Time trends in mortality in forestry and construction workers in Finland 1970–85 and impact of adjustment for socioeconomic variables

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Abstract

Study objective—This study aimed firstly to describe the development of cause-specific mortality in forestry workers, farmer/forestry workers, and skilled and semiskilled construction workers between 1970 and 1985 in Finland, and to compare this with mortality in the total working male population. The second aim was to evaluate how well the cause-specific mortality differences between the occupations could be explained by differences in socioeconomic status, marital status, or in the region of residence.

Design and setting—This is a follow up study based on the 1970, 1975, and 1980 census records in Finland linked with all death certificates for 1971–75, 1976–80, and 1981–85 respectively. Log-linear regression analysis was used.

Subjects—All economically active men in Finland aged between 35 and 64 years in 1971–85 were studied. The number of person-years in the period totals about 10 million.

Main results—Semiskilled construction workers had the highest mortality rate almost independent of the cause of death. The mortality of forestry workers was the second highest. Compared with the reference population, however, the differences were small with regard to neoplasms and cardiovascular diseases. With regard to other diseases, only the mortality of semiskilled workers was fairly high. Differences in mortality as a result of accidents were the highest. Both suicide and accidental death rates were high in semi-skilled construction workers and forestry workers. During the study total mortality fell by about 30% but mortality differences between groups did not decline.

Conclusions—The high mortality of forestry and semiskilled construction workers is partly explained by socioeconomic factors such as marital status and housing conditions. These factors do not, however, explain the high suicide and accident mortality rates of forestry workers or semiskilled construction workers. More research is needed to explain these findings.

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Interest in socioeconomic mortality differences has recently grown.[1] [2] In Finland and in other Scandinavian countries linked records studies based on population censuses and occupational mortality statistics have been carried out.[3] [-5] In Finland socioeconomic differences in mortality

seem either to have increased or remained constant during the past few decades.[4] [5]

Differences in mortality between social classes are often attributed to economic (for example, housing conditions), life style (diet, smoking, alcohol consumption, etc), and occupation or work related risks, and by some authors to genetic susceptibility also.[6] There is, however, considerable uncertainty over the actual contribution made by the various factors and new patterns of explanation seem to be arising.[7]

Socioeconomic classification has most often been based on occupation. In this study the mortality of construction workers, forestry workers, and farmer/forestry workers was compared with that of the total, gainfully employed, male Finnish population. Semiskilled construction workers and forestry workers are usually included in the lowest socioeconomic groups in Finland. The salary level of skilled construction workers is relatively high, however.

Mortality in these occupations has been high through the 1980s in Finland.[3] [8] [9] According to earlier studies, suicide and accidental death rates have been particularly high. Death from respiratory diseases was also high in construction workers but cardiovascular and cancer mortality rates were only slightly higher in these occupational groups.[3] During the same period, the mortality of farmers, who live in the countryside and many of whom also work partly in the forest, has been lower than average in Finland.[10] [11]

The aims of the study were as follows:

(a) To describe the development of the all-cause and cause-specific mortality of forestry workers and construction workers between 1970 and 1985 in Finland, and to compare this with that of the total, gainfully employed, male population;

(b) To evaluate the extent to which the differences in mortality rates in the occupational categories can be explained by differences in socioeconomic status, marital status, or region of residence.

Methods

DATA

The study was based on the 1970, 1975, and 1980 Finnish census records, linked with all death certificates during the periods 1971–75, 1976–80, and 1981–85 respectively. The linkage of data sets was carried out by the Central Statistical Office of Finland by means of personal identification codes (we are grateful to the Central Statistical Office of Finland for their permision (TK-53-816-90) to use the data). The linked data set was handed over to a research project headed by Professor Tapani Valkonen at the University of Helsinki. Personal

Table I Person years and deaths in relation to follow up period according to the variables included in the analysis

