Changes in age-cause structure of educational differences in life expectancy at old ages in Sweden and Finland

Virginia Zarulli[1,2], Domantas Jasilionis[2], Dmitri A. Jdanov[2]

Introduction

The creation of universal welfare states has often led to belief that health and mortality inequalities would fade and eventually vanish (Vallin 1980) but since the early 1980s numerous studies have falsified this approach showing persisting and widening health inequalities (Black, Morris et al. 1980; Mackenbach, Bos et al. 2003; Mirowsky and Ross 2003; Kunst, Bos et al. 2004; Mackenbach 2006).

Despite the existence of substantive literature, the evidence about the long-term trends and determinants of this phenomenon is still inadequate. The lack of census linked data in many countries is often the cause of biased estimates (Vallin 1980; Valkonen 1993; Shkolnikov, Jasilionis et al. 2007). The majority of international studies usually refer to the most recent decade. In addition, international comparisons pose a challenge because of the differences in social class classification schemes across countries (Valkonen 1993; Kunst, Groenhof et al. 1998; Kunst, Bos et al. 2004).

However, thanks to the availability of high quality data, the literature on mortality differentials in the Nordic countries is rich and suggests that even these egalitarian nations experienced widening socio-economic health inequalities (Vagero and Norell 1989; Martelin 1994; Vågerö and Lahelma 1998; Hussain, Lenner et al. 2007; Erikson and Torssander 2008; Tiikkaja, Hemström et al. 2009).

Although analysis on socio economic differences in mortality at older ages are less numerous than young and adult ages, a growing corpus of studies is bringing evidence to the fact that even if they tend to reduce by age, significant differentials still persist late in life (Martelin, Koskinen et al. 1998; Martikainen, Valkonen et al. 2001; Huisman, Kunst et al. 2004; Huisman, Kunst et al. 2005; Shkolnikov, Scholz et al. 2008; Martelin 1994). In addition, differentials among women seem to be less

[1] "La Sapienza" University of Rome, Department of social, economic, actuarial and demographic studies, Rome, Italy.
[2] Max Planck Institute for Demographic Research, Rostock, Germany

prominent than among men but only when the subpopulation of married women is taken into account (Koskinen and Martelin 1994). If the entire marital status range is taken into account, the gradient among women appears as strong as the men gradient (Vagero 2000).

Typically studies on old-age mortality differentials focus on broad and standard groups of causes of death or on one specific group of diseases (Olausson 1991; Huisman, Kunst et al. 2004; Borrell, Plasencia et al. 2005; Fujino, Tamakoshi et al. 2005; Shkolnikov, Scholz et al. 2008). However, the analysis of old ages requires a classification that includes both standard and specifically old age related causes (Meslé and Vallin 2006).

The most frequently socio-economic variable used in health inequality studies is education. Also occupational status, income and housing tenure are often studied. Some analyses employ multi-dimensional variable combining education, marital status, and occupation (Martelin, Koskinen et al. 1998; Martikainen, Valkonen et al. 2001; Huisman, Kunst et al. 2004; Elo, Martikainen et al. 2006; Martikainen, Blomgren et al. 2007; Martikainen, Valkonen et al. 2009).

In our study we examine the contributions of detailed groups of causes of death to the difference in life expectancy between high and low education groups in Finland and Sweden in early 1970s and late 1990s. Such approach will allow us to identify the changing causal mechanisms shaping health and mortality inequality at old ages in both countries. This will give the possibility to improve public health interventions for disease prevention and welfare specific support at older ages.

Data and methods

The census-linked mortality datasets were provided by Statistics Finland and Statistics Sweden. For Finland census-based information was linked with the death registration of the five calendar years after the 1970 and 1995 censuses. For Sweden the counts on deceased and survivors was obtained from 1970 and 1990 census. The data for both countries were aggregated to the two five-year periods (1971-1975 and 1996-2000). As measure of social class we use education level because it refers to the social capital gained early in life and can represent a wider dimension of social classes other than the pure economic one, including attitudes to life and to health factors (Mirowsky and Ross 2003). Two extreme broad education classes (high and low

education) were chosen to measure the magnitude of life expectancy gap. We believe that such restriction allows avoiding potential biases due to: 1) changes in education systems within each country 2) cross-country differences in education systems. The "high" education refers to individuals with completed university or non-university higher education, whereas the "low" education refers to those with lower than secondary education (or education is unknown). Similar definitions were applied in the previous Nordic studies (Valkonen 1993; Valkonen, Sihvonen et al. 1997). The distributions of deaths and person years of exposure are shown in the Table 1.

Table 1 – Person years and number of deaths at age 65+ by sex and level of education in Finland and Sweden in 1971-1975 and 1996-2000.

	Men						Women					
	1971-1975			1996-2000			1971-1975			1996-2000		
	Person years – (%)		Deaths	Person years – (%)		Deaths	Person years – (%)		Deaths	Person years – (%)		Deaths
Finland												
high	38.85	(4.50)	2.29	119.65	(8.39)	4.77	46.14	(3.14)	1.76	122.61	(5.23)	4.01
medium	72.12	(8.35)	4.32	252.49	(17.71)	11.57	101.36	(6.90)	3.79	379.71	(16.19)	12.62
low.	753.14	(87.16)	57.37	1053.25	(73.89)	65.92	1320.82	(89.95)	70.48	1842.63	(78.58)	91.61
tot.	864.11	(100)	63.98	1425.40	(100)	82.26	1468.32	(100)	76.03	2344.96	(100)	108.23
Sweden												
high	86.51	(3.39)	4.36	336.99	(10.63)	12.31	39.69	(1.24)	1.24	299.88	(6.98)	6.78
medium	66.53	(2.61)	3.66	717.94	(22.65)	34.01	19.22	(0.60)	0.57	734.96	(17.11)	21.01
low	2396.09	(94.00)	158.21	2114.14	(66.71)	142.91	3152.18	(98.17)	152.65	3259.81	(75.90)	180.44
tot.	2549.13	(100)	166.22	3169.06	(100)	189.23	3211.09	(100)	154.45	4294.65	(100)	208.23

