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Convergence of Lifestyles and Trends in the Sex Mortality Ratio Among the Middle-Aged in Finland

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Abstract

Male excess mortality has increased rapidly during this century. A hypothesis has been brought forth, however, that the growing equality of the sexes and the concomitantly increasing similarity of lifestyles, result in a convergence of female and male mortality. In addition, it can be assumed that this process is most evident in those »modern» population groups which can be considered forerunners in adopting new behavior patterns, e.g. among the young with higher education or living in the capital region. This article examines the plausibility of these hypotheses among the Finnish middle-aged population during the period 1971–85.

Keywords: mortality, gender, lifestyle, Finland

In the developed countries life expectancy at birth has increased much more rapidly among women than among men for several decades. In Finland this development started at the beginning of this century, when the sex differential in life expectancy at birth was less than three years (Valkonen 1977), and ended in 1977 when the differential reached its maximum, 8.8 years. During the last few years the sex differential in life expectancy has slightly narrowed remaining, however, very large in international comparison: nearly 8 years at the beginning of the 1990s (Koskinen and Martelin 1994, 174).

The difference between female and male life expectancy is a summary measure of the sex mortality differentials in all age groups. The relative excess mortality of men, however, varies considerably according to age. In childhood as well as in old age male death rates are approximately 50 percent higher than female rates. During the whole working age (15–64 years) mortality of men is approximately three times higher than that of women (Koskinen and Martelin 1994, 176).

The causes of death responsible for the male excess mortality appear to be largely the same in different countries (e.g. Preston and Weed 1976; Lopez 1984). Accidents and violence account for the majority of excess male deaths in youth and early adulthood. Alcohol related causes of death play a marked role in male excess mortality during the whole working age. Ischaemic heart disease is the most important cause in the middle-aged population while lung cancer contributes to the mortality differential mainly in old age. In Finland these four causes of death together are responsible for 85 percent of the male excess mortality in working age (Koskinen and Martelin 1994, 186).

The large intertemporal and international variations in sex differentials in mortality, together with the well known differences between men and women in the prevalence of behavioral risk factors for the above-mentioned causes of death, point to the importance of environmental and behavioral factors as sources of differential longevity of men and women (see Waldron 1983, for example). The early adoption of smoking among men, for example, has often been assessed as a major reason for the rapid increase in male excess mortality witnessed in the developed countries during this century (e.g. Preston 1970).

Equality between sexes and converging lifestyles

A hypothesis has been brought forth that increasing equality between the sexes in various areas of life, particularly in work, and the concomitant convergence of life styles result in narrowing of the sex mortality differential (Hart 1989; Waldron 1993). If such narrowing occurs, it seems reasonable to presume that it is first seen in those population groups which are forerunners in the assumed increase in equality between women and men.

According to some indicators, equality between women and men increased during the period under study. For example, the proportion of women aged 35–64 who are economically active increased rapidly, whereas the trend was opposite among men, as can be seen in Table 1.

Table 1. Age-adjusted prevalence of economic activity and higher education in the Finnish population aged 35–64 by sex in 1971 and 1981.

		1971	1981
Economically active (%)	Women	57.4	68.9
	Men	87.6	80.8
Persons with more than basic education (%)	Women	18.5	31.9
	Men	21.9	35.0

On the other hand, the educational structure was relatively similar among women and men already at the beginning of 1970s, and virtually no change took place in the educational difference between middle-aged women and men. Some improvement occurred in women's average taxable income which increased from 59% of men's income in 1970 to 67% in 1985. This development was, however, partly due to some social benefits, such as the maternity allowance, becoming taxable (Hemmilä 1988, 38).

When turning from general indicators of gender equality to those aspects of lifestyle which are more closely related to health and mortality, smoking and alcohol consumption are especially important. Sex-specific trends in smoking and drinking behavior are therefore shortly reviewed below.

Gender differences in smoking are the dominant cause for male excess mortality from chronic lung diseases and lung cancer. In addition, the sex differentials in mortality from ischaemic heart disease, as well as many other diseases, result partly from smoking. The proportion of daily smokers among working-aged women increased from a little over ten percent to nearly twenty percent during the 1960s, remaining at this level thereafter (National Board of Health in Finland 1989, 14). On the other hand, the prevalence of smoking among men diminished rather steadily from the early 1960s (60%) to the early 1980s (35%). The expected result of these trends in smoking habits is, of course, a narrowing of the sex mortality ratio in smoking-related diseases, especially lung cancer.

