Socioeconomic Inequalities in Mortality Among Women and Among Men: An International Study

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ABSTRACT

Objectives. This study compared differences in total and cause-specific mortality by educational level among women with those among men in 7 countries: the United States, Finland, Norway, Italy, the Czech Republic, Hungary, and Estonia.

Methods. National data were obtained for the period ca. 1980 to ca. 1990. Age-adjusted rate ratios comparing a broad lower-educational group with a broad upper-educational group were calculated with Poisson regression analysis.

Results. Total mortality rate ratios among women ranged from 1.09 in the Czech Republic to 1.31 in the United States and Estonia. Higher mortality rates among lower-educated women were found for most causes of death, but not for neoplasms. Relative inequalities in total mortality tended to be smaller among women than among men. In the United States and Western Europe, but not in Central and Eastern Europe, this sex difference was largely due to differences between women and men in cause-of-death pattern. For specific causes of death, inequalities are usually larger among men.

Conclusions. Further study of the interaction between socioeconomic factors, sex, and mortality may provide important clues to the explanation of inequalities in health. (*Am J Public Health.* 1999;89:1800–1806)

During the past 2 decades, socioeconomic inequalities in mortality have been studied extensively in countries around the world. Inequalities in mortality have been documented from the United States[1] to the former Soviet Union,[2] from the Netherlands[3] to New Zealand,[4] and from Bangladesh[5] to Brazil.[6] Many studies, however, have been confined to men, partly because the most frequently used socioeconomic classification, that based on occupation, can less easily be applied to women. Women who are not in paid employment cannot be classified according to their own occupational class, and even if they can be classified, their own occupation may not be an adequate indicator of the socioeconomic status of the household they are part of.[7,8]

From studies that have included women, it has become clear that inequalities in mortality exist among women as they do among men, but they tend to be smaller among women.[9–13] This finding may be an artifact in studies that used occupational class as an indicator of socioeconomic status, but similar findings were reported from a few studies that used education level or material living standards as socioeconomic indicators.[8,14–17] Finnish data suggest that the inequalities in mortality between women and men may partly be the result of differences between women and men in cause-of-death pattern.[15,16]

We report here on a study of differences by sex in the magnitude of socioeconomic inequalities in total and cause-specific mortality in 7 countries: the United States, Finland, Norway, Italy, the Czech Republic, Hungary, and Estonia. These countries participated in a European Union–sponsored concerted action on socioeconomic inequalities in health[18,19]; they were the only countries that could provide data on mortality by educational level, thereby permitting a valid comparison of inequalities in mortality between women and men. The aims of this study were (1) to assess whether inequalities in total mortality are indeed generally smaller among women than among men and (2) to assess the contribution of specific causes of death to these smaller inequalities in total mortality.

Methods

For the United States, we reanalyzed data from the National Longitudinal Mortality Study, which involves a 9-year follow-up of a representative sample of approximately 1 000 000 people from the noninstitutionalized population.[20] For the 3 countries in Western Europe, we analyzed data from longitudinal studies; 2 of these studies (in Finland and Norway) involved a follow-up of the total population enumerated in the

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This article was accepted April 20, 1999.

national census,[11] while the third (in Italy) covered only the population of the city of Turin.[21] For the countries in Central and Eastern Europe, data were analyzed from national unlinked cross-sectional studies. In these studies, deaths are classified according to educational achievement as recorded on death certificates and are related to the population enumerated in the same period, classified according to educational information obtained during the census. Broadly speaking, the mortality data cover the 1980s; for the countries in Central and Eastern Europe, however, data could be obtained only for the 4 or 5 years at the beginning or end of the decade.

Mortality was classified by level of education, which was measured as the highest level of education that the subject had completed. General education, technical education, and vocational education were all taken into account. Owing to differences in educational systems and in educational classifications between countries, comparability could be achieved only at a rather high level of aggregation. Using guidelines from the Organization for Economic Cooperation and Development,[22] we reclassified the original individual-level data into 2 broad classes: a broad lower-education group comprising subjects with no completed education, primary education only, or lower secondary education, and a broad higher-education group comprising subjects with upper secondary or postsecondary education. In the United States, the latter group was defined as having "at least some college." The alternative grouping, which included "4 years of high school" in the higher-education group, produced an educational distribution in the United States very unlike that in Europe; the results in terms of the difference by sex in inequalities in mortality were the same. The proportion of the female population aged 20 to 74 years that fell within the higher-education group ranged from 20% in Italy to 41% in Finland and Norway.