We grouped causes of death in the following categories: 1) heart diseases; 2) cerebrovascular, circulatory diseases; 3) respiratory and infectious diseases; 4) lung cancer; 5) stomach cancer; 6) intestine cancer; 7) breast cancer (for women) or prostate cancer (for men); 8) uterus cancer (for women only); 9) other neoplasms; 10) Alzheimer and senility; 11) other diseases; 12) accidental falls; 13) suicides; 14) other external causes of death; 15) ill-defined, unknown causes (for detailed ICD10 codes see Appendix 1).The percentages of deaths due to ill defined causes is very low in both countries (below 0.25% in both time points).

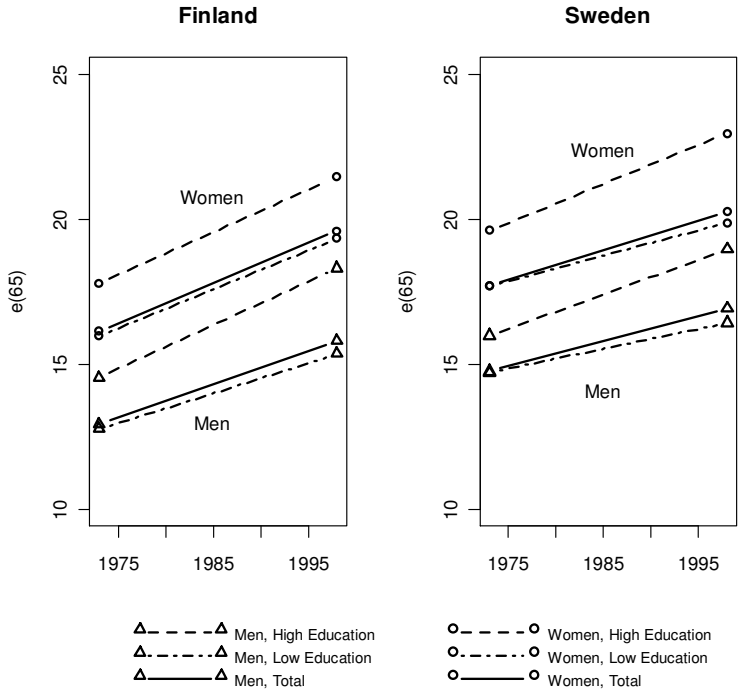
For the decomposition of life expectancy we used the algorithm for decomposition of differences between aggregate demographic measures (Andreev, Shkolnikov et al. 2002).

Results

Trends in life expectancy at age 65

From 1970-75 to 1996-2000, male and female life expectancies at age 65 increased but due to smaller health gains in the low education groups the gap widened (Fig.1). Overall health gains were generally larger for women than for men. However, there were notable differences by education groups: highly educated males and females benefited from more rapid life expectancy improvements than lower educated males and females. Highly educated Finnish males experienced the largest improvement (3.77 years), whereas low educated Swedish men showed the lowest progress (only 1.74 years).

FIGURE 1 - trends in life expectancy at age 65 between 1971-1975 and 1996-2000

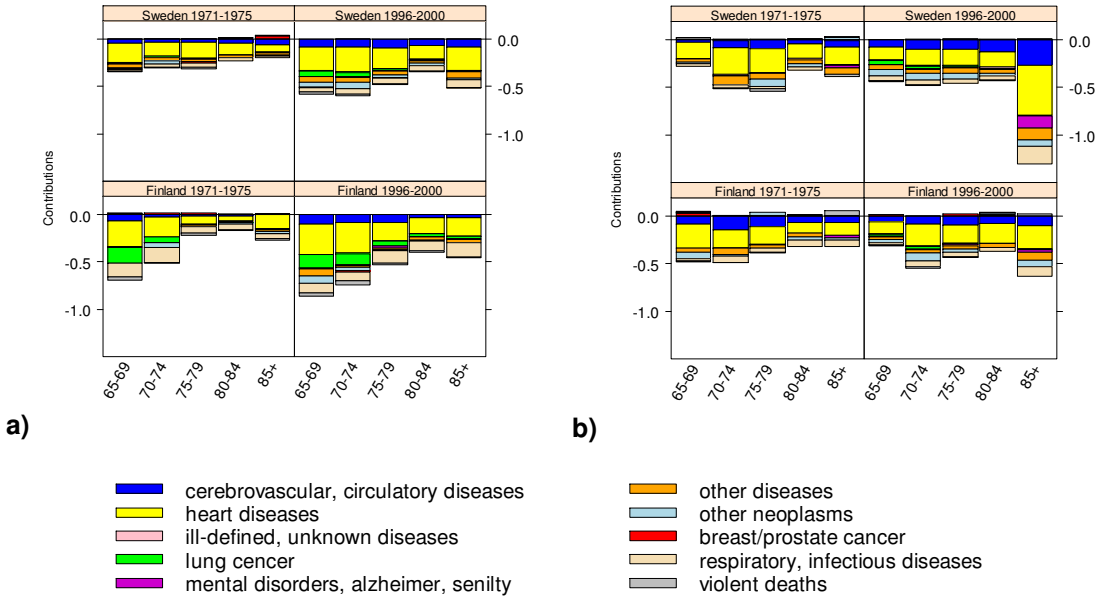


In both time points the widest gap was observed among the Swedish females (1.9 years in 1971-75 and 3.1 years in 1996-2000) and Finnish males (1.8 years in 1971-75 and 3.0 years in 1996-2000). These findings are coherent with the ones of other studies (Olausson 1991; Martikainen, Blomgren et al. 2007).

