# Cross-national comparisons
# of socio-economic differences in mortality

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# Cross-national comparisons of socio-economic differences in mortality

## Internationale vergelijkingen van sociaal-economische verschillen in sterfte

## Proefschrift

Ter verkrijging van de graad van doctor
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door

**Anton Eduard Kunst**

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# Summary

*Introduction*
This century has witnessed an impressive increase in the life expectancy of the populations of industrialised countries. None the less, still large numbers of women and, especially, men die before reaching old age. Further reducing risks of premature death remains a key target for health policies in all industrialised countries.

In each country for which data are available, chances of premature death were found to be higher among people with a lower educational level, a lower income level or a low position in the labour market. Socio-economic differences in mortality have persisted over time and even appeared to have increased during the last decades. Reducing these mortality differences is a major challenge for health policy, not only because most of these differences can be considered unfair, but also because improving the survival chances of disadvantaged people offers great potential for further reducing premature mortality in national populations as a whole.

Several authors have addressed the question whether socio-economic differences in mortality in their own country are large or small from an international perspective. Especially interesting would it be to observe that socio-economic differences in a specific country are larger than elsewhere. This finding would stress the urgency of the problem in that country, as is would imply that mortality differences can be smaller than they are now. In addition, suggestions on how to achieve that reduction could be obtained by a closer look into the situation in other countries.

Cross-national comparisons that have been carried out until about 1990 indeed observed that mortality differences are larger in some countries than in others. Unfortunately, these studies faced serious limitations. First, most studies included only a few countries, thereby limiting the possibility to put each country into a broad international perspective. Second, problems with the comparability and reliability of the data that were available from the different countries might have seriously biased the results, and perhaps led to wrong conclusions. Third, explanations of the observed variations between countries have not yet been forwarded. The available evidence was too fragmentary to substantiate, for example, the widely held expectation that socio-economic differences in mortality are smaller in countries with more egalitarian social and economic policies, such as Sweden, other Nordic countries and the Netherlands.

*This thesis*
The objective of this thesis is to compare industrialised countries with

respect to the magnitude of socio-economic differences in mortality among men about 30-64 years at death. The principal research question is whether socio-economic differences in mortality are about equally large in all countries, or whether these differences are substantially larger in some countries than in others.

This thesis differs from previous publications in several respects. First, it includes more countries, i.e. each country from Europe or northern America with nationally representative data on mortality differences by occupational class or educational level. Second, considerable efforts are made to evaluate and, if possible, to resolve problems with the reliability and comparability of the data that are available from different countries. Third, explanations are suggested for the observed international patterns. Special attention is given to the possibility that egalitarian socio-economic policies are associated with smaller socio-economic differences in premature mortality.

The data that are analyzed in this thesis come from two research projects that were carried out between 1991 and 1996. The first, preliminary project referred to the 1970s. The principal objective of this project was to compare several industrialised countries, especially the Netherlands, with respect to the magnitude of socio-economic differences in mortality. Data on mortality by occupational class and educational level among men 35-64 years were available for the Netherlands and comparable data were obtained for eight other industrialised countries.

The second project referred to the 1980s. It was a concerted action, sponsored by the European Union, in which teams from 15 countries participated. This project aimed at an international overview of socio-economic differences in mortality that was more comprehensive and more reliable than any previous study could produce. In addition, attempts were made to obtain evidence on the circumstances that are associated with larger or smaller socio-economic differences in mortality. To this end, distinctions were made between causes of death such as lung cancer and ischaemic heart disease. Data on cause-specific mortality by occupational class and educational level were obtained for 11 western European countries, the United States and three countries from central and eastern Europe.

The next two sections summarize the methods and main results of the cross-national comparisons that are made in this thesis with the data that were available for, respectively, the 1970s and 1980s.

*Comparisons for the 1970s*

Data on mortality according to occupational class were available from longitudinal studies from seven countries. Data on mortality according to educational level were available for nine countries. The data referred to men 35-64 years at the start of follow-up. Follow-up periods were between 1970 and 1982. Data sets were created both for national populations and, where possible, for large cities. For most countries, unpublished tabulations were acquired. The magnitude of socio-economic differences in mortality was measured by means of regression-based inequality indices.

In chapter 3, countries are compared with respect to mortality differences according to occupational class. These differences appear to be substantially larger in some countries than in others. The smallest differences are observed in the Netherlands, Denmark, Norway and Sweden, with slightly larger mortality differences in England & Wales. The largest mortality differences are observed in Finland and, especially, France. Thus, the difference between Sweden and England & Wales, that is often referred to in the literature, appears to be small from a wider international perspective.

In chapter 4, countries are compared with respect to mortality differences by educational level. These differences were relatively small in the Netherlands, Denmark, Norway and Sweden, slightly larger in England & Wales, and even more so in Finland. The largest mortality differences are observed for France, Italy and the United States. The same rank order of countries is found in a comparison of cities from the Netherlands, Norway, Sweden and Finland. Interestingly, variations between countries in the magnitude of mortality differences appear to be strongly correlated with the egalitarian character of social and economic policies.

*Comparisons for the 1980s*

Nationally representative data on cause-specific mortality according to occupational class and/or educational level were obtained from longitudinal or cross-sectional studies from 11 western European countries, the United States, and three central and eastern European countries. The data referred to mortality among men 30-64 years in the period between 1979 and 1991. Data sets were created by national teams according to a standardised protocol, and analyzed centrally at the coordinating centre at Rotterdam. Extensive efforts were made to enhance the comparability of the data that were available from the different countries. For example, for several countries, individual-level data on the occupation of subjects were recoded according to a standard social class scheme. Problems that could not be resolved were evaluated quantitatively for their potential effect on the results. In most analyses, the magnitude of mortality differences by occupational class was measured by a number of complementary summary measures. Where possible, the results for occupational class were compared to those for educational level.

In chapter 5, western European countries are compared with respect to mortality differences according to occupational class. The results underline the similarities rather than the dissimilarities between these countries. For men 45-59 years, the observed mortality difference between manual classes and non-manual classes was about equally large in both England & Wales, Ireland, Denmark, Norway, Sweden, Switzerland, Italy, Spain and Portugal. A relatively large difference is only observed for France and to a lesser extent for Finland. The same pattern is observed for men 60-64 years, but not for men 30-44 years. In the latter case, there is evidence for larger mortality differences in Norway, Sweden and especially in Finland (no data for France). When the population distribution over occupational classes is taken into account, the smallest mortality differences are observed for Switzerland, Italy and Spain. Contrary to the results for the 1970s, these results do support the expectation that mortality differences are smaller in countries with more egalitarian social and economic policies.

Chapter 6 refers to the same western European countries. It distinguishes nine specific causes of death. This distinction is made in order to assess in more detail the degree to which western European countries are similar or dissimilar, and to obtain clues for the explanation of the dissimilarities that are observed. All analyses are restricted to deaths among men 45-59 years. For some causes of death, a north-south gradient is observed. Ischaemic heart disease mortality was strongly related to occupational class in England & Wales, Ireland, Denmark, Norway, Sweden and Finland, but not in France, Switzerland and Mediterranean countries. Socio-economic differences in mortality from non-lung cancer and gastro-intestinal diseases were generally larger in southern countries. Large international variations are also observed with respect to lung cancer, cerebrovascular disease and external causes of death. As a result, countries appear to differ strongly in the contributions that specific causes of death and associated risk factors make to class differences in total mortality. Class differences in total mortality in France are found to be large mainly because of exceptionally large differences in mortality from liver cirrhosis and cancers of the upper digestive tract. The fact that these diseases have excessive alcohol consumption as a common risk factor strongly suggests that alcohol abuse made an important contribution to the large mortality differences in France.

Chapter 7 extends the analysis to the United States. This country has much less egalitarian socio-economic and health care policies than England & Wales and, especially, Sweden. If egalitarian policies are able to substantially reduce socio-economic differences in mortality, this effect might become visible in a trans-atlantic comparison. In order to look for evidence for such an effect, an in-depth comparison is made between the United States, England & Wales and Sweden. These countries are compared with respect to mortality by occupational class among men 30-59 years. Distinctions are made between two age groups, six occupational classes and nine causes of death. The main finding is that class differences in total mortality were about equally large in each country. More variations are observed, especially between United States and the European countries, for specific occupational classes and specific causes of death. The class of routine non-manual workers had a large mortality excess in the United States, but not in England & Wales and Sweden. The mortality excess of unskilled manual workers was about as large in each country. In the United States, however, this excess was relatively large for respiratory diseases, but relatively small for ischaemic heart disease, cerebrovascular disease, traffic accidents and suicide mortality. These results show that, despite much less egalitarian socio-economic and health care policies, socio-economic differences in mortality among men 30-59 years are not clearly larger in United States than in the two European countries. Specific circumstances seemed to have prevented socio-economic differences in mortality in the United States from being as large as they otherwise would be.

Chapter 8 extends the analysis to central and eastern Europe (CEE). The high rates of premature mortality in CEE countries in the late 1980s, especially among men, raise questions on the fate of lower socio-economic groups. Were they affected disproportionately, or were they protected by egalitarian social and economic policies of the former socialist regimes? Internationally comparable data on socio-economic differences in mortality among men 30-59 years were available for three CEE countries: the Czech Republic, Hungary and Estonia. These data came from cross-sectional studies for circa 1990. In each CEE country, men from lower socio-economic groups had substantially higher risks of premature death. Increased death rates are observed for a wide array of causes of death. For nearly each cause of death, mortality differences in the Czech Republic and Estonia were at least as large as in western countries. Mortality differences in Hungary were by far the largest, and even more so when taking into account the exceptionally high national death rate of this country. These results show that the socio-economic and health care policies of the former socialist rule, which were alleged to be egalitarian, had not resulted in relatively small socio-economic differences in mortality. It is likely that the factors that have contributed to the high national death rates of CEE countries in the late 1980s, including social disintegration, psychological distress and harmful behaviours such as excessive drinking, have affected the lower socio-economic groups in particular.

Chapter 9 focuses on ischaemic heart disease mortality. In the United States and northern Europe, socio-economic differences in mortality from this disease have increased rapidly since the 1950s. This increase raise questions on variations across countries: Is a strong variability observed over space as well as over time? If so, which circumstances are associated with smaller or larger differences in ischaemic heart disease mortality? Chapter 9 compares the United States and 11 western European with respect to mortality differences among men 30-64 years. Within western Europe, the same north-south gradients is observed as in chapter 6: mortality from ischaemic heart disease was strongly related to occupational class in northern Europe but not in France and more southern countries. This gradient is found for each age group. The United States occupied an intermediate position. The small mortality differences in southern Europe are probably related to small or absent social gradients in several risk factors for ischaemic heart disease, including tobacco consumption and dietary factors. The southern European situation can further be understood in terms of 'delayed transition': the transition from positive to inverse gradients in ischaemic heart disease mortality, which occurred in the United States in the 1950s and in northern Europe in the 1960s, occurred in southern Europe in the 1980s or even later. This transition, and its slow diffusion to southern Europe, seems to be conditioned by cultural rather than socio-economic circumstances.

Chapter 10 focuses on cerebrovascular disease mortality. Several American and northern European studies have demonstrated that people from lower socio-economic groups have higher chances to die from stroke before reaching old age. Uncertain is whether this association is generalised across the industrialised world. As with ischaemic heart disease, in some countries this association might be relatively weak and perhaps even absent. Chapter 10 compares the United States and 11 western European with respect to class differences in stroke mortality among men 30-64 years. In all countries, manual classes had higher mortality rates than non-manual classes. Stroke mortality differences were relatively large in England & Wales, Ireland and Finland, and relatively small in Denmark, Norway, Sweden, Italy and Spain. In-between were the United States, France, Switzerland and Portugal. It is concluded that socio-economic differences in stroke mortality are a generalised phenomenon in the industrialised world. The causes of the higher stroke mortality rates in lower socio-economic groups can strongly differ from country to country, with tobacco consumption probably being more important in the United States and northern Europe, and alcohol consumption more important in southern Europe. The relatively large mortality differences in England & Wales illustrate that the removal of financial barriers to the use of health care is not sufficient to substantially reduce socio-economic differences in stroke mortality.

*Discussion*

The results presented above are discussed extensively in chapter 11. A summary of this chapter (section 11.1) and an introduction (11.2) are followed by five sections.

Section 11.3 provides a systematical overview of the results of our cross-national comparisons for the 1970s and 1980s. The combined evidence shows that socio-economic differences in mortality in industrialised countries are a persistent but variable phenomenon. The persistency is evidenced by the finding that there is no country where socio-economic differences in mortality were small from an international perspective or a historical perspective. The fact that mortality differences are observed consistently for a wide array of causes of death underlines their generalised nature. The variability is evidenced by the finding that some countries had socio-economic differences in total mortality well above the international average. In addition, patterns by age group and by cause of death varied considerably between countries. Countries thus strongly differed with respect to the contribution that specific diseases and associated risk factors make to socio-economic differences in premature mortality.

Section 11.4 evaluates the potential effect that data problems could have had on the results. The studies for the 1980s achieved a higher degree of comparability than any previous study, thanks to the intensive collaboration between several national teams and the coordinating centre. A quantitative evaluation made it likely that remaining data problems cannot explain the cross-national variations in the magnitude and patterns of mortality differences that are highlighted in this summary. On the other hand, the true extent of international variability remains uncertain. Some of the countries where mortality differences are found to be close to the international average, notably Portugal, Spain and Ireland, might in fact have had mortality differences as large as those in France.

Section 11.5.1 aims at explaining the persistency of socio-economic differences in mortality across both time and place. This persistency stresses the idea that occupational class acts as a 'fundamental cause' of premature death: it exerts an influence on survival whatever diseases and associated risk factors are the main proximate causes of premature death. It is argued that occupational class owes this property to the fact that it links a wide range of advantages. These include the different resources that a person needs to achieve a high occupational position, and the different rewards that accrue to those who have attained this position.

Despite the persistency of socio-economic differences in mortality, there are substantial variations between countries in their magnitude and patterns. In section 11.5.2, we address the question which factors are able to modify the links between occupational class and premature mortality. The lack of an association with egalitarian social and economic policies implies that there were other factors at work, some of which are so powerful as to conceal a positive effect of egalitarian policies. In a systematical overview, we identified a large number of factors that have the potential to influence the magnitude of mortality differences. Important to acknowledge is that the distribution of income and other rewards over socio-economic groups is not only determined by egalitarian social and economic policies. Mortality differences in specific countries can in addition be influenced by specific patterns of social mobility, by the national prevalence of proximate determinants like alcohol consumption and dietary habits, and by cultural factors that influence social gradients of behavioral risk factors. It is concluded that a wide array of interacting factors determine how large mortality differences in individual countries will be. With the available evidence, it is difficult to assess the role of individual factors, such as egalitarian social and economic policies.

Section 11.6 discusses the relevance of the results for research and policies with regards to socio-economic differences in mortality. The main messages from our study are summarised in the key messages that are given in the next section. This section illustrates that a cross-national comparison can fulfil several purposes: it might (1) provide a yardstick against which to judge socio-economic differences in mortality in individual countries, (2) contribute to the explanation of socio-economic differences in mortality by yielding indications on the contributions made by specific intermediate factors, (3) contribute to policy making by studying individual countries as 'natural experiments' in reducing mortality differences, and/or (4) provide background information to the exchange of research findings across countries, and the international concertation of future research.

Section 11.7 ends the thesis with recommendations for future comparative studies. We start with discussing the four different purposes, mentioned above, that might motivate researchers to embark upon a new comparative study on socio-economic differences in mortality. Next, we discuss three problems that are inherent to comparative research: problems with the availability of data from individual countries, problems with the cross-national comparability of the available data, and problems with explaining the observed cross-national variations. Based on the experiences with the present study, we make several suggestions to cope with these problems in future studies. A plea is made for the combined use of the two complementary research strategies that both are explored in this thesis: empirically *ex*tensive research that includes as many countries as possible, and empirically *in*tensive research that compares a few countries in as much detail as possible.

# Key messages

Below we summarize the implications that the results presented in this thesis have for the judgement of socio-economic differences in mortality, for their explanation, for policies aimed at their reduction, and for cross-national exchange of research findings.

Judgement

- There is no country where socio-economic differences in mortality among middle-aged men can be judged to be small from an international perspective. No country can claim to have had more success in tackling the lamentable situation that men who have less in life, have moreover less years to live.
- There are a few countries, notably France and CEE countries, where mortality differences are relatively large. This stresses the need for policies aimed at reducing mortality differences in these countries, and monitoring their future course.

Explanation

- The situation in France, and perhaps central European countries as well, shows that excessive alcohol consumption by men from lower socio-economic groups can contribute substantially to socio-economic differences in premature mortality.
- The situation in southern European countries provide support to the suggestion of trends studies, that behavioral factors like smoking and dietary habits can strongly modify the socio-economic gradient in ischaemic heart disease mortality.
- The situation in southern European countries, where substantial socio-economic differences in lung cancer mortality exist despite the lack of clear social gradients in tobacco consumption, points to the importance of other risk factors for lung cancer.
- Socio-economic differences in mortality cannot be fully understood with reference to risk factors for disease alone. The question should be addressed which resources and rewards enable higher socio-economic groups to better avoid premature death whatever disease and associated risk factors are the main causes of premature death.
- The fact that socio-economic differences in mortality persist undiminished in countries with high national incomes and small income inequalities, casts doubt on the often made suggestion that 'material deprivation' is

primarily responsible for the higher death rates of men in lower occupational classes.
- Explanatory studies should not confine their attention to individual-level associations between socio-economic status, premature mortality and intermediate factors, but also consider the wider national and local context within which these associations develop.

Policies
- The persistence of socio-economic differences in mortality warns against optimistic expectations from programmes that aim at reducing these differences. It seems unavoidable that higher socio-economic groups are better able to avoid premature death.
- However, it is equally important to recognise that, given the magnitude of the problem, even a modest reduction of the mortality excess of disadvantaged groups can save a lot of human misery.
- The situation in France, and perhaps central European countries as well, warns that an increase in alcohol abuse by lower socio-economic groups could result in a substantial widening of socio-economic differences in mortality.
- The situation in France and more southern countries cautions that substantial socio-economic differences lung cancer mortality might persist even if interventions would succeed to nullify class differences in smoking.
- The situation in southern Europe shows to northern European countries that socio-economic differences in ischaemic heart disease mortality can be reduced if interventions succeed to weaken class differences in behavioral factors like smoking and dietary habits.
- The large differences in stroke mortality in England & Wales illustrate that the removal of financial barriers to the use of medical services is not sufficient to substantially reduce socio-economic differences in premature mortality.
- The persistence of socio-economic differences in mortality even in highly developed welfare states challenges the expectation that egalitarian social and economic policies will result in a substantial reduction of mortality differences.
- This persistency calls for the systematic evaluation of alternative social and economic policies for their effect on the health of disadvantaged people.
- A better understanding of the ways in which socio-economic differences in mortality are modified by the national or local context, is essential to predict the future course of these differences, and to estimate the extent to which alternative policy measures can change their course.

Exchange

- The variations observed in this study warn against a thoughtless exchange of research findings between countries. Researchers should be aware that the results of descriptive or explanatory studies from other countries might not apply to their own country. International overviews should take into account the possibility that results from specific studies are strongly modified by the national or local context.
- The cross-national variations observed in this study point to new opportunities for explanatory research, especially in countries where social gradients in specific risk factors are different from those in northern Europe and the United States.
- International concertation of health inequalities research would contribute considerably to the productivity of research in individual countries.

## Chapter one

# Introduction

## 1.1 Background

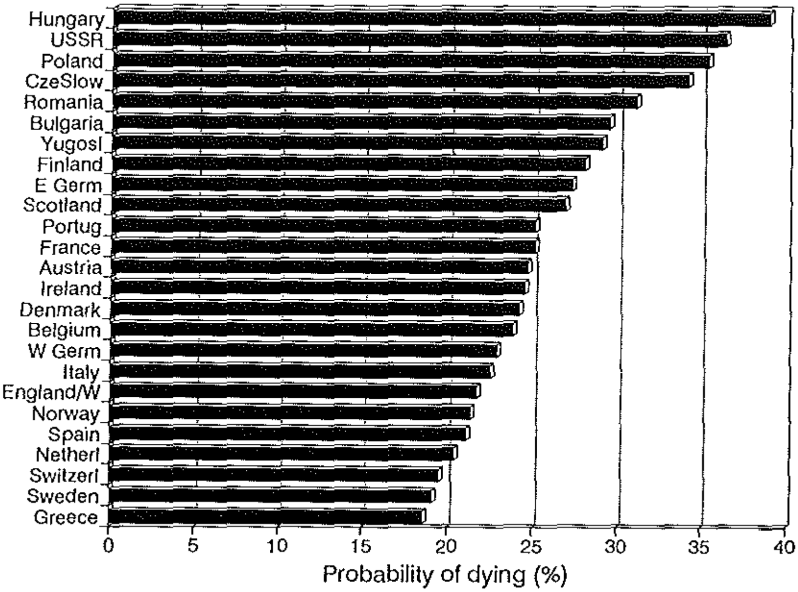
The unprecedented rise in life expectancy during the twentieth century can be considered as one of the greatest achievements of modern society. With sharp declines in infant and child mortality, virtually all deaths in modern societies occur among adults. By the early 1950s, over 95 percent of newborns could be expected to survive to adulthood, and in the 1980s this proportion has reached 98 to 99 percent (Lopez *et al.* 1995).

Despite these advances, still large numbers of men and women die before reaching old age, and when they are economically productive, have dependent children, or have other social roles to fulfil. Premature mortality is especially high among men. In Europe in the 1980s, about 1 out of every 4 boys that reached their 15$^{th}$ birthday can be expected to die before their 65$^{th}$ birthday; in central and eastern European countries even 1 out of 3 boys can expect a premature death (Figure 1). Further reducing mortality below ages of about 65 years is considered to be a major challenge to public health policies of developed countries (WHO 1993). Many efforts are made to identify the principal determinants of premature death, and to find opportunities for their prevention.

A striking finding from many developed countries is that mortality chances at ages below about 65 years are much higher for disadvantaged people than for those in more advantaged positions (Adler *et al.* 1994, Fox 1989, Illsley and Svensson 1990, Mielck and Giraldes 1993). A French study estimated that 1 out of 5 unskilled labourers had a chance to die between age 35 and 60 years, whereas only 1 out of 15 professionals die at these ages (Desplanques 1984). In Finland, almost 1 out of each 5 men with basic education died between age 35 and 60 years, as compared to 1 out of 11 men with higher education (Valkonen *et al.* 1993).

Similar findings are reported from each industrialised country for which data are available on chances of premature death in relation to educational level, income level, or occupational class. Socio-economic differences in mortality are highly persistent over time. Studies from several countries observed that these differences did not diminish over the last decades, but even widened (Costa and Faggiano 1995, Harding 1995, Preston and Elo 1995, Regidor *et al.* 1995a, Vågerö and Lundberg 1995, Valkonen 1993b).

**Figure 1** The probability that a boy who reached his 15th birthday will die before reaching his 65th birthday. Estimates based on period life tables for about 1985. Source: WHO (1988), own calculations.




Socio-economic differences in mortality are of interest because they point to powerful determinants of the health of populations (Evans and Stoddart 1994). High rates of premature mortality among low income groups seem to reflect the adverse health effects of poverty and more specific forms of material deprivation, such as bad housing conditions and inadequate diet due to financial problems (Townsend 1988a, Davey Smith *et al.* 1994). It is increasingly more recognised that poverty and physical conditions of living are not the only factors, perhaps not even the most important ones, that are implied (Adler *et al.* 1994, Carroll *et al.* 1996, Marmot 1996, Vågerö and Illsley 1989). Socio-economic differences in mortality persisted over time despite increasing living standards, and these differences are observed at the higher end of social hierarchies as well as at the lower end. This pervasiveness seems to indicate that the social environment in which people live, and the psychosocial stress they experience, are powerful determinants of their health (Evans *et al.* 1994, Brunner 1969, Wilkinson 1996). A better understanding of how these determinants operate, followed by interventions on these determinants, may proof to be a main way to further reduce national levels of premature mortality (Murray and Chen 1993, Wilkinson 1996).

Reducing national death rates (or the prevalence of any other health problem) is not the only goal to be pursued by health policies. It is important to secure that future health gains are shared by all groups of the population, and that actions are taken to reduce the current mortality excess of disadvantaged groups. Special attention to disadvantaged groups cannot only increase the effectiveness of health policies, but is also a matter of fairness and justice (Whitehead 1990). After all, it is difficult to accept that precisely those people who have less in life, have in addition years to live. It is not without reason that the first target of the Health For All 2000 strategy, which was adopted by the European member states of the World Health Organisation (1993), was about equity in health:

> *"By the year 2000, the differences in health status between countries and between groups within countries should be reduced by at least 25 percent, by improving the level of health of disadvantaged nations and groups."*

A main task for health policies is to monitor socio-economic differences in ill health and premature mortality, to identify the risk factors that are responsible for these differences (be it the well-known risk factors such as smoking, or factors that yet have to be discovered) and to design interventions that are effective in reducing inequalities (Whitehead and Dahlgren 1991). It is this formidable task to which we will attempt to make a contribution and, to this end, to utilise the comparative method.

## 1.2 Why comparing countries?

Concern with socio-economic differences in mortality has lead several authors to study these mortality differences not only in their own country, but to look at the situation in other countries as well (Kagamimori *et al.* 1983, Leclerc 1989, Leclerc *et al.* 1984 & 1990, Minder 1991, Neumann and Liedermann 1981, Vågerö and Lundberg 1989, Valkonen 1987 & 1989, Wagstaff *et al.* 1991). Many of these comparisons were motivated by the question whether socio-economic differences in mortality were smaller or larger in their own country than in other countries. If researchers would find that mortality differences in their own country were large from an international perspective, that would suggest that mortality differences in their country have the potential to be reduced, and that a further look into the situation in other countries may yield suggestions on how to achieve that reduction.

There are four more specific reasons for researchers to assess whether or not socio-economic differences in mortality are smaller in some countries than in others (Kunst and Mackenbach 1996).

The first reason relates to the judgement of socio-economic differences in mortality in a specific country. The magnitude of mortality differences in another country may provide a yardstick against which one can judge the mortality differences in one's own country. If mortality differences in a country are found to be large from an international perspective, that would stress the importance of mortality differences in this country, and the need to put these differences high on the agenda of researchers and policy makers.

The second reason relates to the explanation of socio-economic differences in mortality. If mortality differences are found to be larger in some countries than in others, this would offer an opportunity to identify circumstances that are associated with larger or smaller mortality differences. Mortality differences might perhaps be found to be consistently larger in countries with large socio-economic differences in smoking, drinking or other risk factors for disease or injury. Associations might perhaps also be observed with economic, cultural or other features of the national contexts within which mortality differences are formed and patterned.

The third reason relates to policies that aim at reducing socio-economic differences in mortality (Benzeval *et al.* 1995, Dahlgren and Whitehead 1991, Department of Health 1995, Whitehead and Dahlgren 1991). A main question to these policies is under what conditions socio-economic differences can become smaller than they are now. To policy makers in a specific country, other countries can be considered as 'natural experiments' by means of which it can be evaluated whether mortality differences would become smaller when a number of conditions are changed. Examples of potentially interesting situations are countries with more egalitarian socio-economic, health care and other policies. A comparison with contrasting countries could give some of the evidence, which is difficult to obtain otherwise, on the potential effects that these policies have on socio-economic differences in mortality (Marmot 1996).

The last and more practical reason to compare countries relates to the exchange of research findings between researchers from different countries. In all developed countries, there are important gaps in the available information on socio-economic differences in mortality (Fox 1989, Illsley and Svensson 1990, Mielck and Giraldes 1993). Therefore, a more complete knowledge would be gained by pooling information from different countries. But can research findings from one country be assumed to apply to other countries as well? The answer to this question requires some form of comparison between countries. If the magnitude or pattern of mortality differences would be found to strongly differ between countries, that would warn against an uncritical extrapolation of results from one country to other countries.