Abundant use of alcohol increases the risk of dying of several causes, such as diseases of the liver and the pancreas as well as many types of accidents. Both men and women increased their drinking frequency during the study period but among women the relative change was more substantial. According to Simpura (1985) 53% of working-aged men used alcohol twice a month or more often in 1968 and 69% in 1984. The corresponding proportions among working-aged women were 20% in 1968 and 39% in 1984. The anticipated consequence of these changes in alcohol consumption is increased mortality from alcohol related causes of death, especially among women, which would result in diminishing sex differentials in mortality from accidents and diseases other than neoplasms or cardiovascular diseases.

Purpose of the study

This study describes the changes in the male/female ratio in total mortality in the Finnish middle-aged population during 1971–85. Special emphasis is given to assessing the plausibility of the convergence hypothesis which suggests that the male/female mortality ratio declines owing to converging lifestyles. The middle-aged population has been chosen as the object of this paper, since the relative male excess mortality is largest within this age range. Moreover, the hypothesized tendencies can be assumed to be easiest to detect in this population. In the younger age groups the numbers of death are small in Finland and mortality is dominated by non-natural deaths. On the other hand, in the old age groups the relative difference between male and female mortality becomes small and possible changes in it may therefore be less obvious.

We shall examine whether the possible narrowing of the sex mortality ratio is most evident in those groups of the middle-aged population which can be considered the forerunners in adopting new behavior patterns: the youngest and the best educated and those living in the capital area of the country; i.e. those groups where the possibly increased equality between sexes is likely to be the most evident. If convergence of female and male mortality is particularly obvious in these groups, it can be presumed that the sex mortality ratio will continue decreasing in the future.

Data and methods

The data are extracted from three large data files compiled by Statistics Finland.[1] The first of these data files includes census records of all individuals covered by the

[1] We are indebted to Statistics Finland for permission (TK 53-69-87) to use the data files.

1970 census, linked with death records for the years 1971–75. The second data set consists of 1975 census records, linked with death records for the years 1976–80, and the third file covers 1980 census records and deaths during the period 1981–85 (Valkonen, Martelin and Rimpelä 1990).

A subfile including all women and men, who were in the age bracket 35–64 years in any year covered by the study, was extracted from each of these three files. The subfiles were combined to form the data set of this study. Consequently, the data include death records for the period 1971–85 and census records of the middle-aged population residing in Finland at the beginning of the years 1971, 1976 and 1981. The number of person-years in the material is 24.5 million and the number of deaths is 172,024.

Table 2 gives the variables used in the analysis as well as the classifications applied and the numbers of person-years, numbers of deaths, death rates and age-standardized death rates. The total female and male number of person-years in 1971–85 by age was used as the standard population.

T a b l e 2. Person-years, deaths and death rates according to the variables included in the analysis.

	Women			Men		
	Person-years in 1,000s	Deaths	Deaths[1] /100,000	Person-years in 1,000s	Deaths	Deaths[1] /100 000
Age						
35–39	2,407	2,316	96	2,497	6,777	271
40–44	2,143	3,361	157	2,174	9,432	434
45–49	2,124	5,059	238	2,067	14,646	709
50–54	2,121	7,948	375	1,898	21,318	1,123
55–59	2,049	12,522	611	1,658	29,051	1,753
60–64	1,962	20,116	1,025	1,441	39,478	2,740
Period						
1971–75	4,168	19,402	436	3,686	43,900	1,214
1976–80	4,187	16,646	379	3,816	39,543	1,090
1981–85	4,452	15,274	336	4,232	37,259	948
Education						
< 10 years	9,335	42,893	405	8,133	99,147	1,173
10+ years	3,472	8,429	307	3,601	21,555	802
Region						
Helsinki region	2,144	8,788	415	1,805	17,952	1,122
Rest of Finland	10,664	42,534	377	9,929	102,750	1,073
All	12,808	51,322	383	11,734	120,702	1,080

[1] Age-standardized using the direct method, standard population = all women and men aged 35–64