Decomposition of the difference in life expectancies in 1971-1975 and 1996-2000

Figure 2 shows that the increase in life expectancy gap between the high and low education groups among women is mainly due to increase in mortality differences at the oldest ages. Among men, the corresponding life expectancy gap is more equally distributed across all age groups (for the detailed age-cause specific contributions see Appendix 2).

FIGURE 2 – Age-Cause specific components of difference in life expectancy at age 65 between high educated group and low educated group in 1971-1975 and 1996-2000. a) men; b) women.



The two countries show some common features. Heart diseases and cerebrovascular and circulatory diseases represent the largest contribution to life expectancy gap between high and low education groups at all ages. However, the overall share of cardiovascular diseases decreased over time. For example, in Sweden, they explained about 70% of the total male and female life expectancy gap in 1971-75, whereas thirty years later this contribution decreased to 60% and 50% among women and men, respectively. At the same, time the importance of other causes increased. Excluding lung, breast and prostate cancer, the contribution of group of other cancers increased. This growth was more pronounced for women than for men. In 1996-2000 this component explained about 9% of the educational female life expectancy gap and about 4% of the male life expectancy gap. According to the

literature (Strand, Kunst et al. 2007), breast cancer represents a reversed social mortality gradient. Such reverse gradient persisted in Sweden and Finland in both time points. On the contrary, the initial advantage of low educated men regarding mortality from prostate cancer has disappeared.

The study highlights also some country specific features. In Finland, 14% (-0.26 years) of the life expectancy difference between high and low education groups in both time point was explained by the contribution of smoking-related lung cancers. In Sweden, the contribution of this cause of death was much smaller (about 5%).

Among women, on the contrary, lung cancer shows significantly smaller contribution and a general tendency to reverse the pattern from a situation favorable to lower classes to the one when the advantage disappears, in agreement to the "smoking epidemiological transition" (Lopez, Collishaw et al. 1994; Mackenbach 2006).

Respiratory and infectious diseases were also important components of the life expectancy gap, especially in Finland.

Regarding specifically old age related diseases like Alzheimer and senility, the data show that in the most recent years their importance is growing. These causes of death seen to be more important to the female life expectancy gap, especially in Sweden, where the contribution of these causes of death grew from about 1% in 1971-1975 to 6% in 1996-2000.

Discussion

This study examined changes in age- and cause-specific contributions to the gap in life expectancy at age 65 between high and low education groups in Sweden and Finland from 1971-75 to 1996-2000 using high quality census-linked data. The method of decomposition of differences between aggregate demographic measures was used to identify the most important ages and causes of death responsible for the life expectancy gap at both points in time. We defined 15 groups of causes of death (14 for men) which are of major interest at old ages.

The study presents some limitations. A more detailed classification of causes of death would have probably given a better insight on the dynamics of life expectancy gap over time. However, we adopted a classification that would allow us to minimize potential biases due to: 1) lower quality of registration of causes of death at older ages and 2) changes in the International Classification of Diseases (ICD) or

coding practices (Meslé and Vallin 1996; Janssen and Kunst 2004). We used only one dimension of socio-economic inequality (education). This not only helps to achieve a better comparability of educational categories over time but it also reduces the complexity of a multidimensional phenomenon such as socio-economic inequality.

This study shows that elderly in Sweden and Finland in the last decades experienced an increase of socioeconomic gap in mortality, pointing at the fact that inequality remains an important problem also at later ages.

The gap has increased because of the different age and cause patterns in the two social groups. The high education groups perform better in causes responsible for the higher improvement in survival. In particular, cardiovascular system diseases play the predominant role. Moreover, the increase of the gap is mainly due to the widening differences in mortality at the oldest ages.

The study also revealed that cancers mortality (with the partial exception of breast and prostate cancer) is becoming a more and more relevant cause of death contributing to inequality. This is particularly true for lung cancer among men showing very significant contributions. This is related to exposure to cigarette smoking typical of low social classes. Among women, the phenomenon lags behind in time but it is likely that this cause will become increasingly important for the gap in near future (Lopez, Collishaw et al. 1994; Mackenbach 2006).

Old age related diseases like Alzheimer and nervous system diseases make increasingly important contributions, especially among females. Epidemiological literature suggests a link between factors such as diet, pharmaceutical behavior, physical and cognitive activity, the probability of developing this disease (Szekely, Breitner et al. 2007) and individuals with high education usually perform better in these fields.

Although socioeconomic inequalities in mortality and health are well documented, the underlying mechanisms are not completely uncovered. Some authors emphasize the causal direction from economic to health inequality. Others refer to the opposite causality. One possible explanation of educational inequalities in life expectancy is the indirect selection hypothesis, which refers to confounding factors, like parental condition, able to affect socioeconomic and health status. The materialistic view focuses instead on factors like exposure to low income, physical health and precarious living conditions. On the other hand, financial disadvantage could also influence health through psychosocial stress mechanisms (Cockerham

2007). According to the cultural/behavioral explanation, instead, health and mortality differences result from difference in the prevalence of risk behaviors (Valkonen 2006; Blane, Smith et al. 2008).

