 4 years (life expectancy constituted 47.6 and 43.5 years, respectively). In Sweden, this gap was smaller and constituted 3 years. Life expectancy of females with higher education in Lithuania was almost the same as of Swedish females with lower than higher education (47.6 and 47.4 years, respectively).

Figure 1 shows the contributions of cause- and age-specific mortality to the differences in life expectancy between higher education and remaining population groups in two countries. Among Lithuanian men, the excess mortality at adult ages below 65 explained the major part of the difference between the two educational groups (5.1 years out of the total of 7.4 years). Although cardiovascular system diseases made the major single contribution (2.8 years), almost half of the total gap was explained by the joint contribution of external causes, smoking-related cancers, and alcohol-related causes. At the same time, lower mortality in both age ranges (below and above age 65) contributed

almost equally to the life expectancy gap between the highly educated and remaining population groups in Sweden. Disadvantage in mortality due to cardiovascular diseases in the remaining population explained almost half of the total difference in life expectancy. At the same time, external causes of death, smoking-related cancers, and alcohol-related causes (the joint contribution amounted to 0.8 years) played a much less important role than in Lithuania (Figure 1A).

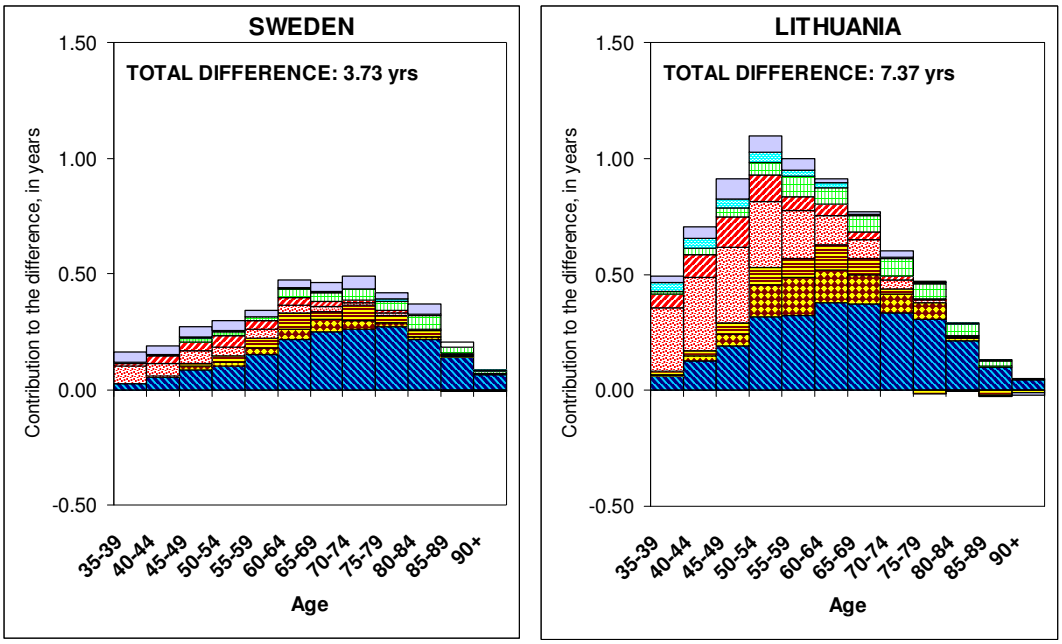
Differences in mortality due to cardiovascular system diseases made the biggest contribution to the total gap between females with higher and lower than higher education groups in both Lithuania and Sweden (Figure 1B). The advantage of Swedish females with higher education almost exclusively concerned older ages (two thirds of the total gap were explained by the mortality differences at ages above 65 years). Among Lithuanian females, the contributions of adult and old age mortality were almost equally significant (Figure 1B). Excess mortality at ages below 65 years in lower than higher education group accounted for a loss of 1.9 years. Such premature mortality was the result of mortality due to alcohol-related and external causes of death. These causes of death played only negligible role in the educational gap in Sweden. Differently from Lithuania, smoking-related and other cancers were important contributors to the educational gap in Sweden.