The analysis is based on a multivariate table for which the data are cross-tabulated according to all the variables included in Table 2. Each cell of this multivariate table gives the number of deaths during a 5-year period and the number of person-years lived during the same period for a specific subgroup defined by the relevant categories of the variables. The table is analysed employing a log-linear regression analysis of the mortality rates (exponential model). The GLIM program package (Payne 1985) is used in fitting the models. The following formula describes the structure of the model:

$$u_i = V_i * e^{a + b_1x_{i1} + b_2x_{i2} + ... + b_px_{ip}}$$

where $u_i = E(d_i)$ is the expected number of deaths in the ith cell
V_i is the number of person-years in the ith cell
$x_1, ..., x_p$ are the explanatory variables
$a, b_1, ..., b_p$ are the parameters to be estimated

Trends in the sex ratio in mortality from all causes

As can be calculated from the figures in Table 2, age-standardized male mortality diminished 22 percent from the period 1971–75 to the period 1981–85, and female mortality 23 percent. The decline was thus approximately the same and the ratio of male mortality to female mortality remained constant. This result can also be seen in the first column of Table 3 which is based on the log-linear regression analysis. No systematic change can be observed in the mortality ratio between men and women aged 35–64 during the period 1971–85.

Table 3. The sex ratio in mortality from all causes by age group and period (95% confidence intervals in parentheses).

Period	Age group 35–64		35–49		50–64	
1971–75	2.78	(2.73–2.83)	2.99	(2.89–3.10)	2.72	(2.67–2.77)
1976–80	2.88	(2.83–2.93)	2.91	(2.79–3.02)	2.87	(2.81–2.93)
1981–85	2.82	(2.77–2.88)	2.73	(2.62–2.84)	2.85	(2.79–2.91)
Change (%) 1971/75–81/85	1.4		–8.7		4.8	

However, the apparent absence of any systematic change in the sex ratio among the middle-aged turns out to result from two opposite trends: the sex ratio has declined by nine percent among those aged 35–49, whereas an increase of five percent has taken place in the age group 50–64. Consequently, further analyses will be carried out separately for these two age groups. The main emphasis will be laid on the younger group in which the change has been more marked and which appears to follow the hypothesized trend in the sex mortality ratio.

The sex ratio in mortality by education and region in the age group 35–49

The observed decrease in the age-standardized male/female mortality ratio among the younger middle-aged may result from different processes. First, the sex mortality ratio may have decreased in all population groups or in some groups only. Furthermore, it is possible that the sex mortality ratio has not changed in any subgroup of the population, but that those subgroups where the ratio is highest have either decreased their relative size or experienced the most rapid female and male mortality decline.

Table 4 describes how controlling for age, education and region of residence affects the trend in the sex mortality ratio. The mortality ratios yielded from Model 1 were presented already in Table 3. Controlling for the effects of education and region

T a b l e 4. The sex ratio in mortality from all causes in the age group 35–49 by period according to two models:
1) age + period + period.sex
2) age + period + education + region + period.sex
(95% confidence limits in parentheses).

Period	Model 1		Model 2	
1971–75	2.99	(2.89–3.10)	3.02	(2.92–3.14)
1976–80	2.91	(2.79–3.02)	2.94	(2.83–3.06)
1981–85	2.73	(2.62–2.84)	2.76	(2.65–2.87)
Change (%) 1971/75–81/85	–8.7		–8.6	

of residence (Model 2) shifts the ratios to a minimally higher level with no effect on the time trend. It is not surprising that the trend in the sex ratio remains unchanged after allowing for the effects of education and region of residence because the alterations in the educational structure (see Table 1) and in the geographic distribution have been quite similar among both sexes.

In the introduction of this paper a hypothesis was presented that female and male mortality would converge especially in those population groups which supposedly are forerunners in the growing equality between women and men, because the growing equality would imply converging lifestyles and risk factor prevalence. In this data set the youngest and best educated and those living in the capital area of the country were considered to be in the front line of this process.

The results presented in Table 3 give support to the hypothesis regarding the effect of age: female and male mortality converged in the age group 35–49 but not among those aged 50–64. Table 5 shows the sex ratios by level of education and by region of residence for the three periods. The ratios are clearly lower among the better educated than among those with basic education only. Similarly, the sex ratios are consistently lower in the capital region than in the rest of the country. These cross-sectional results are in accordance with the hypothesis that sex mortality differentials are smallest in the more »advanced» population groups. On the other hand, time trends by education and region of residence portray a more confusing picture.