Why inequality gap widens is also not very clear. It is likely that several factors contribute systematically. However, in equalitarian countries with universal welfare states like Sweden and Finland there should be very specific factors.

A direct effect of low income and financial strains seems to be unlikely because of the universal coverage of the welfare state and low income inequality characterizing these countries. A recent study found that the linear relation between income and mortality in Finland attenuates by 61% among men and 52% among women once controlling for confounding factors, indicating that income is rather associated with long term accumulation of factors that increase mortality risk (Martikainen, Makela et al. 2001).

The upper classes may benefit more from the introduction of new treatments and might have a better ability of taking advantage of prevention messages (Martelin 1996; Martikainen, Valkonen et al. 2001). Indeed, some studies about inequality in access to treatment lend some support to this interpretation showing that in Finland bypass operations were 35% more common among non-manual than manual workers (Keskimaki, Koskinen et al. 1997). The way how the health care system satisfies the emergent needs of the elderly is extremely important. The health care system nees to adapt to the patient profiles that nowadays are shifting toward chronic long term illness requiring services over time (Lynn, Adamson et al. 2003). These are often very expensive, and not everybody is able to afford such a cost. Therefore, the health care should try to make as much equalitarian as possible the access to the later life services.

Behavioral and life style factors seem to play an important role, especially considering that unhealthy behaviors tend to multiple accumulation that strengthens their negative effect (Laaksonen, Prattala et al. 2001). Non smoking, moderate alcohol usage, physical activity, good dietary habits are related to a lower risk of mortality at adult and at old ages as well (Knoops, de Groot et al. 2004). Being overweight or obese earlier in life carries the burden of higher cardiovascular mortality at old ages (Harris, Savage et al. 1997; Daviglus 2005), as well as smoking, alcohol and lack of physical activity (LaCroix, Guralnik et al. 1993; Leveille, Guralnik et al. 1999).

In Finland, health behaviors (and in particular smoking, vegetable use and physical activity) explain 54% of the educational differences in cardiovascular mortality among men and 22% among women (for the all cause mortality the percentages are 45% and 38%) (Laaksonen, Talala et al. 2008). Although there are signals of improvement in daily habits as a result of public health campaigns (Helakorpi, Paavola et al. 2009), lower socioeconomic classes are still characterized by a unhealthier life style (Mackenbach 2006). In some cases, like in the level of coronary risk factors, the difference between educational groups tends to increase (Pekkanen, Uutela et al. 1995).

Among the risk factors of cardiovascular diseases, smoking seems to play one of the major roles (Janssen, Kunst et al. 2007). The persisting social class differences in the prevalence of smoking in both Finland and Sweden, where low educated classes show increasingly higher smoking rates than high educated groups (Lahelma, Rahkonen et al. 1997; Cavelaars, Kunst et al. 2000), seems to explain at least a part of the widening inequality. The results presented in this paper are coherent with this framework, showing that cardiovascular diseases and lung cancer (two diseases for which smoking is a strong risk factor) represent two major fields where inequality has widened.

This study gives a detailed insight on the dynamics at old ages and provides an important starting point for monitoring this and for the possibility of implementing better targeted policies aimed to health improvements and disease prevention throughout the life course of individuals.

Appendix 1 – Groups of cause of death used in the analysis according to the lists of ICD8, ICD9 and ICD10.

Groups of cause of death used in the analysis according to the international classifications in the time series since 1969			
	1996- ICD-10	**1987-1995 ICD-9**	**1969-1986 ICD-8**
Heart diseases	I20-i25, I30-i425, I427-I52	410-414, 420-4254, 4258-429	410-414, 420-425, 427-429
	I30-i425, I427-I52	420-4254, 4258-429	420-425, 427-429
Cerebrovascular and others	I60-i69, I00-I15, I26-I28, I70-I99	430-434, 436-4376, 4378X-438, 2891-2892, 390-405, 415-417, 440-444, 447-459	2891-2893, 390-404, 426440-4441, 4443-4458, 447-458
Lung caner	C32-C34	161-162	161-162
Breast cancer	C50	174-175	174
Prostate cancer	C61	185	185
Other neoplasms	C00-C97 (excluded C32-C34, C50 and C61)	140-2376, 2379-239, 2733 (excluded 161-192, 174-175, 185)	140-239, 2755 (excluded 161-162, 174, 185)
Alzheimer and Nervous system diseases	F01, F03, G30, R54, G00-G29, G310.0-G311, G31.8-G620, G622-G720, G722-H95	290, 3310, 4378A(2904), 797, 320-3300, 3308-3309, 3311-3570, 3576-389, 435, 7860	290, 794, 320-332, 331-389, 435, 7832
Infectious and Respiratory diseases	A00-B99, J65, J00, J64, J66-J99	001-033, 0341-0401, 0403-0992, 0994-134, 1362-139, 7713, 7908, 0340, 460-519, 7991	000-033, 0341-134, 136 2759 (if year of death >=1984, 5281), 0340, 460-519, 7960
External/Alcohol related	F10, G312, G4051, G621, G721, I426, K292, K70, K860, K8600, 0354, P043, X45, V01-X44, X46-Y89	291, 303, 3050, 3575, 4255, 5353, 5710-5713, 5770D-5770F, 5771C-5771D, 760 A, 7795A, E851, E800-E858, E861-E999	291, 303, 5710, 577, males E860, E800-E859, E861-E999
Other diseases	K00-K291, K293-K67, K71-K85, K861-K93, N00-N99, Q00-Q99, D50-D89, F00, F02, F04-F09, F11-F99, L00-M99, O00-O353, O355-P042, P044-P96, R00-R53, R55-595	0402, 520-5352, 5354-5709, 5714-5770C, 5771A-5771B, 5772-579, 580-629, 7880, 2377, 740-759, 0993, 135-1361, 2682A, 2730, 279, 280-2890, 2894-289, 292-302, 304, 307-319, 446, 630-739, 760-7606A, 7607X-7712, 7714-7794A, 7795B-785, 786B-787, 7881-7907, 7909-796M 7980	269, 520-5280, 5282-570, 5719-576, 577, 580-629, 7860, 7862, 740-759, 135, 2652, 2750-2751, 280-2890, 2894-289, 292-302, 304-315, 4459, 446, 630-738, 760-7831, 7833-785, 7861, 7863-793, 795-796
Ill defined	R96-R99	7981-7989, 7994-7999X	795, 7961-7969