Table 2. *Life expectancy at age 35 for higher education group, lower than higher education group, and total population in Lithuania and Sweden*

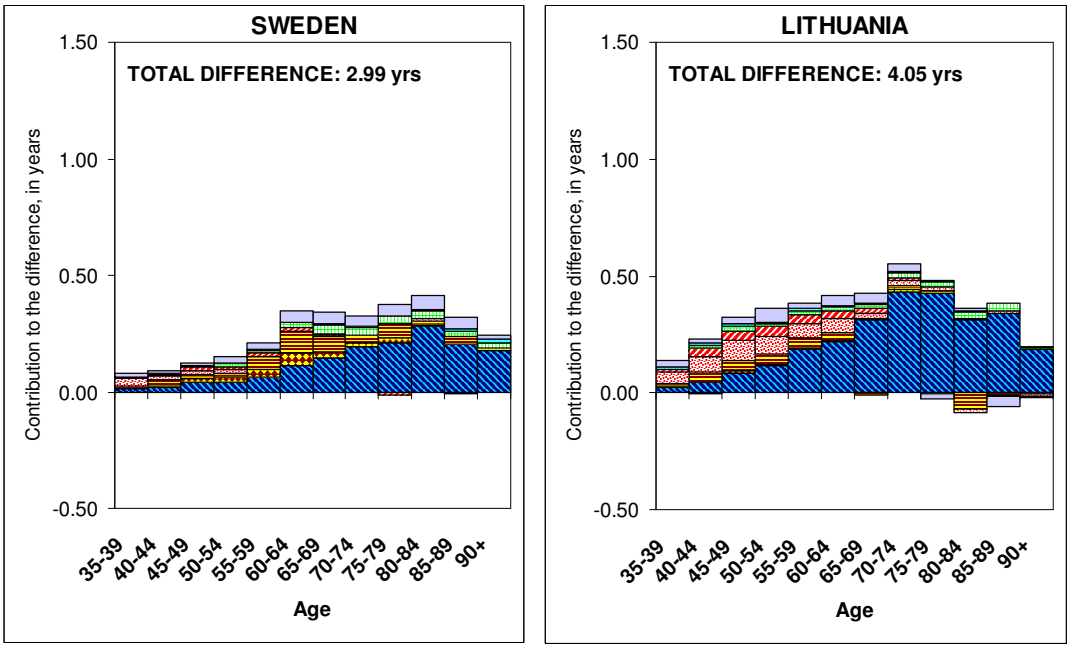
	MALES				**FEMALES**			
	Lithuania		**Sweden**		**Lithuania**		**Sweden**	
	e(35)	*Difference*	**e(35)**	*Difference*	**e(35)**	*Difference*	**e(35)**	*Difference*
Higher education	**40.75** *40.45-41.04*	**0**	**46.23** *46.07-46.39*	**0**	**47.57** *47.23-47.91*	**0**	**50.38** *50.18-50.57*	**0**
Lower than higher ed.	**33.38** *33.27-33.49*	**-7.37**	**42.50** *42.43-42.56*	**-3.73**	**43.52** 43.43-43.61	**-4.05**	**47.39** *47.32-47.46*	**-2.99**
Total	**34.35**	**-6.40**	**43.04**	**-3.19**	**43.99**	**-3.58**	**47.72**	**-2.65**

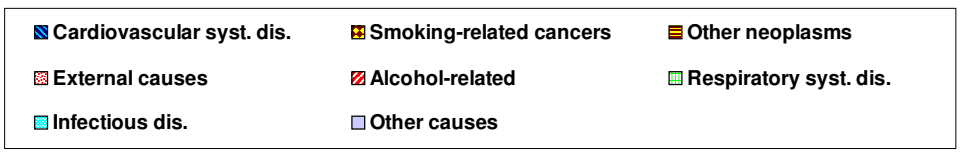
Figure 1. *Contributions of age- and cause specific mortality to differences in life expectancy at age 35 between higher education and remaining (lower than higher education) groups in Sweden and Lithuania.*