## 1.3 Previous comparative studies

Until about 1990, attempts were made by researchers from different European countries to assess whether socio-economic differences in their own country were larger or smaller than those in another country. The most usual reference country was England & Wales, which had a long and well-known tradition in measuring socio-economic differences in mortality. A number of other comparisons had been made between Nordic countries. All comparisons referred to the 1960s or 1970s. Most of the reported results concerned men in the age group that they are economically active, that is, about 25 to 64 years.

A comparison of Vågerö and Lundberg (1989) supported the widely held view that mortality differences by occupational class must be smaller in Sweden than in England & Wales. Some other comparisons found that class differences in mortality in Norway and Denmark were about as small as in Sweden (Lynge *et al.* 1989, Valkonen 1987). Minder (1989) observed that also in Switzerland mortality differences by occupational class were about as large as in England & Wales.

A series of studies made by Leclerc and colleagues (1984, 1989, 1990) showed that mortality differences by occupational class were larger in France than in England & Wales. Relatively large mortality differences were also observed in Finland. However, another study suggested that mortality differences were smaller in Finland than in England & Wales (Wagstaff *et al.* 1991).

A study of Valkonen (1987 & 1989) on mortality differences by educational level (instead of occupational class) led to quite different results. The association between educational level and mortality among men 30-49 years was found to be about equally strong in both England & Wales, Sweden, Norway, Denmark, Finland and Hungary. A similar pattern was observed for women.

Unfortunately, all studies suffered from one or more serious limitations.

First, the geographical scope of most comparisons was narrow. The only comparative study that included more than three countries was that of Valkonen (1987 & 1989). The limited geographical coverage reduced the possibility to put an individual country into a broad international perspective.

Second, there were serious problems with the comparability and reliability of the data that were available from the different countries. For example, most comparisons of mortality by occupational class could have been seriously biased by differences between countries in the available social class schemes, i.e. the rules on the basis of which men with specific jobs were assigned to specific occupational classes. Several authors pointed to the divers data problems that can affect cross-national comparisons (Illsley 1990, Kunst and Mackenbach 1994c, Minder 1991, Valkonen 1993a, Valkonen and Martikainen 1997).

Third, explanations of the observed variations between countries had not been not forwarded. One exception is the study of Vågerö and Lundberg (1989), who suggested that the egalitarian socio-economic policies that have been pursued in Sweden for several decades have contributed to the small mortality differences by occupational class that they observed for Sweden as compared to England & Wales.

## 1.4 The present study

*Objectives*

The objective of the present study is to compare industrialised countries with respect to the magnitude of socio-economic differences in mortality among men in the age group 30 to 64 years. It differs from previous studies in several respects.

First, data are acquired for much more countries. We include each country from Europe or northern America with nationally representative data on mortality differences by occupational class or educational level.

Second, considerable efforts are made to resolve problems with the reliability and comparability of the data that are available from different countries. Problems that cannot be resolved are evaluated quantitatively for their potential effect on the results.

Third, explanations are suggested for the international patterns that will be observed. Special attention is given to the possibility that egalitarian social and economic policies are associated with smaller mortality differences.

These three points will be discussed separately in the rest of this section. We end with a formulation of the research questions that are to be answered by empirical analyses.

*Acquisition of data*

The data that are analyzed in this study come from two research projects. Both projects attempted to include as many countries as possible. The first project was an international comparison that was carried out between 1991 and 1992. The objective of this project was to put socio-economic mortality differences in the Netherlands into an international perspective. The data available for the Netherlands came from two longitudinal studies on mortality by occupational class and educational level. These data referred to men 35-64 years in the 1970s. Comparable data were obtained for each industrialised country with longitudinal data on socio-economic differences in mortality. Details on this project are given by Kunst and Mackenbach (1992).

The second project was held between 1993 and 1996. It was a concerted action, sponsored by the European Union, in which teams from 15 western European countries participated. The main objective of this project was to compare these countries with respect to the magnitude of socio-economic differences in mortality and morbidity. For the mortality part, data on mortality by occupational class and educational level were obtained for 13 western European countries. These data referred to men and women 20-74 years in the 1980s. Details on this project are given by Kunst *et al.* (1996). There, we concluded that 11 western European countries could be compared with respect to mortality differences by occupational class. Data that were acquired for East and West Germany had to be discarded due to data problems. Data on mortality by educational level were available for five countries only. For this reason, this thesis concentrates on the analysis of data on mortality differences by occupational class, and uses data on mortality by educational level mainly as a check to the results obtained for occupational class.

In 1994, a few more countries were added to the second project. Reliable and comparable data could be obtained for the United States, thanks to the availability of a public use file of the National Longitudinal Mortality Study. We also acquired data from a small longitudinal study from Canada, but had to conclude that inequality estimates from these data were too unstable (large confidence intervals) for use in international comparisons. An additional project sponsored by the European Union made possible the participation of national teams from three countries from central and eastern Europe: the Czech Republic, Hungary and Estonia. From each country, the national teams provided detailed and internationally comparable data on socio-economic differences in mortality.

*Enhancing the comparability of data*

International comparisons can be treacherous if no extensive attention is paid to the many problems with the comparability of the data that are available for different countries (Illsley 1990, Kunst and Mackenbach 1994c, Minder 1991, Valkonen 1993a, Valkonen and Martikainen 1997). If mortality differences are found to be larger in some countries than in others, it is tempting to interpret these cross-national variations in substantial terms, for example, to attribute them to socio-economic, cultural or other differences between countries. However, prudence dictates that the first hypothesis one entertains is that the observed variations are somehow a methodological artifact.

This warning applies especially to data on mortality by occupational class. Comparative research on the basis of these data can be biased by (1) poor comparability of the occupational class schemes that are used in different countries, (2) the effect of excluding economically inactive men from analysis, and differences between countries in the size of this effect, and (3) the so-called numerator/denominator bias that is inherent to 'unlinked' cross-sectional studies, and differences between countries in the size and direction of this bias (Kunst and Mackenbach 1994c).

We made considerable efforts to enhance the comparability of the data that were available from the different countries. Important to acknowledge, however, is that complete cross-national comparability is not attainable. As Atkinson *et al.* (1995) remarked on the basis of their experiences with the Luxembourg Income Study, comparability is a matter of degree and all that one can hope for is to reach an acceptably high level. As a general rule, one should be able to make it likely that comparability problems have not substantially biased the patterns of international variation that are observed (Kohn 1987, Ragin 1987). Therefore, the strategy applied in this study consists of two steps. First, extensive efforts are made to enhance the comparability of the data as much as possible. Second, it is evaluated meticulously to what extent the observed international patterns can be explained by remaining comparability problems.

In the future, the international comparability of data is likely to increase as a result of increasing international cooperation and harmonisation with regards to data acquisition and analysis. This study represents two steps in this long-term process. The first step was made in the study on the 1970s, which addressed a number of comparability problems that may have hampered previous comparative studies but that could be resolved relatively easily. The second step is made in the study for the 1980s, which addressed remaining problems by means of intensive international collaboration with both data acquisition and data analysis. The importance of this additional effort is illustrated by our experience, laid down in this thesis, that the second step led to a substantial revision of the conclusions drawn in the first study.

*Explaining international variations*

A second methodological problem is encountered when mortality differences are found to be larger in some countries than in others and these cross-national variations are shown not to be an artifact. One then faces the difficult task to offer a substantial explanation and to ascertain which of the many variations between countries in terms of history, culture, economy and politics have contributed to the observed variations in the magnitude of mortality differences. These differences might be related to the factor that has one's interest (e.g. egalitarian socio-economic policies) but some other factor may be of greater importance. Thus there looms a large risk of confounding.

Studies in other fields of comparative social science have since long faced the same problem (Kohn 1987, Ragin 1987). Their experience is that this problem can most effectively be dealt with the combination of two research strategies. The first strategy is to include as many countries as possible in the analysis. With a large number of countries, one can determine whether the size of mortality differences is consistently associated with a specific factor across a wide range of countries. The relatively large number of countries might make it possible to control for confounding by some other factors, in particular those which are quantitatively measurable.

The alternative strategy is to compare a few countries in more detail than is possible for a large number of countries. In the case of socio-economic mortality differences, one might include different socio-economic indicators, analyze time trends in order to add historical depth and make separate analyses of key causes of death. The results of these detailed analyses may be combined with an in-depth knowledge of the countries that are being compared. All this may help the researcher to select among competing explanations of the observed cross-country variations in the magnitude of mortality differences.

Both strategies will be followed in this study. In the concluding chapter of this thesis, explanations of the observed cross-national variations will be offered on the basis of the information that is generated by both research strategies.

Naturally, the amount of information generated in either strategy heavily depends on the data that are used as input. This study focuses on one type of data that might be highly informative: data on mortality by cause of death. Since different causes of death relate to different risk factors for disease or injury, a distinction between causes of death offer an opportunity to investigate the role of specific risk factors and related explanations. An example is ischaemic heart disease. Socio-economic differences in this cause of death might be strongly influenced by behavioral factors like smoking, diet, and physical exercise. Social gradients in these behavioral factors might, in turn, be influenced by cultural as well as economic characteristics of countries. Therefore, a study of ischaemic heart disease mortality might provide clues on the role of specific risk factors as well as the broader economic and cultural circumstances that shape social gradients in these risk factors.

*Research questions*

The empirical analyses that are reported in this thesis address two questions. First, can socio-economic differences in mortality among middle-aged men be demonstrated for each country for which data are available? Second, can it be demonstrated that these mortality differences are larger in some countries than in others?

These questions will be addressed for the different data sets that were available to this project, that is, on mortality by occupational class in the 1970s, on mortality by educational level in the 1970s, and on mortality by occupational class in the 1980s. In order to generate information that can aid the explanation of the results, the same research questions will also be applied to 1980s data on mortality by cause of death. In addition, separate studies will use the data that in a later stage became available for, respectively, the United States and countries from central and eastern Europe.

We should finally reiterate that all analyses had to be restricted to deaths among men circa 30 to 64 years. We had to do so because of serious problems with the availability and comparability of data for other age-sex groups. Comparisons for women were hampered by large international differences in the rules for classifying women on the basis of their activity status (gainfully employed full time, idem part time, housewife, other), their own occupation, and the occupation of their husband or partner. These comparability problems were compounded by international differences in female labour participation rates. Older men had to be excluded because most national data sets lack information on the last or longest held occupation of men retired from work. The omission of older ages is lamentable, given the fact that most of today's burden of disease and demand for health care is concentrated among the elderly. On the other hand, the dramatic impact of a death at younger ages and the still large numbers of deaths that occur each year among middle-aged men (see Figure 1), justifies a study of these deaths on their own.

## 1.5 Structure of the thesis

Chapter 2 provides an overview of the methods that are available to measure socio-economic differences in mortality, and to make comparisons over time or across countries. This overview discusses the several techniques that are available to measure socio-economic differences in mortality, and among which choices had to be made in the present study. This overview is also given with an eye on future comparative studies. If future comparative studies have access to different sources of data, other techniques that might be chosen than the techniques that were judged to be most suited to the present study.

Part 2 presents the international comparisons that could be made with the data acquired in the first project, on socio-economic mortality differences in the 1970s. Countries are compared with respect to the magnitude of mortality differences by occupational class (chapter 3) and educational level (chapter 4).

Part 3 presents the international comparisons that could be made with the data from the second project, on socio-economic mortality differences in the 1980s. First, 11 western European countries are compared with respect to the differences between occupational classes in total mortality (chapter 5) and in mortality from specific causes of death (chapter 6). Next, in-depth comparisons are made between some western European countries and the United States (chapter 7) and three countries from central and eastern Europe (chapter 8). Finally, a large number of countries are compared with respect to class differences in mortality from ischaemic heart disease (chapter 9) and cerebrovascular disease (chapter 10).

Chapter 11 concludes the thesis. The purposes of this chapter are to summarize the findings of the previous chapters (section 11.3), to evaluate the potential effect of data problems (section 11.4), to suggest explanations for the international patterns that were observed (section 11.5), and to discuss the implications for research and policies with regards to inequalities in health (section 11.6). Chapter 11 ends with for recommendations for future comparative studies (section 11.7).

Chapter two

# Measuring socio-economic differences in mortality

## 2.1 Summary

Studies of socio-economic differences in mortality have to make a choice from a wide array of measurement techniques. The purpose of this chapter is to provide guidelines for the choice of the most appropriate methods when measuring socio-economic differences in mortality in a specific research.

After the general introduction in section 2.2, section 2.3 discusses the possible sources of information on mortality in relation to socio-economic variables. The three most important sources of information are longitudinal studies, unlinked cross-sectional studies and area studies. Section 2.4 discusses the measurement of mortality levels, which is done preferably in terms of life table functions.

Section 2.5 discusses the measurement of socio-economic status. The three core indicators are occupation, educational achievement and income level. Most attention is given to occupation. Two basic approaches are distinguished for classifying men according to their occupation: the 'class structural' approach and the 'hierarchical' approach. Specific guidelines are given for classifying married women and economically inactive men.

Section 2.6 discusses the choice of inequality indices by which the size of mortality differences between socio-economic groups can be summarized into a single figure. It contains a framework of 12 different types of summary indices. The framework takes into account the different perspectives which can be chosen, and recognises the complementarity of many of the indices that have been used in previous studies.

Section 2.7 applies the framework of 12 indices to the description of trends in socio-economic mortality differences in Finland between 1971 and 1990.

## 2.2 Introduction

Traditionally, comparative research has made important contributions to the development of methods to measure socio-economic differences in mortality (e.g. Wagstaff *et al.* 1991). These contributions were made because both comparisons over time and comparisons across countries put high requirements to the methodology used.

A first requirement is that the magnitude of mortality differences in each period or country is measured with as much reliability and precision as possible. Unreliable data or low precision (wide confidence intervals) can make it impossible to determine whether mortality differences have increased or decreased over time, or whether they are larger in some countries than in others. This situation contrasts with the one faced by researchers who describe mortality differences in a single country and period. Their principal aim is to demonstrate the existence of mortality differences and to provide an approximate estimate of the magnitude of these differences. In these country-specific studies, measurements problems can be regarded of minor importance provided that they cannot explain most of the observed mortality differences.

A second requirement that is inherent to comparative studies is that the magnitude of mortality differences is quantified by summary indices on the basis of which time periods or countries can easily be compared. A wide array of summary indices have been developed in comparative studies. We found that at least 15 different summary indices were advocated by different researchers (Mackenbach and Kunst 1997). Unfortunately, there are no clear criteria for the choice between alternative summary indices. This is an unfortunate situation since the use of different summary indices could lead to entirely different conclusions (Wagstaff *et al.* 1991).

The purpose of this chapter is to provide guidelines for measurement of socio-economic differences in mortality. Our general approach is *not* to recommend one common method to be used by all researchers, because no single recommendation can do justice to the great diversity in research interests, conceptual orientations, data availability and aspired levels of technical sophistication. Instead, our aim is to identify the areas where the most important choices have to be made, and to give guidelines for making these choices.

Our own experiences warn against too rigid recommendations. One of these experiences can be traced in this thesis. At the start of this study, we strongly advocated the use of the *Relative Index of Inequality* to measure mortality differences by occupational class and educational level (chapters 3 and 4). By the time of the second part of our study, we concluded that this measure was not appropriate to assess mortality differences by occupational class (chapter 5). We still used it to measure mortality differences by educational level in western Europe (chapter 5) and the United States (chapter 7), but due to practical reasons it was not used in the eastern European study (chapter 8). An overview of the conditions under which the *Relative Index of Inequality* and other summary indices can be used, and the interpretations that can be given to their outcomes, is given in section 2.6.

## 2.3 Sources of data

Mortality is measured as an incidence rate: the rate at which death occurs in a certain number of individuals who are observed over a certain period of time (Kleinbaum and Kupper 1982, Rothman 1986). The most appropriate way of measuring mortality according to socio-economic group is to measure the subjects' socio-economic status at the start of the period over which they are followed. This longitudinal approach has been applied successfully in Nordic countries and the United States, where, thanks to the availability of personal identification numbers, population census records and the death registry can be linked, so that the national population can be followed up for mortality after each census (Andersen 1985, Kristofersen 1986, Sorlie *et al.* 1995, Vågerö and Norell 1989, Valkonen *et al.* 1993). France, England & Wales and Italy have no personal identification numbers, but a sample of the census population could be followed up for mortality by manually linking population records to the death registry (Desplanques 1984, Fox 1982, Golini 1990). Longitudinal mortality studies are also available for some specific regions or cities; for example, where an epidemiological study has been carried out among a sample of the population (Bosma *et al.* 1995, Costa and Segnan 1988, Duijkers *et al.* 1989, Holme *et al.* 1980, Marmot *et al.* 1991, Rosengren *et al.* 1988).

When longitudinal data are not available, sometimes a good alternative exists in the form of linked cross-sectional data (Kunst and Mackenbach 1994c). Such data can be obtained from registries that not only record socio-economic characteristics of each subject but, in addition, record the reasons for any withdrawal from the registry (death or otherwise). With such a registry, the socio-economic status of each person who dies can be determined. The registry of socio-economic characteristics also supplies the denominator data on the numbers of people, according to socio-economic status, who were at risk of dying during the period in which deaths occurred. This approach is called cross-sectional because the socio-economic data in the both numerator and denominator refer to the same period of time. One of the few examples comes from western Germany, where the social insurance and pension registries could in principle provide nation-wide data on mortality rates according to occupational class and educational level (Linke 1990, Mielck 1994, Ritz 1989).

*Unlinked cross-sectional studies*

A more widely available but less satisfactory variant of cross-sectional data is 'unlinked' cross-sectional data. Again, the number of deaths observed during a time interval can be related to the number of people who were exposed to the risk of dying during the same time interval. The term 'unlinked' refers to the fact that the socio-economic information on the deaths is not derived by linkage. Instead, the socio-economic information on the deceased and on the population at risk comes from two different sources: (1) the death registry, which provides the numbers of deaths according to the socio-economic characteristics registered on the death certificate, and (2) the population census, which provides the corresponding numbers of people at risk according to the same socio-economic characteristics as measured in the census. Dividing the number of deaths per socio-economic group (the numerator) by the corresponding number of person-years at risk (the denominator) provides estimates of mortality rates per socio-economic group. The classic example of this type of study is the decennial supplement on occupational mortality of the Registrar General in the United Kingdom (OPCS 1978 & 1986). Similar studies were carried out in many other countries, including Hungary, Ireland, Spain, Switzerland, and the former Yugoslavia (Klinger 1986, Mastilica 1990, Minder 1986, Nolan 1990, Regidor *et al.* 1995a & 1996).

In many countries, however, the validity of this type of study may be compromised by poor comparability of the measurement of socio-economic status on death certificates and in the population census. This 'numerator/-denominator' bias can take various forms.

One example is "promoting the dead" by which is meant the possible propensity among relatives to describe the deceased's occupation in favourable terms, or to report the 'best' occupation that they held during the last years (OPCS 1978). This propensity would result in a shift of deaths from lower to higher occupational classes. If a parallel shift does not occur in the population census, the end result would be to increase the mortality rates of higher occupational classes, to decrease the rate of lower classes, and thus to underestimate the mortality difference between high and low classes.

Another example is the use of vague occupational terms. The frequent use of the term 'labourer' on English death certificates results in a large number of deaths with the occupational code 'labourer not elsewhere classified' (OPCS 1978). Since the registration of occupations at the population census is much more accurate and much less people are classified in that same occupational code, the nett result is an overestimate of the mortality level of this occupation code ('labourers n.e.c.') and also -but to a much smaller extent- of the corresponding occupational class ('all unskilled labourers'). Similarly, the frequent use of the term 'employee' on French death certificates had resulted in an overestimation of the mortality rate of lower non-manual workers (Desplanques 1984).

Elsewhere, we estimated for several western European countries the size and direction of the numerator/denominator bias in estimates of mortality differences by occupational class (Kunst and Groenhof 1996c). It was concluded that the numerator/denominator bias can take various forms and can result in either an overestimation or an underestimation of the size of mortality differences by occupational class (see also section 5.3).

*Area studies*
The unlinked cross-sectional approach is only feasible if the death registry includes information on the socio-economic status of the deceased. In various countries this information is not available, so that it is impossible to categorize mortality by socio-economic status at the individual level. In these circumstances, it is nearly always possible to obtain useful indications of the existence of socio-economic differences in mortality by the ecological approach. In this approach, the study population is divided into smaller or larger areas based on place of residence, and the association between mortality and socio-economic status is then studied by comparing the mortality levels of areas with socio-economic characteristics of these areas. The most frequently applied variant of this approach consist of comparing districts within a specific city (Benzeval *et al.* 1992, Carstairs and Morris 1991, Keil and Backsmann 1975, Mompart 1990, Phillimore *et al.* 1994, Reijneveld 1995, Townsend *et al.* 1988b, Wilkins 1989).

A major problem with comparisons between areas is that it cannot be assumed that associations between mortality and socio-economic indicators at the aggregate level reflect associations at the individual level. This 'ecological fallacy' problem (Susser 1994) is in part due to the fact that the socio-economic status of an area is usually so strongly correlated with other variables (such as housing and environmental conditions) that is may be impossible to separate the effect of each variable. A more fundamental problem is that the socio-economic status of an area (e.g. unemployment rate) represents a different phenomenon than the socio-economic status of individual people (e.g. being unemployed or not).

The main value of ecological studies is that they can provide indications on the effect of socio-economic disadvantage on mortality when no individual-level data are available. In addition, comparisons between areas may provide highly relevant information for local health policies, because they identify clearly defined areas with excess health problems. For this reason, area studies remain interesting even in countries or cities where individual-level data are available (Macintyre *et al.* 1993, Susser 1994).

## 2.4 Measuring mortality

Mortality levels are basically expressed as incidence rates, which are calculated by dividing the observed number of deaths by the corresponding number of person-years (the number of people times the average number years per person) of being exposed to the risk of dying (Kleinbaum and Kupper 1982, Rothman 1986). In longitudinal studies, the number of person-years at risk can be calculated accurately from the available data. In unlinked cross-sectional mortality studies, it is customary to estimate this number as the number of people in the middle of the study period times the number of years covered by the study period.

The effect of confounding variables should be removed by means of standardization or other techniques. Age and sex are the most obvious variables, but in certain circumstances other variables (e.g. race, country of birth, or region of residence) may also need to be controlled for. However, statistical techniques such as age standardisation should not be used thoughtlessly, and sometimes it is better to present separate estimates for subgroups of the population. Since the magnitude of socio-economic mortality differences often varies strongly by sex and age, it is usual to present inequality estimates by sex and by age group (e.g, 0-14, 15-44, 45-64, 65-74 and 75 and over).

Study of specific age groups is also required if one wants to distinguish premature deaths (adult mortality) from death in old age, which cause fewer years of life lost. This line of thought can be further expanded by calculating comprehensive measures such as the life expectancy (at birth or at another age) or the potential years of life lost (Guralnik *et al.* 1993, Kaprio *et al.* 1996, Sihvonen *et al.* 1997, Valkonen *et al.* 1997a). The advantage of such a life-table measure of mortality is that it can be intuitively understood by policy makers and the general public. It is even more concrete to express mortality levels in terms of the probabilities of death or chances of survival. For example, if the study is restricted to the age group 35-60 years, the mortality level could be expressed as the chance that a person aged 35 years will die before reaching the $60^{th}$ birthday.

## 2.5 Measuring socio-economic status

Within each society, material and non-material resources and rewards are unequally distributed. This inequality can be portrayed as a system of social stratification. People attain different positions in the social stratification system according to their occupation, educational achievement, and their income level or standard of living (Giddens 1993, Lenski and Lenski 1987). That position is usually referred to as socio-economic status.

Although occupation, educational level and income level together constitute a person's socio-economic status, these three indicators are sufficiently different to require that they be studied separately in relation to mortality. These indicators are different, for example, in the potential for being modified by public health policy: whereas changes in occupational structures occur outside the sphere of influence of public health policy, policy makers can address some features of the income distribution, and by means of intersectoral policy they can attempt to improve the educational level of disadvantaged sections of the population.

A second reason to study occupation, education and income separately is that these indicators are related to different kinds of resources and rewards. Educational level determines a person's access to information and proficiency in benefitting from new knowledge, whereas income determines the access to scarce material goods. A person's occupation covers both these aspects and adds to them benefits accruing from the exercise of a specific job, such as privileges, prestige, power, and social and technical skills. The complementary nature of the three core indicators of socio-economic status implies that, if all necessary data would be available, each of these indicators should be studied in order to obtain a comprehensive picture of socio-economic differences in mortality.

This chapter provides general guidelines for the measurement of both occupation, education and income. We start with discussing the measurement of the most complex indicator, occupation, and then we proceed with educational level and income level. For technical details such as the wording of questions to be included in surveys, we refer to the specialized literature (e.g. Liberatos *et al.* 1988). For the measurement of socio-economic variables in area studies, we refer to the extensive British literature on this subject (Morris and Carstairs 1991, Macintyre *et al.* 1993). We will only briefly deal with problems that are specific to the measurement of the socio-economic status of women or elderly. With respect to these problems, valuable discussions based on extensive empirical analyses have been presented by Martikainen (1995a & 1995b) and Martelin (1994).

### 2.5.1. Occupation

The main issue in the measurement of occupation is how to classify people according to their place in the social stratification system. Essentially two approaches can be distinguished: the 'class structural' approach and the 'hierarchical' approach (Ganzeboom *et al.* 1992, Erikson and Goldthorpe 1992a). This section discusses these two basic approaches and then deals with specific issues related to the classification of women and economically inactive men.

*The class structural approach*

Much attention has been given in social stratification research to the development of schemes that distinguish people who occupy structurally distinct positions in the labour market and, as a result, differ in access to income and other rewards, and things like voting behaviour and life style. The resulting groups of people are usually referred to as 'occupational classes' or 'social classes'.

Statistical offices of most countries apply their own social class scheme. A good example of such a scheme is the French classification of *Catégories*

*Socio-professionnelles*, which has been used in French studies on mortality differences by occupational class (Desplanques 1984).

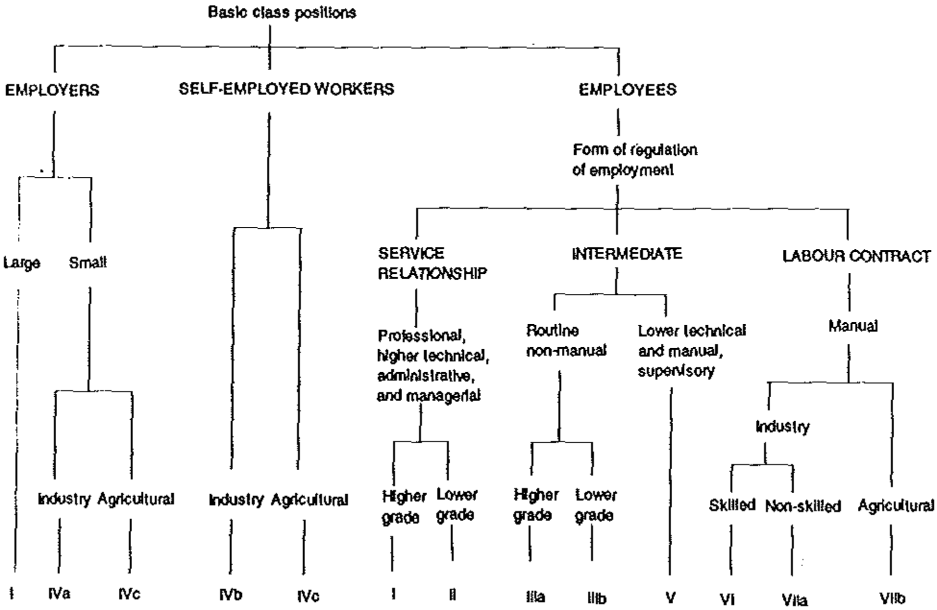
A number of social class schemes has been developed with a view of international applicability. The schemes that are most often applied in social stratification research are those of Wright (1985) and the EGP scheme (Erikson and Goldthorpe 1992a). The Wright schemes are of an explicit Marxist character whereas the 'EGP' scheme is more eclectic. Evaluations of the two schemes suggest that the EGP scheme is in general better able to show 'class' effects among a wide range of phenomena (e.g. Ley and Joye 1994). This structure of the latter scheme is shown in Figure 2.1. It can be constructed on the basis of information on the following aspects of a person's job: the job title (bricklayer, accountant, etc.), employment status (self-employed or in employment) and supervisory status (e.g. number of subordinates). An easily applicable approximation to this scheme has been developed by Ganzeboom *et al.* (1989).