Our main outcome measure is the rate ratio of mortality of women (or men) in the lower-education group as compared with women (or men) in the higher-education group. These rate ratios, as well as their 95% confidence intervals, were calculated on the basis of Poisson regression analysis. The regression models included age as a nominal variable (5-year age groups). In the case of the United States, regression models also included race/ethnicity (Hispanic/non-Hispanic White/Black/all other), because we considered ethnicity to be a potential confounder of the relationship between education level and mortality. Ethnicity is associated with, and causally antecedent to, educational achievement, and it is also an independent risk factor for mortality.[23]

Causes of death were coded according to the *International Classification of Diseases, 9th Revision*.[24] Because causes of death differ in their association with education level, differences in cause-of-death pattern between men and women will automatically produce differences in the rate ratio for total mortality. To quantify this effect, we compared the rate ratio for total mortality observed among women with the rate ratio for total mortality that would have been observed if women had had the same cause-of-death pattern as men. The latter was calculated as a weighted average of cause-of-death—specific rate ratios among women, with cause-specific shares in total mortality among men in the same country used as weights.

More details on data and methods can be found in a technical report.[18]

TABLE 1—Age-Standardized Mortality Rates Among Women and Men, by Level of Education, ca. 1988

Country	Period	Deaths per 100 000 Person-Years[a]			
		Women		Men	
		High[b]	Low[c]	High[b]	Low[c]
United States[d]	1979–1989	392	493	685	934
Finland	1981–1990	341	432	810	1094
Norway	1980–1990	324	401	666	831
Italy[e]	1981–1989	312	362	645	800
Hungary	1982–1985	572	722	930	1660
Czech Republic	1988–1992	568	681	891	1336
Estonia	1987–1991	500	642	1121	1605

Note. All subjects were aged 20 to 74 years, except in the Czech Republic, where the age range was 20 to 64 years.
[a]Calculated from national mortality rates as published by the World Health Organization[24] and relative differences in mortality by educational level as observed in this study. All figures are age-standardized to the European Standard Population.
[b]Upper-secondary/postsecondary education.
[c]No education/primary/lower-secondary education.
[d]This study is based on a sample of 1 000 000 persons. Educational differences in mortality were adjusted for ethnicity. Education classification: at least some college vs no college.
[e]This study covers the city of Turin.

Results

Table 1 presents an overview of the rates of total mortality, by sex and education level, in the 7 countries included in this study. In all countries, mortality was lowest among women with a high level of education and highest among men with a low level of education. Men with a high level of education always had higher mortality rates than women with a low level of education.

Our summary measure, the rate ratio of all-cause mortality in the lower-education group compared with that in the higher-education group, is presented in Table 2. Among women, the rate ratio ranged from 1.09 in the Czech Republic to 1.31 in the United States and Estonia. With the exception of the Czech Republic and Italy, the rate ratios for women in all countries fell within a rather narrow range, between 1.23 and 1.31. Among men, the rate ratios ranged from 1.25 in Norway to 1.78 in Hungary.

Inequalities in mortality were generally larger among men than among women, and the degree of international variation in the size of inequalities in mortality was also larger among men. This applies not only to relative differences as quantified in rate ratios but also to absolute measures like rate differences. These can easily be calculated from Table 1. Among women, the rate differences ranged from 50 (per 100 000 person-years) in Italy to 150 in Hungary. Among men, the rate differences ranged from 155 in Italy to 730 in Hungary.

Table 2 also contains the rate ratios for the 2 largest cause-of-death groups, neoplasms and cardiovascular diseases. For neoplasms, the rate ratios were close to 1.00 for women and clearly in excess of 1.00 for men. For cardiovascular diseases, the rate ratios were well above 1.00 for both women and men, with a tendency toward larger inequalities among women than among men in several countries (the United States, Finland, Norway, Italy, and Estonia).