T a b l e 5. The sex ratio in mortality from all causes by period, level of education, and region of residence in the age group 35–49
(95% confidence intervals in parentheses).

	Years of education				Region of residence			
Period	< 10		10 +		Capital region		Other	
71–75	3.13	(3.01–3.26)	2.56	(2.35–2.78)	2.78	(2.54–3.03)	3.04	(2.92–3.16)
76–80	3.02	(2.89–3.16)	2.66	(2.46–2.89)	2.55	(2.33–2.79)	3.00	(2.87–3.13)
81–85	2.88	(2.74–3.03)	2.52	(2.35–2.70)	2.50	(2.29–2.74)	2.80	(2.67–2.93)
Change (%) 71/75–81/85	–8.0		–1.6		–10.1		–7.9	

The sex mortality ratio decreased among those with only basic education, whereas practically no change took place among the better educated. As a result, the sex ratio among the less educated approached the level of the better educated. This observation is quite contrary to the hypothesis presented above. Moreover, the decrease in the sex ratio was only slightly greater in the capital region than elsewhere in the country.

In conclusion, changes in the population composition do not account for the decrease in the sex mortality ratio, and the decline in the death rates was not exceptionally rapid in those population groups where the sex mortality ratio is highest. The observed decrease in the sex mortality ratio resulted thus totally from convergence of female and male death rates, particularly among the persons with basic education only.

Trends by cause of death in the age group 35–49

The decrease in the male/female ratio in mortality from all causes may further result from at least two different processes. First, age-specific death rates of women and men may converge in many, if not all, causes of death. This would imply that the mortality patterns of women and men are becoming more alike than before. Alternatively, age- and cause-specific ratios of male and female mortality may remain stable while the cause of death structure of mortality changes. Thus the total mortality rates of women and men may converge owing to an especially rapid mortality decline among both women and men in causes with a large sex differential.

The sex ratio in mortality from all causes declined nine percent from 1971–75 to 1981–85. This development was partly due to the trends in lung cancer and accidents and violence (Table 6). The changes in sex ratios in all other causes of death were

T a b l e 6. The change in mortality from 1971–75 to 1981–85 by sex and the sex ratio in mortality in 1971–75 and 1981–85 in the age group 35–49, by cause of death.

Cause of death	Change (%) in mortality from 71–75 to 81–85: Women	Men	Period / Sex ratio: 71–75	81–85	Change from 1971–75 to 1981–85: %	Statistical significance[1]
Cancer	–15.6	–22.3	1.01	0.92	– 9	ns
Lung cancer	– 3.8	–36.3	7.14	4.50	–37	*
Other cancers[2]	–16.0	–17.3	1.15	1.18	+ 3	ns
Circulatory diseases	–40.2	–39.4	4.50	4.47	– 1	ns
Ischaemic heart disease	–38.0	–41.1	11.43	10.78	– 6	ns
Other circ. diseases	–41.0	–35.3	1.79	1.95	+ 9	ns
Other diseases	–26.0	–25.1	2.31	2.36	+ 2	ns
Accidents and violence	– 5.4	–20.9	5.17	4.37	–15	**
All causes	–22.4	–29.4	2.99	2.73	– 9	***

[1] ns = not statistically significant
o = $0.05 \le p < 0.1$
* = $0.01 \le p < 0.05$
** = $0.001 \le p < 0.01$
*** = $p < 0.001$

The test is based on the comparison of the model age + period + sex with the model age + period + sex + period.sex.

[2] other cancers exclude breast cancer and cancer of the uterine cervix as well as lung cancer

small and statistically nonsignificant. The male/female ratio in lung cancer mortality was as high as 7.1 in the early 1970s, but the ratio had fallen to 4.5 by the early 1980s. This decline was due to rising female and declining male mortality. Mortality from accidents and other violent causes of death decreased among both sexes, mainly due to a positive development in deaths from traffic accidents, but the decline was more prominent among men.

On the other hand, mortality trends in other cancers, circulatory diseases and other diseases were very similar among women and men. The lack of any change in the sex ratio in mortality from »other» diseases is contrary to the assumption that the growing alcohol consumption of women would be seen as a decline in the sex ratio in mortality from the group »other» diseases. Probably the increase in women's use of alcohol was not large enough to have any significant influence on the mortality trend in the large group of »other» diseases. However, among middle-aged women mortality from alcohol poisoning doubled from 1971–75 to 1981–85, whereas male mortality increased less than 20 percent (Valkonen et al. 1990). This indicates that converging alcohol use does have some effect on the sex mortality ratio. Converging alcohol use may also play some role in the declining sex ratio in mortality from accidents and violence.