	Person-years (1000s)				Deaths			
	1971–5	1976–80	1981–5	Total	1971–5	1976–80	1981–5	Total
Age (y):								
35–39	682	709	938	2329	1888	1566	1816	5270
40–44	682	642	699	2023	3092	2122	2010	7224
45–49	643	620	618	1880	4505	3377	2659	10 541
50–54	517	553	568	1637	5279	4678	4047	14 004
55–59	426	406	460	1292	6217	5010	4859	16 086
60–64	369	276	272	917	7809	5801	4165	17 055
Total	3319	3204	3555	10 078	28 790	21 834	19 556	70 180
Occupation:								
Reference population	2811	2813	3189	8813	23 793	18 741	17 062	59 596
Forestry workers	118	72	83	272	1213	548	537	2298
Farmer/forestry workers for								
>3 months a year	66	36	31	133	421	218	133	772
Skilled construction workers	212	204	175	591	1986	1473	1100	4559
Semiskilled construction workers	112	79	78	269	1377	854	724	2955
Total	3319	3204	3555	10 078	28 790	21 834	19 556	70 180
Education:								
Basic	2489	2192	2074	6756	23 781	17 030	14 047	54 858
Intermediate	586	725	1078	2389	3706	3600	4260	11 566
Higher	243	287	403	934	1303	1204	1249	3756
Total	3319	3204	3555	10 078	28 790	21 834	19 556	70 180
Housing conditions:								
Spacious	–	484	915	1399	–	3972	5198	9170
Small	–	1778	2003	3780	–	11 226	9723	20 949
Very small	–	915	419	1335	–	6320	2396	8716
Unknown	3319	27	218	3564	28 790	316	2239	31 345
Total	3319	3204	3555	10 078	28 790	21 834	19 556	70 180
Marital status:								
Married	2809	2678	2834	8321	22 672	17 030	13 844	53 546
Single	377	353	445	1175	3994	2880	3164	10 038
Divorced and separated	91	139	242	472	1358	1419	2137	4914
Widowed	43	35	34	111	766	505	411	1682
Total	3319	3204	3555	10 078	28 790	21 834	19 556	70 180
Region of residence:								
Uusimaa	724	733	870	2327	6270	4837	4480	15 587
Kymi	259	248	266	773	2416	1853	1583	5852
Turku, Vaasa, Ahvenanmaa	849	808	878	2535	6651	5177	4575	16 403
Häme, Keski-Suomi	629	615	679	1924	5381	4091	3723	13 195
Mikkeli, Kuopio, Pohjois-Karjala	448	420	447	1316	4421	3212	2850	10 483
Lappi, Oulu	409	381	414	1204	3651	2664	2345	8660
Total	3319	3204	3555	10 078	28 790	21 834	19 556	70 180

identification codes were deleted before the data set was delivered.[5] The analyses include all economically active men in Finland aged 35–64 years between 1971 and 1985. The number of person-years in the period totals about 10 million. The variables and classifications used are shown in table I.

Causes of death were classified according to the 9th revision of the International Classification of Diseases. For this study a more crude classification was compiled (table II). In addition to the all-cause mortality, the classification includes malignant neoplasms, circulatory diseases, other diseases, suicides, and other accidents and violence.

Four occupational groups were studied. The reference group included all occupations except those of interest. The first and second categories were forestry workers and the next two construction workers. Forestry work in Finland is done partly by part-time forestry workers (farmers) and partly by those who work only as forestry workers. For this reason the forestry workers were divided into those who are mainly farmers, but take up forestry for more than three months a year (farmer/forestry workers) and to those who are forestry workers only. Farmer/forestry workers are probably typical farmers but they are not as heterogenous a group as farmers (because of forestry work) in general in Finland and for this reason they are also more appropriate for comparison. The construction workers were divided into skilled and semiskilled workers.

Some data on the socioeconomic conditions within the occupational groups were available. Information on housing conditions (spacious, small, very small, and unknown) was obtained only from the 1975 and 1980 censuses.

Subjects were grouped according to educational attainment, based on the number of years of education. Basic education included primary education or the first five grades of secondary school, lasting for less than 10 years. Intermediate level of education (10 to 12 years) included vocational training and secondary school graduates with no other formal education. Higher education (more than 12 years), included those with a college or university degree.

Four marital status groups were used—married, single, divorced or separated, and widowed. Those who cohabited could not be separated from the single persons. Divorced and separated persons were treated as one group, as the number of separated persons was too small for more detailed analysis.

The region of residence was divided into six categories. The classification is based on the 12 provinces of Finland as shown in table I.

STATISTICS

The cross tabulated data were analysed by log-linear regression. Each cell in the table (the unit of analysis) included information on the number of deaths and the number of person-years during the

Table II Deaths in relation to cause of death according to the follow up period. (ICD codes are given in parentheses.)