The EGP social class scheme identifies two groups of people who clearly have, respectively, an advantaged and a disadvantaged position in society. Classes I and II constitute the 'service class', which occupies the higher and intermediate positions of the professional, administrative and managerial bureaucracies. Classes VI and VII constitute the 'working class', which consists of wage-earning manual occupations. This distinction finds its linguistic recognition in several languages: *staff* versus *workers* (English), *cadres* versus *ouvriers* (French) and *Beamte, Angestellte* versus *Arbeiter* (German).

Not all occupational classes have a clearly hierarchical relationship to each other. For example, there is no general rule that says that lower-level employees are in a better position than skilled labourers. Their differences are not so much in the quantity of resources and rewards that they avail of, as well as in the type of resources and rewards. For example, lower-level employees have in general higher levels of education and may perhaps benefit from their closer relationship with and affinity to people with a higher position in society. On the other hand, their career perspectives and income levels are not clearly better than those of skilled labourers, and a lower-level non-manual job may be the last choice of manual workers when health problems interfere with the exercise of physically demanding manual jobs (Dahl 1993, Dahl and Kjaersgaard 1993a). For this reason, when the aim of a study is to identify population groups with excess mortality, different occupational classes are of potential interest.

A social class scheme that does seem to pretend to be entirely hierarchical is the well-known social class scheme of the British Registrar General that ranks social classes from I to V (Szreter 1984). One of the drawbacks of this classification is that it has not consistently been developed on the basis of specific criteria for ranking occupations from high to low. Classifications that are more consistent in this respect are discussed in the next section.

**Figure 2.1** The EGP social class scheme. Source: Erikson and Goldthorpe (1992).




*The hierarchical approach*

The prime interest of many studies on socio-economic differences in mortality is with the unfair situation that precisely the most disadvantaged sections of the population face the highest risk of dying prematurely. The association between mortality and socio-economic disadvantage could be studied by comparing 'high' occupational classes to 'low' classes, and ignore all occupational classes with a less clear hierarchical position. However, excluding a large part of the population from the analysis is somewhat unsatisfactory. This may be reason to adopt an alternative approach: classifying people with reference to the job they perform along an one-dimensional scale of socio-economic status or socio-economic disadvantage.

The scales that perhaps are most relevant to the study of health inequalities are those based on education and income. These scales give to each occupation a status score on the basis of a weighted sum of the average educational level and the average income level of the persons who exercise that specific occupation. They intend to measure what is probably the most important aspect of an occupation: its potential to convert a person's main resource (education) into a person's main reward (income). Various of these scales have been applied in health research in the United States, but these scales are outdated and not applicable to other countries (Liberatos *et al.* 1988). A more recent application to mortality comes from New Zealand (Pearce *et al.* 1991). Ganzeboom *et al.* (1992) have developed an internationally applicable scale that can be used when jobs are classified according to a 3-digit classification similar to the 1968 or 1988 International Standard Classifications of Occupations.

We should also mention the availability of scales of 'occupational prestige', which express the general desirability of jobs and are derived from the subjective judgement of a panel of lay people or experts (Treiman 1977). These scales are often applied in social stratification research. National scales are available for nearly every country. Although the prestige of occupations may have a high predictive value for some social phenomena, e.g. social mobility patterns, their relevance to health inequalities is much less obvious.

Application of one-dimensional scales implies that one accepts the fact that less of the relevant variation between occupations can be captured than with the more flexible class structural approach. In addition, one should accept the fact that with these one-dimensional scales the link is lost between (trends in) socio-economic differences in mortality and (changes in) occupational structures. For example, the relevance to the population's mortality of a shift in the economy from the goods production (manual work) to the service industry (non-manual work) can be easily traced with the class structural approach but not with one-dimensional scales.

*Classifying economically inactive men*

With economically inactive men we refer to men who are not gainfully employed, such as the unemployed, disabled, retired, or homemakers. They can be dealt with in two ways: either they are studied as a separate group or they are classified according to occupational class (or one-dimensional scales) with reference to a previously held occupation.

The first approach is often the only possible one because of lack of data on a previously held occupation of inactive men. In other cases, specific research interests may lead to the choice for the first approach. The increasing number of men that for long periods are excluded from the labour market has given rise to a new area of research which focuses on questions like: has short-term and long-term exclusion from the labour market demonstrable effects on the health and survival of the men that have become redundant? are disabled people at a specially high risk of being excluded from the labour market in times of massive unemployment? (Jenkins 1991) If these questions are of central interest, the distinction between active and inactive men is of course essential (see e.g. Kunst and Groenhof 1996a).

When the research focuses on the association between occupational class and mortality, however, there are good reasons to adopt the alternative approach of classifying economically inactive men by occupational class on the basis of their last or longest held occupation. A first reason to do so is that economically inactive men may retain many of the (dis)advantages that were related to their last occupation. The second reason is that a large part of the men that become ill and eventually die, will at some moment loose their job and become economically inactive. Exclusion of these men from the analyses would result in a large underestimation of mortality levels. This 'healthy worker effect' is relatively strong for manual occupations and therefore leads to an underestimation of the excess mortality of manual classes over non-manual classes (Dahl 1993, Goldblatt 1989). In a series of evaluations reported elsewhere (Kunst and Groenhof 1996b) we observed that this underestimation can be substantial, and might strongly bias comparisons over time and between countries.

*Classifying married and co-habiting women*

An enduring discussion in social stratification research relates to the question how to classify married and co-habiting women: with reference to their own occupation or with reference to the occupation of their partner (Abbott 1987, Erikson and Goldthorpe 1992a). Central to this issue is the question whether class positions should be determined with the individual or with the family as the unit of class composition. Most authors seem to support the view that if a woman is economically dependent on her husband, her class position -and her children's class position- is derived from that of her husband. A second issue is, then, whether this approach is still tenable now that the vast majority of women enter the labour market for at least some period of their married lives. Important is that a wife's participation in the labour force does not necessarily mean that the economic dependency upon her husband has ceased. The attachment of many women to the work-force is still weak and in many countries the wives' contribution to the family income does not show a strong tendency to increase (Rainwater *et al.* 1986).

The choice between either approach depends not only on theoretical considerations but also on the specific research context. If the interest is with the effect on health of work-related variables such as exposure to toxic compounds or the experience of autonomy and authority, then it may be more relevant to look at a woman's own occupation and to define her occupational class in relation to this occupation. If, on the other hand, the most relevant aspects of occupational class are expected to be related to the household income and general living conditions, the husband's occupation will in many cases be more relevant.

The relevance of either way of classifying married and co-habiting women may be tested empirically: are larger mortality differences found when married and co-habiting women are classified with reference to their own occupation or when they are classified with reference to their partner's occupation? Most studies from England and Nordic countries suggest that the husband's occupation is more important to the wife's health (Arber and Ginn 1993, Dahl 1991, Martikainen 1995c) but, of course, different results may be observed in other countries or in future studies.

A more flexible approach is to allow for a different treatment of different women. Even though most women can perhaps best be classified according to their husband's occupation, other women can have acquired so much economic independence that they can best be classified according to their own occupation. An example of this type of approach is the 'dominance' rule, which classifies a woman according to her own job or to her partner's job, depending on whose job is 'dominant' (Erikson 1984). Note, by the way, that a consistent application of this principle should also be extended to the classification of men.

All depends, of course, on the availability of data. Mortality registries in various European countries record for deceased married women their own last occupation, but not their husband's occupation. In these cases, there is no other option than to classify women according to their own occupation and to accept the fact that the occupational class of housewives and other inactive women cannot be determined.

If women are classified according to their own occupation, social class schemes may need to be adjusted to the fact that many women work in a few typically female occupations such as nurses, teachers and secretaries. These revised schemes should be able to take into account the fact that a large part of women with lower-level non-manual work in the service sector perform jobs that are not clearly 'higher' than jobs in the manufacturing industry.

### 2.5.2. Education

Information on the educational achievement of persons complements information on their occupation by its emphasis on knowledge and other intellectual and cultural resources. The relevant aspect of education is therefore the achieved level of education. The most direct measure is the highest level of education that has successfully been completed (with diploma, if applicable). If possible, this measure takes into account not only general education but also technical and vocational education, and not only full-time education but also part-time study or training after leaving school.

Census-based studies on mortality by education often suffer from the problem that lower educational levels are combined into one broad category that covers more than one half of the population, especially among older birth cohorts (Valkonen 1989). If possible, one should distinguish at least the following categories: no education completed, elementary education, lower secondary education, upper secondary education, and post-secondary education.

When no information is available on the level of education that is completed, substitute measures might be used such as the highest level of education that a person has attended but not necessarily completed, the number of years of education that a person has attended school, or the age at leaving school. The two latter measures have the disadvantage that they do not take into account the type, and therefore the level, of the education that was received.

### 2.5.3. Income, living standards and poverty

Income can be used as an approximate measure of the occupational status of the income recipient, with higher personal income indicating a better position in the labour market. More common is, however, to use information on income as complementary to information on education and occupation, because of its emphasis on material standards of living. The material standard of living can be expressed most adequately when the income level is measured by:

- adding all income components (this yields total income)
- subtracting tax deductions and social security contributions (disposable income)
- adding the incomes of all household members (household disposable income)
- adjusting for the size of the household (equivalent disposable income).

For various countries, standard formulae are available on the way to adjust for the size and -less often- the age composition of households. A simple formula that has been used in international comparisons on income inequalities consists of dividing the household income by the square root of the number of household members (Atkinson *et al.* 1995).

When the equivalent disposable income level of each individual is assessed, an instrument is available to identify *the poor* as those who have an income below the poverty line. Poverty lines can be established in various ways, and each country has its own lines. A common approach in international comparisons is to define poverty in a purely relative sense, that is, in relation to the income level of other persons living in the same country. A frequently used poverty line is 50 percent of the nation's median income (Förster 1993).

Unfortunately, the measurement of income is fraught with problems. A practical problem is that survey questions on income sometimes meet high non-response rates. Moreover, willing respondents may not report income accurately or validly. An accurate measurement of income requires a large battery of questions, but often surveys have no room for an extensive measurement of income. A second problem with income is that it may vary substantially, even in the short run, due to changes in household composition or in the employment and remuneration of household members. The consequence is that the current income level might be an inaccurate measure of the long-term standard of living.

In order to overcome the above-mentioned problems, many mortality studies have used proxy measures for material living standards. A wide variety of indicators of income, living standards and poverty are available. Examples are:

1. Entitlement to social security or to health insurance, if that entitlement depends on people's position in the labour market and their income levels (e.g. Loeffel *et al.* 1990);
2. Socio-demographic variables that define people that are likely to live in a special situation of deprivation, such as single mothers or people that depend on social assistance benefits (e.g. Judge and Benzeval 1993);
3. Questions in surveys on specific financial problems or, more generally, on the present or past experience of economic hardship (Stronks 1997);
4. Proxy measures of long-term living standards, such as the possession of durable consumer goods, car ownership, house ownership, or indicators of the quality of housing (e.g. Marmot 1995, Fox and Goldblatt 1982, Tzoumaka Bakoela *et al.* 1989);

Naturally, proxy measures that are considered to be reasonably valid in one situation may be invalid in other situations. In any case, one should be careful to interpret associations with mortality as reflecting effects of low living standards. For example, the often reported lower mortality among homeowners (e.g. Filakti and Fox 1995) probably reflects not only the higher living standards of homeowners but also the differences between them and tenants in educational levels, the motivation to invest in the future (and health), and selection for health in obtaining mortgages.

## 2.6 Measuring the association between mortality and socio-economic status

Any measurement of socio-economic differences in mortality should start with describing in detail how mortality probabilities or age-standardized mortality rates differ between groups with different positions in the social stratification system. This description may sometimes be sufficient, but more often the researcher wants to calculate an index that expresses the magnitude of mortality differences between advantaged and disadvantaged sections of the

population. Such indices can be used for various purposes:
- to be able to provide a concrete, understandable answer for non-statisticians to the question "How large are the socio-economic differences in mortality in our country?"
- to facilitate comparisons, e.g. over time, between countries, between age-sex groups, between causes of death, or between intervention and control populations.

A comparative perspective is also present in explanatory studies, which usually consist of looking at the association between mortality and socio-economic status in two situations: before and after control for a set of intermediary variables such as smoking.

Many summary indices for the size of socio-economic differences in mortality have been applied in the international literature. In this chapter, we present a scheme that allows researchers to choose the summary index that most fits with their research interests, conceptual orientations, data availability and aspired level of technical sophistication. We first discuss the considerations that are most important to the choice between the different summary indices (section 2.6.1), then present a coherent scheme of inequality indices that corresponds to the different choices that can be made (section 2.6.2), and finally discuss a family of alternative inequality indices (section 2-.6.3).

### 2.6.1. Three basic considerations

*1. Relative and/or absolute differences in mortality*

Socio-economic differences in mortality can be expressed in both relative terms (e.g. mortality rate ratios) or absolute terms (e.g. differences in mortality rates or in life table functions). Most studies look at inequalities in relative terms because these are of higher analytical interest. Absolute differences, on the other hand, better express the importance of inequalities for the total mortality burden of a population: a 10 percent higher mortality rate of a large cause of death may be more important than a 50 percent higher rate for a small cause of death. Since relative measures can easily be transformed into absolute measures, and vice versa, it is often worth the small additional effort to look at both.

*2. Indices of effect and/or indices of total impact*

Most studies apply indices that compare specific socio-economic groups such as manual versus non-manual classes, or those with secondary education versus those without secondary education. In this way, they look at the *effect* that a fixed change in socio-economic status has on mortality rates.

There are alternative measures that are not only sensitive to the effect of socio-economic status on mortality, but in addition take into account the size of the socio-economic groups that are compared. These measures come up with a measure of the *total impact* that socio-economic differences in mortality have on the mortality level of the general population. For example, a measure on the effect of income on mortality would calculate the difference in mortality between two income levels, e.g. 1000 Euro versus 2000 Euro. A measure of total impact, however, would combine this information with data on the size of the lower income groups to produce an estimate of the impact that the excess mortality of low income groups has on the mortality level of the whole population. The larger the size of lower income groups, the higher that measure of total impact will be.

Often the most informative would be to use the two types of indices in a complementary way. In the study of trends in occupational class differences in mortality, for example, it would enable the researcher to decompose changes in the total size of mortality differences related to occupational class (as measured by a total impact index) into changes in the size of mortality differences between specific occupational classes (as measured by an effect index) and changes in the population sizes of these occupational class. This distinction between effect and total impact indices is also relevant to the evaluation of health policy measures: the distribution of the population over socio-economic groups is largely outside the realm of public health policy, whereas the modifiable aspect is the effect of socio-economic status on mortality (as measured by an effect index). Nevertheless, policy makers can address some features of the socio-economic distribution (such as income distribution or the educational level of disadvantaged groups) and this sometimes favours the inclusion of measures on total impact.

*3. Simple and/or sophisticated measurement techniques*

Most studies on mortality differentials apply simple measures such as rate ratios or rate differences. These indices have the advantage of easy calculation and straightforward interpretation. In addition, data problems are sometimes so large that there is no justification for using highly sophisticated summary measures.

The problem with these simple measures is, however, that they ignore parts of the available information that might be available. For example, rate ratio measures do not take into account the mortality rates of the socio-economic groups that are in-between the highest and lowest groups. A more complete assessment of mortality differences can be made with more sophisticated indices. They do this, however, at the expense of greater complexity in calculation. In addition, some of these measures have a complex interpretation and can easily lead to misunderstandings. Therefore, a good research practice is often to start with using simple measures and then to check the results obtained with simple measures against the results obtained with more refined measures.

Table 2.1 A framework of 12 indices for the magnitude of socio-economic differences in mortality (absolute versions of indices are given in italic).

| Degree of sophistication | Indices of effect | Indices of total impact | |
|---|---|---|---|
| | | no inequalities = everyone has (mortality of) high SES | no inequalities = everyone has (mortality of) average SES |
| Simple | Rate ratio of lowest versus highest group | Population attributable risk (%) | Index of dissimilarity (%) |
| | *Rate difference of lowest versus highest group* | *Population attributable risk (absolute version)* | *Index of dissimilarity (absolute version)* |
| Sophisticated | Regression-based index of relative effect | Regression-based population attributable risk (%) | Regression-based index of dissimilarity (%) |
| | *Regression-based index of absolute effect* | *Regression-based population attributable risk (absolute version)* | *Regression-based index of dissimilarity (absolute version)* |

### 2.6.2. A framework of 12 types of summary indices

The three considerations presented in section 3.1 can be combined into eight different classes of summary measures. Because, as will be shown below, the measures of total impact can be further divided in two groups based on their underlying assumptions, there are 12 types of summary measures, each represented by a cell in Table 2.1. For each type, the table mentions one example. The choice of examples is based on our desire to illustrate our framework with indices that have clear interrelationships. Excluded is a family of indices that will be discussed in the next section.

Details on the calculation of the different summary indices are given elsewhere (Kunst and Mackenbach 1994c, Mackenbach and Kunst 1997). Their application is illustrated in section 2.7. Whereas the differences between some indices seem subtle, section 2.7 shows that in practice they can work out very differently!

We start with four measures of effect.

*1. Mortality rate ratio of disadvantaged versus advantaged groups.* There are often many options for the choice of the groups to be compared. This choice should be a compromise between two conflicting requirements.

On the one hand, the two groups should not be so extreme that the summary measure ignores most of the population and that is becomes highly sensitive to idiosyncrasies of the two groups that are compared. On the other hand, the two groups should not be so broad that the summary measure conceals the real extent of mortality differences in the population. When occupational classes are to be compared, a good reference group is often the 'service class' and the low classes to be compared to this reference group may be the 'working class' or another lower class.

2. *Mortality rate difference between disadvantaged and advantaged groups.* This is the absolute equivalent to the mortality rate ratio.

3. *Regression-based index of relative effect.* A drawback of indices 1 and 2 is that they only take into account mortality differences between the two socio-economic groups that are compared and that they ignore all other mortality differences (differences within the two groups and differences with groups that are excluded from the comparison). For that reason, regression-based indices have been developed that consider all socio-economic groups separately and that assess how mortality levels vary according to the position of these groups in the social stratification system (Valkonen 1989). A convenient way of doing this is to apply regression analysis in which a mortality measure (the dependent variable) is related to the socio-economic status of these groups (the independent variable). This requires socio-economic status be converted into some numerical measure, such as years of education, average income or the score of occupations on a one-dimensional scale. This approach might also be applied to social class schemes if each occupational class could be given a score along a single hierarchical dimension. However, such a procedure would not do justice to the many social class schemes that are constructed on the basis of several criteria instead of one single hierarchical principle.

4. *Regression-based index of absolute effect.* Whereas relative effect indices express the proportional mortality increase with one unit decrease in socio-economic status, absolute effect indices express the absolute mortality difference associated with the same one unit decrease.

We continue with a number of measures of total impact, all related to the population-attributable risk. The PAR has been applied in some studies to express the importance of socio-economic differences in mortality to the overall level of mortality (Leon *et al.* 1992, Mackenbach 1992, Yeracaris 1978).

5. *Population-attributable risk (%).* The PAR can be interpreted as the proportional reduction in overall mortality levels that would occur in the hypothetical case that each socio-economic group would have the death rates

of the most advantaged group. It is calculated as the difference between the overall mortality level and the mortality level of the reference socio-economic group, e.g. the 'service class' or the people who have completed post-secondary education. The PAR not only reflects the mortality level of lower socio-economic groups as compared with the reference group, but also their population size: the larger the groups with high mortality levels, the larger the potential reduction in the overall mortality level.

*6. Population-attributable risk (absolute version).* Multiplying the PAR by a measure of the mortality level of population as a whole yields a measure of the absolute reduction of the overall mortality level, or increase in overall life expectancy, in the hypothetical case that each group would experience the mortality level of the most advantaged group.

*7. Regression-based population-attributable risk (%).* The simple calculation of the population-attributable risk is used at the price of ignoring the association between socio-economic status and mortality among all socio-economic groups below the reference group. A more sophisticated measure could be used (but has not yet been applied) that takes into account the association between socio-economic status and mortality across the entire social hierarchy. As with regression-based effect indices, this sophisticated version of the PAR can be calculated by regression analysis. The first step is to calculate the regression-based index of effect (index 3 or 4), and the next step is to recalculate the PAR. This calculation is identical to that of the simple PAR, except that the reference mortality level is not the *observed* mortality level of the highest socio-economic group, but the *predicted* mortality level of this group, or for some high value of socio-economic status, e.g. 20 years of education. The corresponding interpretation is that this index measures the proportional reduction in overall mortality level that would occur in the hypothetical case that everyone experiences the mortality level that, according to the regression model, corresponds to 20 years of education or any other high value of socio-economic status.

*8. Regression-based population-attributable risk (absolute version).* An absolute version of index 7 can be obtained by multiplying that index by a measure of the mortality level of the population as a whole.

Finally, we describe four alternative measures of total impact, all related to the Index of Dissimilarity. The ID has frequently been used to study mortality differences by socio-economic status and other socio-demographic variables (e.g. Koskinen 1988, Mackenbach 1993, Pappas *et al.* 1993).

*9. Index of Dissimilarity (%).* The ID can be interpreted as follows: the percentage of all deaths that has to be redistributed to obtain the same mortality level for all socio-economic groups. The ID is larger if the groups with the highest or lowest mortality rates are larger. This usually implies that the ID is larger if a larger part of the population is in the least or most advantaged socio-economic groups and relatively few people occupy intermediate positions. In other words, the ID is larger if inequalities in socio-economic variables themselves are large. The interpretation of the ID is subtly but significantly different from that of the population-attributable risk: whereas the ID reflects the extent to which the population distribution approaches the situation of the same socio-economic level for all, the population-attributable risk reflects the extent to which the population distribution approaches the situation of the same *high* socio-economic level for all. Section 2.7 shows how these two indices can produce very distinct results and offer complementary perspectives on socio-economic differences in mortality.

*10. Index of Dissimilarity (absolute version).* Multiplying the ID by the total mortality rate yields a measure of the total number of deaths (per 100 population) that has to be redistributed to obtain equality in mortality.

*11. Regression-based index of dissimilarity (%).* A drawback of the ID is that is does not take into account whether the highest mortality levels are found in the lower, the higher or intermediate socio-economic groups. A more sophisticated measure could be used (but has not yet been applied) that takes into account the association between socio-economic status and mortality. Just as with the sophisticated indices discussed above, the sophisticated version of the ID can be calculated on the basis of regression analysis. The first step is to calculate the regression-based index of effect (index 3 or 4), and the next step is to recalculate the ID. This calculation is identical to that of the simple ID, except that what is redistributed are not the observed number of deaths, but the number of deaths that were predicted with the regression model. The corresponding interpretation is that this index measures the percentage of all deaths that has to be redistributed to obtain the same *predicted* mortality level for all socio-economic groups. This is equivalent to a situation in which there is no systematic association between socio-economic status and mortality.

*12. Regression-based index of dissimilarity (absolute version).* Multiplying the regression-based ID by the total mortality rate yields a measure of the total number of deaths (per 100 population) that has to be redistributed to obtain the situation in which there is no systematic association between socio-economic status and mortality.

### 2.6.3. Another family of summary indices

Not discussed in the previous section is a family of summary indices that have been advocated and applied by different authors: the quintile ratio (Carr-Hill 1990), the relative index of inequality (Pamuk 1985 & 1988), the concentration index (Wagstaff *et al.* 1991), the pseudo-GINI coefficient (Leclerc *et al.* 1990), and a regression-based index developed by Minder (1991).

These measures have in common that they emphasize the relative nature of a person's position in the social stratification system. For example, having completed lower secondary education formerly implied a high knowledge level *as compared to* other people of the same generation, whereas it now means a relatively low knowledge level. This implies, among others, that older people with lower secondary education have had a relatively good position in the labour market whereas young people with the same educational level have not. In a similar way, it has been argued that the decrease in the proportion of men who work in unskilled manual occupations implies a decline in the relative position of those who are still working in these occupations (Carr-Hill 1990).

In each of the five measures discussed in this section, the relative nature of socio-economic status is consistently taken into account in the measurement of a person's socio-economic status. This socio-economic status is set equal to the proportion of the population that has a higher position in the social hierarchy. For example, if the highest educational group comprises 10 percent of the population, the relative position of its members would be between 0 and 0.1, the average being 0.05. If the next highest educational group comprises 20 percent of the population, the relative position of its members would be between 0.1 and 0.3, the average being 0.2.

The application of this principle and the place of the resulting summary indices in our framework of 12 types of indices is illustrated below for a pair of simple indices (numbers 13 and 14) and a pair of sophisticated indices (numbers 15 and 16).

*13. Mortality rate ratio of the lowest quintile versus the highest quintile.* The groups to be compared are defined in a purely relative sense: as the 20 percent (or any other percentage below 50) of the population with the lowest and highest socio-economic status respectively. The association with our framework of 12 types of indices can be illustrated with the following example. When applied to income, a large value of the quintile ratio implies large mortality differences between people with relatively low income and people with relatively high incomes. This large mortality difference can be attributed to (1) a large effect of income on mortality and/or (2) a large income gap between those at the top and those at the bottom of the income hierarchy. Thus, the quintile ratio not only reflects the effect of income on mortality but is also larger if inequalities in income themselves are larger. This implies that in terms of our framework of summary indices, the quintile ratio is a measure of total impact similar to the index of dissimilarity.

*14. Mortality rate difference of the lowest quintile versus the highest quintile.* The absolute equivalent to the quintile rate ratio is the mortality rate difference between the extreme quintile groups.

*15. The Relative Index of Inequality (RII).* A drawback of the quintile ratio and similar ratios is that they only take into account mortality differences between the groups that are compared and that they ignore all other mortality differences. This problem is avoided with the RII, a regression-based index which considers all socio-economic groups separately and assesses how mortality levels changes systematically according to the socio-economic status of these groups (Pamuk 1985 & 1988). That status is measured in the way discussed above, that is, between 0 and 1 according to the proportion of the population that occupies a higher position in the social stratification system. On the basis of the regression coefficient, a figure can be calculated with a fairly complex interpretation: the mortality level that the regression model predicts for those in the least advantaged position (with the position score of 1) as a ratio to the mortality level that is predicted for those in the most advantaged position (with score 0). In terms of our scheme of summary indices (Table 2.1), the RII is a measure of total impact similar to the regression-based index of dissimilarity. For example, when applied to income, this index does not only reflect the 'effect' of income on mortality, but also the size of income differences between people at high and at low positions in the income hierarchy.

*16. The Slope Index of Inequality (SII).* This absolute version of the RII expresses the magnitude of mortality differences along the social hierarchy in terms of the predicted mortality difference between the low and the high end of the hierarchy.

The RII and SII can be applied whenever the available socio-economic classification is strictly hierarchical. This is a very convenient property with classifications of people in educational levels or income groups. Most social class schemes, on the other hand, cannot be assumed to be hierarchical. Even if one is willing to assume that, for example, the class of lower non-manual employees has on the average a higher position than the class of skilled labourers, there is so much status overlap between individual workers of both classes that this invalidates the application of the 0-1 ranking procedure that underlies the RII and SII.