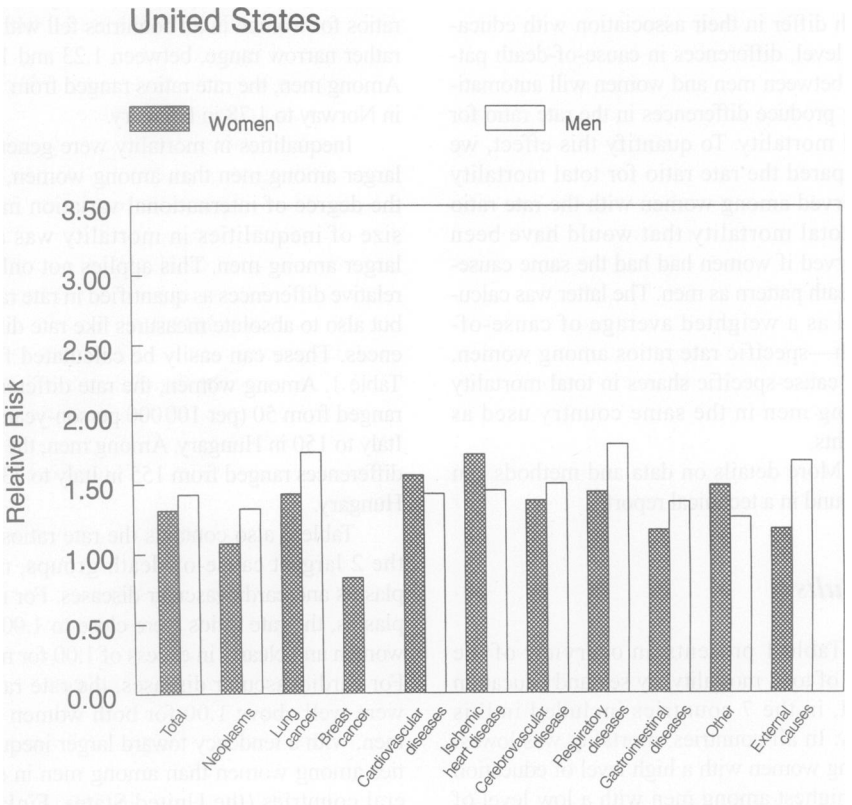
Figures 1, 2 and 3 illustrate inequalities in mortality for a wider range of causes of death, on the basis of 3 examples: the United States, Norway, and the Czech Republic. In most countries, lower-educated women had

TABLE 2—Educational Differences in Mortality Among Women and Men: All Causes of Mortality and 2 Broad Cause-of-Death Groups, ca. 1988

	Rate Ratio[a] (95% CI)					
	All Causes		Neoplasms		Cardiovascular Diseases	
Country	Women	Men	Women	Men	Women	Men
United States[b]	1.31 (1.25, 1.38)	1.42 (1.37, 1.48)	1.07 (0.99, 1.16)	1.31 (1.23, 1.42)	1.56 (1.44, 1.70)	1.43 (1.35, 1.52)
Finland	1.30 (1.28, 1.32)	1.41 (1.40, 1.43)	1.05 (1.02, 1.07)	1.28 (1.25, 1.32)	1.44 (1.41, 1.47)	1.36 (1.34, 1.38)
Norway	1.23 (1.21, 1.26)	1.25 (1.24, 1.27)	1.06 (1.03, 1.09)	1.11 (1.08, 1.13)	1.44 (1.40, 1.49)	1.25 (1.23, 1.27)
Italy	1.18 (1.12, 1.25)	1.29 (1.24, 1.33)	1.02 (0.94, 1.11)	1.29 (1.22, 1.36)	1.43 (1.29, 1.58)	1.19 (1.13, 1.26)
Czech Republic	1.09 (1.06, 1.12)	1.66 (1.64, 1.69)	0.85 (0.81, 0.88)	1.63 (1.58, 1.68)	1.30 (1.24, 1.36)	1.43 (1.40, 1.46)
Hungary	1.28 (1.25, 1.30)	1.78 (1.76, 1.80)	0.86 (0.84, 0.88)	1.45 (1.42, 1.48)	1.55 (1.51, 1.60)	1.57 (1.54, 1.59)
Estonia	1.31 (1.26, 1.37)	1.50 (1.46, 1.55)	1.01 (0.95, 1.08)	1.38 (1.30, 1.46)	1.50 (1.41, 1.60)	1.38 (1.32, 1.44)