Cause of death	1971–5	1976–80	1981–5	Total
Malignant neoplasms (140–239)	5983	4820	4501	15 304
Diseases of the circulatory system (390–458)	14 560	10 946	9037	34 543
Other diseases	2667	1827	1788	6282
Suicide (E950–E959)	1716	1603	1599	4918
Other accidents and violence (E000–E999 except suicide	3864	2638	2631	9133
All	28 790	21 834	19 556	70 180

Table III   Age adjusted rate ratio (95% confidence interval) of death in relation to causes of death and occupation in Finland 1970–85.

	All causes of death	Neoplasms	Circulatory diseases	Other diseases	Suicides	Other accidents
Reference population	1·00	1·00	1·00	1·00	1·00	1·00
Forestry workers	1·34 (1·29, 1·40)	1·17 (1·06, 1·29)	1·20 (1·12, 1·28)	0·78 (0·63, 0·97)	2·10 (1·85, 2·38)	2·17 (1·98, 2·39)
Farmers/forestry workers	0·83 (0·77, 0·89)	0·74 (0·63, 0·87)	0·83 (0·75, 0·92)	0·60 (0·44, 0·84)	1·15 (0·91, 1·46)	1·01 (0·84, 1·22)
Skilled construction workers	1·08 (1·04, 1·11)	1·22 (1·15, 1·30)	0·98 (0·94, 1·03)	0·74 (0·64, 0·85)	1·05 (0·93, 1·18)	1·38 (1·27, 1·49)
Semiskilled construction workers	1·47 (1·42, 1·53)	1·31 (1·21, 1·43)	1·18 (1·11, 1·25)	1·55 (1·34, 1·80)	2·07 (1·82, 2·35)	2·70 (2·48, 2·93)

period 1981–85. The model describing the relationship between mortality and the explanatory variables can be explained by the following formula:

$$\log(E(d_i)) = \log(V_i) + a + b_1 x_{i1} + b_2 x_{i2} + \ldots + b_p x_{ip},$$

where $E(d_i)$ is the expected number of deaths in the ith cell, V_i is the number of person years lived in the ith cell, $x_1, \ldots, x_p$ are the independent explanatory variables and $a, b_1, \ldots, b_p$ are the parameters to be estimated.[12] The GLIM statistical package was used. The dependent variable is the number of deaths. The population at risk for example, the number of person-years, is 'moved' to the left of the equation by defining it as the OFFSET term. The error is assumed to be Poisson distributed and the link function is taken to be logarithmic.[13]

The results of the log-linear regression analyses are presented as rate ratios. The first category of each explanatory variable is taken as a reference group, with a relative rate of one. A more detailed description of the data and methods used can be found in the report of Valkonen et al.[5]

Results

OCCUPATIONAL DIFFERENCES

Table III summarises the results of cause-specific mortality in relation to occupation for 1970–85. The all cause mortality of the semiskilled construction workers was the highest, and that of the forestry workers the second highest. The mortality of farmer/forestry workers was lower than that of the reference population, but the differences were rather small in neoplasms and diseases of the circulatory system. Mortality from other diseases (that is, other than diseases of the circulatory

system and neoplasms) showed that only semi-skilled construction workers had a high rate compared with the other groups.

The differences between the occupational groups in mortality from accidents and violence were the highest. The relative mortality for both suicide and death as a result of other accidents and violence was high among both semiskilled construction workers and forestry workers.

CHANGE IN MORTALITY DIFFERENCES

From 1981–85 mortality decreased clearly by about 30% but the differences in mortality did not decline dramatically (fig1, table IV). Death from diseases of the circulatory system and neoplasms and from other diseases has, however, declined most among farmer/forestry workers. The mortality differences between farmer/forestry workers
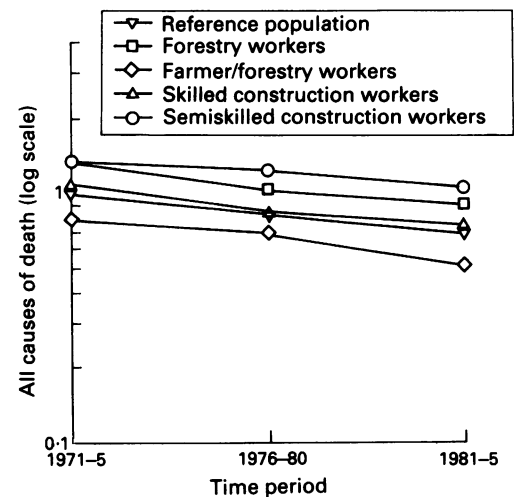
Rate ratio of death by time period and occupation in Finland, adjusted for age.