The falling sex ratio in lung cancer mortality correlates well with the increasing proportion of daily smokers among women and the decrease in smoking among men, referred to earlier. Among women lung cancer has become more frequent, while male mortality from this cause has diminished. Smoking also increases the risk of dying from respiratory diseases, for example. Therefore it could be expected that the convergence of smoking habits between sexes would decrease the sex ratio also in mortality from »other diseases». No signs of such development can be seen, which is plausible since respiratory diseases constitute only approximately fifteen percent of deaths from this group of causes of death within the age range 35–49.

The influence of changes in the cause of death structure

Controlling for the changing cause structure in mortality is performed by calculating an adjusted sex ratio of mortality for the period 1981–85. This adjusted sex ratio is calculated as a weighted average of age- and cause-specific sex ratios using the weights prevailing in the period 1971–75. The cause-classification employed is shown in Table 7 and the method used for obtaining the relevant weights is presented in the Appendix.

The major change in the cause structure of both female and male mortality was a decline in the proportion of circulatory diseases with a corresponding increase in the share of deaths from accidents and violence and, among women, also cancer. Conse-

Table 7. The distribution of age-standardized mortality by cause of death by sex in 1971–75 and 1981–85 in the age group 35–49 (%).

Cause of death	Women 71–75	Women 81–85	Men 71–75	Men 81–85
Lung cancer	1.3	1.6	3.1	2.8
Other cancers	34.1	36.9	8.8	10.3
Ischaemic heart disease	7.8	6.3	30.0	25.0
Other circulatory diseases	20.1	15.3	12.0	11.0
Other diseases	18.0	17.1	13.9	14.7
Accidents	18.7	22.8	32.3	36.2
All causes	100.0	100.0	100.0	100.0

quently, controlling for the change in the cause structure of mortality means that the low sex ratio in cancer mortality and the moderate sex ratio in deaths from accidents and violence (see Table 6) are given less importance in 1981–85 than is the case if changes in the cause of death structure are not allowed for. Correspondingly, in the adjustment procedure the male/female ratios in mortality from circulatory diseases are given more weight in the latest period.

T a b l e 8. The effect of adjusting for changes in the cause of death structure on the trend in the sex mortality ratio in the age group 35–49.

Period	Unadjusted sex ratio	Adjusted sex ratio
1971–75	2.99	2.99
1981–85	2.73	2.82
Change (%)		
1971/75–1981/85	–8.7	–5.7

Controlling for the changes in the cause structure of mortality after the period 1971–75 (Table 8) appears to have a significant effect on the trend in sex ratios: more than one third of the decline of the sex ratio is caused by the changing distribution of mortality into causes of death.

While the sex ratio in mortality varies a lot from one cause to another it is obvious that a weighted average of the cause-specific ratios is sensitive to the choice of weights. Therefore, also weighted averages of the age- and cause-specific female/male mortality ratios were calculated in an analogous way. A reciprocal was then taken of these weighted inverse sex ratios. The result of this procedure emphasized the effect of the changing cause of death structure even more: the sex ratio, adjusted in this way, was 2.89 in 1981–85, suggesting that nearly two-thirds of the original decline in the sex mortality ratio can be accounted for by changes in the cause structure of mortality, and not by changes in cause-specific sex ratios.

Cause-specific sex mortality ratios by education

The sex ratio in mortality from all causes decreased markedly among those with basic education only, while, contrary to expectations, no obvious change occurred among persons with ten or more years of education. Cause-specific analysis reveals that this development reflects a general trend (Table 9). In the higher educational group the sex ratio has in most causes of death either increased or declined less than in the group with only basic education.

The difference between education-specific trends is especially large, and statistically significant, in mortality from accidents and violence. This is due to an increase of mortality among women in the lower education group. The sex ratio in lung cancer mortality has declined in both educational groups but considerably faster in the lower than in the higher group. Also this development is due to an increase in mortality among women with basic education only.

