

# Change in male and female life expectancy by social class: decomposition by age and cause of death in Finland 1971–95

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## Abstract

**Study objective**—To quantify the contribution of different causes of death and age groups for trends in life expectancy for two major social classes.

**Design and setting**—Prospective study of mortality in Finland among all over 35 year old men and women. Baseline social class (manual/non-manual) was from the 1970, 1975, 1980, 1985 and 1990 census records, and follow up was by computerised record linkage to death certificates for 1971–1995.

**Main results**—From the early 1970s to the early 1990s life expectancy at age 35 increased by about five and four years among Finnish men and women respectively, with largest gains among 55–74 year old men and 65–84 year old women. Life expectancy increase was 5.1 years among non-manual and 3.8 years among manual men; corresponding figures for women were 3.6 and 3.0 years. In the 1980s, when differences in life expectancy increased most rapidly, decline in cardiovascular disease mortality was more rapid in the non-manual than the manual class. Furthermore, increasing mortality for alcohol associated causes, “other diseases”, and accidents and violence were most prominent in the manual class.

**Conclusions**—Explanations of increasing social inequalities in mortality that are based on one underlying factor are difficult to reconcile with the variability in the cause specific trends in social inequalities in mortality. The contribution of older ages to social inequalities in mortality should be more widely recognised.

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Increasing social inequalities in mortality have been observed in several European countries and the US in the past 15–25 years.<sup>1–4</sup> Although the explanations of the increasing inequalities have been of increasing interest and debate, most studies have still relied on relatively crude and undivided analyses of the actual changes in mortality. Furthermore, they usually cover limited aged ranges such as the middle aged population.<sup>5 6</sup>

Studies on socioeconomic inequalities in mortality are usually based on age standardised death rates or probabilities of death. However, in studies dealing with many other aspects of mortality than socioeconomic differences, such as trends or cross national differences, life

expectancy is the most usual measure of mortality. Life expectancy has several advantages over age standardised death rates; it summarises the age specific death rates in a meaningful way, has a more concrete interpretation and is familiar to the general public. In addition, differences in life expectancy between periods or population groups can be decomposed to show the contribution of specific age groups and causes of death to the differences under study.

The purpose of this study is to systematically analyse trends in life expectancy at age 35 in Finland separately for men and women for two major social classes, and to quantify the contribution of different causes of death and age groups for these trends. The findings of these analyses will provide a sound basis for the understanding of the causes of changes in life expectancy differences between social classes.

## Methods

The data used in the study consist of five subsets, the first of which is based on the population records of the 1970 census, which have been linked to the records of all deaths in 1971–75 by Statistics Finland. The other datasets were constructed in the same way by linking the 1975, 1980, 1985 and 1990 census records to the death records for the periods 1976–80, 1981–85, 1986–90 and 1991–95. These five datasets form the five periods of our study. More than 99.5% of all death records could be linked to the deceased persons' records in the previous census.<sup>7 8</sup> This study is restricted to men and women aged 35 years and over during the years 1971–95. Younger age groups have been excluded because of problems in classifying them on the basis of information on occupation.

The occupation based social classes used in the study are based on the socioeconomic classification of Statistics Finland.<sup>7</sup> For the sake of brevity we use the following two classes: (1) non-manual workers, (2) manual workers. The non-manual workers include all current and former managers and higher administrative and clerical employees, and the manual workers include skilled and specialised workers, unskilled workers as well as farm and forestry workers.

Economically active persons were classified according to the occupation reported in the census on which the relevant subset of data was based. To avoid the bias associated with the so called “healthy worker effect”, it is necessary to classify all persons to occupational classes and

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Table 1 Person years, number of deaths, life expectancy at age 35 and change in life expectancy at age 35 from the previous period (in parentheses) by sex