A) Males



B) Females





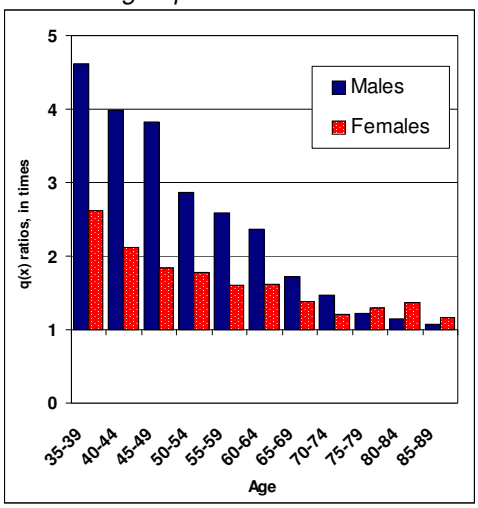
Differences in life expectancy by education <u>between</u> countries

The purpose of this subchapter is to compare higher education groups in Lithuania and Sweden. In particular, it is interesting to see whether higher education group in Lithuania is very different from the remaining population in terms of age- and cause-specific mortality disadvantage against the corresponding groups in Sweden.

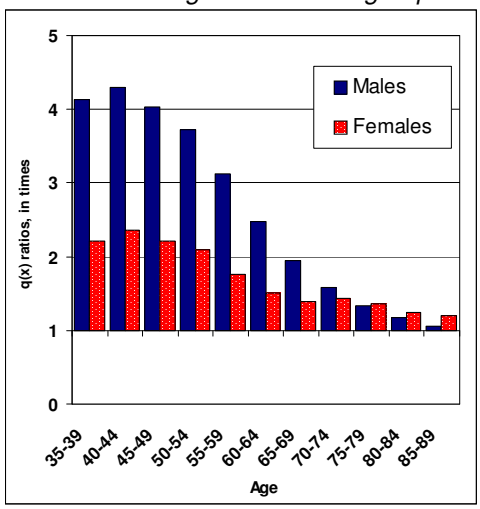
Table 2 shows that life expectancy of highly educated Lithuanian males was by about 5.5 years lower than in the corresponding group in Sweden (40.8 and 46.2 years, respectively). The corresponding disadvantage of Lithuanian females with higher education was only 2.8 years. At the same time, the advantage of Swedish people with lower than higher education against the lower educated Lithuanians was striking for males (9.1 years) and moderate (3.9 years) for females.

Figure 2. *Age-specific ratios of probabilities of dying between the education groups in Lithuania and corresponding education groups in Sweden*

A) Higher education group in Lithuania vs. higher education group in Sweden



B) Lower than higher education group in Lithuania vs. lower than higher education group in Sweden



The differences in age-specific mortality patterns between the educational groups in Lithuania and corresponding groups in Sweden can be depicted from Figure 2. Both highly and lower educated population groups in Lithuania suffer from notable excess premature mortality. Ratios of probabilities of dying among highly educated men in Lithuania versus highly educated men in Sweden reached their maximum of about 3.8-4.6 times at ages 35-49 (Figure 2). Similar (albeit slightly higher) ratios at these ages were also observed when comparing lower educated males in two countries. However, after age 50 the two patterns of age-specific ratios became different. In case of higher education, the ratios were rapidly decreasing with increasing age, whereas notable mortality disadvantage of lower educated Lithuanians remained very significant up to the age 75 (Figure 2). Quite a similar pattern of age-specific ratios of probabilities of dying (although more uniform across ages) was also observed for females. The peak of mortality disadvantage among highly educated Lithuanian females was found in the youngest age group of 35-39 years. After this age, the ratios were gradually decreasing

and stabilizing at the level of about 1.2-1.6 times at older ages. Lower educated females in Lithuania continued showing excess mortality of about 2.1-2.4 times throughout the age range 35-55 (Figure 2).