Note. All subjects were aged 20 to 74 years, except in the Czech Republic, where the age range was 20 to 64 years. CI = confidence interval.
[a]No education/primary/lower-secondary vs upper-secondary/postsecondary.
[b]Adjusted for ethnicity. At least some college vs no college.

higher mortality rates than higher-educated women for most causes of death, including all cardiovascular diseases, ischemic heart disease, cerebrovascular disease, respiratory diseases, and gastrointestinal diseases. For neoplasms, mortality was not clearly higher among lower-educated women, and in some countries (the Czech Republic and Hungary) it was actually higher among higher-educated women. Lung cancer mortality was less common among lower-educated women in the Czech Republic and Hungary, and breast cancer mortality was less common among lower-educated women in all countries.



Note. Similar figures for Finland, Italy, Hungary, and Estonia are available from the corresponding author.

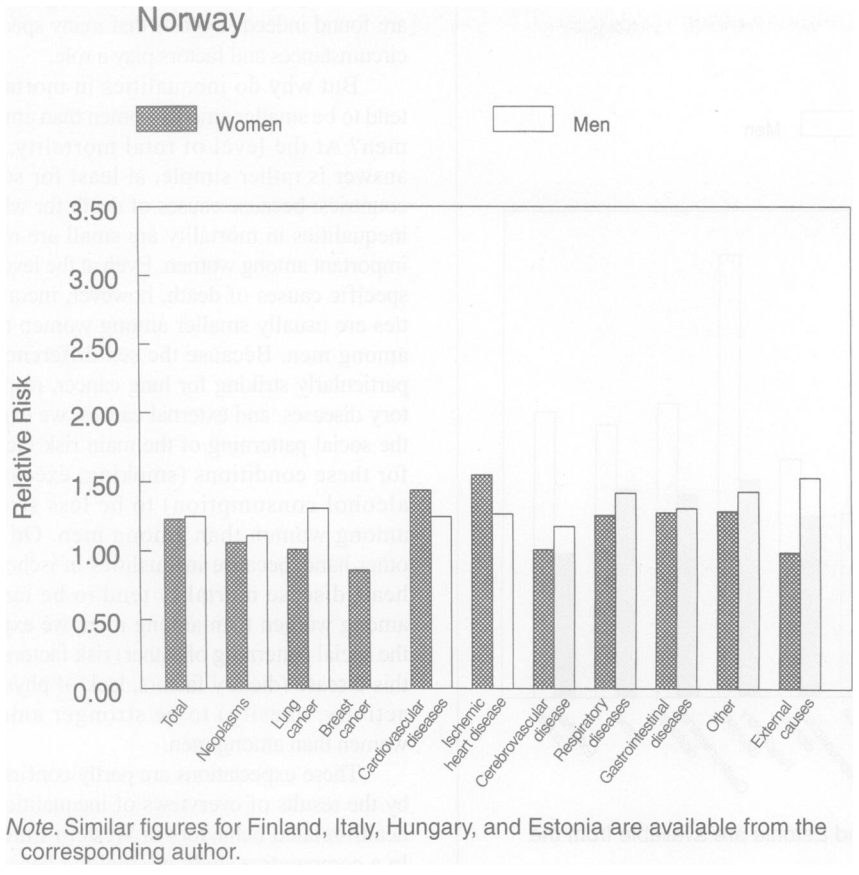
FIGURE 1—Educational differences in cause-specific mortality among women and men in the United States, ca. 1988.

Another cause-of-death group for which lower-educated women did not always have higher mortality rates than higher-educated women was external causes: in Norway, Italy, and the Czech Republic, the rate ratios are close to 1.00.