	Manual			Non-manual			
	Person years (1000s)	Deaths (1000s)	Life expectancy (change in life expectancy)*	Person years (1000s)	Deaths (1000s)	Life expectancy (change in life expectancy)*	Difference in life expectancy (change in difference)*
<i>Men</i>							
1971-75	2 206	53	33.53 (—)	966	17	36.58 (—)	3.06 (—)
1976-80	2 294	54	34.49 (0.95)	1 235	19	37.84 (1.26)	3.35 (0.30)
1981-85	2 570	54	35.85 (1.36)	1 531	22	39.02 (1.18)	3.17 (-0.18)
1986-90	2 769	57	36.29 (0.44)	1 771	21	40.57 (1.55)	4.28 (1.11)
1991-95	2 892	57	37.30 (1.01)	1 990	23	41.68 (1.11)	4.38 (0.10)
Total	12 731	276		7 493	102		
<i>Women</i>							
1971-75	2 231	38	41.79 (—)	1 601	17	43.35 (—)	1.56 (—)
1976-80	2 328	40	43.14 (1.35)	1 952	19	44.67 (1.32)	1.54 (-0.02)
1981-85	2 522	44	44.08 (0.95)	2 465	24	45.55 (0.87)	1.46 (-0.08)
1986-90	2 498	49	44.23 (0.15)	2 982	27	46.10 (0.56)	1.87 (0.41)
1991-95	2 415	51	44.80 (0.57)	3 436	30	46.99 (0.89)	2.19 (0.32)
Total	11 993	222		12 434	117		

\*Life expectancy at age 35 and change in life expectancy at age 35 is measured in years.

not only the economically active population.<sup>9</sup> Pensioners, unemployed persons and others for whom information on current occupation was not available were classified according to occupational information in earlier censuses. The 1970 and 1975 censuses also included information on the former occupation of retired persons. Housewives and other family members working at home were classified according to the head of household's occupation. After these attempts to classify all participants, about 1% to 2% of men and women at each census year could not be allocated to an occupational class and they were thus excluded. We have also excluded self employed persons whose mortality falls between the manual and non-manual classes.

The analyses are based on 10 groups of causes of death for men and 11 for women. We have chosen a cause of death classification that incorporates the largest causes of death (for example, ischaemic heart disease (IHD)), those that are strongly related to behavioural causes (lung cancer, alcohol causes, accidents and violence), and also cover all deaths. The 8th Revision of the International Classification of Diseases (ICD) was used in 1971-86 and the Cause of Death Classification 1987 of Statistics Finland in 1987-95.<sup>10</sup> The latter classification is based on the 9th Revision of the ICD.

In this study we calculate age specific (five year age groups) death rates by cause of death, five year period (1971-75, ..., 1991-95), sex and social class. All cause death rates were used to obtain abridged life tables<sup>11</sup> for each social class and period. Changes in life expectancy between periods were decomposed by age and cause of death for each class by applying the method used by the United Nations.<sup>12</sup>

## Results

### CHANGE IN LIFE EXPECTANCY BY SOCIAL CLASS

Male life expectancy at age 35 was about 35 years in Finland in the early 1970s. Life expectancy has since increased rapidly and it was about five years higher in the early 1990s. Overall female life expectancy at age 35 increased from about 42 years in the early 1970s to about 46 years in the early 1990s.

Life expectancy increased in all social classes but not equally (table 1). The increase was 5.1 years among non-manual men and 3.8 years among manual men. As a result the gap between these two classes was 1.3 years greater in the early 1990s than in the early 1970s. Among men there was little change in the differences between classes during the 1970s. The widening of the mortality gap has mainly occurred during the 1980s (83% of the total increase among men). In the 1980s non-manual men gained more than 1.5 years in life expectancy. The corresponding increase was less than half a year among manual men.

From the early 1970s to the early 1990s life expectancy increased by 3.6 years among non-manual and 3.0 years among manual women. Thus, the gap between social classes increased by about 0.6 years. Among women the social class difference grew in the 1980s (65% of the total increase among women) as well as early 1990s, although at a slower pace.

Table 1 also shows the distributions of person years in two broad social classes; during the whole period manual workers were clearly the larger of these two groups among men. However, among men the proportion of manual employees decreased from about 70% in 1971-75 to about 59% in 1991-95. Among women the decrease in the proportion of manual workers was even greater.