Appendix 2 – Age and cause components of differences in life expectancy at age 65 between high and low education group

Women: Age and cause of death components inlife expectancy gap in Finland and Sweden in 1971-1975 and 1996-2000

Country and Cause	1971-1975						1996-2000					
	Age goup						Age group					
	65-69	74-74	75-79	80-84	85+	*Tot*	65-69	74-74	75-79	80-84	85+	*Tot*
Finland												
Heart dis.	-0.250	-0.188	-0.184	-0.111	-0.133	*-0.866*	-0.132	-0.233	-0.192	-0.209	-0.246	*-1.011*
Cerebrovascular, circulatory dis.	-0.085	-0.143	-0.110	-0.067	-0.066	*-0.470*	-0.053	-0.079	-0.090	-0.074	-0.097	*-0.393*
Respiratory, infectious dis.	-0.030	-0.063	-0.048	-0.065	-0.068	*-0.274*	-0.027	-0.064	-0.054	-0.036	-0.106	*-0.288*
Lung cancer	0.009	0.005	0.002	0.000	0.001	*0.017*	-0.014	-0.023	-0.008	0.001	-0.009	*-0.053*
Stomach cancer	-0.025	-0.027	-0.026	-0.015	-0.015	*-0.107*	-0.014	-0.004	-0.007	-0.006	-0.008	*-0.039*
Intestine cancer	0.001	-0.005	0.009	0.000	-0.008	*-0.003*	-0.010	0.001	0.002	0.010	-0.007	*-0.004*
Breast cancer	0.039	0.008	0.005	0.004	0.003	*0.059*	0.024	0.007	0.027	0.006	0.003	*0.066*
Uterus cancer	-0.004	0.004	0.023	0.002	-0.001	*0.025*	0.001	0.011	0.004	0.002	-0.004	*0.015*
Other neoplasms	-0.035	0.008	0.023	-0.018	-0.005	*-0.028*	-0.015	-0.087	-0.029	0.010	-0.043	*-0.165*
Alzheimer, senility	0.003	-0.002	0.006	0.005	-0.024	*-0.013*	-0.008	-0.008	-0.016	0.005	-0.023	*-0.048*
Other diseases	-0.044	-0.070	-0.031	-0.040	0.005	*-0.180*	-0.024	-0.038	-0.037	-0.046	-0.088	*-0.233*
Accidental falls	-0.010	-0.006	-0.015	0.001	0.044	*0.014*	-0.003	-0.012	-0.005	0.005	0.025	*0.010*
Suicides	0.004	-0.002	0.004	-0.001	0.000	*0.004*	0.002	0.001	0.002	0.003	0.001	*0.009*
Other external causes	-0.005	0.003	0.003	0.004	0.000	*0.005*	-0.002	-0.004	0.001	0.006	-0.002	*-0.001*
Ill-defined, unknown	0.002	0.000	-0.008	0.007	0.007	*0.007*	-0.008	-0.009	-0.002	0.008	-0.001	*-0.012*
Tot.	*-0.431*	*-0.479*	*-0.348*	*-0.294*	*-0.260*	*-1.811*	*-0.282*	*-0.541*	*-0.403*	*-0.315*	*-0.606*	*-2.147*
Sweden												
Heart dis.	-0.179	-0.281	-0.258	-0.156	-0.182	*-1.056*	-0.136	-0.169	-0.173	-0.159	-0.519	*-1.156*
Cerebrovascular, circulatory dis.	-0.019	-0.077	-0.089	-0.036	-0.073	*-0.293*	-0.070	-0.100	-0.095	-0.126	-0.270	*-0.661*
Respiratory, infectious dis.	-0.027	-0.031	-0.032	-0.034	0.007	*-0.118*	-0.050	-0.052	-0.040	-0.043	-0.185	*-0.370*
Lung cancer	0.002	0.010	-0.004	0.007	-0.003	*0.012*	-0.038	-0.020	-0.014	0.000	0.003	*-0.069*
Stomach cancer	-0.010	-0.020	-0.012	-0.019	-0.025	*-0.086*	-0.006	-0.007	-0.004	-0.008	-0.009	*-0.034*
Intestine cancer	-0.008	0.002	-0.002	0.027	0.029	*0.048*	-0.002	-0.012	-0.015	-0.002	-0.025	*-0.056*
Breast cancer	0.007	-0.001	0.002	0.003	-0.002	*0.009*	0.001	0.008	0.011	0.011	0.005	*0.036*
Uterus cancer	-0.010	-0.002	-0.013	-0.007	0.022	*-0.009*	-0.004	-0.009	0.000	-0.001	-0.002	*-0.017*
Other neoplasms	0.016	0.017	-0.045	-0.034	0.003	*-0.043*	-0.056	-0.045	-0.045	-0.011	-0.030	*-0.187*
Alzheimer, senility	-0.002	-0.003	-0.001	0.001	-0.028	*-0.033*	-0.004	-0.013	-0.013	-0.016	-0.131	*-0.177*
Other diseases	-0.036	-0.091	-0.060	-0.042	-0.064	*-0.293*	-0.053	-0.037	-0.055	-0.043	-0.130	*-0.317*
Accidental falls	0.000	-0.006	-0.025	0.002	-0.021	*-0.050*	-0.001	-0.002	-0.003	-0.002	0.002	*-0.006*
Suicides	-0.003	0.006	0.001	0.003	-0.001	*0.006*	0.000	0.002	-0.001	0.002	0.004	*0.006*
Other external causes	0.023	-0.007	-0.001	-0.002	-0.005	*0.008*	-0.003	-0.004	0.009	-0.009	0.002	*-0.005*
Ill-defined, unknown	0.001	-0.017	0.007	-0.013	-0.008	*-0.031*	-0.012	-0.009	0.000	-0.012	-0.008	*-0.040*
Tot.	*-0.243*	*-0.501*	*-0.532*	*-0.301*	*-0.351*	*-1.928*	*-0.434*	*-0.471*	*-0.437*	*-0.419*	*-1.294*	*-3.054*