Mathematically nearly equivalent to the RII is the Concentration Index, which has been advocated by Wagstaff and Van Doorslaer (1991 & 1994). The main difference is that the RII is calculated on the basis of regression analysis, whereas the concentration index is based on the concentration curve. This curve has some similarities to the (pseudo-) Lorentz curve, which is widely used in income inequalities research (Kakwani 1980). The choice between the RII or the Concentration Index is in practice largely determined by the familiarity of the researcher with either regression analysis or the Lorentz curve and derived curves. To epidemiologists, who have regression analysis in their standard analytical repertoire, the RII is most convenient to use. The RII can be used in combination with different types of regression analyses, including logistic regression (Kunst et al 1995) and, what is most common in mortality analyses, Poisson regression (see chapters 3 and 4).

The index developed by Minder (1991) and the pseudo-Gini coefficient (Leclerc *et al.* 1990) are similar to, respectively, the RII and the concentration index. Their particular feature is that socio-economic groups are ranked along the 0-1 scale not according to their socio-economic status, but according to their mortality level. The rationale of such a way of ranking groups is not clear, and it anyhow creates circularity in the whole measurement procedure: first the mortality level of socio-economic groups is used to determine their position along a hierarchical scale, and then this position is used to predict mortality levels. Perhaps because of their ambiguous nature, these indices have not been applied after since their introduction.

### 2.6.4. Recommendations

Table 2.2 presents the 'relative' versions of the summary indices that we would recommend for consideration by researchers who want to measure the magnitude of socio-economic differences in mortality by means of one or more summary indices. The choice between the different indices should depend on the three basic considerations that are discussed in the previous sections and that will be illustrated in section 2.7.

Important is to note that the choice for a specific summary index also depends, of course, on the possibility to apply that index to the available data. Especially when comparisons are made between periods or across countries, the available data often impede the application of some or most summary indices. Therefore, Table 2.2 summarizes for each inequality index the requirements that it makes to data in comparative research.

Most demanding to the data is the regression-based index of dissimilarity, which as a general rule cannot be applied in comparative research. For that reason, we did not recommend this index in other publications. Instead, we suggested the use of the closely related Relative Index of Inequality (Kunst and Mackenbach 1994a, Mackenbach and Kunst 1997).

**Table 2.2** Overview of suggested summary indices for the magnitude of socio-economic differences in mortality.

| Summary index | Requirements to socio-economic data in comparisons over time or place |
|---|---|
| Ratio of two contrasting groups | - the two contrasting groups are identical for each period or area |
| Regression-based index of effect | - the same numerical measure of SES is used for each period or area |
| Population-attributable risk (PAR) | - the high reference group is identical for each period or area |
| Regression-based PAR | - the same numerical measure of SES is used for each period or area |
| Index of dissimilarity (ID) | - the socio-economic classification is identical for each period or area [a] |
| Regression-based ID | - the same numerical measure of SES is used for each period or area;<br>- the socio-economic classification is identical for each period or area [a] |
| Ratio of two percentile groups | - the two percentile groups (deciles, quintiles, etc) are identical for each period or area |
| Relative index of inequality | - the socio-economic classification is or concentration index strictly hierarchical for each period or area |

[a] More specifically, a comparison using the (regression-based) ID is biased if in one period or area a distinction is made between groups with lower and higher-than-average mortality rates whereas these groups are combined in the other period or area.

## 2.7 An illustration: trends in mortality differences in Finland in 1971-1990

Time trends are of central concern to the study of socio-economic differences in mortality. The suggestion of the Black Report (Townsend *et al.* 1988a) that mortality differences by occupational class increased in England & Wales during the post-war period generated wide interest among researchers and policy makers, engendered a hot debate on various measurement issues, and resulted in the introduction of several of the inequality indices discussed above (Carr-Hill 1990).

The purpose of this chapter is to illustrate with data from Finland how trends in mortality differences can be assessed. Finland has one of the best sources of data on mortality by socio-economic status in the world. Data from the national mortality registry can be retrospectively linked to the socio-economic characteristics of the deceased as registered at the last population census. The linkage started with the 1971 census, following up for mortality in subsequent years, and has been repeated with the censuses of 1975, 1980 and 1985. Finland was the first country for which individual-level data on trends in mortality differences during both the 1970s and the 1980s were reported.

All data used in this section come from detailed reports of Valkonen *et al.* (1990b & 1993). Mortality data are presented by both occupational class and educational level. Both socio-economic indicators are included in this example because of their complementary nature, and because this gives us the opportunity to illustrate the different ways in which mortality by occupational class and mortality by educational level should be analyzed.

### 2.7.1. Occupation

Table 2.3 presents basic data on the situation in 1971 and 1990 respectively. Four occupational classes are distinguished (except for a small groups of other occupations): upper white-collar employees, lower white-collar employees, manual workers and farmers. Such broad groups had to be formed in order to achieve comparability over time. Men that were economically inactive at the time of the last census were classified according to the occupation of the head of household.

**Table 2.3** Distribution (%) of the Finnish population aged 35-64 years according to occupational class.

| Occupational class | Men | | Women | |
|---|---|---|---|---|
| | 1971 | 1990 | 1971 | 1990 |
| Upper white collar | 8 | 16 | 6 | 12 |
| Lower white collar | 13 | 17 | 23 | 41 |
| Manual workers | 50 | 48 | 40 | 33 |
| Farmers | 22 | 9 | 22 | 7 |
| Total (including other occupations) | 100 | 100 | 100 | 100 |

**Figure 2.2** The probability of dying between the 35th and 65th birthday. Finnish men and women, according to occupational class, 1971-1990.


Figure 2.2 shows trends in mortality according to occupational class between 1971 and 1990. The mortality level is expressed as the probability of dying between the ages of 35 and 64 years.

Between 1971 and 1990, the probability of dying declined among men and women in all occupational classes. The constant distance between the lines for manual workers and upper white-collar employees suggest that the absolute mortality difference between advantaged and disadvantaged occupational classes has not substantially changed. Since the overall probabilities have strongly declined, the constant differences in absolute terms imply widening differences in relative terms. The situation of the farmers' wives has deteriorated in both absolute and relative terms.

**Table 2.4** Summary measures on the magnitude of mortality differences by occupational class among Finnish men and women aged 35-64 years.

| Summary measure | Men | | Women | |
|---|---|---|---|---|
| | 1971-75 | 1986-90 | 1971-75 | 1986-90 |
| Ratio of probabilities of dying [a] | 1.58 | 1.86 | 1.34 | 1.41 |
| *Difference between probabilities of dying (%)* [a] | 13.2 | 13.3 | 3.6 | 3.3 |
| Population Attributable Risk (PAR; %) [b] | 30.0 | 38.0 | 19.5 | 20.4 |
| *PAR x overall probability of dying (%)* | *9.8* | *9.5* | *2.6* | *2.1* |
| Index of Dissimilarity (ID;%) | 7.5 | 11.7 | 4.9 | 7.4 |
| *ID x overall probability of dying (%)* | *2.5* | *2.9* | *0.7* | *0.8* |

[a] Manual workers *versus* upper white-collar employees
[b] Upper white-collar employees as reference category

Table 2.4 shows that the ratio of the probability of dying among manual workers as compared to upper white-collar employees increased, both among men and women. The absolutes difference remained more or less the same among men and decreased among women.

The population-attributable risk (PAR; %) increased too. Thus, despite the declining proportion of Finns belonging to the class of manual workers, an increase occurred in the extent to which the overall probability of dying could be reduced by lowering the mortality rate of the whole population to that of upper white-collar employees. This increase in the total impact of socio-economic differences in mortality only occurred in relative terms; the absolute version of the PAR became smaller.

Finally, the index of dissimilarity (ID; %) increased substantially. Even the absolute version of this index increased for both men and women. This increase can be explained by increasing social class differentiation within the population. As shown in Table 2.3, in 1971 many men and women were manual workers and few were in the highest occupational class, whereas by 1990 the spread over occupational classes was much more even. This implied an increase in the proportion of men and women in jobs with higher status (thus leading to the only modest increase of the PAR) but also implied an increase in the variation within the population in occupational status (thus contributing to the large increase in the ID). This shift of the population towards higher occupational classes is thus valued differently by the PAR and by the ID. The PAR reflects the fact that, because of this shift, more people enjoy the favourable mortality level of the higher occupational class, whereas the ID reflects the fact that the social class distribution has become less homogeneous.

Of course, both indices are simple thought experiments. Using them to measure the magnitude of occupational class differences in mortality does not require the user to believe that these experiments can ever be carried out in real life.

Similar to many other social class schemes, the classification in Finland is not hierarchical. Upper white-collar employees are higher in the social hierarchy than lower white-collar employees, but the latter are not necessarily more advantaged than manual workers. The relative position of farmers is even more difficult to determine. This precludes the use of the RII. For similar reasons, other regression-based summary indices are difficult to apply to this social class scheme.

### 2.7.2. Education

Table 2.5 presents basic data on the situation in 1971 and 1990 respectively. Three educational levels are distinguished: completed no or only elementary education, completed secondary education, and completed post-secondary education. The population distribution over these three levels is very uneven, especially in 1971, due to the fact in the population censuses no further distinction was made among the many people who did not complete secondary education.

**Table 2.5** Distribution (%) of the Finnish population aged 35-64 years according to level of education.

| Educational level | Men | | Women | |
|---|---|---|---|---|
| | 1971 | 1990 | 1971 | 1990 |
| Elementary | 78 | 50 | 81 | 52 |
| Secondary | 16 | 38 | 14 | 37 |
| Post-secondary | 6 | 12 | 5 | 11 |
| Total | 100 | 100 | 100 | 100 |

**Figure 2.3** The probability of dying between the 35th and 65th birthday. Finnish men and women, according to educational level, 1971-1990.

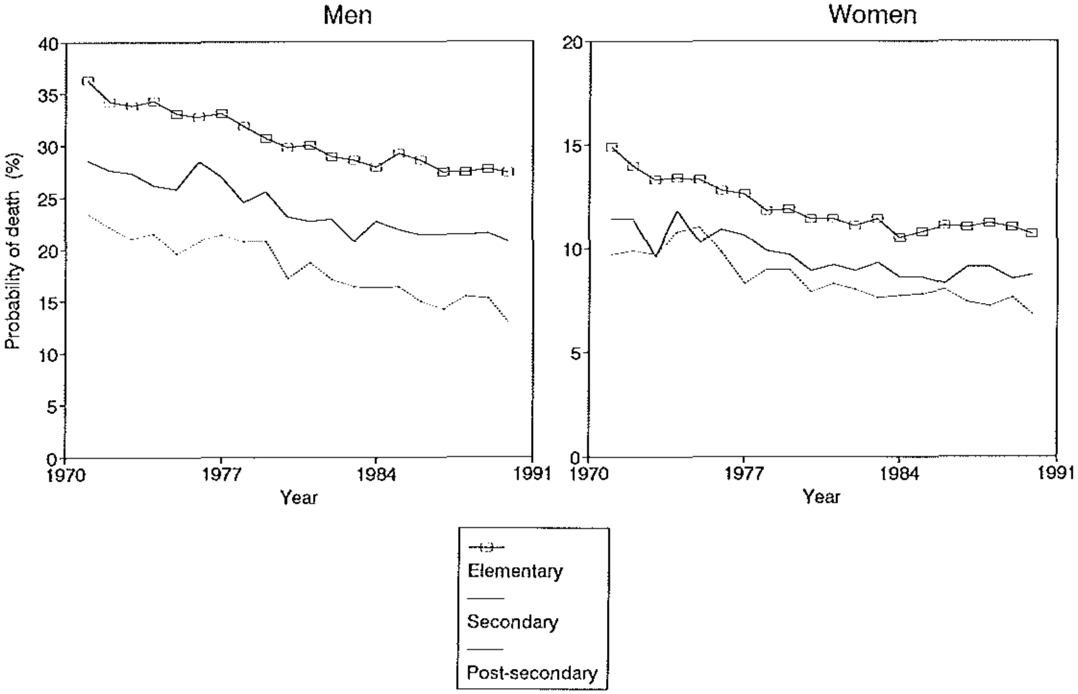



Figure 2.3 shows trends in mortality according to educational level between 1971 and 1990. The probability of dying declined steadily among men and women of all educational levels. The constant distance between the lines for the highest and lowest educational levels suggests that the absolute mortality difference has not substantially changed. Since the overall probabilities have strongly declined, the constant differences in absolute terms imply widening differences in relative terms. Among women, the mortality difference between secondary and post-secondary education has increased in both absolute and relative terms.

Table 2.6 confirms the impression from Figure 2.3: the ratio of the probability of dying at the lowest level as compared to the highest level increased, whereas the absolutes difference remained more or less the same among both men and women.

The PAR increased moderately. Thus, despite the decreasing proportion of Finns with lower education, an increase occurred in the extent to which the overall probability of dying would be reduced when the mortality rate of people with low education would become equal to the rate of people with post-secondary education. This increase in the total impact of socio-economic differences in mortality only occurred in relative terms; the absolute version of the PAR became slightly smaller.

The ID increased substantially. Even the absolute version of this index increased for both men and women. This increase can be explained by an increase in the educational inequality within the Finnish population. As shown in Table 2.5, the share of the population having only basic education declined (thus leading to the only modest increase of the PAR) but the distribution of the population over educational levels became less homogeneous (thus contributing to the large increase in the ID).

**Table 2.6** Summary measures on the magnitude of mortality differences by educational level among Finnish men and women aged 35-64 years.

| Summary measure | Men | | Women | |
|---|---|---|---|---|
| | 1971-75 | 1986-90 | 1971-75 | 1986-90 |
| Ratio of probabilities of dying [a] | 1.59 | 1.91 | 1.34 | 1.49 |
| *Difference between probabilities of dying (%)* [a] | *12.8* | *13.2* | *3.6* | *3.6* |
| Population Attributable Risk (PAR; %) [b] | 34.0 | 41.6 | 23.0 | 26.6 |
| *PAR x overall probability of dying (per 100 people)* | *11.1* | *10.4* | *3.1* | *2.7* |
| Index of Dissimilarity (ID; %) | 4.4 | 8.1 | 3.4 | 6.3 |
| *ID x overall probability of dying (per 100 people)* | *1.4* | *2.0* | *0.4* | *0.6* |

[a] Elementary *versus* post-secondary education
[b] Post-secondary education as reference category

There seems to be little need for applying more sophisticated summary indices, since the basic pattern presented in Figure 2.3 is fairly clear and the simple summary indices of Table 2.6 seem to be able to adequately represent this pattern. It is therefore mainly for illustrative purposes that we present estimates from sophisticated measures.

To calculate these regression-based measures, the educational levels had to be converted into some numerical measure. We use here the minimum number of years of schooling needed to achieve these educational levels (estimated to be 8, 11 and 15.5 years, respectively). Figure 2.4 presents the associations between mortality probabilities (on a logarithmic scale) and the estimated numbers of years of education. These associations were modelled by ordinary least-squares regression analysis, with the logarithmically transformed mortality probabilities as the dependent variable.

**Figure 2.4** The probability of dying between the 35th and 65th birthday. Finnish men and women, according to number of years of education, 1971-1975 and 1986-1990.

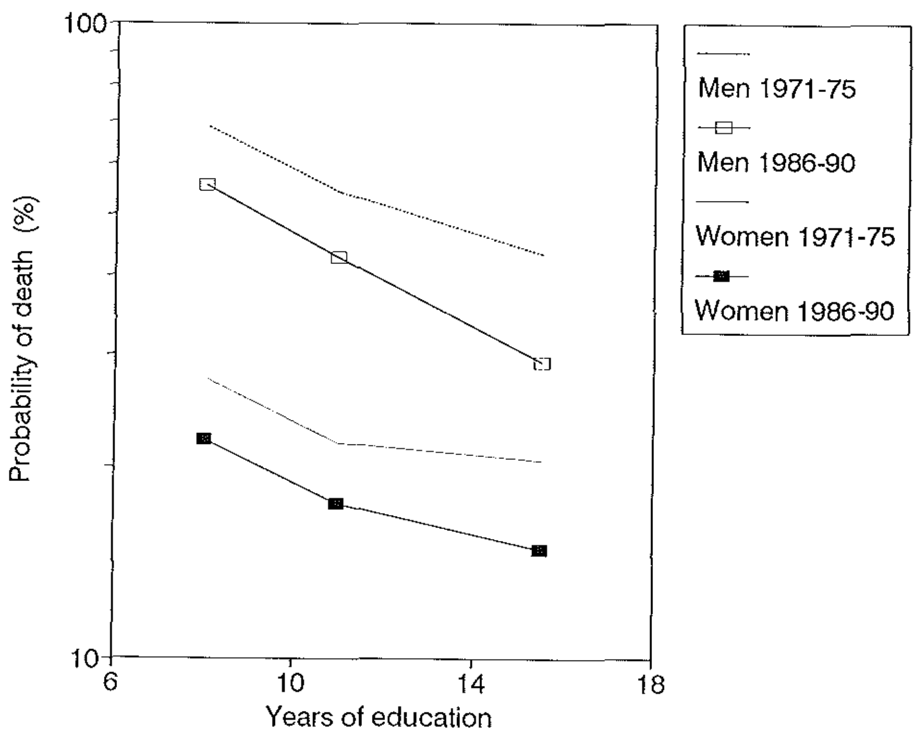


**Table 2.7** Regression-based summary measures on differences in mortality by educational level among Finnish men and women aged 35-64 years.

| Summary measure | Men | | Women | |
|---|---|---|---|---|
| | 1971-75 | 1986-90 | 1971-75 | 1986-90 |
| Regression-based index of relative effect [a] | 1.063 | 1.087 | 1.042 | 1.054 |
| *Regression-based index of absolute effect [b]* | *1.56* | *1.58* | *0.46* | *0.45* |
| Regression-based estimate of PAR (%) [c] | 32.9 | 38.7 | 24.7 | 26.4 |
| *Regression-based PAR x overall probability of dying (per 100 people)* | *10.8* | *9.6* | *3.3* | *2.7* |
| Regression-based estimate of ID (%) | 5.0 | 10.1 | 2.6 | 6.4 |
| *Regression-based ID x overall probability of dying (per 100 people)* | *1.6* | *2.5* | *0.3* | *0.6* |

[a] Probability ratio for one year less education
[b] Predicted difference between those with 10 and 11 years of education in probability of dying (per 100 people)
[c] 15.5 years as reference value

The regression coefficients were translated into the regression-based index of relative effect that is presented in Table 2.7. This index is 1.063 for men in the period 1971-75, which implies that one year of education less increased the mortality probability by 6.3%. The estimate for men in 1986-1990 is 8.7%, which implies an about 40 percent increase during the study period. This is virtually the same magnitude of increase as was observed with the simple probability ratios. Also for women, the regression-based index of relative effect confirms the trend towards larger mortality differences that was observed with rate ratios.

The regression-based versions of the PAR and the ID yield estimates that are close to the estimates with the simple versions of these indices. The largest discrepancy concerns women in 1971-75, for which the simple ID yields a larger value than the regression-based ID. The explanation for the larger value of the simple ID is that the association between educational level and mortality was irregular in 1971-75 (see Figure 2.4) so that the simple ID includes some mortality variation that is not systematically related to educational level.

### 2.7.3 Discussion

There is something odd with our analysis of the Finnish material: the number of basic figures on mortality and population size is exceeded by the number of indices that are supposed to *summarize* these basic figures! We should stress, however, that the purpose of this analysis was to illustrate *all* possible summary indices. The first message from this example is, then, that in specific studies one should make a choice between the various possible indices and, to this end, one should make explicit one's position with respect to the different perspectives that are embodied in the different indices.

The most often used summary indices are ratio measures. Application of these measures in trend studies from other countries suggest that widening mortality differences between specific socio-economic groups is a generalised phenomenon in industrialised countries (e.g. Dahl and Kjaersgaard 1993b, Desplanques 1984, Goldblatt 1989, Harding 1995, Marmot and McDowall 1986, Pappas *et al.* 1993, Pearce *et al.* 1991). The increasing disparities in mortality between specific groups is in itself sufficiently disquieting to bring it to the attention of health-policy makers, and to try to explain it by in-depth studies on trends in specific causes of death, risk factors for disease such as drinking and smoking, and more distal socio-economic or socio-cultural factors.

But this is not the only message arising from the Finnish data. Other inequality indices embody supplementary perspectives, most of which give a less gloomy picture.

Measures of absolute effect show constant instead of widening mortality differences between socio-economic groups. They show that the increasing *relative* mortality differences are compensated for by a decrease in overall mortality levels, with the nett result that the *absolute* mortality excess of lower socio-economic groups is not larger in 1990 than it was in 1971. Although this is perhaps a less interesting fact from an analytical point of view, it is highly relevant for public health and for the people themselves, since it is the absolute chance of dying or surviving that counts for the people.

Another trend which has tended to mitigate the effect of widening mortality disparities between socio-economic groups is the decrease in number of people which are living in the least advantaged groups. Behind this trend are fundamental changes that occur in modern societies, namely the shift in the economy from the goods production (manual work) to the service industry (non-manual work), and the steady cohort-wise increase in educational levels. Although these changes may be viewed as outside the realm of public health policy, they are sensitive to socio-economic policies in general. Because ever less people experience the high chances of dying of the least advantaged groups, the total impact of socio-economic differences in mortality on the overall mortality level of Finland has not increased that much, and even decreased in an absolute sense.

However, this development has a counter-side that is expressed in the index of dissimilarity. The steady decline in the number of people living in disadvantaged groups also implies that in some sense socio-economic inequalities have increased: whereas the high chances of dying were previously shared by the large majority of the people, now these chances are confined to a minority of low educated people or those who are (economically dependent on) manual workers. Indeed, if one would insist on a semantically precise interpretation of the term 'inequalities', one would stick to the latter perspective and state that 'inequalities' in mortality have increased over time.

It is a matter of subjective judgement how to look at changes in the socio-economic composition of the population. Frequently, these is no clear preference for either of the two perspectives presented above, and the presentation of both perspectives provides interesting material for discussion among researchers and policy makers.

## Chapter three

# Mortality and occupational class in 7 western European countries

## 3.1 Summary

Previous cross-national comparisons on the size of mortality differences by occupational class relied on summary indices with one or more drawbacks. This study re-assesses the international pattern of mortality differences by using a sophisticated summary index.

Data on mortality by occupational class were obtained from longitudinal studies from seven countries. The data referred to men 35-64 years. Follow-up periods were between about 1970 and 1981. The size of mortality differences by occupational class was measured by a modification of the *Relative Index of Inequality.*

Application of this index demonstrated considerable cross-national variations in the magnitude of mortality differences associated with occupational class. The smallest differences were observed in Norway, Denmark and Sweden, with slightly larger mortality differences in England & Wales. The largest mortality differences were observed in Finland and, especially, France. Mortality differences by occupational class in a Dutch city, Rotterdam, were as small as in Danish and Swedish cities, and smaller than in Finnish and French cities. Results of sensitivity analyses suggested that this international pattern can probably to only a small extent be attributed to differences between countries with respect to the measurement of occupational class.

The results of most previous international comparisons fit in the general pattern observed here. This simultaneous comparison of several countries shows that the frequently cited difference between Sweden and England & Wales is small from a wider international perspective.

## 3.2 Introduction

During the 1980s, various authors have addressed the question whether socio-economic differences mortality in their own country are small or large as compared to other countries (Kagamimori *et al.* 1983, Leclerc *et al.* 1984 and 1990, Lynge *et al.* 1989, Minder 1991, Neumann and Liedermann 1981, Vågerö and Lundberg 1989, Valkonen 1987 & 1989). Unfortunately, as Wagstaff *et al.* (1991) argued, these comparisons relied on inequality indices with one or more drawbacks. Some comparative studies relied on inequality indices which consist of a ratio of the mortality rates of two contrasting occupational classes, e.g., unskilled labourers and professionals (e.g. Kagamimori *et al.* 1983, Leclerc *et al.* 1984, Vågerö and Lundberg 1989). Their drawback is that all other occupational classes are excluded from the calculation of the index. This drawback is overcome in studies which rely on ratios that compare two broad groups which together cover (almost) the entire population, e.g., manual and non-manual classes (e.g. Vågerö and Lundberg 1989, Valkonen 1987). This index, however, fails to take into account the relationship between occupational status and mortality *within* these broad groups.

A few international comparisons attempted to overcome these drawbacks by using indices that consider all occupational classes separately (Leclerc *et al.* 1990, Minder 1991). These indices have in common that they measure *all* mortality differences between occupational classes. However, it might be more informative to measure *only* the mortality differences that are systematically related to the ordering of occupations from high to low status, and thus to take into account whether mortality is positively, inversely or not systematically related to occupational status.

It has been suggested that the choice of the inequality measure could be crucial to the assessment of international variation in the magnitude of mortality differences (Wagstaff *et al.* 1991). For example, Leclerc *et al.* (1990), who applied a measure on the size of *all* mortality differences between occupational classes (the pseudo-Lorentz curve), found larger differences for Finland than for England & Wales. Wagstaff *et al.* (1991), however, who applied a measure on the size of mortality differences that were systematically related to the status of occupational classes (the concentration index), found that mortality differences in Finland were smaller than in England & Wales.

The purpose of this chapter is to re-assess international variation in mortality differences associated with occupational status. We will apply the *Relative Index of Inequality (RII)*, which has been developed by Pamuk (1985 & 1988) in her analyses of time trends in class differences in mortality in England & Wales. This index does not suffer from the drawbacks mentioned above (Wagstaff *et al.* 1991) yet it has not been applied before in international comparisons.

## 3.3 Material and methods

*Material*

Data were obtained on the number of deaths and the number of person-years at risk by age group and occupational class. Two data sets were created, one referring to national populations and the other to large cities. The latter data set was created in order to be able to include data for the Netherlands, where a study was carried out in Rotterdam (Appels *et al.* 1990). Table 3.1 presents the selected studies and some of their characteristics. The Rotterdam study consists of a mortality follow-up to an epidemiological survey of a sample of 3365 men. All other studies consist of a mortality follow-up of national population censuses by linkage of census records to the death registry.

These studies were selected because they met the following criteria: (1) the study design was longitudinal, (2) the study population consisted of (a representative sample of) all men approximately 35-64 years old, (3) the start of follow-up was in the early 1970s, (4) the length of follow-up was 10 years. For various countries, unpublished tabular data were obtained in order to be able to meet these criteria. The follow-up period in the French study was 5 instead of 10 years (Desplanques 1984).

**Table 3.1** Overview of sources of data.

| Country or city | Reference, data source [a] | Follow-up period | Age groups in available data [b] |
|---|---|---|---|
| Rotterdam | *Appels et al (1990)* | 1972-1982 | 45-49, 50-54, 55-59 |
| Denmark | Andersen (1985) | 1970-1980 | 35-39, 40-44, .. 60-64 |
| Copenhagen | Andersen (1985) | 1970-1980 | 35-64 [c] |
| Norway | *Kristofersen (1986)* | 1970-1980 | 35-39, 40-44, .. 60-64 |
| Sweden | *Vågerö and Norell (1989)* | 1971-1980 | 35-39, 40-44, .. 60-64 |
| Stockholm, Gothenburg, Malmö | *Vågerö and Norell (1989)* | 1971-1980 | 35-39, 40-44, .. 60-64 |
| Finland | *Valkonen et al (1990b)* | 1970-1980 | 35-39, 40-44, .. 60-64 |
| Helsinki | *Valkonen et al (1990b)* | 1970-1980 | 35-39, 40-44, .. 60-64 |
| England & Wales | *Fox and Goldblatt (1982)* | 1971-1981 | 35-39, 40-44, .. 60-64 |
| France | Desplanques (1984) | 1975-1980 | 35-44, 45-54, 55-64 |
| French cities [c] | Desplanques (1984) | 1975-1980 | 30-64 [c] |

[a] If publications are given in italic data were obtained from unpublished tables. Otherwise data were extracted from publications.

[b] Age at beginning of follow-up, except for France, where data refer to age at death.