Figures 1–3 also show that cause-specific inequalities were generally smaller among women than among men. This applies to neoplasms (including lung cancer), respiratory diseases, gastrointestinal diseases, all other diseases (except in the United States), and external causes. The male/female contrast was particularly striking for lung cancer, respiratory diseases, and external causes: in many countries, inequalities for these causes of death were very large among men but smaller or even absent among women. Part of the lower rate ratio for neoplasms among women was due to the fact that in some countries lung cancer mortality was less frequent among lower-educated women, while in all countries breast cancer mortality was less frequent among lower-educated women.

The only cause of death for which (relative) inequalities often were larger among women than among men was cardiovascular diseases. This applies to the United States, the 3 countries in Western Europe, and Estonia, but not to the Czech Republic and Hungary. Inequalities in ischemic heart disease mortality were consistently larger among women than among men, including in Central and Eastern Europe. For cerebrovascular disease mortality, this male/female contrast was not consistently found.

The smaller inequalities in total mortality among women thus appear to be the result of smaller inequalities for many specific causes of death. They were also due, however, to differences between men and women in cause-of-death pattern. Both among women and among men, neoplasms and cardiovascular diseases accounted for a large



Note. Similar figures for Finland, Italy, Hungary, and Estonia are available from the corresponding author.

FIGURE 2—Educational differences in cause-specific mortality among women and men in Norway, ca. 1988.

majority of all deaths, but neoplasms had a larger share in total female mortality than in total male mortality. Table 3 shows that sex differences in cause-of-death patterns accounted for between 16% of the contrast (the Czech Republic; $[(1.18-1.09)/(1.66-1.09)]\times 100\%$) and more than 100% of the contrast (Norway; $[(1.30-1.23)/(1.25-1.23)]\times 100\%$).

While differences in cause-of-death patterns explain a large part of the sex differences in the size of inequalities in total mortality in the United States and Western Europe, this does not apply to the Czech Republic and Hungary (Table 3), the countries where inequalities among men were larger than elsewhere (Table 2).

Discussion

Summary of Findings

This international study confirms that socioeconomic inequalities in total mortality tend to be smaller among women than among men, in both a relative and an absolute sense. It also shows, however, that sex differences in the size of the inequality vary importantly between countries, from almost none in Norway to huge in the Czech Republic.

At the level of specific causes of death, relative inequalities in mortality among women are usually smaller than those among men (e.g., neoplasms), but they are sometimes larger (i.e., cardiovascular diseases). In the United States and Western Europe, the sex difference in the size of the inequalities in total mortality is largely or wholly due to sex differences in cause-of-death pattern. While this confirms the result of a similar study based on Finnish data,[15] our results also show that this finding cannot be generalized to Central and Eastern Europe.