Lung cancer provides an illustrative example of how important it is to take into account changes in the structure of the population when examining trends in the sex mortality ratio. In Table 6 we can see that the male/female mortality ratio has declined 37 percent in the whole age group 35–49. Dividing the age group according to level of education produces a surprising result: the sex ratio in lung cancer mortality decreased less than 37% in both education groups, 34% in the lower and only 17% in

T a b l e 9. The sex ratio in mortality by cause of death and level of education in the periods 1971–75 and 1981–85 in the age group 35–49.

Cause of death	Educ.	Period 71–75	Period 81–85	Change from 1971–75 to 1981–85 %	Statistical significance[1]
Cancer	< 10	1.07	0.97	– 9	ns
	10 +	0.81	0.86	+ 6	ns
Lung cancer	< 10	8.58	5.65	– 34	o
	10 +	2.81	2.33	– 17	ns
Other cancers[2]	< 10	1.15	1.13	– 2	ns
	10 +	1.13	1.24	+ 10	ns
Circulatory diseases	< 10	4.46	4.55	+ 2	ns
	10 +	5.01	4.40	– 12	ns
Ischaemic heart disease	< 10	11.13	10.06	– 10	ns
	10 +	14.64	13.64	– 7	ns
Other circ. diseases	< 10	1.75	1.99	+ 14	ns
	10 +	2.07	1.92	– 7	ns
Other diseases	< 10	2.26	2.33	+ 3	ns
	10 +	2.81	2.47	– 12	ns
Accidents and violence	< 10	5.79	4.61	– 20	***
	10 +	3.48	4.06	+ 17	ns
All causes	< 10	3.13	2.88	– 8	*
	10 +	2.56	2.52	– 2	ns

[1] ns = not statistically significant
o = $0.05 \leq p < 0.1$
* = $0.01 \leq p < 0.05$
** = $0.001 \leq p < 0.01$
*** = $p < 0.001$

The test is based on the comparison of the models age + period + sex and age + period + sex + period.sex, fitted separately for the subgroup with basic education and for those with higher education.

[2] other cancers exclude breast cancer and cancer of the uterine cervix as well as lung cancer

the higher group (Table 9). This apparent controversy can be explained by the growing prevalence of higher education (see Table 1) and by the lower sex ratio in lung cancer mortality among those with higher education.

Trends in the sex mortality ratio in the age group 50–64

In the older middle-aged population the sex ratio in mortality from all causes increased 4.8 percent (see Table 3). This appears to result from the trend among those with only basic education and those living outside the capital area. In both groups the sex ratio in mortality from all causes increased 6% from the period 1971–75 to the period 1981–85. The better educated and those living in the capital region did not show any change in the sex ratio. Thus the total mortality sex ratio did not decline in any subgroup of the 50–64-year-old population. No change occurred in the »modern» subgroups whereas an increase was observed in the other groups. These findings neither give strong support to the hypothesis of converging lifestyles of women and men, especially in »advanced» population groups, nor are they completely opposite to the expected development.

In both education groups the sex ratio declined considerably in lung cancer mortality. On the other hand, the male/female ratio in mortality from circulatory diseases increased 13% in the higher education group and as much as 24 percent in the lower group as a result of a more rapid mortality decline among women than among men. Only minor changes occurred in other causes of death.

The sex ratio in lung cancer mortality was nearly halved both in the Helsinki region and elsewhere in the country. A much smaller decrease occurred in mortality from accidents and violence in the capital region. A corresponding increase took place in the Helsinki region in the sex mortality ratio in circulatory diseases. Elsewhere in the country this increase was even larger, leading to an increase in the sex differential in mortality from all causes.

In summary, the cause-specific results concerning the age group 50–64 show that the sex ratio in lung cancer mortality declined rapidly, owing to a convergence of smoking habits. An opposite, increasing trend in the sex ratio occurred in both ischaemic heart disease and other circulatory diseases, for unknown reasons.

Controlling for the changes in the cause structure of mortality after the period 1971–75 did not affect the ascending trend in the sex mortality ratio in the older middle-aged population.