Table IV   Rate ratio (95% confidence interval) of death in relation to causes of death, time period, and occupation in Finland, adjusted for age.

	Reference population	Forestry workers	Farmer/ forestry workers	Skilled construction workers	Semiskilled construction workers
All causes of death:					
1971–5	1·00*	1·34 (1·26, 1·42)	0·79 (0·71, 0·87)	1·09 (1·04, 1·14)	1·35 (1·28, 1·43)
1976–80	0·83 (0·81, 0·84)	1·03 (0·94, 1·12)	0·69 (0·60, 0·79)	0·85 (0·81, 0·90)	1·24 (1·16, 1·33)
1981–5	0·69 (0·68, 0·71)	0·89 (0·81, 0·97)	0·51 (0·43, 0·61)	0·74 (0·70, 0·79)	1·05 (0·98, 1·14)
Neoplasms:					
1971–5	1·00*	1·29 (1·13, 1·48)	0·68 (0·54, 0·87)	1·31 (1·19, 1·44)	1·16 (1·02, 1·33)
1976–80	0·90 (0·87, 0·94)	0·95 (0·77, 1·16)	0·76 (0·57, 1·01)	1·04 (0·93, 1·16)	1·21 (1·04, 1·41)
1981–5	0·80 (0·77, 0·84)	0·79 (0·64, 0·98)	0·52 (0·36, 0·76)	0·91 (0·81, 1·03)	1·19 (1·01, 1·39)
Diseases of the circulatory system:					
1971–5	1·00*	1·16 (1·07, 1·27)	0·78 (0·68, 0·90)	0·98 (0·92, 1·05)	1·09 (1·00, 1·18)
1976–80	0·82 (0·80, 0·84)	0·93 (0·82, 1·06)	0·70 (0·58, 0·84)	0·77 (0·71, 0·83)	1·04 (0·94, 1·16)
1981–5	0·64 (0·62, 0·66)	0·75 (0·65, 0·85)	0·44 (0·34, 0·57)	0·64 (0·58, 0·70)	0·72 (0·63, 0·82)
Other diseases:					
1971–5	1·00*	0·72 (0·56, 0·93)	0·44 (0·29, 0·67)	0·85 (0·72, 1·00)	1·58 (1·34, 1·87)
1976–80	0·74 (0·69, 0·79)	0·40 (0·26, 0·61)	0·49 (0·30, 0·82)	0·63 (0·52, 0·77)	0·96 (0·74, 1·24)
1981–5	0·66 (0·62, 0·70)	0·61 (0·44, 0·85)	0·36 (0·19, 0·60)	0·60 (0·48, 0·75)	1·07 (0·84, 1·36)
Suicides:					
1971–5	1·00*	2·04 (1·69, 2·49)	1·28 (0·93, 1·76)	1·07 (0·87, 1·30)	2·00 (1·64, 2·45)
1976–80	1·00 (0·92, 1·08)	1·89 (1·47, 2·43)	0·86 (0·51, 1·43)	1·00 (0·81, 1·23)	2·10 (1·67, 2·65)
1981–5	0·89 (0·82, 0·96)	2·06 (1·64, 2·59)	1·02 (0·61, 1·70)	0·94 (0·75, 1·19)	1·82 (1·42, 2·33)
Other accidents and violence:					
1971–5	1·00*	2·21 (1·94, 2·51)	1·00 (0·78, 1·27)	1·35 (1·20, 1·52)	2·40 (2·12, 2·72)
1976–80	0·73 (0·69, 0·77)	1·56 (1·29, 1·89)	0·58 (0·38, 0·86)	0·98 (0·85, 1·13)	2·00 (1·70, 2·34)
1981–5	0·67 (0·63, 0·71)	1·17 (0·96, 1·44)	0·66 (0·44, 0·99)	0·91 (0·77, 1·06)	1·92 (1·63, 2·26)

*=reference group.