### AGE DECOMPOSITION OF CHANGE IN LIFE EXPECTANCY BY SOCIAL CLASS 1971-75 to 1991-95

Table 2 shows the decomposition of change in life expectancy for each successive five year study period and for the first (1971-75) to the last (1991-95) period by age and social class. Among manual and non-manual men about 60% of the increase in life expectancy at age 35 between 1971-75 and 1991-95 has come from improvements in mortality among the 55-74 year olds (table 2). However, other age groups have also made substantial contributions. Among women age groups 65-84 made the largest contribution to the increasing life expectancy, accounting for 63% and 69% of the non-manual and manual gain respectively.

Table 2 Decomposition of the change in life expectancy at age 35 between periods by age group, non-manual and manual workers, men and women

Age	Deaths 1991–95		Change in life expectancy					% of total change 1971–75/1991–95
			1971–75/ 1976–80	1976–80/ 1981–85	1981–85/ 1986–90	1986–90/ 1991–95	1971–75/ 1991–95	
<i>Men</i>								
35–44	1 279	Non-manual	0.10	0.15	–0.03	0.10	0.32	6
	4 119	Manual	0.24	0.14	–0.16	0.01	0.23	6
45–54	2 620	Non-manual	0.38	0.24	0.25	0.07	0.93	18
	5 892	Manual	0.20	0.38	0.06	0.15	0.79	21
55–64	3 579	Non-manual	0.24	0.32	0.55	0.40	1.52	30
	10 390	Manual	0.22	0.40	0.22	0.36	1.20	32
65–74	5 917	Non-manual	0.41	0.26	0.49	0.38	1.53	30
	16 273	Manual	0.17	0.31	0.24	0.31	1.04	28
75–84	6 463	Non-manual	0.08	0.21	0.26	0.12	0.67	13
	15 038	Manual	0.09	0.11	0.09	0.16	0.45	12
85+	2 756	Non-manual	0.06	0.00	0.03	0.04	0.13	3
	5 742	Manual	0.02	0.02	0.01	0.01	0.06	2
Total	22 614	Non-manual	1.26	1.18	1.56	1.11	5.10	100
	57 454	Manual	0.95	1.36	0.45	1.01	3.77	100
<i>Women</i>								
35–44	1 153	Non-manual	0.09	0.03	0.02	–0.01	0.12	3
	849	Manual	0.02	0.07	–0.07	–0.06	–0.05	–2
45–54	2 070	Non-manual	0.10	0.08	0.03	0.03	0.25	7
	1 536	Manual	0.18	0.14	–0.16	0.00	0.16	5
55–64	2 738	Non-manual	0.21	0.15	0.15	0.18	0.69	19
	3 438	Manual	0.20	0.21	0.09	0.09	0.60	20
65–74	5 787	Non-manual	0.39	0.21	0.23	0.32	1.15	32
	9 803	Manual	0.36	0.25	0.17	0.29	1.06	35
75–84	10 095	Non-manual	0.41	0.32	0.12	0.30	1.14	31
	20 328	Manual	0.48	0.20	0.13	0.21	1.03	34
85+	8 285	Non-manual	0.12	0.09	0.02	0.06	0.29	8
	15 461	Manual	0.12	0.08	–0.02	0.03	0.21	7
Total	30 128	Non-manual	1.32	0.87	0.56	0.89	3.64	100
	51 415	Manual	1.35	0.95	0.15	0.57	3.01	100

#### 1981–85 to 1986–90

Most of the widening of the social difference took place in the 1980s. The very rapid improvements in life expectancy among non-manual men in this period can be observed in all ages above 44 years. However, among manual men the improvements in the 1980s were more modest than in the previous decade in most age groups. In both classes mortality increased among the 35–44 year olds. Also manual women experienced modest improvements in life expectancy in the 1980s with mortality actually increasing among the 35–54 and over 84 year olds.

#### CAUSE OF DEATH DECOMPOSITION OF CHANGE IN LIFE EXPECTANCY BY SOCIAL CLASS 1971–75 to 1991–95

Among men about 50% of the increase in life expectancy from 1971–75 to 1991–95 was attributable to decrease in mortality from IHD in both non-manual and manual workers (table 3). The contribution was, however, somewhat smaller among manual workers. A further 25% and 10–20% of the increase in life expectancy was attributable to all other cardiovascular diseases than IHD, and all cancers respectively.