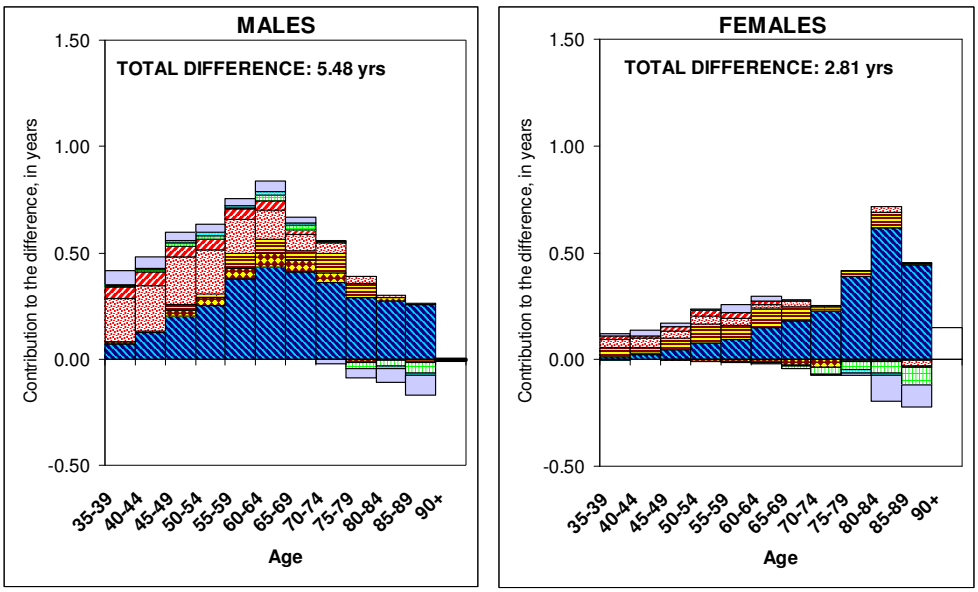
Figures 3A and 3B show patterns of age-and cause-specific contributions to the differences in life expectancies between a) highly educated groups and b) lower than higher education (remaining population) groups in Sweden and Lithuania (for exact figures also see Appendix 1). Once again, we can observe a striking impact of excess premature mortality among Lithuanian males. The life expectancy disadvantage of both highly and lower educated males against the corresponding groups in Sweden came from very significant mortality excess at ages below the age 65 (Figures 3A & 3B). The range of cause-specific excess mortality observed for highly educated Lithuanian males was somewhat different from the corresponding pattern for lower educated males. The life expectancy gap between highly educated Swedes and Lithuanians equal to 5.5 years was mostly attributable to the excess cardiovascular mortality (3 years). The second important contribution came from so called "man-made" diseases, mostly affecting the age range 35-70 (alcohol- related, smoking-related, and external cause), which explained about one third of the total gap. Excess mortality due to the latter causes of death was the most important contributor to the total life expectancy difference between the lower educated males in two countries (4.1 years out of the total of 9.1 years). These causes of death dominated the age-specific contributions between the ages 35 and 60.

Almost entire life expectancy gap between the highly educated Swedish and Lithuanian females came from the excess mortality due to cardiovascular diseases at older ages with some important contributions of other cancers between the ages of 50 and 65 years (Figure 3A). Among lower educated females, the situation was different. The major disparity was produced by premature mortality which was more prominent than in the case of higher education group (Figure 3B). The excess premature mortality of lower educated Lithuanian females was the result of external and alcohol related causes of death. These causes of death play only a negligible role in the life expectancy gap between highly educated females. Lower mortality due to smoking-related cancers in Lithuania has an opposite effect (contribute negatively) both among highly and lower educated females (Figures 3A & 3B).