Discussion

The main emphasis in the analysis has been in testing whether the hypothesis of converging male and female mortality, owing to the growing similarity of the lifestyles of both sexes, receives support in a Finnish data set concerning mortality of the middle-aged population during the period 1971–85. The sex ratio in total mortality appears to have decreased moderately in the age group 35–49, while a small increase has taken place among those aged 50–64. This finding is in reasonable accordance with the assumption that the convergence of female and male mortality starts in those population groups which are especially prone to adopt new lifestyles. The same reasoning would imply that the decrease in the sex mortality ratio is strongest among those with higher education as well as among the population residing in the capital region of the country. Analyses by level of education, however, produced results contradictory to the hypothesis: the decrease in the sex ratio which was observed in the 35–49-year-old population has occurred only in the lower education group. Moreover, the decrease has been similar in the capital region and elsewhere in the country.

It appears to be very important to take into account the distribution of mortality by cause of death. Large shifts can occur in the cause structure of mortality during rather short periods and even larger differences may be observed in comparison of subgroups of population or when different populations are compared. There is a great risk of drawing biased conclusions if attention is paid only to the sex ratio in mortality from all causes. This reservation is, of course, valid regarding all summary measures which compress a lot of detailed information into one figure. In this data set, changes in the cause structure of mortality accounted for a considerable proportion of the observed decline in the »total» sex mortality ratio in the younger middle-aged population.

Time trends in smoking and lung cancer mortality provide the only indisputable piece of support to the convergence hypothesis in the material of this study. It may be reasonable to conclude that such a hypothesis is too simple a generalization to serve as a fruitful basis for the study of sex differentials in mortality from most causes of death.

Probably the convergence hypothesis is most useful in the analysis of causes of death which are largely determined by behavioral factors and where the role of biologically based susceptibility is very small. Examples of such causes are diseases strongly associated with smoking or alcohol use and many groups of accidental and violent deaths. These causes, however, account for only a small proportion of all deaths in the middle-aged and elderly population. Therefore, trends and associations specific to these causes may easily remain undetected in the analysis of total mortality.

It was assumed that the most rapid decline in the sex mortality ratio would be observed among those sections of the population which are forerunners in adopting modern behavior patterns. This assumption did not get much support from the results. It is, nevertheless, possible that persons with high education and those living in the capital area do experience changes in mortality patterns earlier than other subgroups. These new patterns may have manifested themselves in the »advanced» subgroups already before the period which was studied in this paper while the other subgroups may have followed the same trends later, during the period which was studied here.

Finally, it is perhaps justified to criticize the assumption that modernization and the growing equality of the sexes in the economic and political spheres of life, for example, automatically imply that women and men start to resemble each other in all other, e.g. culturally determined areas of life. On the contrary, it is possible that modernization of life includes trends which accentuate the differences between the sexes in behavioral and psychic factors relevant to health and longevity.

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Appendix

Adjusting the total sex mortality ratio for the change in the distribution of causes of death

The adjusted total sex ratio for the period 1981–85 was calculated as a weighted sum of the age- and cause-specific male/female mortality ratios (rr_{ik}). The derivation of weights was based on the following decomposition of the indirectly standardized index of male mortality (ISI) (which is approximately equal to the total sex ratio or $rr_{..}$ obtained from the model assuming no interaction between age and sex):

$$ISI = \frac{\text{total number of male observed deaths}}{\text{total number of male expected deaths, assuming that female death rates prevailed among men}}$$

$$= \frac{\sum_i \sum_k V^M_i * m^M_{ik}}{\sum_i V^M_i * (\sum_k m^F_{ik})} = \sum_i \sum_k \frac{V^M_i * m^F_{ik}}{\sum_i V^M_i * (\sum_k m^F_{ik})} * rr_{ik}$$

$$= \sum_i \sum_k \frac{\textit{male expected deaths from cause k in age group i}}{\textit{total number of male expected deaths, assuming that female death rates prevailed among men}} * rr_{ik}$$

where V^M_i and V^F_i denote, respectively, the number of male and female person years lived in age group i, and m^M_{ik} and m^F_{ik} denote the male and female rates of mortality from cause k in age group i. The italicized part of the last formula gives the age- and cause-specific weights. They were calculated according to the situation in 1971–75. When applied to the age- and sex-specific sex ratios of the period 1971–75, these weights produce a total sex ratio equal to the observed one. The adjusted sex ratio for the latter period was obtained applying these weights to the age- and cause-specific sex ratios (rr_{ik}) in 1981–85. This procedure eliminates the effects of changes in the age structure of the population as well as those in the distribution of causes of death.