Table V Age adjusted rate ratio (95% confidence interval) of death in relation to region of residence, level of education, marital status, housing conditions and cause of death in Finland 1970–85.

	All causes of death	Neoplasms	Circulatory diseases	Other diseases	Suicides	Other accidents
Region of residence:						
Uusimaa	1·00*	1·00*	1·00*	1·00*	1·00*	1·00*
Kymi	1·08 (1·05, 1·11)	0·93 (0·87, 1·00)	1·22 (1·17, 1·28)	0·76 (0·68, 0·84)	1·11 (0·99, 1·24)	1·08 (1·00–1·18)
Western Finland	0·89 (0·87, 0·91)	0·97 (0·92, 1·01)	0·92 (0·89, 0·95)	0·71 (0·66, 0·76)	0·86 (0·79, 0·94)	0·81 (0·76, 0·86)
Central Finland	0·98 (0·96, 1·00)	0·96 (0·92, 1·01)	1·05 (1·02, 1·09)	0·75 (0·70, 0·81)	1·01 (0·92, 1·10)	0·93 (0·87, 0·99)
Eastern Finland	1·14 (1·11, 1·17)	0·96 (0·90, 1·01)	1·29 (1·24, 1·33)	0·81 (0·75, 0·88)	1·21 (1·11, 1·33)	1·16 (1·08, 1·24)
Northern Finland	1·07 (1·04, 1·10)	0·98 (0·93, 1·04)	1·21 (1·16, 1·25)	0·64 (0·58, 0·70)	1·07 (0·97, 1·18)	1·12 (1·04, 1·20)
Education:						
Primary education	1·00*	1·00*	1·00*	1·00*	1·00*	1·00*
Intermediate education	0·78 (0·77, 0·80)	0·82 (0·79, 0·86)	0·81 (0·79, 0·84)	0·86 (0·80, 0·92)	0·73 (0·67, 0·78)	0·62 (0·59, 0·66)
Higher education	0·62 (0·60, 0·64)	0·65 (0·60, 0·70)	0·64 (0·61, 0·67)	0·74 (0·67, 0·82)	0·56 (0·49, 0·63)	0·48 (0·44, 0·53)
Marital status:						
Married	1·00*	1·00*	1·00*	1·00*	1·00*	1·00*
Single	1·67 (1·64, 1·71)	1·20 (1·13, 1·26)	1·39 (1·34, 1·44)	2·33 (2·18, 2·49)	2·32 (2·16, 2·49)	2·88 (2·74, 3·03)
Divorced	1·83 (1·78, 1·89)	1·33 (1·24, 1·44)	1·34 (1·28, 1·41)	3·30 (3·04, 3·58)	2·44 (2·21, 2·70)	3·57 (3·35, 3·82)
Widowed	1·42 (1·36, 1·50)	1·13 (1·01, 1·25)	1·37 (1·28, 1·47)	1·84 (1·57, 2·17)	2·03 (1·64, 2·51)	1·98 (1·70, 2·31)
Housing (based on data 1975–85):						
Spacious	1·00*	1·00*	1·00*	1·00*	1·00*	1·00*
Small	1·08 (1·06, 1·11)	1·15 (1·09, 1·21)	1·11 (1·07, 1·15)	0·92 (0·85, 1·01)	0·94 (0·86, 1·04)	1·06 (0·98, 1·14)
Very small	1·34 (1·30, 1·38)	1·34 (1·26, 1·43)	1·36 (1·30, 1·42)	1·22 (1·10, 1·35)	1·21 (1·08, 1·35)	1·42 (1·31, 1·55)
Unknown	1·73 (1·65, 1·81)	1·49 (1·35, 1·65)	1·50 (1·40, 1·60)	1·84 (1·59, 2·12)	2·00 (1·71, 2·34)	2·96 (2·65, 3·31)

*=reference group

and the other groups have thus increased, although not statistically significantly. Suicide mortality differences between the occupational groups did not change during the study. The suicide rate in forestry workers and semiskilled construction workers did not, in fact, fall at all. The differences in mortality as a result of accidents have diminished because the mortality of forestry workers has clearly declined, whereas that of the other study groups has remained almost stable.