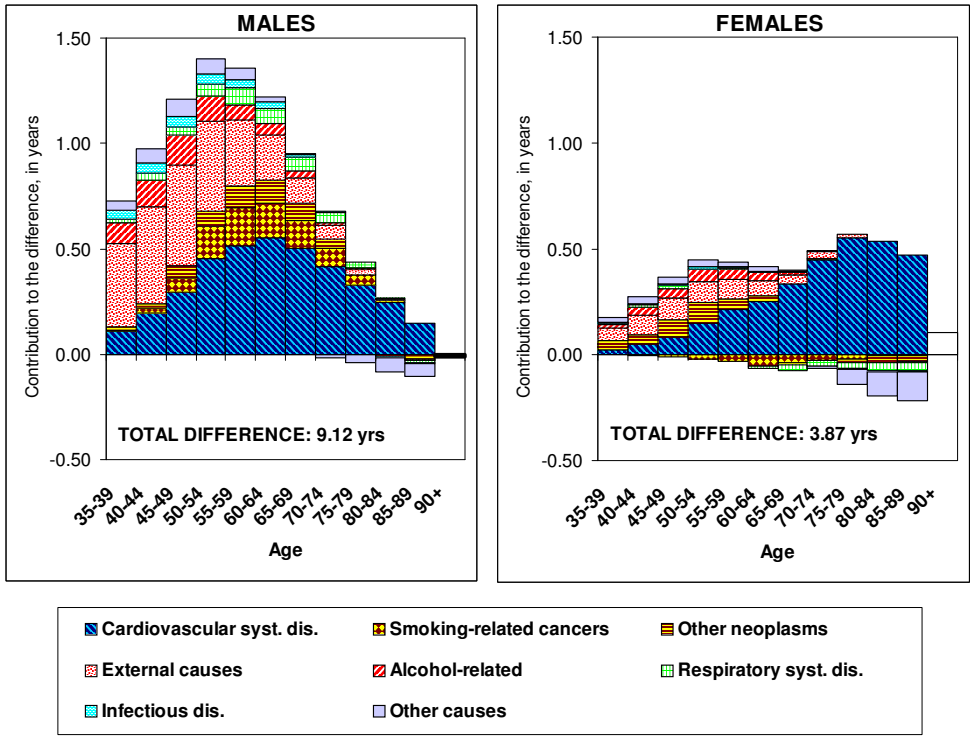
Figures 3A & 3B also point to significant negative contributions of excess mortality due to respiratory system diseases and other causes of death at old ages (above 75). Among females aged 90 years and older, the contributions of these causes of death almost counterbalance positive impacts of cardiovascular system diseases (Appendix 1). We assume that such pattern of cause-specific contributions at oldest ages is an artifact which can be explained by the differences in the practices of coding of causes of death. Therefore, we conclude that the overall importance of the cardiovascular system diseases may be slightly overestimated.

Figure 3. *Contributions of age- and cause specific mortality to differences in life expectancy at age 35 between education groups in Sweden and corresponding education groups in Lithuania.*

A) Higher education group in Sweden vs. higher education group in Lithuania



B) Lower than higher education group in Sweden vs. lower than higher education group in in Lithuania



Note: the negative contributions of respiratory system diseases and other causes of death at ages above 75 may be attributable to differences in coding practices between the two countries. Such effect was particularly significant at ages 90+, therefore the cause-specific contributions for these ages are not shown.

Concluding remarks

Our results suggest that there are substantial differences in patterns of age- and cause-specific contributions to the life expectancy gaps between highly educated versus remaining population groups in Lithuania and Sweden. These dissimilarities were particularly evident for males. Lithuanian males with lower than higher education showed striking excess mortality at young adult ages due to external, smoking-related, and alcohol-related deaths. Similar albeit less important impact of premature mortality was also observed among Lithuanian females. In Sweden, the role of excess adult mortality was much less significant. These results suggest that health progress among highly educated Lithuanians did not expand to lower education groups. Very high prevalence of alcohol-related and external causes of death points to extreme socio-economic disadvantages and poor psychosocial conditions, experienced by a substantial share of lower educated people in Lithuania.