Men: Age and cause of death components inlife expectancy gap in Finland and Sweden in 1971-1975 and 1996-2000

Country and Cause	1971-1975						1996-2000					
	Age goup						Age group					
	65-69	74-74	75-79	80-84	85+	*Tot*	65-69	74-74	75-79	80-84	85+	*Tot*
Finland												
Heart dis.	-0.270	-0.211	-0.083	-0.051	-0.147	*-0.762*	-0.315	-0.321	-0.191	-0.167	-0.191	*-1.184*
Cerebrovascular, circulatory dis.	-0.065	-0.021	-0.011	-0.013	0.010	*-0.100*	-0.101	-0.085	-0.081	-0.034	-0.031	*-0.332*
Respiratory, infectious dis.	-0.148	-0.164	-0.070	-0.060	-0.049	*-0.489*	-0.100	-0.098	-0.130	-0.102	-0.158	*-0.588*
Lung cancer	-0.168	-0.057	-0.014	-0.015	-0.003	*-0.257*	-0.143	-0.121	-0.052	-0.030	-0.021	*-0.368*
Stomach cancer	-0.033	-0.037	-0.025	-0.005	-0.006	*-0.108*	-0.022	-0.008	-0.005	-0.007	-0.011	*-0.053*
Intestine cancer	0.031	0.001	0.000	0.005	0.000	*0.037*	0.001	0.008	0.009	0.007	0.012	*0.038*
Prostate cancer	0.008	0.016	0.013	0.014	-0.001	*0.050*	0.001	-0.016	0.003	0.007	0.002	*-0.002*
Other neoplasms	0.004	-0.012	0.020	-0.009	-0.023	*-0.020*	-0.053	-0.029	-0.018	-0.014	0.003	*-0.110*
Alzheimer, senility	0.004	-0.002	-0.001	0.000	0.001	*0.001*	-0.009	-0.009	-0.020	-0.001	-0.007	*-0.045*
Other diseases	0.004	-0.001	-0.011	-0.001	-0.018	*-0.027*	-0.081	-0.015	-0.019	-0.031	-0.034	*-0.179*
Accidental falls	0.001	0.013	-0.003	-0.006	-0.003	*0.001*	-0.014	-0.003	0.003	-0.006	-0.003	*-0.024*
Suicides	-0.012	-0.004	-0.006	-0.004	-0.003	*-0.028*	-0.012	-0.013	-0.006	-0.003	-0.006	*-0.040*
Other external causes	-0.023	-0.017	-0.016	0.002	-0.011	*-0.065*	-0.011	-0.022	-0.013	-0.002	0.000	*-0.049*
Ill-defined, unknown	-0.008	0.005	0.005	-0.005	-0.005	*-0.007*	-0.003	-0.006	-0.004	-0.001	-0.006	*-0.019*
Tot.	*-0.676*	*-0.490*	*-0.202*	*-0.148*	*-0.258*	*-1.774*	*-0.861*	*-0.737*	*-0.524*	*-0.383*	*-0.450*	*-2.955*
Sweden												
heart dis.	-0.210	-0.145	-0.166	-0.124	-0.075	*-0.720*	-0.242	-0.262	-0.220	-0.143	-0.242	*-1.110*
cerebrovascular,circulatory dis.	-0.035	-0.026	-0.034	-0.042	-0.058	*-0.196*	-0.082	-0.085	-0.090	-0.067	-0.083	*-0.406*
respiratory, infectuious dis.	-0.023	-0.036	-0.046	-0.030	-0.016	*-0.151*	-0.047	-0.056	-0.055	-0.061	-0.085	*-0.305*
lung cancer	-0.010	-0.016	0.001	0.009	-0.001	*-0.018*	-0.056	-0.039	-0.014	-0.006	-0.011	*-0.127*
stomach cancer	-0.014	-0.033	-0.024	-0.007	-0.015	*-0.093*	-0.012	-0.012	-0.008	-0.008	-0.007	*-0.046*
intestine cancer	0.007	0.007	0.021	-0.001	-0.008	*0.027*	-0.016	-0.013	-0.004	-0.004	-0.001	*-0.037*
prostate cancer	-0.003	0.003	-0.012	-0.007	0.041	*0.023*	-0.008	0.003	-0.009	0.001	0.007	*-0.006*
other neoplasms	-0.001	-0.009	0.005	0.017	0.019	*0.031*	-0.017	-0.046	-0.019	-0.013	-0.004	*-0.100*
alzheimer.senilty	0.002	-0.002	-0.003	-0.003	-0.004	*-0.009*	-0.002	-0.008	-0.010	-0.003	-0.003	*-0.025*
other dis.	-0.047	-0.033	-0.032	-0.018	-0.026	*-0.155*	-0.062	-0.051	-0.038	-0.030	-0.070	*-0.251*
accidental falls	0.003	-0.004	-0.004	-0.001	0.006	*0.000*	0.000	-0.007	-0.002	-0.001	0.000	*-0.010*
suicides	-0.003	0.001	-0.001	0.001	0.002	*0.000*	-0.014	-0.004	-0.004	-0.001	-0.003	*-0.026*
other external causes	-0.007	-0.007	-0.008	0.001	0.001	*-0.019*	-0.012	-0.003	-0.007	-0.004	-0.003	*-0.029*
ill-defined,unknown	-0.003	0.001	-0.001	0.001	-0.005	*-0.008*	-0.012	-0.008	-0.002	-0.002	-0.003	*-0.026*
Tot.	*-0.347*	*-0.298*	*-0.302*	*-0.204*	*-0.138*	*-1.289*	*-0.581*	*-0.592*	*-0.483*	*-0.342*	*-0.507*	*-2.505*