DIFFERENCES BY REGION OF RESIDENCE, LEVEL OF EDUCATION, MARITAL STATUS, AND TYPE OF HOUSING
There were clear regional mortality differences, the highest mortality occurring in eastern Finland (table V). This trend was independent of the cause of death. The mortality of divorced men was particularly high. Mortality differences in relation to the level of education, marital status, and type of housing were also clear. These factors may explain some of the differences between occupational groups.

OCCUPATIONAL DIFFERENCES AFTER ADJUSTING FOR EFFECT OF MARITAL STATUS, EDUCATION, REGION OF RESIDENCE, AND TYPE OF HOUSING
When marital status was taken into account, the rate ratio of all-cause mortality for the semiskilled workers and forestry workers declined (table VI). Adjusting for education and housing conditions did not reduce the mortality differences. When all four variables were standardised for, only the mortality of semiskilled workers was high; the mortality of forestry workers was at the same level as that of the reference population.

Table VI Rate ratio (95% confidence interval) of death in relation to causes of death and occupation in Finland 1970–85. (the risk in reference population in the case of A, B, C, D, and E=1·00)

	A	B	C	D	E
All causes of death:					
Forestry workers	1·25 (1·20, 1·31)	1·10 (1·06, 1·15)	1·18 (1·13, 1·24)	1·20 (1·15, 1·25)	1·04 (0·99, 1·08)
Farmer/forestry workers	0·77 (0·72, 0·83)	0·77 (0·72, 0·83)	0·74 (0·69, 0·79)	0·76 (0·71, 0·82)	0·74 (0·69, 0·80)
Skilled construction workers	1·06 (1·03, 1·09)	1·05 (1·01, 1·08)	1·00 (0·97, 1·04)	1·05 (1·02, 1·08)	1·00 (0·97, 1·03)
Semiskilled construction workers	1·42 (1·36, 1·47)	1·29 (1·24, 1·34)	1·34 (1·29, 1·39)	1·37 (1·32, 1·42)	1·21 (1·16, 1·26)
Neoplasms:					
Forestry workers	1·16 (1·05, 1·28)	1·12 (1·01, 1·23)	1·11 (1·00, 1·22)	1·12 (1·01, 1·24)	1·05 (0·95, 1·16)
Farmer/forestry workers	0·73 (0·62, 0·86)	0·73 (0·62, 0·86)	0·70 (0·60, 0·83)	0·72 (0·62, 0·85)	0·71 (0·60, 0·83)
Skilled construction workers	1·21 (1·14, 1·29)	1·20 (1·13, 1·28)	1·15 (1·08, 1·23)	1·20 (1·12, 1·27)	1·14 (1·08, 1·22)
Semiskilled construction workers	1·29 (1·19, 1·41)	1·25 (1·15, 1·36)	1·23 (1·13, 1·34)	1·26 (1·15, 1·37)	1·18 (1·08, 1·28)
Diseases of the circulatory system:					
Forestry workers	1·07 (1·00, 1·14)	0·99 (0·93, 1·06)	1·02 (0·96, 1·09)	1·04 (0·97, 1·11)	0·94 (0·88, 1·00)
Farmer/forestry workers	0·75 (0·67, 0·83)	0·74 (0·67, 0·82)	0·72 (0·65, 0·80)	0·74 (0·67, 0·82)	0·72 (0·65, 0·80)
Skilled construction workers	0·97 (0·92, 1·01)	0·96 (0·92, 1·00)	0·92 (0·88, 0·97)	0·96 (0·92, 1·00)	0·92 (0·88, 0·96)
Semiskilled construction workers	1·12 (1·06, 1·19)	1·06 (1·00, 1·13)	1·07 (1·01, 1·13)	1·10 (1·03, 1·16)	1·01 (0·95, 1·07)
Other diseases:					
Forestry workers	0·78 (0·65, 0·93)	0·61 (0·51, 0·73)	0·74 (0·62, 0·89)	0·73 (0·61, 0·88)	0·58 (0·48, 0·70)
Farmer/forestry workers	0·54 (0·41, 0·73)	0·55 (0·41, 0·73)	0·53 (0·39, 0·70)	0·54 (0·40, 0·72)	0·54 (0·40, 0·72)
Skilled construction workers	0·86 (0·77, 0·97)	0·84 (0·75, 0·94)	0·83 (0·74, 0·92)	0·85 (0·76, 0·96)	0·81 (0·72, 0·91)
Semiskilled construction workers	1·54 (1·36, 1·74)	1·26 (1·11, 1·42)	1·46 (1·29, 1·65)	1·47 (1·30, 1·66)	1·20 (1·06, 1·35)
Suicides:					
Forestry workers	2·01 (1·76, 2·29)	1·61 (1·41, 1·84)	1·85 (1·62, 2·11)	1·89 (1·66, 2·15)	1·49 (1·31, 1·70)
Farmer/forestry workers	1·10 (0·87, 1·40)	1·09 (0·86, 1·38)	1·04 (0·82, 1·33)	1·09 (0·86, 1·39)	1·04 (0·82, 1·33)
Skilled construction workers	1·04 (0·92, 1·17)	1·02 (0·90, 1·15)	0·97 (0·86, 1·10)	1·03 (0·91, 1·16)	0·96 (0·85, 1·09)
Semiskilled construction workers	2·03 (1·78, 2·31)	1·69 (1·48, 1·92)	1·87 (1·64, 2·13)	1·94 (1·71, 2·21)	1·57 (1·38, 1·79)
Other accidents and violence:					
Forestry workers	2·00 (1·82, 2·20)	1·50 (1·36, 1·65)	1·81 (1·64, 2·00)	1·83 (1·67, 2·02)	1·36 (1·24, 1·50)
Farmer/forestry workers	0·92 (0·76, 1·11)	0·92 (0·76, 1·11)	0·86 (0·71, 1·04)	0·91 (0·75, 1·10)	0·87 (0·72, 1·06)
Skilled construction workers	1·35 (1·24, 1·46)	1·30 (1·20, 1·41)	1·24 (1·14, 1·34)	1·33 (1·22, 1·44)	1·22 (1·12, 1·32)
Semiskilled construction workers	2·56 (2·35, 2·79)	2·01 (1·85, 2·19)	2·32 (2·13, 2·53)	2·41 (2·21, 2·62)	1·83 (1·68, 2·00)