Both higher and lower education groups in the two countries seem to be very distinct especially in terms of age patterns of mortality. Lithuanian males both with higher and lower education showed striking importance of excess premature mortality due to external and alcohol-related deaths. These findings informs on high prevalence of specific risk factors across all educational groups. Lithuanian females seem to have more benefits from higher education than males. A relatively small life expectancy disadvantage of highly educated Lithuanian females against their Swedish counterparts can be entirely explained by the excess mortality due to cardiovascular system diseases at older ages. This pattern substantially differed from lower educated females showing notable excess premature mortality due to external and alcohol-related causes in Lithuania.

It is rather plausible that persisting strikingly high premature mortality among highly educated males in Lithuania have contributed to the diminishing contribution of this group to the recovery of health situation of the entire population. The recent reversal in male life expectancy trends in Lithuania may refer to the consequences of this unfavorable trend.

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Appendix 1

Contributions of age- and cause specific mortality to differences in life expectancy at age 35 between education groups in Sweden and corresponding education groups in Lithuania.

A) Higher education group in Sweden vs. higher education group in Lithuania

Males

Age	Cardiovascular syst. dis.	Smoking-related cancers	Other neoplasms	External causes	Alcohol-related	Respiratory syst. dis.	Infectious dis.	Other causes
35-39	0.0705	0.0079	-0.0034	0.2066	0.0546	0.0068	0.0056	0.0648
40-44	0.1260	0.0060	0.0003	0.2136	0.0627	0.0112	0.0078	0.0534
45-49	0.2010	0.0297	0.0258	0.2240	0.0511	0.0143	0.0137	0.0356
50-54	0.2531	0.0373	0.0178	0.2074	0.0500	0.0123	0.0161	0.0381
55-59	0.3775	0.0483	0.0697	0.1580	0.0542	0.0049	0.0095	0.0312
60-64	0.4342	0.0609	0.0652	0.1420	0.0399	0.0316	0.0158	0.0495
65-69	0.4090	0.0543	0.0468	0.0727	0.0216	0.0262	0.0073	0.0277
70-74	0.3588	0.0445	0.0958	0.0456	0.0030	0.0033	0.0044	-0.0235
75-79	0.2876	-0.0172	0.0687	0.0302	0.0038	-0.0262	-0.0038	-0.0410
80-84	0.2717	0.0184	-0.0039	0.0111	-0.0035	-0.0265	-0.0087	-0.0698
85-89	0.2546	0.0012	-0.0177	0.0038	-0.0026	-0.0454	-0.0141	-0.0926
90+	0.1718	-0.0029	-0.0198	-0.0158	0.0000	-0.0445	0.0009	-0.0953
Total	**3.2158**	**0.2884**	**0.3453**	**1.2993**	**0.3349**	**-0.0320**	**0.0546**	**-0.0219**

Females

Age	Cardiovascular syst. dis.	Smoking-related cancers	Other neoplasms	External causes	Alcohol-related	Respiratory syst. dis.	Infectious dis.	Other causes
35-39	0.0124	-0.0005	0.0423	0.0412	0.0156	-0.0005	-0.0005	0.0084
40-44	0.0227	0.0065	0.0275	0.0437	0.0079	0.0026	0.0004	0.0267
45-49	0.0425	-0.0039	0.0579	0.0317	0.0201	0.0008	-0.0009	0.0152
50-54	0.0796	-0.0096	0.0830	0.0417	0.0240	0.0043	0.0036	0.0005
55-59	0.0948	-0.0121	0.0671	0.0294	0.0307	-0.0041	-0.0012	0.0331
60-64	0.1495	-0.0144	0.0941	0.0134	0.0182	-0.0067	-0.0011	0.0204
65-69	0.1799	-0.0260	0.0662	0.0273	-0.0028	-0.0160	0.0010	0.0060
70-74	0.2257	-0.0344	0.0194	0.0064	-0.0015	-0.0318	0.0002	-0.0097
75-79	0.3887	-0.0062	0.0286	-0.0018	-0.0002	-0.0386	-0.0176	-0.0120
80-84	0.6149	-0.0049	0.0712	0.0274	-0.0056	-0.0524	-0.0126	-0.1210
85-89	0.4432	-0.0031	0.0073	-0.0275	-0.0051	-0.0822	0.0033	-0.1044
90+	0.6402	-0.0037	-0.0343	-0.0049	-0.0019	-0.1025	-0.0037	-0.3397
Total	**2.8941**	**-0.1122**	**0.5303**	**0.2280**	**0.0993**	**-0.3270**	**-0.0292**	**-0.4764**