Acknowledgments

We would like to thank Vladimir Shkolnikov for his comments and suggestions. We would like to thank also Statistics Finland and Statistics Sweden for providing high quality census linked data.

References

Andreev, E. M., V. M. Shkolnikov, et al. (2002). "Algorithm for decomposition of differences between aggregate demographic measures and its application to life expectancies, healthy life expectancies, parity-progression ratios and total fertility rates." *Demographic Research* **7**(14): 499-522.

Black, D., J. Morris, et al. (1980). "Inequalities in health: report of a Research Working Group." *London: Department of Health and Social Security*.

Blane, D., G. D. Smith, et al. (2008). "Social selection: what does it contribute to social class differences in health?" *Sociology of Health & Illness* **15**(1): 1-15.

Borrell, C., A. Plasencia, et al. (2005). "Education level inequalities and transportation injury mortality in the middle aged and elderly in European settings." *Injury Prevention* **11**(3): 138.

Cavelaars, A., A. E. Kunst, et al. (2000). "Educational differences in smoking: international comparison." *British Medical Journal* **320**(7242): 1102.

Cockerham, W. C. (2007). *Social causes of health and disease*, Polity Pr.

Daviglus, M. L. (2005). "Health care costs in old age are related to overweight and obesity earlier in life." *Health affairs.*

Erikson, R. and J. Torssander (2008). "Social class and cause of death." *The European Journal of Public Health* **18**(5): 473.

Fujino, Y., A. Tamakoshi, et al. (2005). "A nationwide cohort study of educational background and major causes of death among the elderly population in Japan." *Preventive medicine* **40**(4): 444-451.

Harris, T. B., P. J. Savage, et al. (1997). "Carrying the burden of cardiovascular risk in old age: associations of weight and weight change with prevalent cardiovascular disease, risk factors, and health status in the Cardiovascular Health Study." *American Journal of Clinical Nutrition* **66**(4): 837.

Helakorpi, S., M. Paavola, et al. (2009). *Health Behaviour and Health among the Finnish Adult Population*, Spring 2008.

Huisman, M., A. E. Kunst, et al. (2004). "Socioeconomic inequalities in mortality among elderly people in 11 European populations." *Journal of Epidemiology and Community Health* **58**(6): 468.

Huisman, M., A. E. Kunst, et al. (2005). "Educational inequalities in cause-specific mortality in middle-aged and older men and women in eight western European populations." *The Lancet* **365**(9458): 493-500.

Hussain, S. K., P. Lenner, et al. (2007). "Influence of education level on cancer survival in Sweden." *Annals of Oncology*.

Janssen, F., A. Kunst, et al. (2007). "Variations in the pace of old-age mortality decline in seven European countries, 1950–1999: The role of smoking and other factors earlier in life." *European Journal of Population/Revue européenne de Démographie* **23**(2): 171-188.

Janssen, F. and A. E. Kunst (2004). "ICD coding changes and discontinuities in trends in cause-specific mortality in six European countries, 1950-99." *Bulletin of the World Health Organization* **82**: 904-913.

Keskimaki, I., S. Koskinen, et al. (1997). "Socioeconomic and gender inequities in access to coronary artery bypass grafting in Finland." *The European Journal of Public Health* **7**(4): 392.

Knoops, K. T. B., L. C. de Groot, et al. (2004). "Mediterranean diet, lifestyle factors, and 10-year mortality in elderly European men and women: the HALE project." Jama **292**(12): 1433.

Koskinen, S. and T. Martelin (1994). "Why are socioeconomic mortality differences smaller among women than among men?" *Social Science & Medicine* **38**(10): 1385-1396.

Kunst, A. E., V. Bos, et al. (2004). "Monitoring of trends in socioeconomic inequalities in mortality: experiences from a European project." *Demographic Research* **2**: 232-254.

Kunst, A. E., F. Groenhof, et al. (1998). "Socio-economic inequalities in mortality. Methodological problems illustrated with three examples from Europe." *Revue d'épidémiologie et de santé publique* **46**(6): 467-479.

Laaksonen, M., R. Prattala, et al. (2001). "Patterns of unhealthy behaviour in Finland." *The European Journal of Public Health* **11**(3): 294.

Laaksonen, M., K. Talala, et al. (2008). "Health behaviours as explanations for educational level differences in cardiovascular and all-cause mortality: a follow-up of 60 000 men and women over 23 years." *The European Journal of Public Health* **18**(1): 38.