A=adjusted for age, time and region;
B=adjusted for age, time, region and marital status;
C=adjusted for age, time, region and level of education;
D=adjusted for age, time, region and housing conditions;
E=adjusted for age, time, region, marital status, level of education and housing conditions.

Few changes in cancer mortality differences were observed when marital status was accounted for. The effects of housing and education were also negligible. However, these three variables together explained some 30% of the difference between the semiskilled workers and the reference population: the rate ratio of the semiskilled workers declined from 1·29 to 1·18 after the adjustments.

After adjustment for age, period, and region, the differences between occupations in rate ratios of death because of diseases of the circulatory system were small, and when marital status was included in the model the differences declined further. The effect of housing and education was almost as great as the effect of marital status. When all three variables together with period, age, and region were included in the model, the differences almost disappeared. The mortality of farmer/forestry workers was still lower than the average, however.

Of the variables considered, only marital status seemed to have an effect on mortality differences due to the category of other diseases. When marital status was adjusted for, the rate ratio of death for the semiskilled construction workers declined from 1·54 to 1·26. Adjustment for housing and education did not have an effect on the rate ratio.

The rate ratio of suicidal death declined considerably after the adjustment for marital status. Standardising for education and housing also reduced the rate ratio slightly. After adjusting for all variables, however, there were still clear differences in suicide mortality: the rate ratio for suicide was about 50% higher in the forestry and semiskilled construction workers than in the the farmer/forestry workers or the reference population.

The high mortality ratio for other accidents and violence among the forestry workers and the semiskilled construction workers declined considerably after adjustment of marital status. Again, the effect of standardising for education and housing was much smaller. As in the case of suicides, the rate ratio of the semiskilled construction workers and the forestry workers was still very high.

INTERACTION EFFECTS

The interaction effects between variables were small. There were four statistically significant interaction effects in relation to cause of death. The most significant effect in cause-specific mortality was observed between occupation and region of residence in deaths from other accidents and violence (table VII). The rate ratio of the forestry workers or part-time forestry workers was higher in counties other than Uusimaa, but among the construction workers the pattern was the opposite. The rate ratio for accidents in construction workers was higher in Uusimaa than in other counties. The patterns of other interaction effects were not clear. An interaction effect of occupation and marital status was observed in cardiovascular

and accident mortality. In both cases, the mortality risk was especially high for divorced farmer/forestry workers (2·0 in cardiovascular diseases and 6·0 in accidents). The accident mortality risk was increased to 2·8 for widowed farmers.