[c] All cities with more than 200 000 inhabitants except Paris.

As will be explained in the next section, application of the RII requires that occupations are classified hierarchically, i.e., from high to low socio-economic status. The preferred occupational classification comprised the following occupational classes: (a) non-manual classes, upper level, (b) non-manual classes, lower level, (c) skilled manual workers, and (d) unskilled manual workers. On the premise that manual occupations have a lower status than non-manual occupations (this premise will de discussed at the end of this article) this classification can be considered to be hierarchical.

The available data had to rely on the occupational classifications that were used in the respective countries. These classifications are presented in Table 3.2. Differences can be noted with respect to three points.

1. Distinctions between high and low level non-manual classes, and between skilled and unskilled manual classes. These distinctions commonly take into consideration the educational requirements, supervisory power and prestige of occupations. The available occupational classifications differ, however, with respect to both the extent to which these characteristics are explicitly applied, and the relative weight given to each characteristic. For example, whereas most socio-economic classifications give much weight to educational requirements and supervisory power, the British Registrar General's social class scheme is to large extent a classification of occupations according to their general standing in society (OPCS 1980). An additional difference between countries refers to the number of manual and non-manual classes that are distinguished, and the population sizes of these classes. Whereas detailed distinctions could be made for France and England & Wales, the Swedish data only permitted the distinction between manual workers, high-level non-manual classes and intermediate/low-level non-manual classes.

2. Treatment of self-employed men. In England & Wales, self-employed men are assigned to manual or non-manual classes on the basis of the prestige of their occupation. In other countries, however, self-employed other than professionals are classified in separate categories (farmers and other self-employed). The problem with these categories is that they are highly heterogenous with respect to socio-economic status and therefore do not neatly fit in a hierarchical order of occupational classes (Erikson and Goldthorpe 1992a, Ganzeboom *et al.* 1989, Treiman 1977).

3. Treatment of economically inactive men. In the Finnish data, most inactive men could be assigned to an occupational class on the basis of their last occupation. In other countries, however, (a part of) inactive men are classified in separate categories. Unfortunately, the exclusion of inactive men results in an appreciable underestimation of the magnitude of socio-economic differences in mortality (Dahl and Kjaersgaard 1993a, Goldblatt 1989, Valkonen and Martikainen 1997).

Below we will evaluate the effects that these data problems could have on comparisons between countries.

**Table 3.2** Distribution of study populations over occupational classes.

| Country or city *[a]* | Occupational groups *[b]* | Share (%) in the total study population *[c]* | |
|---|---|---|---|
| Rotterdam | Professionals and upper-level employees | 14.3 | |
| | Employees, intermediate level | 10.7 | |
| | Employees, lower level | 18.9 | |
| | Self employed men | 8.8 | |
| | Labourers, (semi-)skilled | 36.7 | |
| | Labourers, unskilled | 10.6 | |
| | *Information missing* | | *1.7* |
| Denmark | Self employed men, level I to II [d] | 6.0 | |
| | Employees, level I to IV [d] | 27.4 | |
| | Farmers and fishermen | 12.6 | |
| | Self employed men, level III | 10.5 | |
| | Labourers, skilled | 13.3 | |
| | Labourers, semi- and unskilled | 30.2 | |
| | *Family workers and inactive men* | | *7.2* |
| Norway | Employees, upper and intermediate level | 24.6 | |
| | Employees, lower level | 3.9 | |
| | Farmers and fishermen | 12.2 | |
| | Self employed men | 10.4 | |
| | Labourers, skilled | 12.9 | |
| | Labourers, semi- and unskilled | 36.0 | |
| | *Inactive men* | | *8.6* |
| Sweden | Professionals and upper-level employees | 4.0 | |
| | Other employees, technicians | 31.0 | |
| | Farmers | 7.6 | |
| | Self employed men | 7.8 | |
| | Labourers | 49.6 | |
| | *Inactive men* | | *10.1* |
| Finland | Employees, upper level | 7.5 | |
| | Employees, lower level | 13.0 | |
| | Self-employed men [e] | 6.6 | |
| | Farmers | 22.3 | |
| | Labourers, skilled | 36.6 | |
| | Labourers, semi- and unskilled | 14.0 | |
| | *Information missing* | | *1.7* |
| England & Wales | Professionals (class I) | 5.0 | |
| | Employers and employees (II) | 20.4 | |
| | Employees, lower level (IIIN) | 10.8 | |
| | Skilled labourers, foremen (IIIM) | 37.6 | |
| | Semi-skilled labourers, personal service and agricultural workers (IV | 18.3 | |
| | Unskilled labourers (V) | 7.9 | |
| | *Information missing, Armed forces, permanently sick* | | *4.1* |
| France [f] | Cadres supérieurs et professions libérales | 10.3 | |
| | Instituteurs, techniciens, cadres moyens | 11.2 | |
| | Employés | 9.6 | |
| | Agriculteurs | 10.2 | |
| | Artisans et petis commerçants | 8.6 | |
| | Contremaîtres | 4.6 | |
| | Ouvries qualifiés | 18.5 | |
| | Ouvriers spécialisés | 17.2 | |
| | Salariés agricoles | 2.7 | |
| | Manoeuvres | 7.0 | |
| | *Other active men [g]* | | *5.5* |
| | *Inactive men* | | *13.1* |

*Notes to Table 3.2:*

[a] Data for cities from France and Scandinavian countries are based on the same occupational classification as the national data.

[b] Occupational groups given in italic are excluded from analysis. Occupational groups are presented in the order from high to low status. The same order was assumed when calculating the inequality index (see section 3.3).

[c] Numbers at the beginning of follow-up. In the left column: as % of all subjects included in the analysis; in the right column: as % of all subjects.

[d] In the analysis a further distinction was made by level.

[e] Self employed men in Finland include professionals.

[f] Instituteurs = teachers. Contremaîtres = foreman. Manoeuvres= unskilled manual workers.

[g] Employers in commerce, service workers, armed forces, clergy, artists. They were excluded because no detailed mortality data were available.

*Methods*

The RII is based on regression analysis. The application of regression analysis requires that the socio-economic status (SES) of occupational classes is quantified. This SES is quantified by conceptualising it as the relative position of occupational classes on the occupational hierarchy. More specifically, SES is equated to the proportion of men with a higher position on this hierarchy. For example, if the highest occupational group comprises 10 percent of the population, this proportion is on the average 0.05. If the next highest group also comprises 10 percent of the population, its proportion is on the average 0.15.

We related the SES measure to mortality by means of Poisson regression. The regression equation is

$$\log(D_{ij}) = \log(P_{ij}) + \alpha_i + ß^*SES_j$$

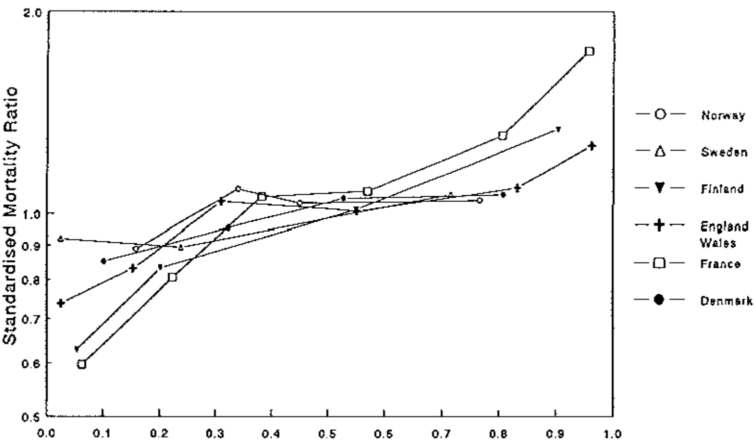
where D is the observed number of deaths, P is the number of person-years at risk, and SES is the 0-1 variable on socio-economic status. The subscripts i and j denote age group and occupational group. $\alpha$ and ß are the regression coefficients.

The formula $\exp^{\beta}$ yields the inequality index used in this study, the RII. It represents the mortality level that the regression model predicts for those with the lowest occupational status (with the SES score of 1) as a ratio to the mortality level that is predicted for those with the highest occupational status (with score 0).

## 3.4 Results

*Inequality in mortality at national level: basic estimates*
Figure 3.1 shows the relationship between mortality and occupational status for each country. Occupational classes are ranked between 0 and 1 according to the procedure outlined in section 3.3. In countries where self-employed men are assigned to a separate category, they were excluded from the figure.

**Figure 3.1** Mortality level by occupational class in six countries. Occupational classes are ranked between 0 (the upper end of social hierarchy) and 1 (the lower end) on the basis of their cumulative population size.




In general, low status (i.e. a high score on the X axis) is associated with a substantial mortality excess. Often, the increase in mortality with increasing status is not linear. Most inconsistencies could have resulted from chance fluctuations in numbers of death of small occupational classes. A consistently occurring non-linearity is that the death rates of skilled manual workers are nearly as low as or even lower than those of lower-level employees.

In France and Finland, low socio-economic status is associated with a relatively large mortality excess. Smaller mortality differences are observed for England & Wales; the large mortality deviations of the two outermost classes (occupational classes I and V) are related to the small population sizes and, correspondingly, extreme socio-economic status of these classes. Socio-economic differences in mortality in Denmark, Norway and Sweden are small and principally consist of lower mortality rates of employees at the upper and intermediate level.

Corresponding estimates on the basis of the RII are presented in Table 3.3, column 1. The smallest inequality estimates are observed for Norway and Denmark. Compared to Norway, larger mortality differences are observed for Sweden (about 1.5 times as large), England & Wales (2 times), Finland (5 times) and France (8 times).

**Table 3.3** The magnitude of mortality differences by occupational class: the Relative Index of Inequality (RII). Three variants (see text). Men circa 35-64 years at start of follow-up.

| Country | Basic estimate | | Manual versus non-manual | | Including self-employed | |
|---|---|---|---|---|---|---|
| | RII | 95% CI | RII | 95% CI | RII | 95% CI |
| Finland | 1.95 | (1.90 - 2.01) | 1.96 | (1.90 - 2.03) | 1.80 | (1.76 - 1.84) |
| Sweden | 1.29 | (1.26 - 1.32) | 1.30 | (1.27 - 1.34) | 1.27 | (1.24 - 1.30) |
| Norway | 1.18 | (1.14 - 1.22) | 1.21 | (1.16 - 1.25) | 1.20 | (1.16 - 1.23) |
| Denmark | 1.23 | (1.19 - 1.26) | 1.25 | (1.22 - 1.29) | 1.25 | (1.22 - 1.28) |
| England & Wales | 1.40 | (1.31 - 1.51) | 1.36 | (1.25 - 1.48) | | *no data* |
| France | 2.66 | (2.45 - 2.88) | 2.14 | (1.96 - 2.34) | 2.29 | (2.13 - 2.46) |

*Inequality in mortality at national level: sensitivity analyses*

A number of evaluations was made of the sensitivity of (international variation in) the inequality estimates to the three data problems discussed in section 3.3.

1. Distinctions between high and low level non-manual classes, and between skilled and unskilled manual classes. Countries were found to differ with respect to the criteria and the level of detail used in these distinctions. In order to remove this international variation, inequality estimates were made on the basis of a simple classification which could be applied to all countries: all manual classes *versus* all non-manual classes. Results are given in Table 3.3, column 2. The new RII values are close to the estimates of column 1. As a consequence, also the international pattern is nearly identical.

The exception is France, where the RII decreases by about 25 percent if no distinction is made within the manual classes and within the non-manual classes. This can be understood from Figure 3.1, which shows that mortality differences in France were especially large between manual classes, and between non-manual classes. Not taking into account these differences results in a smaller inequality estimate for France. Even that estimate, however, is almost 6 times larger than the corresponding estimate for Norway.

2. Treatment of self-employed men. Whenever farmers and other self-employed men are assigned to separate categories, they do not neatly fit into an hierarchical order and had therefore to be excluded from analysis. They could tentatively be included, however, since on the average, they have a status in-between that of manual and non-manual classes (Erikson and Goldthorpe 1992a, Ganzeboom *et al.* 1989, Treiman 1977). The corresponding inequality estimates are presented in Table 3.3, column 3. The new inequality estimates are close to the estimates of column 1, except that the French estimates decreased by approximately 25 percent.

3. Treatment of economically inactive men. Inactive men had to be excluded from most countries except Finland. Their exclusion causes an underestimation of the size of socio-economic differences in mortality (Dahl and Kjaersgaard 1993a, Goldblatt 1989, Valkonen and Martikainen 1997). An evaluation of the potential effect on the RII is given in Table 3.4. This table deals with the question whether differential treatment of inactive men could explain the fact that smaller socio-economic differences in mortality were observed for England & Wales (where inactive men are excluded) than for Finland (where they are included). Including the unemployed and retired to the data for England & Wales raises inequality estimates from 1.40 to 1.48 (column 1). The new inequality estimate for England & Wales is still substantially smaller than the Finnish estimate.

**Table 3.4** Evaluation of the effect of including economically inactive men on the comparison between England & Wales and Finland. Men circa 35-64 years at start of follow-up.

| Country | All 10 years of follow-up | | First 5 years of follow-up | | Last 5 years of follow-up | |
|---|---|---|---|---|---|---|
| | RII | 95% CI | RII | 95% CI | RII | 95% CI |
| England & Wales | | | | | | |
| - excluding all inactive men | 1.40 | (1.31 - 1.51) | 1.24 | (1.11 - 1.39) | 1.58 | (1.44 - 1.72) |
| - excluding only permanently sick | 1.48 | (1.39 - 1.58) | 1.35 | (1.21 - 1.50) | 1.59 | (1.46 - 1.72) |
| Finland | 1.95 | (1.90 - 2.01) | 1.95 | (1.87 - 2.03) | 1.98 | (1.91 - 2.06) |

However, the estimates for England & Wales still excluded the 'permanently sick', who made up 2.7 percent of the total population (Fox and Goldblatt 1982). The potential bias resulting from their exclusion is evaluated in Table 3.4 by distinguishing two follow-up periods: 0-4 years and 5-9 years. The rationale for this procedure is that exclusion of inactive men deflates inequality estimates principally in the first years of follow-up, while after 5 years this bias wanes off because of mortality selection (Fox and Goldblatt 1982, Goldblatt 1989). This is reflected in the inequality index, which increases during the follow-up period from 1.35 to 1.59. The inequality estimate of 1.59 for the follow-up period 5-9 years is nearly equal to the estimate of 1.58 that is based on data from which all inactive men are excluded. This suggests that inequality estimates for 5 to 9 years of follow-up are practically insensitive to exclusion of inactive men at the start of follow-up.

The inequality estimate for Finland remains virtually the same with increasing follow-up. This is in agreement with the idea that inequality estimates increase strongly with increasing follow-up only if inactive men are excluded at the start of follow-up. Also after 5 to 9 years of follow-up, the inequality estimate for Finland is substantially larger than that for England & Wales.

An additional evaluation could be made by excluding inactive men from the Finnish data. From analyses of data from Finnish documents (T Valkonen, personal communication, 1993) we found that exclusion of inactive men reduces the mortality difference between manual and non-manual classes by about 20 percent. If the inequality estimate of 1.95 (presented in Table 3.3) would also be reduced by 20 percent, it would remain much higher than the 1.40 estimate for England & Wales. As compared to Norway, the Finnish estimate would be 4 times as large.

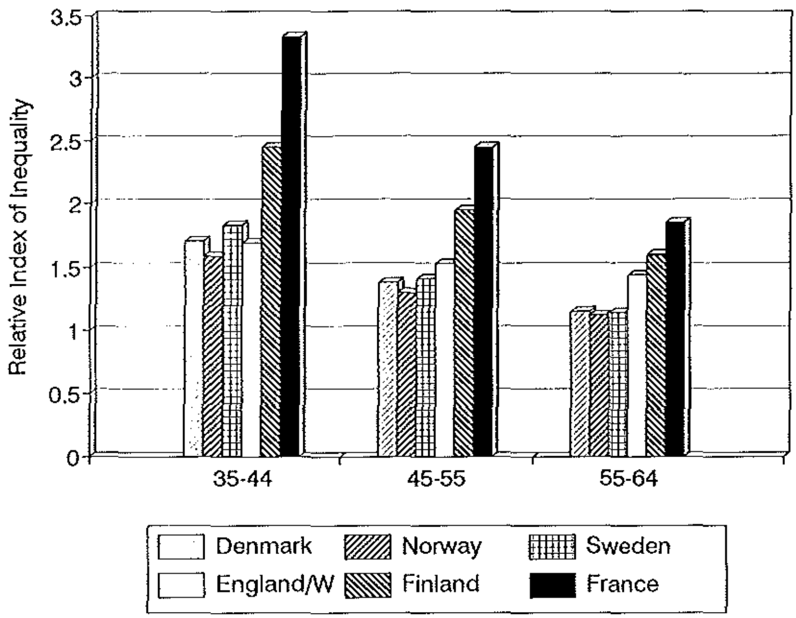
**Table 3.5** The magnitude of mortality differences by occupational class in cities from five countries: the Relative Index of Inequality (RII). Men circa 35-64 years at start of follow-up.

| City | Basic estimate | | Manual versus non-manual | | Including self-employed | |
|---|---|---|---|---|---|---|
| | RII | 95% CI | RII | 95% CI | RII | 95% CI |
| Helsinki | 2.04 | (1.99 - 2.10) | 1.96 | (1.90 - 2.03) | 2.01 | (1.96 - 2.06) |
| Swedish cities | 1.67 | (1.60 - 1.76) | 1.71 | (1.63 - 1.80) | 1.60 | (1.53 - 1.67) |
| Copenhagen | 1.55 | (1.48 - 1.62) | 1.68 | (1.59 - 1.78) | 1.69 | (1.61 - 1.78) |
| French cities | 3.68 | (2.03 - 4.46) | 2.66 | (2.18 - 3.24) | 3.21 | (2.68 - 3.83) |
| Rotterdam | 1.65 | (1.11 - 2.47) | 1.59 | (1.10 - 2.48) | 1.60 | (1.09 - 2.34) |

### *Mortality differences within cities*

The size of socio-economic differences in mortality in cities from five countries is presented in Table 3.5. In both France and the Nordic countries, mortality differences within cities are substantially larger than at the national level. Important for the present study is that the rank order from small to large mortality differences is the same as at the national level: Copenhagen, Swedish cities, Helsinki, French cities. Again, the difference between Denmark and Sweden is small. Mortality differences within Rotterdam are as small as in the Danish and Swedish cities. Nearly the same pattern is found when no distinctions are made within manual classes or within non-manual classes (column 2) or when self-employed are included (column 3).

**Figure 3.2** The magnitude of mortality differences by occupational class: the Relative Index of Inequality. Men in the age groups 35-44, 45-54 and 55-64 years at start of follow-up.




*Mortality differences among men in specific age groups*

Figure 3.2 presents national estimates of the magnitude of mortality differences in three specific age groups: 35-44, 45-54 and 55-64 years. Self-employed men are excluded from all data, except for England & Wales. For each age group, mortality differences are relatively small in Denmark, Norway and Sweden, and large in Finland and, especially, France. The international position of England & Wales varies by age group, with relatively small differences in mortality at ages 35-44 years, and moderate differences in mortality at ages 55-64 years. We should add that, due to the small number of deaths observed in the Longitudinal Study, confidence intervals around inequality estimates for England & Wales are broad especially for younger age groups (1.36-2.11 for 35-44 years, 1.30-1.80 for 45-54 years, and 1.33-1.57 for 55-64 years).

## 3.5 Discussion

Application of a modification of the RII demonstrated considerable international variation in the magnitude of mortality differences according to occupational class. The smallest differences were observed in Norway, Denmark and Sweden, with slightly larger mortality differences in England & Wales. The largest mortality differences were observed in Finland and, especially, France. Mortality differences by occupational class in a Dutch city, Rotterdam, were as small as in Danish and Swedish cities, and smaller than in Finnish and French cities.

Cross-national comparisons of socio-economic differences in mortality are bound to have large margins of uncertainty due to numerous data problems (Valkonen 1993a). The data included in this study were comparable in most respects. However, we could not avoid a number of differences with respect to the occupational classifications. Evaluations of the potential bias resulting from these data problems suggested that they probably cannot explain the international pattern observed here, but that the precise magnitude of international differences remains uncertain. The differences between Norway, Denmark, Sweden and the Netherlands are so small that they may be attributable to differences in occupational classifications. Mortality differences in Finland and France as compared to these other countries are perhaps overestimated but are certainly large from an international perspective.

A comparison with previous comparative studies is of interest because they all applied inequality indices with one or more drawbacks. The general pattern that emerges from studies which are based on rate ratio measures is that mortality differences are largest in France, smallest in Denmark, Norway and Sweden, with Finland and England & Wales in-between (Leclerc 1984 & 1989, Vågerö and Lundberg 1989, Valkonen 1987). A study that used the pseudo-Lorentz curve found that mortality differences in Finland are larger than in England & Wales (Leclerc 1990). The correspondence with our results is remarkable. Thus, despite the drawbacks of other inequality indices, their application does not seem to have introduced serious biases in previous cross-national comparisons.

An unexpected discrepancy is with a study of Wagstaff *et al.* (1991). Although they applied an inequality index that is equivalent to the RII, they found that mortality differences in Finland are smaller instead of larger than in England & Wales. The explanation is that they underestimated mortality differences in Finland because Finnish occupational classes were not accurately ranked according to their socio-economic status. For example, high-level non-manual classes were placed below self-employed men and skilled manual workers were placed below agricultural workers.

This case illustrates that the RII and similar indices should be used with caution. Their applicability strongly depends on the availability of a hierarchical classification of occupations. Our use of this index had therefore to be based on the premise that manual occupations have a lower status than non-manual occupations. This premise, that is basic to much research on health inequalities, has some ground in sociologic research (Runciman 1966). However, in many respects the distinction between manual and non-manual classes is less clear-cut. Skilled manual workers and lower-level non-manual workers show considerable overlap with respect to educational requirements, income levels and occupational prestige (Erikson and Goldthorpe 1992a, Treiman 1977). It is therefore no surprise that lower-level non-manual workers and skilled manual workers have approximately similar mortality levels (see Figure 3.1). An important step ahead in the measurement of socio-economic differences in mortality would therefore be to move beyond the manual *versus* non-manual distinction, and to apply more direct measures of the socio-economic status of men with specific jobs (e.g. Ganzeboom *et al.* 1992).

Our study also differed from previous studies in that it compared various countries simultaneously. This led to some new insights. First, the smallest mortality differences are not exclusively found in Scandinavia, but also in the Netherlands. Second, the often cited difference between Sweden and England & Wales is relatively small from a wider international perspective.

The results show that socio-economic differences in mortality are not an invariable phenomenon, but that their magnitude is strongly dependent on the national context. This raises the question which factors are responsible for the large cross-national variations observed in this chapter. The answer is likely to be complicated, involving cross-national variations at three levels: (1) socio-economic differences in mortality from specific diseases, (2) socio-economic differences in the prevalence of risk factors for these diseases, and (3) economic, social of cultural circumstances that determine the social distribution of these risk factors. We hope that the results presented here give rise to explanatory studies involving one or more of these levels.

Chapter four

# Mortality and educational level in 8 western European countries and the United States

## 4.1 Summary

This study addresses the question whether mortality differences by educational level are about equally large in all countries, or whether important variations exist.

Data on mortality by educational level were obtained from longitudinal studies from nine countries. The data referred to men between 35 and 64 years. Follow-up periods were between 1970 and 1982. The size of mortality differences associated with educational level was measured by means of two inequality indices which both are based on Poisson regression analysis.

Mortality differences by educational level were relatively small in the Netherlands, Sweden, Denmark and Norway and about two times as large in the United States, France and Italy. England & Wales and Finland occupy intermediate positions. The same rank order of countries was found in a comparison of cities from the Netherlands, Norway, Sweden and Finland. The large mortality differences in the United States and France can in part be attributed to large inequalities in education level itself.

The same international pattern was observed in comparisons which use occupational class as the socio-economic indicator. Variations between countries in the magnitude of mortality differences may be partially explained by variations in the egalitarian character of social and economic policies.

## 4.2 Introduction

Socio-economic differences in mortality are a generalized phenomenon in the industrialized world. In each country for which data are available, death rates were found to be higher in groups with lower occupational status, educational level or income level. The question whether socio-economic differences in mortality are about equally large in all countries or whether important differences exist, has called wide interest. The primary reason for this interest is that situation in other countries provide a point of reference for judging whether health inequalities in one's own country are small or large.

In addition, cross-national comparisons provide a unique opportunity to assess the effect of national socio-economic policies on the magnitude of health inequalities.

Cross-national comparisons have traditionally used occupational status as the socio-economic indicator (Leclerc *et al.* 1990, Kagamimori 1983, Minder 1991, Neumann 1981, Ramis-Juan and Sokou 1989, Vågerö and Lundberg 1989, Wagstaff *et al.* 1991). Most of these studies were confronted with serious data problems such as international differences in occupational classifications and the lack of information on the occupational class of large sections of the population (Valkonen 1993a). There is therefore a strong need to complement these studies with international comparisons that are based on other indicators of socio-economic status.

The aim of this chapter is to compare a large number of countries with respect to mortality differences associated with educational level. This study refers to men in the age group 35 to 64 years. Data were obtained from studies from both the United States and several European countries.

## 4.3 Material and methods

*Material*

Data on mortality by educational level were acquired for as many countries as possible. Two data sets were created, one referring to national populations and the other referring to large cities. The latter data set was created in order to be able to include epidemiological studies from Rotterdam (Appels *et al.* 1990) and Oslo (Holme *et al.* 1980).

Studies were selected which met the following criteria: (1) the study design was longitudinal, (2) the follow-up period concerned the 1970s or the early 1980s, and (3) the study population was representative for all men aged 35 to 64 years. The selected studies are presented in Table 4.1. The study on the United States consists of a three-year follow-up of the National Longitudinal Mortality Study, which is a mortality follow-up of eight samples of the Current Population Survey of circa 1980 (Rogot *et al.* 1988). The Dutch study is an epidemiologic follow-up study of subscripts to military service, born in 1930. All other European studies consist of a follow-up of the national population census, for either a representative sample (England & Wales, and France) or the entire population.

The length of follow-up in most studies is about 10 years. Studies with shorter follow-up times were also included because from analyses of data from the Netherlands, Finland and France we found that the size of mortality differences by educational level does not change with increasing follow-up length.

A potential confounder in the relationship between educational level and mortality is minority status. This confounder cannot have played an important role in European countries, either because minorities groups formed a small part of the population in the 1970s (Italy and Nordic countries) or because they were excluded from the study (France and Rotterdam). The data on England & Wales included immigrant minorities, but since the mortality level of all immigrants together was close to the national average (Balajaran and Bulusu 1989) confounding bias is probably small.

**Table 4.1** Overview of sources of data.

| Country or city | Reference [a] | Follow-up period | Age groups in available data [b] |
|---|---|---|---|
| Netherlands | Doornbos and Kromhout (1990) | 1970-1981 | 38 |
| Rotterdam | *Appels et al (1990)* | 1972-1982 | 45-49, 50-54, 55-59 |
| Denmark | *Andersen (1985)* | 1970-1980 | 35-39, 40-44 |
| Norway | Valkonen (1987) | 1971-1980 | 30-49 [c] |
| Oslo | Holme et al (1980) | 1972-1977 | 40-49 [c] |
| Sweden | *Vågerö and Norell (1989)* | 1971-1980 | 35-39, 40-44, .. 55-59 |
| Stockholm, Gothenburg, Malmö | *Vågerö and Norell (1989)* | 1971-1980 | 35-39, 40-44, .. 55-59 |
| Finland | *Valkonen et al (1990b)* | 1970-1980 | 35-39, 40-44, .. 60-64 |
| Helsinki | *Valkonen et al (1990b)* | 1970-1980 | 35-39, 40-44, .. 60-64 |
| England & Wales | *Fox and Goldblatt (1982)* | 1971-1981 | 15-44, 45-64 |
| France | Desplanques (1984) | 1975-1980 | 35-44, 45-54, 55-64 |
| Italy | Pagnanelli (1991) | 1981-1982 | 18-54 [c] |
| United States | Rogot et al (1988) | 1979-1981 | 35-44, 45-54, 55-64 |

[a] If publications are given in italics data were obtained from unpublished tables. Otherwise data were extracted from publications.
[b] Age at beginning of follow-up, except for England & Wales and France, where data refer to age at death.
[c] Mortality figures were only available as age standardised death rates or SMR's

Table 4.2 presents the educational classifications used in the respective studies. The average number of years of education was estimated by the authors in consultation with contact persons from the respective countries.