Among women the largest contribution to increasing life expectancy was by other cardiovascular diseases, accounting for about 30% and 40% of the increase in non-manual and manual classes respectively. Together IHD and cerebrovascular diseases accounted for between 40% to 50%. Other cancers than breast cancer and lung cancer accounted for about 10% of the life expectancy increase. Thus, within each sex the overall structure of the life expectancy gain by cause of death was quite similar. However, the absolute gain in life

expectancy was much greater among non-manual than manual Finns.

Over the study period from 1971–75 to 1991–95 mortality has increased for several causes of death, and has thus slowed down the otherwise increasing trend in life expectancy. Among both men and women mortality from alcohol associated causes has increased continuously during the study period in both social classes, especially in the manual class.

#### 1981–85 to 1986–90

In the period of the largest increase in the social class life expectancy difference, decline in cardiovascular mortality contributed almost 1.4 years to the life expectancy increase of the non-manual men, while among manual men the contribution was about half of this. Corresponding figures for women are about 0.6 and 0.4 years. In the same period mortality increased for alcohol associated causes but also for “other diseases”, and accidents and violence among both men and women. For these causes of death the increase was most prominent for the manual class, and has continued in the 1990s for both manual men and women. Among women also lung cancer mortality increased in both classes and breast cancer among manual women.

Simultaneous age and cause of death decomposition of life expectancy change show that the great majority—80% to 90%—of the contribution of the alcohol associated causes to declining life expectancy can be attributed to ages below 65 years (results not presented here). The contribution of IHD to increasing life expectancy mainly takes place among the over 54 year olds.

Table 3 Decomposition of the change in life expectancy at age 35 between periods by cause of death, non-manual and manual workers, men and women