Appendix 1 (continued)

B) Lower than higher education group in Sweden vs. lower than higher education group in in Lithuania

Males

	Cardiovascular syst. dis.	Smoking-related cancers	Other neoplasms	External causes	Alcohol-related	Respiratory syst. dis.	Infectious dis.	Other causes
35-39	0.1070	0.0077	0.0165	0.3950	0.0965	0.0189	0.0414	0.0466
40-44	0.1944	0.0234	0.0213	0.4606	0.1246	0.0347	0.0475	0.0696
45-49	0.2935	0.0662	0.0601	0.4774	0.1420	0.0396	0.0501	0.0802
50-54	0.4515	0.1535	0.0758	0.4251	0.1212	0.0540	0.0516	0.0688
55-59	0.5135	0.1833	0.1045	0.3080	0.0752	0.0790	0.0381	0.0534
60-64	0.5520	0.1639	0.1082	0.2155	0.0547	0.0714	0.0317	0.0255
65-69	0.5010	0.1345	0.0809	0.1192	0.0362	0.0636	0.0121	0.0041
70-74	0.4142	0.0882	0.0443	0.0637	0.0114	0.0497	0.0084	-0.0185
75-79	0.3257	0.0517	0.0017	0.0235	0.0052	0.0290	-0.0010	-0.0384
80-84	0.2425	0.0157	-0.0127	0.0052	-0.0003	0.0022	-0.0034	-0.0654
85-89	0.1454	0.0026	-0.0235	-0.0028	0.0000	-0.0162	-0.0029	-0.0611
90+	0.0752	0.0008	-0.0148	-0.0040	-0.0004	-0.0209	-0.0026	-0.0457
Total	**3.8160**	**0.8917**	**0.4624**	**2.4864**	**0.6662**	**0.4048**	**0.2708**	**0.1190**

Females

	Cardiovascular syst. dis.	Smoking-related cancers	Other neoplasms	External causes	Alcohol-related	Respiratory syst. dis.	Infectious dis.	Other causes
35-39	0.0246	0.0000	0.0410	0.0584	0.0212	0.0039	0.0073	0.0166
40-44	0.0509	-0.0015	0.0445	0.0905	0.0415	0.0068	0.0096	0.0291
45-49	0.0833	-0.0096	0.0830	0.1009	0.0426	0.0163	0.0094	0.0308
50-54	0.1479	-0.0180	0.1008	0.0972	0.0563	-0.0025	0.0113	0.0369
55-59	0.2141	-0.0315	0.0505	0.0889	0.0537	0.0005	0.0060	0.0250
60-64	0.2502	-0.0524	0.0316	0.0701	0.0365	-0.0119	0.0071	0.0190
65-69	0.3340	-0.0393	-0.0100	0.0427	0.0140	-0.0270	0.0005	0.0065
70-74	0.4508	-0.0285	0.0009	0.0337	0.0054	-0.0271	0.0020	-0.0092
75-79	0.5511	-0.0178	-0.0167	0.0179	-0.0010	-0.0313	-0.0053	-0.0656
80-84	0.5328	-0.0031	-0.0344	-0.0006	-0.0011	-0.0353	-0.0076	-0.1140
85-89	0.4727	-0.0015	-0.0276	-0.0062	-0.0009	-0.0366	-0.0073	-0.1377
90+	0.3764	-0.0001	-0.0226	-0.0137	-0.0001	-0.0508	-0.0083	-0.1739
Total	**3.4889**	**-0.2033**	**0.2409**	**0.5798**	**0.2681**	**-0.1951**	**0.0245**	**-0.3366**