**Table 4.2** Distribution of study populations over educational groups.

| Country or city *[a]* | Educational groups | Average number of years of education | Share (%) in the total male population *[b]* |
|---|---|---|---|
| Netherlands | Primary education | 8.0 | 48.2 |
| | Lower vocational education | 10.0 | 21.0 |
| | Lower secondary education | 12.0 | 17.8 |
| | Higher level | 15.5 | 12.9 |
| Rotterdam | Primary education [c] | 8.0 | 46.9 |
| | Lower vocational education [c] | 10.5 | 22.6 |
| | Secondary education [c] | 13.0 | 11.1 |
| | Pre-university education | 14.0 | 8.7 |
| | Higher vocational education | 16.0 | 5.6 |
| | University | 19.0 | 5.2 |
| Denmark | Education 9 years or less | 8.0 | 27.8 |
| | Educational level unknown | 8.0 | 12.6 |
| | Education 10-12 years | 11.0 | 40.0 |
| | Vocational education, level unknown | 11.5 | 7.1 |
| | Education 13-14 years | 13.5 | 6.2 |
| | Education 15 years or more | 16.0 | 6.3 |
| Norway | Primary school; not reported | 7.5 | 38.9 |
| | Second level, first stage | 9.0 | 20.8 |
| | Second level, second stage | 11.0 | 27.6 |
| | Third level, first stage | 14.0 | 8.2 |
| | Third level, second stage | 17.0 | 4.4 |
| Oslo | Education 8 years or less | 7.5 | 45.5 |
| | Education 9-10 years | 9.0 | 24.1 |
| | Education 11-12 years | 11.0 | 10.0 |
| | Education 13-16 years | 14.0 | 12.5 |
| | Education 17 years or more | 17.0 | 7.8 |
| Sweden | Educational level unknown | 8.0 | 2.6 |
| | Primary education | 8.0 | 81.6 |
| | Some education after primary school | 9.5 | 6.3 |
| | Secondary education | 14.0 | 9.5 |
| Finland | Basic education, lower level | 8.0 | 76.6 |
| | Basic education, upper level | 9.0 | 3.1 |
| | Secondary education, lower level | 10.5 | 8.7 |
| | Secondary education, upper level | 12.0 | 5.8 |
| | Higher education, lowest level | 13.5 | 2.1 |
| | Higher education, undergraduate level | 15.0 | 0.9 |
| | Higher education, post-graduate level | 17.0 | 2.8 |

| Country or city *[a]* | Educational groups | Average number of years of education | Share (%) in the total male population *[b]* |
|---|---|---|---|
| England & Wales | Educational level unknown | 10.0 | 2.2 |
| | No higher qualifications | 10.0 | 82.1 |
| | A-level only | 12.0 | 6.3 |
| | Non-degree higher qualifications | 14.0 | 5.0 |
| | Degree or equivalent | 17.0 | 4.4 |
| France | No qualifications | 7.0 | 31.6[d] |
| | Second level first stage (CEP) | 10.0 | 46.1 |
| | Second level second stage (BEPC) | 12.0 | 8.2 |
| | Baccalaureate | 15.0 | 6.6 |
| | Higher education | 18.0 | 7.6 |
| Italy | Elementary education not completed | [e] | 3.9[f] |
| | Elementary education completed | | 40.1 |
| | Lower secondary education | | 31.5 |
| | Upper secondary education | | 17.3 |
| | Post-secondary education | | 7.2 |
| United States | Elementary, grade 1-4; lower | 3.0 | 2.8 |
| | Elementary, grade 5-7 | 6.0 | 5.5 |
| | Elementary, grade 8 | 8.0 | 8.2 |
| | High school, year 1-3 | 10.0 | 14.8 |
| | High school, year 4 | 12.0 | 35.3 |
| | College, year 1-3 | 14.0 | 13.7 |
| | College, year 4 | 16.0 | 10.0 |
| | College, 5 years or more | 18.0 | 9.7 |

[a] The educational classifications used for Swedish and Finnish cities are identical to those used at the national level

[b] Number of subjects at the beginning of follow-up.

[c] A further distinction is made between men with and without additional education.

[d] Percentages refer to entire French population instead of the study population because the latter is bases on a stratified sample in which some socio-economic groups are over-represented.

[e] No reliable estimates are available for the number of years of education.

[f] Estimated from data on the same cohort in the survey on the Health Conditions of the Population and the Use of Health Services, 1986-1987.

The educational level was unknown for more than 1 percent of the populations of Denmark, Sweden and England & Wales. It was assumed that the educational level of this 'unknown' group was equal to the level of the group with the lowest educational level. Support for this assumption in the Swedish case is that the 'unknown' group had a similar occupational composition as the lowest educational category (Hemström and Vågerö, personal communication 1992). For Denmark, a comparison that we made with more complete data from the Danish Health and Morbidity Survey suggested that the group with unknown education in the mortality data should have a low educational level. Because the mortality level of English 'unknown' group was close to the national average, alternative assumptions about their educational level had a negligible effect on the measurement of the association between mortality and educational level.

Two other data problems are briefly mentioned here, and will be discussed more extensively in the section 4.5. First, the educational level of men in the national Dutch study was assessed when they were 18 or 19 years, i.e., when some of them had still not left school. Second, more than two thirds of the population in Sweden, Finland and England & Wales was assigned to a single (the lowest) educational category.

*Methods*

Countries will be compared by means of inequality indices which for each country separately measure the size of mortality differences associated with educational level. Indices were selected on the basis of two criteria: (1) all educational groups should be included separately into the calculation of these indices and (2) not all mortality differences should be measured, but only mortality differences that are systematically related to an ordering of educational groups from high to low socio-economic status (Wagstaff 1991).

These two criteria can be met by means of regression analysis. We applied Poisson (log-linear) regression using the following regression model:

$$D_{are} = P_{are} * e^{(\alpha_{ar} + \beta\ SES_e)}$$

where D is the estimated number of deaths, P is the number of persons-years at risk, and SES is a measure on the socio-economic status of each educational group. The subscripts a, r and e denote 5-year age group, race (black *versus* white; United States only) and educational group. $\alpha$ and $\beta$ are regression coefficients.

The socio-economic status of educational groups can be quantified in two ways. The first way is to quantify the educational level as the average number of years that is formally needed to complete that level. If SES is quantified in this way, the formula ($\exp^{\beta}$-1) yields one of the inequality indices used in this study. This index, which we call the *regression-based index* *of effect*, represents the proportional mortality increase associated with one year extra education. This index has been applied in an earlier international comparison (Valkonen 1987 & 1989).

In the second way of quantifying the socio-economic status of an educational group, the status of this group is conceptualized as the relative position of this group on the social hierarchy. Following Pamuk (1985 & 1988) this position is quantified as the proportion of the population that has a higher position on the social hierarchy. For example, if the highest educational group comprises 10 percent of the population, the relative position of its members would be between 0 and 0.1, the average being 0.05. If SES is quantified in this way, the formula $\exp^{\beta}$ yields the second inequality index used in this study. This index, called by Pamuk (1985 & 1988) the *Relative Index of Inequality* (RII), represents the mortality level that the regression model predicts for those with the lowest education (with the position score of 1) as a ratio to the mortality level that is predicted for those with the highest education (with score 0).

These indices are related as follows. If the score of a country on the RII is large as compared to other countries, this implies large mortality differences between high and low positions on the social hierarchy. This large mortality difference can attributed to:
- large differences between high and low social positions in the number of years of education, i.e., large educational inequalities,
- a large effect of one extra year of extra education on mortality, i.e. a large score on the regression-based index of effect.

Thus, while the latter index measures the size of the effect of one year of extra education on mortality, the RII takes also into account the extent of inequalities in educational level itself. The RII therefore measures the total magnitude of the mortality differences in a population that are related to educational inequality. Since the two indices are complementary and each has a specific interpretation, both will be applied in the present study.

The regression equation assumes that mortality has a log-linear relationship with educational level. This assumption was checked for by means of (1) inspection of residuals and (2) the inclusion of a quadratic term for the educational measures in the regression equation. No large departures from (log)linearity were observed.

## 4.4 Results

*The size of mortality differences associated with educational level*
Table 4.3 presents the estimates of the total amount of mortality differences, as measured by the RII. The size of mortality differences decreases strongly with increasing age. Since the precise delimitation of age groups differs

among studies, comparisons between studies cannot readily be made on the basis of Table 4.3. In order to facilitate comparisons, RII estimates are presented in Figure 4.1 according to mean age at death.

**Table 4.3** The magnitude of mortality differences by educational level. Men in the age groups 35-44, 45-54 and 55-64 years at start of follow-up.

| Country | Relative Index of Inequality (95% confidence interval) | | |
|---|---|---|---|
| | 35-44 years | 45-54 years | 55-64 years |
| Netherlands | 1.72<br>1.51-1.95 [a] | | |
| Denmark | 2.17<br>2.02-2.33 | | |
| Norway | 2.02<br>1.89-2.16 [b] | | |
| Sweden | 2.20<br>2.02-2.41 | 1.60<br>1.51-1.69 | 1.36<br>1.28-1.45 [c] |
| Finland | 2.49<br>2.32-2.68 | 1.99<br>1.90-2.08 | 1.79<br>1.71-1.87 |
| England & Wales [d] | 2.04<br>1.43-2.92 | 1.75<br>1.49-2.06 | |
| France [e] | 2.97<br>2.60-3.39 | 2.59<br>2.31-2.90 | 2.28<br>2.02-2.56 |
| Italy | 2.85<br>2.75-2.97 [f] | | |
| United States | 3.62<br>2.26-5.78 | 2.06<br>1.51-2.80 | 2.05<br>1.69-2.48 |

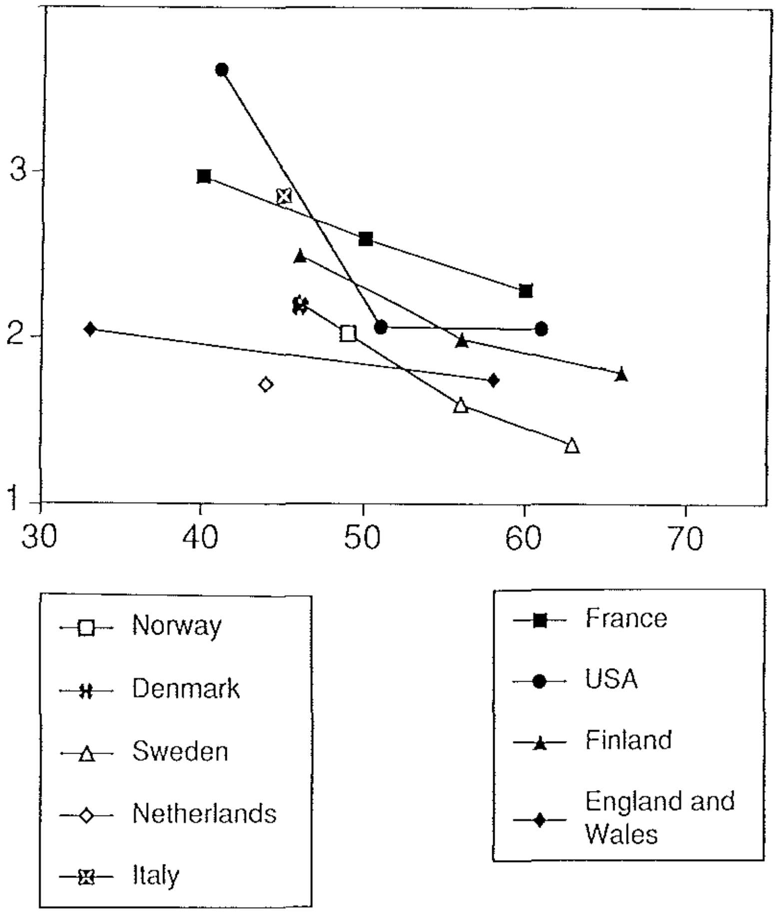
[a] 38 years; [b] 30-49 years; [c] 55-59 years
[d] Age groups 10-40 and 40-60 years approximately
[e] Age groups 32-41, 42-51 and 52-61 years approximately
[f] 18-54 years

At ages 55 years and over, the smallest mortality differences are observed in Sweden. The value of 1.36 for the oldest age group implies that, according to the fitted regression equation, death rates estimated for the bottom of the Swedish educational hierarchy are 36 percent higher than the death rates estimated for the top. Larger differences in mortality are observed for, in order of magnitude, England & Wales, Finland, the United States and France. The total amount of mortality differences is almost 4 times as large in France as in Sweden.

At ages below 55 years, the differences between Sweden, Finland and France follow the same pattern but are less pronounced. The total amount of mortality differences in France is less than two times as large as in Sweden. The small RII estimates for England & Wales and the very large estimate for the United States might have resulted from large chance fluctuations.

Data on mortality differences by educational level below the age of 55 years were available for four additional countries. Inequality estimates for the Netherlands are sizably smaller than that for Sweden, while the estimates for Norway and Denmark are nearly identical to that for Sweden. The inequality estimate for Italy is equally large as the one for France.

**Figure 4.1** The magnitude of mortality differences by educational level: the Relative Index of Inequality. Men according to age at death.



Cities are compared in Table 4.4. Mortality differentials within cities are substantially larger than at the national level. Important for the present study is that the rank order of countries from large to small mortality differences is the same at the city level as at the national level. Most inter-city differences are not statistically significant due to the small observed numbers of deaths in most data sets.

**Table 4.4** The magnitude of mortality differences by educational level in cities from four countries. Men 35-44, 45-54 and 55-64 years at start of follow-up.

| City | Relative Index of Inequality (95% confidence interval) | | |
|---|---|---|---|
| | 35-44 years | 45-54 years | 55-64 years |
| Rotterdam | | 1.50<br>1.02-2.21[a] | |
| Oslo | | 2.59<br>1.89-3.55[b] | |
| Stockholm, Malmö, Gothenburg | 3.18<br>2.72-3.71 | 2.19<br>2.00-2.40 | 1.71<br>1.54-1.89[c] |
| Helsinki | 3.04<br>2.59-3.56 | 2.57<br>2.32-2.84 | 2.02<br>1.84-2.21 |

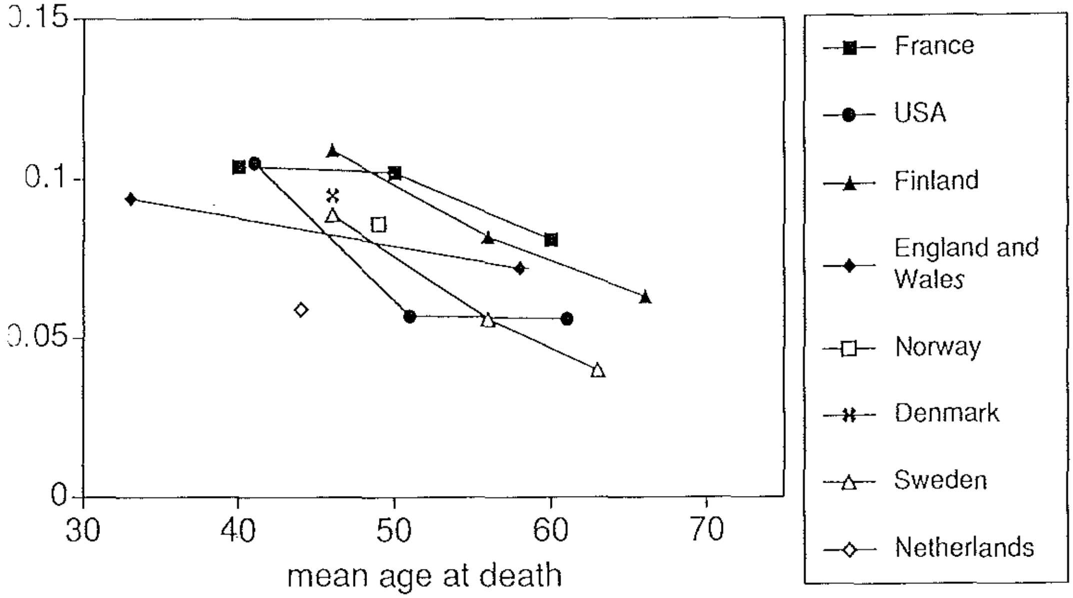
[a] 45-59 years; [b] 40-49 years; [c] 55-59 years

*The size of the effect of educational level on mortality*

In Figure 4.2 countries are compared with respect to the regression-based index of effect, which measures the proportional increase in mortality associated with one additional year of education. Italy could not be included due to the absence accurate estimates of the number of years of education per educational level.

The rank order of countries from small to large partial inequality estimates is the same as in Figure 4.1 for the RII. The only exception are the United States, where the total amount of mortality differences between educational levels (the RII) is large, but where the effect of one additional year of education is relatively small (the effect index). Among European countries, the rank order of countries is the same for both inequality indices. However, the contrast between France and the other European countries is more pronounced with regards to the total amount of mortality differences (the RII) than with regards to the effect on mortality of one year of additional education (the effect index).

**Figure 4.2** The magnitude of mortality differences by educational level: the regression-based index of effect. Men according to age at death.




*The size of inequalities in education itself*

As explained in the section 4.3, large mortality differences between educational levels (the RII) can be attributed to a large effect of educational level on mortality (the effect index) or to large inequalities in education itself. The results suggest that the first explanation does not seem to hold for the United States and to only some extent for France. This suggests that the large mortality differences by education in the United States and France is, at least in part, related to large inequalities in educational levels itself.

In order to test this inference, we used a measure on inequalities in educational levels that could be applied to the data for most countries: the average number of years of education of the top 20 percent of the population *minus* the corresponding number of the bottom 80 percent of the population. According to this approximate measure, inequalities in education in the United States (5.75 years) and France (6.75 years) are indeed larger than in other countries, for example, England & Wales (3.75 years) and Sweden (4.25 years).

## 4.5 Discussion

Important for the evaluation of socio-economic differences in health is the question to what extent they can be regarded as variable. This question has often been approached by means of comparisons over time, which showed for various countries an increase in socio-economic differences in mortality during the post-war period. We chose a different approach by addressing the question to what extent the size of socio-economic differences in mortality varies across countries. Substantial cross-national variations were observed in the size of mortality differences associated with educational level in the 1970s. Differences were relatively small in the Netherlands, Sweden, Denmark and Norway and about two times as large in the United States, France and Italy. Finland and England & Wales occupy intermediate positions. The same rank order of countries was found in a comparison of cities from the Netherlands, Norway, Sweden and Finland.

*Evaluation of potential sources of bias*

The educational level of subjects in the Dutch study was determined in 1950, when they were 18 or 19 years old. The level of the educational institution that a 18/19-year old boy in 1950 attended or had completed was probably closely related to the educational level that he finally would achieve. However, discrepancies may exist, which implies misclassification of subjects. The most likely effect on inequality estimates is underestimation. Perhaps the underestimation is so large that it explains the relatively small mortality differences that were observed for the Netherlands. We therefore judge that there is not sufficiently strong evidence to suggest that mortality differences in the Netherlands were smaller than in Nordic countries.

More than two thirds of men in Sweden, Finland and England & Wales were assigned to a single educational category that comprised all men with low or intermediate levels of education. As a consequence, the regression-based summary indices compare the relatively few persons with high education to all other persons with lower levels of education. This raises the question whether the regression-based estimates would have been different when more educational levels would have been distinguished.

We evaluated this point by additional analyses for all countries with a detailed educational classification. Inequality indices were re-estimated after combining the lower 80 percent of the population into one large educational category. In most countries, the new inequality estimates were about as large as the estimates that are based on detailed educational classifications (a less than 10 percent difference). In some countries, however, the regression-based inequality indices, and in particular the RII, were found to be overestimated by more than 10 percent when lower educational levels were combined into a single group. This happened because the association between mortality and educational level appeared to be relatively weak among lower educational levels and relatively strong among higher levels.

Thus, application of the regression-based summary indices is problematic for those data sets where more than two thirds of the population are combined into one single educational category. In these cases, we cannot assume that the regression-based summary indices represent the magnitude of mortality differences across the entire educational hierarchy. Instead, it is safer to recognise that they only measure the mortality difference between the relatively few persons with high education and all other persons with lower levels of education.

*Comparison to previous studies*

We observed that the 'effect' measure of the association between education and mortality under 50 years is approximately equally large in each country. This finding corroborates the fascinating finding of Valkonen's comparative study of England & Wales, Hungary and Nordic countries (Valkonen 1987 & 1989), who observed for the 1970s that at ages below 50 years the relationship between education and mortality was 'surprisingly similar': in each country death rates diminish by about 8 percent with an increase in one year of educational attainment. He warned, however, that this finding should not be taken as evidence of a 'universal law' of health inequalities, because large cross-national variations were observed for specific causes of death and in addition might be observed for other time periods or other age groups. Indeed, we found that at ages older than 50 years, the effect of one year of additional education on mortality varied substantially among countries, with the effect being two times as large in France as compared to Sweden.

Our study used educational level as the socio-economic indicator because this indicator has been judged to be internationally more comparable than occupation (Valkonen 1993a). Although in individual populations educational level and occupational status are strongly correlated (Ganzeboom *et al.* 1992), the question remains whether the same international pattern would be found with occupation as the socio-economic indicator. The answer is probably affirmative. The comparisons made in chapter 3 with respect to mortality by occupational class produced virtually the same rank order of countries from small to large mortality differences: (1) the Netherlands, Denmark, Norway, Sweden, (2) England & Wales, (3) Finland and (4) France.

*Explanations*

Cross-national comparisons provide a new opportunity to identify circumstances that are associated with large or small mortality differentials. A relevant question is therefore why the extent of socio-economic differences in premature mortality varies between countries.

The first line of explanation relates to the selection hypothesis, which states that health and education are in part related because educational achievement depends among others on health or health-related factors. The contribution of health selection to the generation of socio-economic differences in adult mortality has much been disputed but is bound to be the subject of conjecture as long as life-long longitudinal studies are not carried out (Dahl and Kjaersgaard 1993a, West 1991). Important for the present study is that the magnitude of health selection is likely to vary between countries as a function of educational and training structures (West 1991). Lahelma and Valkonen (1990) formulated a more specific hypothesis: in countries where people coming from different strata have more equal access to education, the achieved educational level may depend less on social background and more strongly on personal characteristics, including health and health-related factors. Paradoxically, then, health and education may be relatively closely related in open, competitive societies (Lahelma and Valkonen 1990). Testing this hypothesis requires detailed assessment of international variation in educational and training structures, which is outside the scope of this chapter.

The alternative line of explanation relates to the causation hypothesis, which stresses the effect of educational level on health. The higher death rates of lower educational groups are at least in part explained by a higher prevalence of risk factors for disease, such as factors related to life styles, material living conditions, working conditions and (coping with) stress. A logical extension of this assertion is that international variation in the social distribution of risk factors explain at least in part the international variation in socio-economic differences in mortality.

Explanations cannot be confined to risk factors for disease, but should also consider the more distal social, economic and cultural factors. One factor of high potential relevance are welfare and income policies. Wilkinson's work (1992a, 1992b, 1996) might be particularly relevant here. He suggested that national death rates are strongly related to the extent of income inequality, and inferred from this finding that large income inequalities are associated with large socio-economic differences in mortality. Our study allows for a first test of this hypothesis. During the 1970s, income inequalities were relatively large the United States, France and Italy, and approximately equally small in the other countries (Taylor and Jodice 1983, United Nations 1985). Income inequalities in Finland, still large in the 1960s, diminished rapidly during the 1970s. This rank order of countries in terms of income inequalities strongly corresponds to their rank order in terms of inequalities in mortality. Thus, our material corroborates Wilkinson's inferences. A main challenge to future international comparisons is to determine whether this association is spurious, or whether is reflects a true positive effect of egalitarian social and economic policies.

Chapter five

# Mortality and occupational class in 11 western European countries

## 5.1 Summary

This study compares eleven countries with respect to the magnitude of mortality differences by occupational class, thereby paying extensive attention to problems with the reliability and comparability of the data that are available for different countries.

Nationally representative data on mortality by occupational class among men 30-64 years at death were obtained from longitudinal and cross-sectional studies. A common social class scheme was applied to most data sets. The magnitude of mortality differences was quantified by three summary indices. Three major data problems were identified, and their potential effect on inequality estimates was quantified for each country individually.

For men 45-59 years, the mortality rate ratio comparing manual classes to non-manual classes was about equally large for four Nordic countries, England & Wales, Ireland, Switzerland, Italy, Spain and Portugal. Relatively large ratios were only observed for France. The same applied to men 60-64 years (data for only 5 countries, including France). For men 30-44 years, there was evidence for smaller mortality differences in Italy and larger differences in Norway, Sweden and especially Finland (no data for France and Spain).

Application of other summary indices to men 45-59 years showed slightly different patterns. When the population distribution over occupational classes was taken into account, relatively small differences were observed for Switzerland, Italy and Spain. When national mortality levels were taken into account, relatively large differences were observed for Finland and Ireland. For each summary index, however, France leads the international league table.

Data problems were found to have the potential to substantially bias inequality estimates, especially those for Ireland, Spain and Portugal.

The results underline the similarities rather than the dissimilarities between western European countries. There is no evidence that mortality differences are smaller in countries with more egalitarian social and economic policies.

## 5.2 Introduction

International comparisons have since long formed part of research on socio-economic differences in mortality. Their results have called wide interest for at least two reasons.

Studies on mortality differences by occupational class found that these differences were much larger in some European countries than in others (Leclerc *et al.* 1990, Leon *et al.* 1992, Minder 1991, Vågerö and Lundberg 1989, Wagstaff *et al.* 1991). For example, in chapter 3 we found that class differences in mortality among men 35-64 years in the 1970s were much larger in France and Finland than in Norway. Such a finding implies that, even though socio-economic differences in mortality are persistent in modern societies, they are highly variable. This variability has been referred to in order to argue that inequalities in health are liable to change through intervention (Department of Health 1995).

Equally interesting were our observations in chapters 3 and 4 that the smallest mortality differences by occupational class or educational level were found for Sweden, Norway, Denmark and the Netherlands, countries where income equalities were small and where egalitarian socio-economic and other policies have been pursued for many years (cf. Leon *et al.* 1992, Vågerö and Lundberg 1989, Wagstaff *et al.* 1991). This finding supported the expectation that egalitarian socio-economic, health care and other policies are able to bring about a substantial and lasting reduction in mortality differences.

Despite the plausibility of these observations, they should be interpreted with caution. As some reviewers have noted, international comparisons can be treacherous if no extensive attention is paid to the many problems with the reliability and comparability of the data that are available for different countries (Illsley 1990, Kunst and Mackenbach 1994c, Minder 1991, Valkonen 1993a, Valkonen and Martikainen 1997). This warning applies especially to data on mortality by occupational class. Comparative research on the basis of these data can be biased by: (a) poor comparability of the social class schemes that are available for different countries; (b) the effects of excluding economically inactive men from inequality estimates, and differences between countries in the size of these effects; and (c) the so-called numerator/denominator bias that is inherent to unlinked cross-sectional studies (see section 2.3), and differences between countries in the size and direction of this bias.

A few previous comparative studies have been able to cope satisfactorily with some of these problems. For example, researchers from Sweden and Switzerland have compared their countries to England & Wales by applying the British Registrar General's social class scheme to the data available for each country (Leon *et al.* 1992, Lundberg 1986, Minder 1991, Vågerö and Lundberg 1989). However, no study has resolved all potential data problems or has assessed to what extent unresolved data problems could have biased the results.