Cause of death	Deaths 1991–95		Change in life expectancy					% of total change 1971–75/1991–95
			1971–75/ 1976–80	1976–80/ 1981–85	1981–85/ 1986–90	1986–90/ 1991–95	1971–75/ 1991–95	
<b>Men</b>								
Lung cancer (ICD 162)	1 248	Non-manual	-0.03	0.07	0.17	0.06	0.27	5
	4 409	Manual	0.00	0.14	0.16	0.13	0.43	11
Other cancers	4 272	Non-manual	0.06	0.08	0.12	0.04	0.30	6
	8 288	Manual	0.07	0.07	0.04	0.08	0.25	7
Ischaemic heart diseases (ICD 410–414)	6 884	Non-manual	0.46	0.48	0.98	0.66	2.58	51
	17 574	Manual	0.19	0.46	0.50	0.63	1.79	47
Cerebrovascular diseases (ICD 430–438)	2 287	Non-manual	0.26	0.11	0.19	0.05	0.61	12
	5 111	Manual	0.13	0.12	0.05	0.12	0.42	11
Other cardiovascular diseases	1 513	Non-manual	0.19	0.17	0.20	0.15	0.71	14
	3 743	Manual	0.20	0.15	0.13	0.10	0.58	15
Respiratory diseases (ICD 460–519)	1 441	Non-manual	0.07	0.09	0.07	0.05	0.28	5
	4 712	Manual	0.12	0.17	0.06	0.06	0.41	11
Alcohol associated causes* (ICD 291, 303, 571, 577, E860)	870	Non-manual	-0.06	-0.02	-0.06	-0.03	-0.17	-3
	2 578	Manual	-0.05	-0.03	-0.18	-0.06	-0.33	-9
Other diseases	2 077	Non-manual	0.21	0.11	-0.03	0.04	0.33	6
	4 847	Manual	0.16	0.12	-0.11	0.00	0.16	4
Suicide (ICD E950–E959)	765	Non-manual	0.01	0.03	-0.02	0.01	0.02	0
	2 234	Manual	-0.02	0.03	-0.08	-0.02	-0.09	-2
Other accidents and violence	1 257	Non-manual	0.09	0.06	-0.08	0.10	0.17	3
	3 958	Manual	0.15	0.13	-0.12	-0.02	0.15	4
All causes	22 614	Non-manual	1.26	1.18	1.56	1.11	5.10	100
	57 454	Manual	0.95	1.36	0.45	1.01	3.77	100
<b>Women</b>								
Lung cancer (ICD 162)	632	Non-manual	-0.02	-0.01	-0.01	-0.01	-0.05	-1.5
	833	Manual	-0.03	-0.02	0.00	-0.02	-0.08	-2.7
Breast cancer (ICD 174)	1 574	Non-manual	0.03	-0.01	-0.03	0.04	0.04	2
	1 355	Manual	0.00	0.00	-0.02	-0.01	-0.03	-1.0
Other cancers	5 618	Non-manual	0.09	0.05	0.11	0.09	0.34	9
	7 641	Manual	0.07	0.12	0.04	0.08	0.31	10
Ischaemic heart diseases (ICD 410–414)	7 063	Non-manual	0.18	0.21	0.21	0.38	0.98	27
	14 446	Manual	0.11	0.17	0.11	0.29	0.67	22
Cerebrovascular diseases (ICD 430–438)	4 399	Non-manual	0.33	0.17	0.13	0.12	0.74	20
	8 001	Manual	0.30	0.14	0.12	0.13	0.69	23
Other cardiovascular diseases	2 301	Non-manual	0.36	0.32	0.26	0.20	1.14	31
	4 648	Manual	0.48	0.31	0.23	0.23	1.26	42
Respiratory diseases (ICD 460–519)	1 812	Non-manual	0.08	0.10	0.04	0.01	0.22	6
	3 693	Manual	0.12	0.14	0.01	-0.03	0.24	8
Alcohol associated causes* (ICD 291, 303, 571, 577, E860)	347	Non-manual	-0.02	-0.02	-0.02	-0.01	-0.07	-2
	376	Manual	-0.02	-0.01	-0.08	-0.03	-0.14	-5
Other diseases	4 669	Non-manual	0.24	0.05	-0.11	0.04	0.23	6
	8 289	Manual	0.27	0.09	-0.13	-0.05	0.18	6
Suicide (ICD E950–E959)	515	Non-manual	0.02	-0.01	0.00	0.00	0.01	0.3
	468	Manual	0.00	0.01	-0.06	-0.02	-0.08	-3
Other accidents and violence	1 198	Non-manual	0.03	0.03	-0.03	0.03	0.06	2
	1 665	Manual	0.06	0.02	-0.06	-0.01	0.00	0.2
All causes	30 128	Non-manual	1.32	0.87	0.56	0.89	3.64	100
	51 415	Manual	1.35	0.95	0.15	0.57	3.01	100

\*Alcohol associated causes include alcoholic psychosis (ICD 291), alcoholism (ICD 303), cirrhosis of liver (ICD 571), diseases of pancreas (ICD 577) and poisoning by alcohol (ICD E860).

## Discussion

From the early 1970s to the early 1990s life expectancy at 35 has increased by about five years among Finnish men and four years among Finnish women. Although life expectancy has increased in all social classes over the same period, the life expectancy differences between manual and non-manual classes have increased by 1.3 years among men and 0.6 years among women, and now stand at 4.4 years and 2.2 years correspondingly. Within both manual and non-manual social classes largest gains in life expectancy over the whole study period are among 55–74 year old men and 65–84 year old women. Most of these gains can be attributed to rapidly declining mortality from cardiovascular diseases, especially IHD among men. On the other hand, increase in alcohol associated causes of death in both sexes and lung cancer among women have slowed down the increase in life expectancy over the whole study period.