Discussion

We have studied the 15 year mortality development in men from four occupational groups—three groups of blue collar employees (skilled and semiskilled construction workers and forestry workers), and one self-employed group (farmers who also did forest work for a minimum of a quarter of a year). Two of these groups lived mainly in the countryside (forestry workers and farmers), and two in more urban areas (construction workers).

All-cause mortality declined from 1971–85 by about 30% in all occupational groups studied. The decrease was most evident in the diseases of the circulatory system. Mortality differences between the occupational groups did not change significantly, however. Compared with the reference population, the risk of all-cause mortality was highest in the semiskilled construction workers and second highest in the forestry workers. The mortality of the skilled construction workers did not differ much from that of the reference population—that is, the total gainfully employed male Finnish population (index groups not included). The mortality risk of the farmer/forestry workers, however, was significantly below unity. Farmer/forestry workers are probably typical farmers, and the mortality of this group is the same as the mortality among farmers.[10] Forest work is not an additional risk factor for those farmers who are also part-time forestry workers.

Differences in mortality in different socioeconomic groups have increased to some extent during the study period, in Finland,[4] as well as in other countries.[14] Educational level, occupation, and housing conditions all reflect certain aspects of the social status of an individual in a stratified society. As the occupational groups studied here were rather strictly defined, variation in the educational level or housing conditions within groups could, a priori, be assumed to be small. We wished, however, to assertain empirically the effects of these factors, as well as that of marital status, on the cause-specific mortality risk in the index groups.

The mortality differences between the forestry and the semiskilled construction workers compared with the reference population were reduced after adjustment for the level of education, housing conditions, and marital status. The effect of adjustments in the group of farmer/forestry workers was negligible.

Educational level[15][16] is associated with health related behaviour. Health behaviour is believed to

Table VII The interaction effects between occupation and region, marital status, education, and housing.

	All causes of death	Neoplasms	Circulatory diseases	Other diseases	Suicides	Other accidents and violence
Occupation/region	NS	NS	NS	NS	NS	p<0·01
Occupation/marital status	p<0·01	NS	p<0·05	NS	NS	p<0·05
Occupation/education	p<0·05	NS	NS	NS	NS	NS
Occupation/housing (based on data 1975–85)	NS	NS	NS	NS	NS	p<0·05

have a particular effect on cardiovascular and cancer morbidity. In the occupational groups studied the educational level was generally low, and little effect on mortality was observed from adjusting for this.

Housing conditions reflect the economic well-being of the individual. In the present index groups the effect of housing was of the same magnitude as that of education—small.

The effect of marital status was greater than that of education or housing, especially in relation to violent deaths and deaths from "other diseases". If marital status is considered as a measure of social ties,[17][18] its effect on suicide and other violent deaths seems understandable. Marital status is also associated with lifestyle—unmarried and divorced men have more high risk behaviours.[15][19] General risk taking could be a factor that increased the number of violent deaths in these men.

After all adjustments for background factors, the cancer mortality of both groups of construction workers was still somewhat high. This could be the result of specific occupational exposure to carcinogens such as asbestos in construction work.

Similarly, after all adjustments the mortality from "other diseases" and especially suicide and violence was still high in the semiskilled construction workers. The group may be in a somewhat "marginal" position in the Finnish society, supposedly with a more unhealthy lifestyle than the average.

The mortality development was the most favourable in accident mortality among the forestry workers. A possible explanation for this is the change in the nature of forestry work. The work has become more mechanised, the workers more skilled, and employment more permanent and full time. As a result, safety at work has improved. As the productivity of forestry work has increased, the number of employees has decreased during the past two decades.[20]

Why, then, was the risk of suicide in the forestry workers twice as high as that in the reference population? And, why was there no favourable risk development in this group during the study period? The relative risk of suicide was still high at the end of the study period in the 1980s, after adjustement for the effects of region, marital status, education, and housing. Durkheim[21] has divided suicides into "altruistic", "egoistic", and "anomic" categories. The two former do not seem

very likely in the present context. "Anomic" suicide occurs typically when an economic change disrupts society and the structure of its norms and beliefs. In Finland, a rapid urbanisation process continued during the 1960s and 1970s, perhaps leaving those who stayed as salaried employees in the country, in a growing state of relative deprivation.[7]

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