*The present study*
The objective of this chapter is to compare western European countries with respect to the size of mortality differences by occupational class, thereby paying extensive attention to the strength of the available evidence. This chapter is based on an international project on socio-economic differences in morbidity and mortality (Kunst *et al.* 1996, Mackenbach *et al.* 1997). The mortality data that were acquired in this project differed in several respects from the data used in previous studies. First, whereas previous studies referred to the 1970s, these new data referred to the 1980s (either circa 1980-82 or circa 1980-89). Second, data were included for as many western European countries as possible. Ireland was included for the first time. By also including France, Switzerland, Italy, Spain and Portugal, the southern part of western Europe was covered as well as its northern part. Third, every effort was made to make the data that are available from the different countries as comparable as possible. For several countries, original, individual-level data on the occupation of subjects were recoded according to a standard social class scheme, the EGP scheme (Erikson and Goldthorpe 1992a, Ganzeboom *et al.* 1989, Bartley *et al.* 1996).

## 5.3 Material and methods

*Material*
An overview of the data sources that are used in this study is presented in Table 5.1. For each western European country, we attempted to obtain data from longitudinal studies that covered (a representative sample of) the national population. Where longitudinal data were not available, data were obtained from national cross-sectional studies. Most longitudinal studies covered the period of circa 1980-1989, with the exception of Sweden (1980-1986) and Italy (1981-1982). The follow-up period of the latter study was only 0.5 years. All cross-sectional studies were centred around the national population censuses of 1980 or 1981.

Most studies covered the entire national population. The data for England & Wales and France apply to a representative sample of the national population. The only excluded subpopulation of substantial size (more than 5 percent of all men 30-64 years) are foreigners in France and Switzerland.

Data from different countries had to refer to the same age group in terms of age at death. The age groups 30-44 and 45-59 years were distinguished in cross-sectional studies and in longitudinal studies that classified deceased men according to their age at death.

**Table 5.1** Overview of sources of data.

| Country | Design | Period | Excluded populations | Observed no. of deaths[a] |
|---|---|---|---|---|
| Finland | longitudinal | 1981-1990 | none | 39,090 |
| Sweden | longitudinal | 1980-1986 | none | 39,789 |
| Norway | longitudinal | 1980-1990 | none | 22,033 |
| Denmark | longitudinal | 1981-1990 | none | 34,400 |
| England & W | longitudinal | 1981-1989 | none | 2,703 |
| Ireland | cross-sectional | 1980-1982 | none | 6,348 |
| France[b] | longitudinal | 1980-1989 | French born out of France, foreigners | 15,016 |
| Switzerland | cross-sectional | 1979-1982 | foreigners | 13,317 |
| Italy | longitudinal | 1981-1982 | institutionalised population | 8,325 |
| Spain | cross-sectional | 1980-1982 | military | 70,524 |
| Portugal | cross-sectional | 1980-1982 | military | 22,581 |

[a] Among men 45-59 years. The numbers of deaths for England & Wales and France are small as compared to the national population because the longitudinal studies refer to samples of, respectively, 1 and 5% of the national population.

[b] Start of follow-up is the 1975 population census. The data presented in this paper refer to the 5th to 15th year of follow-up.

In longitudinal studies that classified men according to their age at the start of the 10-year follow-up period, the birth cohorts aged 25-39 and 40-54 years were distinguished. With a follow-period of 10 years, it was in addition possible to study class differences in dying at the age of about 60-64 years by following men aged 55-59 years at the start of follow-up.

A common social class scheme, the EGP scheme, was applied to as many countries as possible. This scheme was developed in order to facilitate international comparisons of social stratification and mobility, and is therefore particularly suited for our purposes. A description of this scheme is given in section 2.5.1.

For as many countries as possible, EGP conversion algorithms were applied to individual-level data on the following aspects of the jobs that men perform: occupational title (by 3 digit code), employment status (self-employed or not) and supervisory status (e.g. number of subordinates). For Sweden, England & Wales and France, conversion algorithms were available from the CASMIN project of Erikson and Goldthorpe (1992a). For Finland, Norway and Switzerland we derived conversion algorithms from a standard schedule (the 'GLT' algorithm) developed by Ganzeboom, Luijkx and Treiman (Ganzeboom *et al.* 1989).

Conversion algorithms based on the EGP scheme could not be applied to the data that were available for Denmark, Ireland, Italy, Spain and Portugal. Mortality data were available for these countries on the basis of national social class schemes. These national schemes could only be made comparable to the EGP scheme at the level of three broad classes: non-manual classes (classes I to IVb in the EGP scheme), manual classes (V to VIIa), and farmers and farm labourers (IVc and VIIb).

Table 5.2 shows the distribution of men by occupational class. Most similar are the population distributions observed for Sweden, Norway, Denmark, France and Switzerland. In each of these countries, circa 45 to 50 percent of the male working population is in non-manual classes, circa 40 percent is in manual classes, and circa 5 to 10 percent works in agriculture. The proportion of men working in agriculture increases with age. Particular to England & Wales is that a very small part of men work in agriculture, and that there are more men in manual classes than non-manual classes. In Finland, Ireland, Italy, Spain and Portugal, more than 15 percent of men work in agriculture. As in England & Wales, manual classes form the largest group in Finland, Spain and Portugal. The proportion of men belonging to the class of professionals, large employers, administrators and managers is given only for countries where occupational classes could be defined with reference to the EGP scheme. For men 45-59 years, this proportion ranges from circa 35 percent in Switzerland to circa 25 percent in France and Finland.

*Methods*

The relative mortality level of men in specific occupational classes was measured by means of Standardized Mortality Ratios (SMRs), with the national age-specific mortality rates as the standard. Several summary indices are available to express the magnitude of mortality differences by occupational class (see section 2.6). There is not one single measure which is clearly superior to all other measures; different measure capture different perspectives on class differences in mortality. In this chapter, we present three types of measures.

The first type of measure, the *Rate Ratio,* compares the mortality rate of a lower occupational class to that of a higher occupational class. We will apply a commonly used distinction, that between manual classes (classes V to VIIa in the EGP scheme) and non-manual classes (I to IVb). A disadvantage of the manual *versus* non-manual distinction is that there is no general theoretical principle that states that foremen and skilled manual workers have a less advantaged position in society than routine non-manual workers or self-employed men. A clearly hierarchical distinction can however be obtained by comparing manual classes to the class of professionals, large employers, administrators and managers (I and II). We will therefore also present the rate ratio that corresponds to this distinction.

Rate ratios and their 95 percent confidence intervals were estimated by means of Poisson regression analysis. The regression model included a term that represented the contrast between manual and (upper) non-manual classes. A series of terms representing 5-year age groups were included in the regression model in order to control for different age compositions of manual and (upper) non-manual classes.

**Table 5.2** Distribution of study population over 3 broad occupational classes. Men, 30-44, 45-59 and 60-64 years.

| Country | Age group | Share (%) in total population[a] | | | |
|---|---|---|---|---|---|
| | | Non-manual classes | (Of which classes I, II)[b] | Manual classes | Agricultural classes |
| Finland | 30-44 | 39.1 | (27.5) | 51.5 | 9.4 |
| | 45-59 | 36.3 | (24.1) | 46.8 | 17.0 |
| | 60-64 | 32.8 | (20.6) | 42.5 | 24.7 |
| Sweden | 30-44 | 51.4 | (31.8) | 44.3 | 4.3 |
| | 45-59 | 52.2 | (30.6) | 40.3 | 7.5 |
| Norway | 30-44 | 51.5 | (35.2) | 42.5 | 5.9 |
| | 45-59 | 48.4 | (33.2) | 42.3 | 9.3 |
| | 60-64 | 44.5 | (28.5) | 44.0 | 11.5 |
| Denmark | 30-44 | 51.6 | | 44.5 | 3.9 |
| | 45-59 | 52.8 | | 37.5 | 9.7 |
| | 60-64 | 49.4 | | 38.0 | 12.6 |
| England & Wales | 30-44 | 49.6 | (32.2) | 48.4 | 2.0 |
| | 45-59 | 43.4 | (27.4) | 53.9 | 2.7 |
| | 60-64 | 39.8 | (23.5) | 57.3 | 2.9 |
| Ireland | 30-44 | 45.3 | | 38.4 | 16.3 |
| | 45-59 | 38.9 | | 32.9 | 28.3 |
| France | 45-59 | 46.6 | (25.6) | 42.2 | 11.2 |
| | 60-64 | 45.1 | (23.1) | 37.6 | 17.2 |
| Switzerland | 30-44 | 54.1 | (41.3) | 39.4 | 6.6 |
| | 45-59 | 49.5 | (35.8) | 40.1 | 10.4 |
| Italy | 30-44 | 51.7 | | 31.9 | 16.4 |
| | 45-59 | 48.0 | | 29.2 | 22.9 |
| Spain | 45-59 | 30.8 | | 47.3 | 21.9 |
| Portugal | 30-44 | 40.2 | | 48.2 | 11.6 |
| | 45-59 | 32.9 | | 39.4 | 27.7 |

[a] As % of the total population per age group, less men with occupation unknown.
[b] The class of professionals, employers, administrators and managers. Distinguished for studies to which the EGP or GLT conversion algorithms could be applied.

The second type of measure, the *Index of Dissimilarity (ID),* is slightly more complex (section 2.6). Unlike a rate ratio, it takes into account the population distribution across occupational classes. This measure reflects the 'total impact' of class differences in mortality, in the sense that it is sensitive to both the effect of lower occupational class on mortality, and the population share of different occupational classes. The larger the size of occupational classes with extreme mortality rates, the higher the ID will be. Age-adjustment was accomplished by calculating the ID from SMRs.

The third type of measure, the absolute *Difference in death probabilities,* is applied in order to take into account national mortality levels. Relative measures as rate ratios are often used because of their high analytical value. They do not take into account national mortality levels. This level is relevant, however, if one wants to express the importance of class differences for the total disease burden in a country: a class difference of 10 percent may be judged to be a more important public health problem in countries with high national death rates than in countries with low death rates. In order to compare countries from this point of view, we also applied a measure that is sensitive to national mortality levels. Unfortunately, our data did not provide internationally comparable estimates of national mortality levels, due to differences between studies in the exclusion of subpopulations and length of follow-up. However, national mortality registrations with a complete coverage of every country's population could be used as an alternative source (WHO 1988). National estimates of the probability of dying between the ages of 45 and 65 years were combined with the SMRs of manual and non-manual classes in order to estimate mortality probabilities for these two classes, and their difference.

*Potential data problems*

We identified three major problems with the reliability and comparability of the data on mortality by occupational class that were available from different countries (Kunst *et al.* 1996). Each problem was evaluated for the potential size of effect that it has on manual *versus* non-manual rate ratios (Kunst and Groenhof 1996b, 1996c & 1996d). Quantitative estimates of the potential size of bias are presented in section 5.4. Here we describe how we derived these estimates.

The first problem relates to the comparability of the manual *versus* non-manual distinctions that were made with the available social class schemes. There are differences between the EGP conversion algorithms as devised by Erikson and Goldthorpe, and the standardised GLT algorithm that we applied to Finland, Norway and Switzerland (Erikson and Goldthorpe 1992b, Kunst and Cavelaars 1996). However, the effect of these differences on manual *versus* non-manual rate ratios is likely to be small. Evaluations that we made with data from the Swedish longitudinal study showed that the original EGP algorithm and the GLT algorithm produced nearly identical rate ratios. The manual *versus* non-manual rate ratio for the age group 20-44 years was 1.44 with the original algorithm and 1.49 with the GLT algorithm (Kunst and Groenhof 1996d). The values for the age group 45-59 years were 1.23 and 1.22. This suggests that rate ratios are biased by about 5 percent or less if the GLT approximation to the EGP conversion scheme is applied.

There is a larger potential for error when occupational classes are not defined with reference to the EGP scheme. But even then, the error cannot be very large for a rate ratio that compares all manual classes to all non-manual classes, because these two broad classes are fairly clearly defined by the nature of the work that men perform, and borderline movements can be expected to have relatively small effects on the mortality rates for these broad groups. We therefore estimated that the use of an occupational classification that is not based on the EGP scheme biases rate ratios by 10 percent at most.

The second problem relates to economically inactive men (retired, disabled, unemployed, etc). In most of the available mortality data sets there was insufficient information on the former occupation of economically inactive men. These men therefore had to be excluded from the analysis. Their exclusion is likely to lead to an underestimation of the magnitude of mortality differences between occupational classes, because economically inactive men have high mortality rates and originate predominantly from lower occupational classes (Valkonen and Martikainen 1997, Kunst and Mackenbach 1994c). We have developed an adjustment procedure which approximately corrects for this underestimation (see Appendix and Kunst and Groenhof 1996b).

Due to the approximate nature of this procedure, however, some bias might remain. The question is, then, how large this residual bias could be. A number of evaluations (Kunst and Groenhof 1996b) made it likely that adjusted rate ratios are at least as close to the real rate ratio as the unadjusted rate ratios. This implies that after an adjustment of, say, 10 percent, the residual bias around the adjusted rate ratio is 5 percent or less. This bias could be in either direction. Application of this general rule yielded estimates of the potential size of residual bias for each country and age group.

The third problem is the so-called 'numerator/denominator bias' that is inherent to unlinked cross-sectional studies. This bias is described in detail in section 2.3. In short, information on the occupation of deceased is given in death certificates whereas information on the occupation of the corresponding living population is obtained from another source such as the population census. The validity of these studies is compromised if the measurement of occupation is different in these two sources of information. In an evaluation that we reported elsewhere (Kunst and Groenhof 1996c), estimates of manual *versus* non-manual rate ratios on the basis of unlinked studies from England & Wales and France were compared to the corresponding estimates on the basis of longitudinal studies. These evaluations suggested that rate ratios can be biased by about 20 percent or less. This bias could be in either direction.

An additional evaluation was possible for Switzerland, thanks to a special study in which for a sample of death certificates, the occupation mentioned at the certificate was compared to the occupation of the same person as registered at the preceding population census (Beer *et al.* 1986). On the basis of an analysis of data from this sample, we estimated that manual *versus* non-manual rate ratios for Switzerland are underestimated by 15 percent or less (Kunst and Groenhof 1996c).

## 5.4 Results

Table 5.3 presents the pattern of mortality variation by occupational class among men 30-44 years. No data were available for men 30-44 years in Spain and France. In each country, the adjusted SMRs are lower than the national average for non-manual classes and higher than average for manual classes. The adjusted SMRs for agricultural classes are higher than average in most countries, and especially for Portugal. The manual *versus* non-manual rate ratios for most countries are close to 1.50. Larger rate ratios are observed for Norway, Sweden and especially for Finland. The smallest rate ratio is observed for Italy.

Comparison to the estimates given in *italic* shows to what extent the results have been modified by our adjustment for the exclusion of economically inactive men. In each country, the unadjusted rate ratio is smaller than the adjusted rate ratio. The difference is relatively large (0.15 units or more) in Finland, Sweden, Norway and Italy, where a relatively large proportion of men have their occupation unknown (see Appendix). Note, however, that even the unadjusted rate ratios for Finland, Sweden and Norway are larger than those for other countries.

Table 5.4 presents the results for men in the age group 45-59 years. Also included are France and Spain. Again, in each country, the SMRs for non-manual classes are lower than the national average whereas the SMRs for manual classes are higher. The mortality rate of agricultural classes is relatively low in each country except Portugal. In most of northern Europe, agricultural classes even have a lower mortality level than non-manual classes. The manual *versus* non-manual rate ratios for most countries are in a narrow range that goes from 1.33 to 1.44. Larger rate ratios are observed for Finland (1.53) and France (1.71). The confidence interval for the French rate ratio does not overlap with those for other countries. The confidence interval for the Finnish rate ratio only overlaps with that for England & Wales.

**Table 5.3** Age-standardised mortality ratios of three broad occupational classes and the manual *versus* non-manual mortality rate ratio, with (without) adjustment for the exclusion of men with occupation unknown.[a] Men 30-44 years at death.

| Country | SMR with (*without*) adjustment | | | Rate ratio and 95% CI with (*without*) adjustment | |
|---|---|---|---|---|---|
| | Non-manual | Manual | Agricultural | | |
| Finland | 0.70 | 1.23 | 1.17 | 1.76 | (1.70 - 1.83) |
| | *0.74* | *1.17* | *1.22* | *1.60* | *(1.54 - 1.67)* |
| Sweden | 0.77 | 1.26 | 1.33 | 1.66 | (1.59 - 1.75) |
| | *0.82* | *1.19* | *1.40* | *1.48* | *(1.40 - 1.56)* |
| Norway | 0.77 | 1.27 | 1.11 | 1.65 | (1.57 - 1.74) |
| | *0.81* | *1.21* | *1.16* | *1.49* | *(1.41 - 1.58)* |
| Denmark | 0.82 | 1.25 | 0.70 | 1.53 | (1.47 - 1.59) |
| | *0.85* | *1.21* | *0.72* | *1.43* | *(1.37 - 1.49)* |
| England & Wales | 0.82 | 1.20 | 1.01 | 1.46 | (1.24 - 1.74) |
| | *0.84* | *1.16* | *1.03* | *1.38* | *(1.16 - 1.66)* |
| Ireland | 0.84 | 1.20 | 1.00 | 1.43 | (1.28 - 1.59) |
| | *0.87* | *1.14* | *1.03* | *1.31* | *(1.16 - 1.47)* |
| Switzerland | 0.82 | 1.20 | 1.23 | 1.45 | (1.36 - 1.55) |
| | *0.83* | *1.19* | *1.24* | *1.43* | *(1.34 - 1.53)* |
| Italy | 0.83 | 1.13 | 1.22 | 1.35 | (1.25 - 1.46) |
| | 0.88 | 1.05 | 1.27 | *1.18* | *(1.08 - 1.29)* |
| Portugal | 0.70 | 1.06 | 1.78 | 1.50 | (1.42 - 1.59) |
| | *0.73* | *0.89* | *1.61* | *1.38* | *(1.30 - 1.47)* |

[a] Adjusted by multiplying the observed SMRs and rate ratios with the adjustment factors discussed in the appendix.

In each country, the unadjusted rate ratio is smaller than the adjusted rate ratio. The difference is relatively large (0.15 units or more) in Finland, Sweden, Italy and Spain. Without this adjustment, Sweden would have seemed to have a significantly smaller rate ratio than England & Wales, and mortality differences in Italy and Spain would have seemed to be quite small from an international perspective.

Table 5.5 presents the results for men in the age group 60-64 years. Data for this age groups are only available for the five countries with a longitudinal study of at least 10 years of follow-up. Also in this age group, the SMRs for both non-manual and agricultural classes are lower than national average. The SMRs for manual classes are higher.

**Table 5.4** Age-standardised mortality ratios of three broad occupational classes and the manual *versus* non-manual mortality rate ratio, with (without) adjustment for the exclusion of men with occupation unknown.[a] Men 45-59 years at death.

| Country | SMR with (*without*) adjustment | | | Rate ratio and 95% CI with (*without*) adjustment | |
|---|---|---|---|---|---|
| | Non-manual | Manual | Agricultural | | |
| Finland | 0.79 | 1.20 | 0.92 | 1.53 | (1.49 - 1.56) |
| | *0.84* | *1.13* | *0.97* | *1.36* | *(1.32 - 1.39)* |
| Sweden | 0.86 | 1.20 | 0.79 | 1.41 | (1.38 - 1.44) |
| | *0.90* | *1.14* | *0.83* | *1.26* | *(1.23 - 1.29)* |
| Norway | 0.87 | 1.16 | 0.88 | 1.34 | (1.30 - 1.39) |
| | *0.91* | *1.11* | *0.92* | *1.22* | *(1.18 - 1.27)* |
| Denmark | 0.91 | 1.21 | 0.64 | 1.33 | (1.30 - 1.36) |
| | *0.94* | *1.17* | *0.66* | *1.24* | *(1.21 - 1.27)* |
| England & Wales | 0.81 | 1.18 | 0.78 | 1.44 | (1.33 - 1.56) |
| | *0.82* | *1.16* | *0.79* | *1.40* | *(1.29 - 1.52)* |
| Ireland | 0.91 | 1.26 | 0.82 | 1.38 | (1.30 - 1.46) |
| | *0.93* | *1.23* | *0.83* | *1.32* | *(1.24 - 1.40)* |
| France | 0.76 | 1.30 | 0.90 | 1.71 | (1.66 - 1.77) |
| | *0.77* | *1.28* | *0.89* | *1.65* | *(1.60 - 1.71)* |
| Switzerland | 0.87 | 1.17 | 0.97 | 1.35 | (1.29 - 1.39) |
| | *0.88* | *1.16* | *0.97* | *1.32* | *(1.27 - 1.37)* |
| Italy | 0.89 | 1.18 | 0.93 | 1.35 | (1.28 - 1.42) |
| | *0.97* | *1.06* | *0.99* | *1.10* | *(1.03 - 1.17)* |
| Spain | 0.84 | 1.16 | 0.97 | 1.37 | (1.34 - 1.39) |
| | *0.90* | *1.07* | *1.01* | *1.18* | *(1.15 - 1.20)* |
| Portugal | 0.78 | 1.07 | 1.15 | 1.36 | (1.31 - 1.40) |
| | *0.81* | *1.02* | *1.18* | *1.25* | *(1.20 - 1.29)* |

[a] Adjusted by multiplying the observed SMRs and rate ratios with the adjustment factors given in Table A of the appendix.

In Table 5.5, the rate ratio for Finland is larger than the one for Denmark, with Norway in-between. Unlike for younger age groups, the rate ratio for England & Wales is as large as the one for Finland. The largest rate ratio is again observed for France. Adjustment for the exclusion of economically inactive men has greatly increased the rate ratios for the three Nordic countries. Without this adjustment, mortality differences in these countries would have seemed to be much smaller than those in England & Wales.

**Table 5.5** Age-standardised mortality ratios of three broad occupational classes and the manual *versus* non-manual mortality rate ratio, with (without) adjustment for the exclusion of men with occupation unknown.[a] Men 60-64 years at death.

| Country | SMR with (*without*) adjustment | | | Rate ratio and 95% CI with (*without*) adjustment |
|---|---|---|---|---|
| | Non-manual | Manual | Agricultural | |
| Finland | 0.87 | 1.14 | 0.92 | 1.32 (1.27 - 1.37) |
| | *0.94* | *1.06* | *0.98* | *1.13 (1.08 - 1.18)* |
| Norway | 0.90 | 1.15 | 0.82 | 1.28 (1.24 - 1.33) |
| | *0.95* | *1.09* | *0.86* | *1.15 (1.11 - 1.20)* |
| Denmark | 0.95 | 1.15 | 0.69 | 1.21 (1.18 - 1.24) |
| | *0.99* | *1.11* | *0.71* | *1.12 (1.09 - 1.15)* |
| England & Wales | 0.85 | 1.13 | 0.80 | 1.33 (1.22 - 1.45) |
| | *0.86* | *1.11* | *0.81* | *1.29 (1.18 - 1.40)* |
| France | 0.84 | 1.26 | 0.87 | 1.50 (1.44 - 1.56) |
| | *0.86* | *1.13* | *0.88* | *1.44 (1.38 - 1.50)* |

[a] Adjusted by multiplying the observed SMRs and rate ratios with the adjustment factors discussed in the appendix.

**Table 5.6** Mortality rate ratio comparing manual classes to the class of professionals, employers, administrators and managers. Adjusted for the exclusion of men with occupation unknown.[a] Men, 30-44, 45-59 and 60-64 years at death.

| Country | 30-44 years | 45-59 years | 60-64 years |
|---|---|---|---|
| | Rate ratio 95 % CI | Rate ratio 95% CI | Rate ratio 95% CI |
| Finland | 2.02 (1.93 - 2.11) | 1.71 (1.66 - 1.76) | 1.41 (1.35 - 1.47) |
| Sweden | 2.16 (2.03 - 2.29) | 1.59 (1.55 - 1.63) | *no data* |
| Norway | 1.78 (1.67 - 1.89) | 1.47 (1.42 - 1.53) | 1.31 (1.26 - 1.35) |
| England & Wales | 1.49 (1.23 - 1.82) | 1.61 (1.47 - 1.78) | 1.47 (1.32 - 1.63) |
| France | *no data* | 2.15 (2.07 - 2.23) | 1.70 (1.60 - 1.80) |
| Switzerland | 1.46 (1.36 - 1.57) | 1.37 (1.31 - 1.42) | *no data* |

[a] Using the same adjustment factors as those applied to the manual *versus* non-manual rate ratio. Adjustment factors that were developed especially for comparison of manual classes to professionals and others had nearly the same values.

*Alternative summary indices*

Table 5.6 presents rate ratios in which manual classes are not compared to all non-manual classes, but only to the class of professionals, large employers, administrators or managers. This comparison is made only for countries where occupational classes could be defined with reference to the EGP scheme. Each rate ratio in Table 5.6 is larger than the corresponding manual *versus* non-manual estimate given in Tables 5.3 to 5.5. More importantly, the international pattern of mortality differences is the same: rate ratios for men 30-44 years are larger in the Nordic countries than in England & Wales and Switzerland, whereas rate ratios for men 45-59 and 60-64 years are relatively large for France and -to a lesser extent- Finland. Table 5.6 more clearly shows that the rate ratios for England & Wales are, as compared to those for most Nordic countries, relatively small for men 30-44 years and relatively large for men 60-64 years.

**Figure 5.1** The Index of Dissimilarity (%). Men, 45-59 years at death.

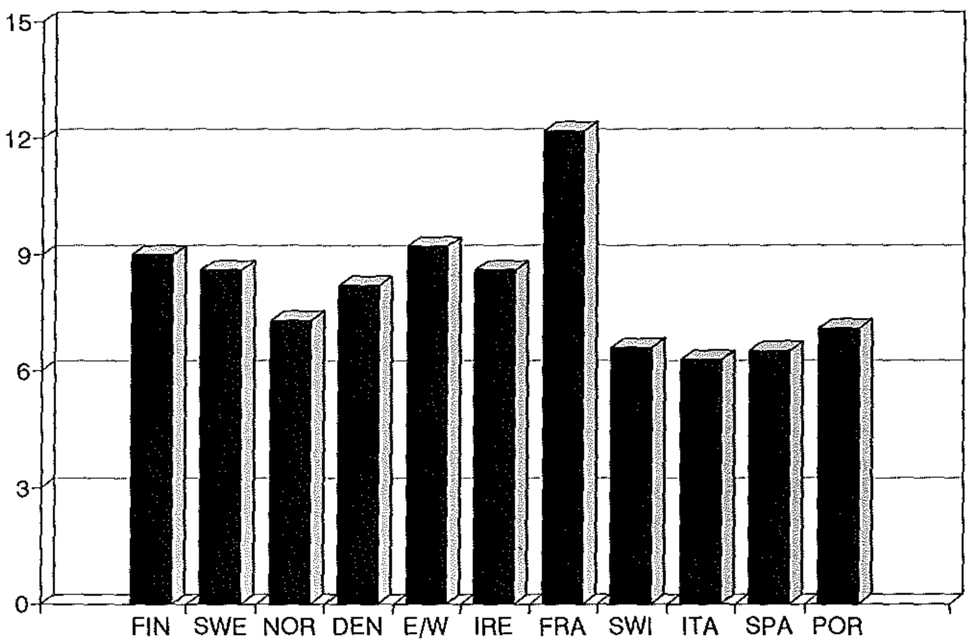



Figure 5.1 illustrates the application of the *Index of Dissimilarity* (ID) to deaths among men 45-59 years. The international pattern observed with the ID is approximately the same as the one observed with rate ratio measures.