Evaluation of Data Problems

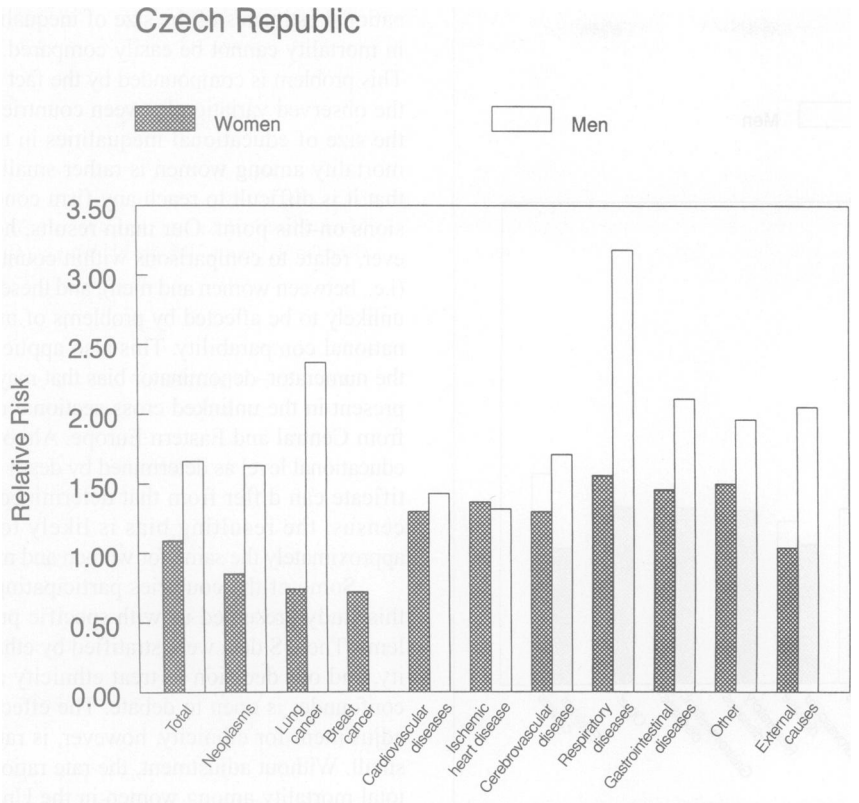
The results of this study should be carefully evaluated against problems with the reliability and comparability of data on mortality by educational level. An obvious problem is that of international comparability: because of differences between countries in study design, year of study, and measurement of education (i.e., educational system), national estimates of the size of inequalities in mortality cannot be easily compared.[18,25] This problem is compounded by the fact that the observed variation between countries in the size of educational inequalities in total mortality among women is rather small, so that it is difficult to reach any firm conclusions on this point. Our main results, however, relate to comparisons within countries (i.e., between women and men), and these are unlikely to be affected by problems of international comparability. This also applies to the numerator–denominator bias that may be present in the unlinked cross-sectional data from Central and Eastern Europe. Although educational level as determined by death certificate can differ from that determined by census, the resulting bias is likely to be approximately the same for women and men.

Some of the countries participating in this study presented us with specific problems. The US data were stratified by ethnicity, and our decision to treat ethnicity as a confounder is open to debate. The effect of adjustment for ethnicity, however, is rather small. Without adjustment, the rate ratio for total mortality among women in the United Sates is 1.33 (95% confidence interval [CI] = 1.26, 1.39), and that among men is 1.45 (95% CI = 1.39, 1.50) (see Table 2 for the adjusted figures).

The Italian data cover the north Italian city of Turin only, and because of the large north–south contrast within Italy in levels and patterns of mortality,[26] this coverage might threaten the generalizability of our data. We were able to obtain data on total mortality by level of education for Italy as a whole,[18] and these show that the rate ratio among women is 1.29 (95% CI = 1.22, 1.36) and that among men is 1.32 (95% CI = 1.28, 1.36). This suggests that differences between women and men in the size of inequalities in mortality in Italy as a whole are even smaller than in the city of Turin. Unfortunately, data on cause-specific mortality by level of education were not available for Italy as a whole. Finally, the data for the Czech Republic covered the age group 20 to 64 years, instead of 20 to 74 years. Because inequalities in mortality are larger in the younger age groups, this coverage may bias the comparison between the rate ratios of the Czech Republic and those of other countries included in this study, and it is an additional reason to refrain from directly comparing rate ratios between countries.

Implications

Although many explanatory studies of socioeconomic inequalities in mortality were



Note. Similar figures for Finland, Italy, Hungary, and Estonia are available from the corresponding author.

FIGURE 3—Educational differences in cause-specific mortality among women and men in the Czech Republic, ca. 1988.

limited to men, one can safely assume that there is important overlap between the explanation of inequalities among men and that among women. Material disadvantage, childhood conditions, psychosocial factors, and health-related behaviors are likely to contribute to inequalities among women as well.[27] The wide range of causes of death for which inequalities in mortality among women are found indeed suggests that many specific circumstances and factors play a role.

But why do inequalities in mortality tend to be smaller among women than among men? At the level of total mortality, the answer is rather simple, at least for some countries: because causes of death for which inequalities in mortality are small are more important among women. Even at the level of specific causes of death, however, inequalities are usually smaller among women than among men. Because the sex difference is particularly striking for lung cancer, respiratory diseases, and external causes, we expect the social patterning of the main risk factors for these conditions (smoking, excessive alcohol consumption) to be less strong among women than among men. On the other hand, because inequalities in ischemic heart disease mortality tend to be larger among women than among men, we expect the social patterning of (other) risk factors for this disease (dietary factors, lack of physical activity, obesity) to be stronger among women than among men.