LaCroix, A. Z., J. M. Guralnik, et al. (1993). "Maintaining mobility in late life. II. Smoking, alcohol consumption, physical activity, and body mass index." *American Journal of Epidemiology* **137**(8): 858.

Lahelma, E., O. Rahkonen, et al. (1997). "Changes in health status and health behavior among Finnish adults 1978-1993." *Scandinavian Journal of Work Environment and Health* **23**(3): 85-90.

Leveille, S. G., J. M. Guralnik, et al. (1999). "Aging successfully until death in old age: opportunities for increasing active life expectancy." *American Journal of Epidemiology* **149**(7): 654.

Lopez, A. D., N. E. Collishaw, et al. (1994). "A descriptive model of the cigarette epidemic in developed countries." *Tobacco control* **3**(3): 242.

Lynn, J., D. M. Adamson, et al. (2003). "Living well at the end of life. Adapting health care to serious chronic illness in old age."
Mackenbach, J. P. (2006). "Health inequalities: Europe in profile", produced by COI for the Department of Health.
Mackenbach, J. P., V. Bos, et al. (2003). "Widening socioeconomic inequalities in mortality in six Western European countries." *International Journal of Epidemiology* **32**(5): 830.
Martelin, T. (1994). "Mortality by indicators of socioeconomic status among the Finnish elderly." *Social Science & Medicine* **38**(9): 1257-1278.
Martelin, T. (1996). "Socio-demographic differentials in mortality at older ages in Finland. Health and mortality among elderly populations", Oxford University Press, USA**:** 112–134.
Martelin, T., S. Koskinen, et al. (1998). "Sociodemographic mortality differences among the oldest old in Finland." *The Journals of Gerontology: Series B* **53**(2): S83.
Martikainen, P., J. Blomgren, et al. (2007). "Change in the total and independent effects of education and occupational social class on mortality: analyses of all Finnish men and women in the period 1971–2000." *Journal of Epidemiology and Community Health* **61**(6): 499.
Martikainen, P., P. Makela, et al. (2001). "Income differences in mortality: a register-based follow-up study of three million men and women." *International Journal of Epidemiology* **30**(6): 1397.
Martikainen, P., T. Valkonen, et al. (2001). "Change in male and female life expectancy by social class: decomposition by age and cause of death in Finland 1971–95." *Journal of Epidemiology and Community Health* **55**(7): 494.
Martikainen, P., T. Valkonen, et al. (2009). "The effects of individual taxable income, household taxable income, and household disposable income on mortality in Finland, 1998–2004." *Population Studies* **63**(2): 147-162.
Meslé, F. and J. Vallin (1996). "Reconstructing long-term series of causes of death." *Historical Methods: A Journal of Quantitative and Interdisciplinary History* **29**(2): 72-87.
Meslé, F. and J. Vallin (2006). "Diverging trends in female old-age mortality: The United States and The Netherlands versus France and Japan." *Population and Development Review*: 123-145.
Mirowsky, J. and C. E. Ross (2003). "Education, social status, and health", Aldine de Gruyter.
Olausson, P. O. (1991). "Mortality among the elderly in Sweden by social class." *Social science & medicine* **32**(4): 437-440.
Pekkanen, J., A. Uutela, et al. (1995). "Coronary risk factor levels: differences between educational groups in 1972-87 in eastern Finland." *British Medical Journal* **49**(2): 144.
Shkolnikov, V. M., D. Jasilionis, et al. (2007). "Linked versus unlinked estimates of mortality and length of life by education and marital status: evidence from the first record linkage study in Lithuania." *Social Science & Medicine* **64**(7): 1392-1406.
Shkolnikov, V. M., R. Scholz, et al. (2008). "Length of life and the pensions of five million retired German men." *The European Journal of Public Health* **18**(3): 264.
Strand, B. H., A. Kunst, et al. (2007). "The reversed social gradient: higher breast cancer mortality in the higher educated compared to lower educated. A comparison of 11 European populations during the 1990s." *European Journal of Cancer* **43**(7): 1200-1207.
Szekely, C. A., J. C. S. Breitner, et al. (2007). "Prevention of Alzheimer's disease." *International Review of Psychiatry* **19**(6): 693-706.
Tiikkaja, S., Ö. Hemström, et al. (2009). "Intergenerational class mobility and cardiovascular mortality among Swedish women: A population-based register study." *Social Science & Medicine* **68**(4): 733-739.
Vagero, D. (2000). "Health inequalities in women and men." *British Medical Journal* **320**(7245): 1286.
Vågerö, D. and E. Lahelma (1998). "Women, work and mortality: an analysis of the relation between female mortality rates." *Women, Stress and Heart Disease*. Mahwah, NJ: Erlbaum: 73–85.
Vagero, D. and S. E. Norell (1989). "Mortality and social class in Sweden--exploring a new epidemiological tool." *Scandinavian Journal of Public Health* **17**(1): 49.
Valkonen, T. (1993). "Problems in the measurement and international comparison of socio-economic differences in mortality." *Social science & medicine* **36**(4): 409-418.
Valkonen, T. (2006). "Social Inequality in Mortality. Demography. Analysis and synthesis. A Treatise in Population Studies", Academic Press, USA. **Volume 2:** 195-206.
Valkonen, T., A. P. Sihvonen, et al. (1997). "Health expectancy by level of education in Finland." *Social Science & Medicine* **44**(6): 801-808.
Vallin, J. (1980). "Socio-economic determinants of mortality in industrialized countries." *Population bulletin of the United Nations*(13): 26.