In studies that assess the long term changes in mortality between the social classes, large changes in the distribution of the population

into these classes may complicate the interpretation of the results. More specifically, in analyses of several social classes the dwindling in size of a lower status social class (for example, unskilled workers) may be hypothesised to be associated with health related selection out of that particular class and thus lead to an unfavourable long term mortality trend in that class. This process is an unlikely cause for the increasing life expectancy difference in this study, because (1) we use only two very broad social classes, (2) the main increase in the life expectancy difference takes place in a relatively short time period (from 1981–85 to 1986–1990) and (3) other analyses suggests that such intra-generational social mobility would lead to narrowing rather than increasing social class differences in mortality.<sup>13</sup>

## EXPLANATIONS FOR INCREASING INEQUALITIES IN THE 1980s

Most of the increase in the class difference in life expectancy occurred in the 1980s. Differences increased because of slower rate of decline of cardiovascular disease mortality and

rapidly increasing mortality from alcohol related causes of death, accidents and suicide in the manual classes. However, simultaneously social inequalities in some other causes of death remained stable (for example, lung cancer and respiratory disease mortality among men). Explanations for the increasing social differences in life expectancy that are based on one “underlying” factor, such as increasing income inequality or poverty, are difficult to reconcile with the variability in the cause specific trends. Also cohort effects are an unlikely explanation, as changes in mortality occurred simultaneously in the majority of age groups.

Results from eastern Finland indicate that changes in smoking, serum cholesterol level and blood pressure explain most of the decline in mortality from IHD and stroke during the 1970s and 1980s in the total population,<sup>14 15</sup> and also among manual workers.<sup>16</sup> However, among non-manual employees, the mortality decline in the 1980s was considerably larger than could be expected on the basis of changes in risk factor levels.<sup>16</sup>

The non-manual class may have benefited more from the introduction of new methods in treatment and secondary prevention of cardiovascular diseases in the 1980s than lower social strata.<sup>4</sup> Evidence regarding coronary surgery lends some support to this interpretation; bypass operations were 35% more common among male non-manual than manual workers in Finland despite mortality and morbidity differences in the opposite direction.<sup>17</sup>

The changes in mortality from accidents and suicide were similar to those in mortality from alcohol related causes. This is not surprising as nearly half of the middle aged men who died from accidents and suicides in 1987–93 were intoxicated according to information on contributing causes of death.<sup>18</sup> The increase in mortality from these two broad causes of death may thus be largely caused by the rapid increase in the consumption of alcohol in the 1980s<sup>4</sup>; annual alcohol consumption (including estimated unrecorded use) increased by almost 20% from 1985 to 1990.<sup>19</sup> The increase in alcohol consumption seem to have had more harmful effects in the manual than in the non-manual class.

#### CONCLUSIONS

Increasing social inequalities in mortality in European countries and US have been partly related to unequal decline in cardiovascular disease mortality.<sup>1 2 4</sup> Internationally the causes of the varying rate of decline remain largely unknown, but we hypothesise that in Finland the introduction of new methods of treatment and secondary prevention may have disproportionately benefited the higher social strata. The large contribution of alcohol related causes of death, accidents and suicide to the increasing mortality differences in our data may be a particularly Finnish experience. However, cross sectional studies indicate that alcohol related chronic diseases are of great importance for social inequalities in mortality also in France<sup>20 21</sup> and Russia.<sup>22 23</sup>

#### KEY POINTS

- Explanations of the increasing social inequalities in mortality have often relied on undivided analyses of the actual mortality trends and usually cover limited age ranges.
- From the early 1970s to the early 1990s life expectancy at age 35 increased by 5.1 years among non-manual and 3.8 years among manual Finnish men; corresponding figures for women were 3.6 and 3.0 years.
- Social differences increased because of slower rate of decline of cardiovascular disease mortality in the manual class; we hypothesise that the introduction of new methods of treatment and secondary prevention may have disproportionately benefited the higher social strata.
- Increasing social differences were also partly attributable to rapidly increasing mortality from alcohol related causes of death, accidents and suicide in the manual classes.
- A substantial part of the increase in life expectancy and social differences in life expectancy can be attributed to ages above 64 years; thus the contribution of older ages to increasing social inequalities in mortality should be more widely recognised.

In the calculation of life expectancy each death at a younger age contributes more to loss of life expectancy than a death at an older age, because more potential years of life are lost because of deaths at younger rather than older ages. However, the majority of deaths occur at older ages and a substantial part of the increase in life expectancy and social differences in life expectancy can be attributed to ages above 64 years. This age group is often neglected in the analyses of social differences in health, and the life circumstances of the retired population are disregarded in the attempts to build explanatory frameworks around the experiences of the working age population.

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