These expectations are partly confirmed by the results of overviews of inequalities in health-related behaviors in Western Europe. In a comparative study of smoking behavior from around 1990, we found that in the northern parts of Western Europe, inequalities in current cigarette smoking were actually larger among women than among men.[28] However, the smaller inequalities in lung cancer and respiratory disease mortality among women than among men in the United States and Western Europe in the 1980s are likely to reflect the social patterning of smoking in, for example, the 1960s, when smoking was already more prevalent among men in the lower socioeconomic groups, while a reverse pattern still applied among women.[29,30]

In another overview, also covering Western Europe around 1990, we analyzed inequalities in a wider range of health-related behaviors, including excessive alcohol consumption and obesity. While inequalities in excessive alcohol consumption tended to be larger among men, inequalities in the prevalence of obesity were clearly larger among women.[31] Independent evidence from national studies supports this overall picture.[32,33] Although we do not know of any comparative study of inequalities in excessive alcohol consumption that included Central and Eastern Europe, it is likely that this factor plays an important role in the exceptionally large inequalities in mortality among men in these countries.[34]

Whereas sex differences in the social patterning of health-related behaviors may provide part of the answer, the next question then becomes how these differences in social

TABLE 3—Comparison of Educational Differences in Total Mortality Between Women and Men, Before and After Adjustment for Differences in Cause-of-Death Pattern

	Rate Ratio[a]		
	Women		
Country	Observed	Adjusted[b]	Men
United States	1.31	1.41	1.42
Finland	1.30	1.37	1.41
Norway	1.23	1.30	1.25
Italy	1.18	1.30	1.29
Czech Republic	1.09	1.18	1.66
Hungary	1.28	1.38	1.78
Estonia	1.31	1.40	1.50

Note. All subjects were aged 20 to 74 years, except in the Czech Republic, where the age range was 20 to 64 years.
[a]No education/primary/lower-secondary vs upper-secondary/postsecondary.
[b]Weighted average of cause-of-death–specific rate ratios among women, with cause-specific shares in total mortality among men as weights. Distinction by cause of death is as in Figure 1, plus other neoplasms, other heart disease, and other cardiovascular disease.

patterning have arisen. These differences are unlikely to be just the result of sex differences in the patterning of material disadvantage and/or psychosocial stressors, because these patterns are likely to be similar among women and men, with higher levels of exposure in the lower socioeconomic groups.[35] We hypothesize that these differences are due to an interaction between sex roles and exposure to material disadvantage and/or psychosocial stressors: women respond differently (e.g., with obesity instead of excessive alcohol consumption), because their role gives them access to other types of health-related behavior than those more accessible to men. Because the male role gives access to the more dangerous behaviors (smoking, excessive alcohol consumption), the net effect is that men experience higher excess mortality than women when they are exposed to material disadvantage and/or psychosocial stressors.[36,37] This is evident in several areas other than that of socioeconomic inequalities in mortality.[38] Differences in mortality by marital status are also larger among men than among women. In Central and Eastern Europe, the recent increase in mortality is also mainly limited to men.[39]

The interaction of sex with socioeconomic status in the latter's effect on mortality thus appears to provide important clues for understanding the mechanisms underlying socioeconomic inequalities in mortality. We suggest that explanatory studies explicitly address the differences between the sexes. Conversely, studies of the mechanisms underlying sex differences in mortality should not ignore the socioeconomic perspective. □

Contributors

J. P. Mackenbach designed the study and wrote and revised the paper. A. E. Kunst and F. Groenhof did most of the analyses. The other coauthors prepared national data files according to uniform specifications. All authors participated in discussions on the design of the study and on the interpretation of the results, and commented on previous versions of this paper.

Acknowledgments

This study was supported by a grant from the European Union's Biomed-1 program (CT92-1068). The central statistical offices of all participating countries gave permission for the use of unpublished data from national mortality registries. Data for the United States were obtained from the public use file of the National Longitudinal Mortality Study (1979–1989).

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