A high ID is observed for France. The ID value for other countries is between 6 and about 9, implying that between 6 and 9 percent of all deaths in these countries should be redistributed in order to have the same mortality level in the three broad occupational classes. The ID is smallest for Switzerland, Italy and Spain. The class of farmers and farm labourers contributes to the small ID values for these countries, because there this class forms a substantial part of the population while its mortality level is close to the national average.

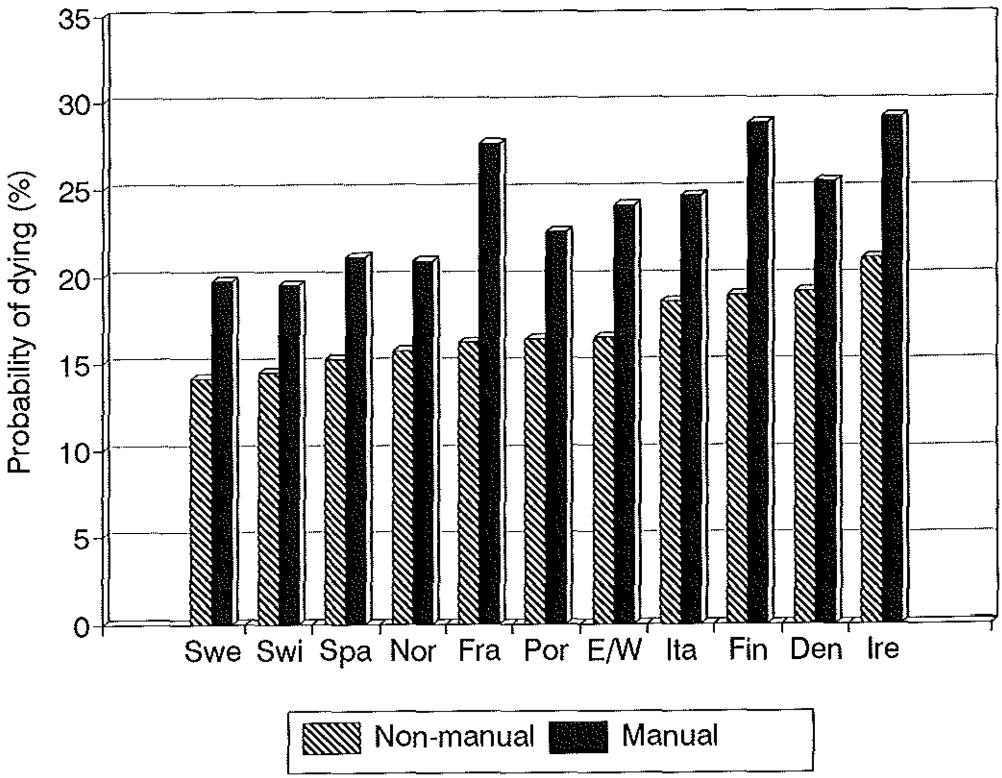
Table 5.7 presents absolute measures of mortality differences. Columns 2 and 3 are illustrated in Figure 5.2, which orders countries according to the death probabilities of non-manual classes. National probabilities of dying between the ages of 45 and 65 years range from about 16.5 percent in Sweden and Switzerland, to more than 23 percent in Finland and Ireland. Manual classes in Finland, Ireland and France have the highest probabilities. Most important for the present analysis is the absolute difference between manual and non-manual classes. As with relative measures, the largest differences are observed for France. Finland and Ireland have a more unfavourable position than they had on the basis of relative measures. Small absolute mortality differences are observed for both northern and southern European countries.

**Table 5.7** Absolute difference between men from manual and non-manual classes in the probability of dying between the ages 45 and 65 years.

| Country | Probability of dying (%) | | | Absolute manual *vs* non-manual difference |
|---|---|---|---|---|
| | National population [a] | Non-manual classes [b] | Manual classes [b] | |
| Finland | 24.0 | 18.9 | 28.8 | 9.8 |
| Sweden | 16.4 | 14.1 | 19.7 | 5.6 |
| Norway | 18.0 | 15.7 | 20.9 | 5.2 |
| Denmark | 21.0 | 19.1 | 25.4 | 6.3 |
| England & Wales | 20.3 | 16.5 | 24.0 | 7.5 |
| Ireland | 23.1 | 21.0 | 29.1 | 8.1 |
| France | 21.3 | 16.2 | 27.6 | 11.5 |
| Switzerland | 16.7 | 14.5 | 19.5 | 5.0 |
| Italy | 20.8 | 18.5 | 24.6 | 6.0 |
| Spain | 18.1 | 15.2 | 21.1 | 5.8 |
| Portugal | 21.0 | 16.4 | 22.5 | 6.1 |

[a] Calculated from national life tables presented by the WHO (1988).
[b] Estimated by multiplying national values with the class-specific SMRs (adjusted values) presented in Table 5.4.

**Figure 5.2** The probability of dying between the 45th and 65th birthday. Men in non-manual and manual classes.




*Evaluation of data problems*

Table 5.8 presents estimates of the potential size of bias in the manual *versus* non-manual rate ratios that have been presented in Tables 5.3 to 5.5. Three major sources of systematic error are evaluated. Their potential effects on rate ratios is quantified on the basis of the evaluations that are described in section 5.3.

The potential size of bias related to the approximate nature of social class schemes is estimated to be 5 percent for countries to which the GLT algorithm was applied, or 10 percent for countries with class schemes not based on the EGP scheme. The potential size of bias related to the unlinked design of cross-sectional studies is larger (15 or 20 percent) but confined to only four countries. The bias related to the approximate nature of our correction for exclusion of economically inactive men (see Appendix) is likely to be modest, but it adds to the uncertainty of the rate ratios for all countries.

**Table 5.8** The potential size of bias related to three sources of systematic error, expressed as the possible over- or underestimation of manual *versus* non-manual mortality rate ratios.

| Country | Potential size of specific biases (in %) | | | | | Sum for 45-59 years |
|---|---|---|---|---|---|---|
| | Approximation to EGP scheme | Unlinked study design | Exclusion of men with occupation unknown[a] | | | |
| | | | 30-44 | 45-59 | 60-64 | |
| Finland | 5 | 0 | 5 | 7 | 9 | 12 |
| Sweden | 0 | 0 | 7 | 6 | [b] | 6 |
| Norway | 5 | 0 | 6 | 6 | 6 | 11 |
| Denmark | 10 | 0 | 4 | 4 | 4 | 14 |
| England & Wales | 0 | 0 | 3 | 2 | 2 | 2 |
| Ireland | 10 | 20 | 5 | 3 | [b] | 33 |
| France | 0 | 0 | [b] | 2 | 3 | 2 |
| Switzerland | 5 | 15 [c] | 1 | 1 | [b] | 21 |
| Italy | 10 | 0 | 8 | 12 | [b] | 22 |
| Spain | 10 | 20 | [b] | 8 | [b] | 38 |
| Portugal | 10 | 20 | 5 | 5 | [b] | 35 |

[a] Estimated as one half of the adjustment factor for the manual *versus* non-manual rate ratio. The adjustment factors for men 45-59 years are given in Table A of the appendix. Quotients are rounded off upwards.
[b] No rate ratio estimates are made for these age groups.
[c] A special evaluation of the Swiss data (see text) showed that the numerator/denominator error in these data is likely to be 15 percent or less, and in upwards direction.

In the last column of Table 5.8, the total potential size of error is estimated as the sum of all three sources of error. This sum size of error would only occur if all specific sources of error would attain their maximum value and, in addition, happen to be in the same direction. This sum estimate is therefore likely to overestimate the real size of error. The sum value indicates that rate ratio estimates are highly certain in Sweden, England & Wales and France (potential error < 10 percent), followed by Finland, Norway and Denmark (< 15 percent). Highly uncertain are rate ratio estimates for Ireland, Spain and Portugal.

Table 5.9 applies these estimates of potential size of systematic error to the rate ratios given in Tables 5.3 to 5.5. The resulting margins of uncertainty can be used to assess the strength of the evidence for differences between countries in the size of the manual *versus* non-manual rate ratio. When the margins of uncertainty of two rate ratios clearly overlap, differences between these rate ratios might be wholly due to the combined effect of the three sources of systematic error that are evaluated in Table 5.8. If they do not overlap, or only marginally, there is strong evidence that mortality differences are larger in one country than in the other country.

For men 30-44 years, there is strong evidence that mortality differences in Finland and Sweden are larger than in England & Wales and Italy. For men 45-59, and in some cases for men 60-64 years, there is strong evidence that mortality differences in France are larger than in both Sweden, Norway, Denmark, England & Wales, Switzerland and Italy. For men 60-64 years, there is strong evidence that mortality differences in England & Wales are larger than in Denmark.

In some of these cases, however, 95 percent confidence intervals overlap, implying that the differences between rate ratios can be attributed to *random* error instead of *systematic* error. This applies especially to the comparisons involving England & Wales, including those with Finland and Sweden (30-44 years), Denmark (60-64 years) and France (60-64 years, but not 45-59 years).

**Table 5.9** Margins of uncertainty [a] for manual *versus* non-manual rate ratios [b]. Men, 30-44, 45-59 and 60-64 years at death.

| Country | 30-44 years | | 45-59 years | | 60-64 years | |
|---|---|---|---|---|---|---|
| | Rate ratio | Margin of uncertainty | Rate ratio | Margin of uncertainty | Rate ratio | Margin of uncertainty |
| Finland | 1.76 | (1.58 - 1.94) | 1.53 | (1.34 - 1.70) | 1.32 | (1.20 - 1.44) |
| Sweden | 1.66 | (1.54 - 1.78) | 1.41 | (1.33 - 1.49) | | [c] |
| Norway | 1.65 | (1.47 - 1.83) | 1.34 | (1.19 - 1.49) | 1.28 | (1.20 - 1.36) |
| Denmark | 1.53 | (1.32 - 1.74) | 1.33 | (1.14 - 1.52) | 1.21 | (1.16 - 1.26) |
| England & Wales | 1.46 | (1.42 - 1.50) | 1.44 | (1.41 - 1.47) | 1.33 | (1.30 - 1.36) |
| Ireland | 1.43 | (0.93 - 1.93) | 1.38 | (0.92 - 1.84) | | [c] |
| France | | [c] | 1.71 | (1.68 - 1.74) | 1.50 | (1.46 - 1.55) |
| Switzerland | 1.45 | (1.36 - 1.75) | 1.35 | (1.27 - 1.63) | | [c] |
| Italy | 1.35 | (1.11 - 1.59) | 1.35 | (1.05 - 1.65) | | [c] |
| Spain | | [c] | 1.37 | (0.85 - 1.89) | | [c] |
| Portugal | 1.50 | (0.98 - 2.03) | 1.36 | (0.88 - 1.84) | | [c] |

[a] Margins of uncertainty are calculated as the rate ratio plus/minus the potential size of error. This size of error is calculated as the rate ratio estimate times the sum value given in the last column of Table 5.8 (and divided by 100). The sum value given there refers to 45-59 years; the values for 30-44 and 60-64 years can be slightly different.

[b] The rate ratio estimates are taken from Tables 5.3 to 5.5.

[c] No rate ratio estimates are made for these age groups.

There remain a few cross-national differences that cannot be explained by random error *or* systematic error, especially those related to France (45-64 years). Most of these cross-national differences could in principle be explained by a combined effect of both random *and* systematic error. This would only occur, however, if both types work in the same direction. In addition, recall that the potential effect of systematic error is probably overestimated. Therefore, the evidence for larger mortality differences in France can be considered to be strong.

## 5.5 Discussion

The objective of this chapter was to compare European countries with respect to mortality differences by occupational class, thereby paying extensive attention to potential data problems. In comparison to previous studies, more countries were included, more recent data were used, and more efforts were made to increase the reliability and comparability of the available data.

*Re-evaluation of data problems*

Inequality estimates were evaluated against three problems with the reliability and international comparability of the available data. This evaluation supported the observation made by previous authors, that data problems have the potential to substantially bias comparisons between countries. This applied especially to comparisons involving Spain, Portugal and Ireland. We cannot exclude the possibility that mortality differences in these countries are as large as in France. On the other hand, the available data provided strong evidence that other countries have smaller mortality differences than in France.

When evaluating the three major data problems, we have probably exaggerated their potential effect on the observed size of mortality differences. This conservative approach was motivated by the fact that there are a few other data problems that could not be evaluated quantitatively but that might have caused additional bias. In this section, we discuss these other data problems.

The first problem relates to the study period. Whereas the data for most countries refer to circa 1985 (1980 to 1989), the data for Ireland, Switzerland, Italy, Spain and Portugal refer to circa 1981 (1980 to 1982). This 4-year difference would bias the comparison between countries if mortality differences strongly change over time. Increases in mortality differences during the 1980s have been observed for countries in both the northern and southern part of western Europe (Valkonen 1993b, Dahl and Kjaersgaard 1993b, Harding 1995, Vågerö and Lundberg 1995, Lang and Ducimetière

1995, Regidor *et al.* 1995a & 1996, Costa and Faggiano 1995). As a result, slightly larger mortality differences would probably have been observed for Ireland, Switzerland, Italy, Spain and/or Portugal when data would have been available for the entire 1980s. It is unlikely, however, that mortality differences increase dramatically within 4 years time. Trend estimates for France and Italy that are presented in Appendix Table D suggest that manual *versus* non-manual rate ratios may have increased by about 0.10 units in 5 years time. This increase is not negligible, but taking into this increase would not alter the international position of these countries.

The second problem relates to confounding. Socio-demographic characteristics like nationality, region of birth and place of residence can act as confounders to the association between occupational class and mortality. These variables have not been controlled for in the inequality estimates presented in this chapter. One might question whether control for confounding would have substantially changed these inequality estimates. Inequality estimates for Finland have been found to be fairly insensitive to confounding by several socio-demographic characteristics (Valkonen and Martelin 1988), but this type of evaluation has not been made for other European countries. In France, the magnitude of mortality differences strongly varies by region of residence (Desplanques 1984, Vallin 1995), but uncertain is to what extent control for region would change estimates of class differences in mortality in France as a whole. In Italy, confounding by region of birth reduces the observed socio-economic mortality differences to a small extent. Preliminary calculations, for which we used data from the Turin study (Costa and Faggiano 1995), showed that control for region of birth increases manual *versus* non-manual rate ratios with 0.04 units only.

The third problem is that foreigners are excluded from the data for Switzerland and France. The inequality estimates for these countries therefore refer to the native population only. It is uncertain how these estimates would change when the foreign population would be included in an appropriate way. Simply adding this population to the data would probably result in smaller inequality estimates, because foreigners in these countries have usually manual occupations but do not have high mortality rates (Brahmi 1980). However, simply adding foreigners to the study population might introduce confounding by, for example, ethnic-cultural factors and health selection during international migration. If attempts would be made to control for this confounding, the adjusted inequality estimates might become either smaller or larger than the original estimates. Unfortunately, there are no Swiss or French data that can be used to make proper estimates of the size of mortality differences in the total population instead of the native population only.

*Generalisability of the results*
It should be born in mind that this study is restricted to deaths among men younger than 60 years or, for some countries, 65 years. The restriction to these age groups might be justified with reference to the dramatic nature of pre-mature deaths, and the fact that mortality differences tend to be much larger below the age of 60 years than at older ages (Lynge *et al.* 1989, Martelin 1994, Fox *et al.* 1985, Olausson 1991). Nonetheless, deaths below 60 years represent only a small part of the burden of mortality in industrialised countries. The results of this study cannot be assumed to apply to ages of 60 years and over.

Another concern relates to the choice of the socio-economic indicator. The indicator used here, occupational class as defined in the EGP scheme, is perhaps more relevant to some European societies than to others. This raises the question whether the same international pattern of socio-economic differences in mortality would be observed with the use of other socio-economic indicators. Comparisons between countries with respect to mortality by income, housing tenure or other indicators of material deprivation is one alternative, but these comparisons are not possible due to problems with the availability and cross-national comparability of the necessary data. Instead, data on mortality by educational level in the 1980s were available for five countries: Finland, Norway, Denmark, France and Italy. The results are summarised in Table 5.10. More detailed results are presented elsewhere (Kunst *et al.* 1996). Table 5.10 shows that the relative position of countries was about the same for education as for occupational class. There is, however, one important exception. Whereas class differences in mortality among men 30-44 years in Italy were relatively small, differences by educational level were found to be as large as in France.

**Table 5.10** The size of mortality differences associated with educational level. Men, 30-44 and 45-59 years at death.

| Country | 30-44 years | | 45-59 years | |
|---|---|---|---|---|
| | RII *[a]* | 95 % CI | RII *[a]* | 95 % CI |
| Finland | 3.12 | (2.93 - 3.31) | 2.41 | (2.30 - 2.53) |
| Norway | 3.31 | (3.02 - 3.63) | 2.09 | (1.98 - 2.21) |
| Denmark | 2.40 | (2.23 - 2.58) | 1.81 | (1.72 - 1.90) |
| France [b] | | *no data* | 2.15 | (2.07 - 2.23) |
| Italy | 3.71 | (3.23 - 4.27) | 1.73 | (1.57 - 1.92) |

[a] The Relative Index of Inequality. For calculation and interpretation, see sections 2.6.3 and 4.3.

Mortality differences by occupational class among women were difficult to assess due to problems with the classification of housewives and other women not gainfully employed (Kunst *et al.* 1996). Much more easier is it to classify women according to their educational level. For the five countries mentioned above, we observed that mortality differences by educational level among women have approximately the same pattern as for men (Kunst *et al.* 1996).

*Comparison to results of previous studies*
Studies on mortality differences by occupational class in the 1970s observed larger cross-national variations than we observed for the 1980s (chapters 3 and 4; Leclerc *et al.* 1990, Leon *et al.* 1992, Minder 1991, Vågerö and Lundberg 1989, Wagstaff *et al.* 1991). The general impression of these studies was that mortality differences by occupational class were much smaller in Denmark, Sweden, and Norway than in Finland and France, with England & Wales in-between.

The situation in the 1970s is reassessed in Table 5.11. This table is based on unpublished data that were available to the analysis reported in chapter 3. We reanalysed these data according to the methods used in the present chapter.

**Table 5.11** Mortality rate ratio comparing manual classes to non-manual classes, longitudinal results for the 1970s compared to results for the 1980s. Men, 45-59 or 45-69 years at death [a].

| Country | Observed rate ratio (95% CI) [b] | | Adjusted rate ratio | |
|---|---|---|---|---|
| | 1970s, men 45-69 years | 1970s, men 45-59 years | 1970s,[c] 45-59 | 1980s,[d] 45-59 |
| Norway | 1.05 (1.04 - 1.07) | 1.12 (1.09 - 1.15) | 1.18 | 1.34 |
| Denmark | 1.07 (1.06 - 1.09) | 1.18 (1.15 - 1.20) | 1.22 | 1.33 |
| Sweden | 1.09 (1.08 - 1.10) | 1.18 (1.16 - 1.21) | 1.26 | 1.41 |
| England & W | 1.20 (1.16 - 1.25) | 1.21 (1.13 - 1.30) | 1.25 | 1.44 |
| Finland | 1.35 (1.33 - 1.37) | 1.39 (1.36 - 1.43) | 1.40 | 1.53 |
| France | 1.39 (1.33 - 1.46) | 1.44 (1.35 - 1.55) | 1.61 | 1.71 |

[a] Most 1970s cohorts were aged 40-64 (40-54) years at the baseline year and followed for 10 years (circa 1971-1980). The French 1970s cohort was 40-64 (40-59) years at baseline and followed for 5 years (1976-1980).
[b] Calculated as in Table 5.4. Self-employed men (excluding farmers) are added to non-manual classes in most countries except England & Wales. Source: unpublished data from the study reported in chapter 3.
[c] Adjusted with the formula given in the appendix, using as input the population share and relative mortality of men with occupation unknown in the 1970s.
[d] Taken from Table 5.4.

The first column of Table 5.11 reproduces the results for the 1970s as they were reported before. For men 45-69 years, manual *versus* non-manual rate ratios were very small in Norway, Denmark and Sweden, followed by England & Wales, then by Finland, and then by France.

A main problem with these estimates is that economically inactive men are excluded from the estimates for Norway, Denmark, Sweden and France, and to a lesser extent for England & Wales. As a first step to avoid this problem, rate ratios were calculated for men 45-59 years only, thereby excluding men 60-69 years, most of whom were retired. As shown in column 2, all rate ratios increase, but the increase is largest for Norway, Denmark and Sweden. As a second step, the rate ratios for men 45-59 years were adjusted for the exclusion of inactive men. As shown in column 3, this adjustment results in much larger rate ratios for Norway, Denmark, Sweden and France.

The adjusted rate ratios can be compared to our estimates for the 1980s (summarised in column 4). This comparison suggests that the rate ratios have increased in each country, similar to what has been observed in most national trend studies (Dahl and Kjaersgaard 1993b, Harding 1995, Lang and Ducimetière 1995, Valkonen 1993b, Vågerö *et al.* 1995). Important to the present study is to note that the relative positions of these countries have remained approximately the same over time. Thus, the discrepancies between the results of the present study and previous studies are in part due to the failure of previous studies to adjust for the exclusion of economically inactive men, and in part due to different selections of age groups. A high degree of correspondence is observed when restricting the analysis to men 45-59 years. This consistency over time lends further credibility to the patterns observed in the present study with relatively large socio-economic differences in mortality in Finland and, especially, France.

*Explanations*

The results are surprising because they do not support the expectation that mortality differences are consistently smaller in Nordic countries as compared to countries like England & Wales, Ireland and Mediterranean countries. Smaller mortality differences were expected to have resulted from the egalitarian socio-economic policies that have been pursued since the 1930s in Sweden and with some delay in the other Nordic countries as well.

These results agree with the observation made by stratification sociologists, that occupational class membership persists as a major determinant of the life styles and living conditions of citizens of industrialised countries (Goldthorpe and Marshall 1992, Warde 1994). This persistency was stressed by Erikson and Goldthorpe (1992a), who observed that patterns of intergenerational mobility between occupational classes were highly stable over time and across industrialised countries. For example, Sweden was found to have only slightly higher rates of social mobility than England and

France. In view of this persistency of occupational class as a determinant of one's chances in life, it is no surprise to find for each European country that occupational class remains an important determinant of one's chances of death as well.

This common theme can nonetheless have major variations. The present study provided strong evidence for at least one instance of cross-national variations. Mortality differences in France were shown to be about two times as large as in England & Wales. This finding contrasts with the evidence of recent studies that these two countries are highly similar with respect to the size of income inequalities in the early 1980s (Atkinson *et al.* 1995), and with respect to social mobility patterns until the 1970s (Erikson and Goldthorpe 1992a). This suggests that additional factors should be invoked when explaining the large mortality differences in France. Causes of death related to alcohol abuse have been found to contribute much to the mortality excess of manual classes in France (Desplanques 1984). The reasons for their higher alcohol consumption are not well understood, but it is likely that some unique socio-cultural factors (e.g. related to tastes, traditions and values attached to wine consumption) have strengthened the links between health and disadvantage in French society.

A comparison that has already been given attention in the Black Report is that between Sweden and England & Wales (Townsend *et al.* 1988a). Previous studies concluded that mortality differences by occupational class were smaller in Sweden than in England & Wales (Kunst and Mackenbach 1994b, Minder 1991, Vågerö and Lundberg 1989). However, this conclusion needs more nuance. There is evidence from the present study that the position of Nordic countries *versus* England & Wales varies by age, with mortality differences in Nordic countries being relatively small at ages 60-64 years, but relatively large at ages 30-44 years (Tables 5.6 and 5.9). This pattern does not contest the possibility that egalitarian socio-economic policies are associated with smaller differences in mortality. Is seems, however, that a positive effect of egalitarian policies is overshadowed in these countries by specific factors that operate at younger ages or among younger birth cohorts. There might be a relationship with external causes of death (accidents and violence), for which mortality rates among men 30-44 years are higher in most Nordic countries than in England & Wales (WHO 1988). Perhaps the age-dependency is in part cohort-specific and a reflection of class differences in childhood living conditions in the 1940s or later. Against this possibility speaks the fact that socio-economic differences in the height of younger birth cohorts are relatively small in Sweden (Kunst *et al.* 1995).

The position of Sweden as compared to England & Wales is more favourable when class differences are expressed in absolute terms (Table 5.7). One might question whether small absolute differences can be considered a merit of the egalitarian socio-economic and other policies that have been pursued in Sweden since several decades. These policies would reduce class differences in mortality in absolute terms rather than relative terms, if they bring benefit to high as well as low occupational classes. This would imply that the main effect of egalitarian socio-economic and other policies would be to reduce national mortality levels. There is some but controversial evidence for an effect on national life expectancies (Wilkinson 1992a & 1996, Kaplan *et al.* 1996, Judge 1995, Judge *et al.* 1997). Nonetheless, it is still surprising that, in relative terms, lower occupational classes do not seem to have benefitted more than higher classes.

*Implications*

Available data on the magnitude of class differences in all-cause mortality cannot provide support to the suggestion of previous studies that these class differences are highly variable across western European countries. Nor can they provide support to the suggestion that egalitarian socio-economic and other policies are able to bring about a substantial reduction in socio-economic differences in mortality. The situation in France illustrates that there are other determinants as well, some of which may have concealed a beneficial effect of egalitarian policies.

More focused research is needed to assess the effects of egalitarian policies and other potentially relevant circumstances. There are sufficient possibilities for further cross-national comparisons. One might attempt to include women, distinguish more age-groups, include different socio-economic indicators, and analyze key causes of death and associated risk factors. One might also study time trends in order to add historical depth and follow specific birth cohorts. These in-depth comparisons can help us to better understand why socio-economic differences in mortality are as large as they are in the different European countries.

# Chapter six

# Cause-specific mortality and occupational class in 11 western European countries

## 6.1 Summary

In chapter 5, we observed that class differences in total mortality are about equally large in most western European countries, although larger in France and Finland. This chapter compares these countries with respect to class differences in mortality from specific causes of death, and the contributions these causes make to class differences in total mortality.

Nationally representative data on mortality by occupational class among men 45-59 years at death were obtained from longitudinal and cross-sectional studies. Nine causes of death were distinguished. The magnitude of mortality differences was measured by rate ratios that compare manual to non-manual classes.

A north-south gradient was observed. Mortality from ischaemic heart disease was strongly related to occupational class in England & Wales, Ireland, Finland, Sweden, Norway and Denmark, but not in France, Switzerland and Mediterranean countries. In the latter countries, non-lung cancer and gastro-intestinal diseases made a large contribution to class differences in total mortality. Large international variations were also observed with respect to lung cancer, cerebrovascular disease and external causes of death.

These cause-specific variations indicate large differences between countries in the contribution that disease-specific risk factors like smoking and alcohol consumption make to socio-economic differences in mortality. The cause-specific variations observed in this study contrast strongly with the nearly constant class differences in total mortality in most western European countries. This constancy underlines the generalised ability of higher occupational classes to better avoid premature death whatever diseases and associated risk factors are the main causes of premature death.

## 6.2 Introduction

Socio-economic differences in morbidity and mortality have been observed for each European country for which data are available (Illsley and Svensson 1990, Mielck and Giraldes 1993). Health inequalities in different European countries seem to represent only minor variations on a common theme. But perhaps there is more diversity.

There are several reasons for an interest in the degree to which health inequalities are similar or dissimilar in the different European countries. Large dissimilarities would imply that socio-economic differences in health are highly sensitive to specific national circumstances. Further study might show which circumstances are most influential, and perhaps identify circumstances that are liable to change through intervention.

A second reason relates to the international exchange of research findings and policy experiences. An example are the findings from explanatory studies, most of which are from the United Kingdom, the Netherlands or Nordic countries (Davey Smith *et al.* 1994, Lundberg 1991b, Mackenbach 1992). Combination of research findings from different countries can provide a more comprehensive picture of the causes of health inequalities. This exchange is only possible, however, to the extent that the patterns and causes of health inequalities are similar in these countries. Some degree of similarity is also required when extrapolating these findings to other parts of Europe.

Several studies have compared countries with respect to the magnitude of differences in mortality. In chapter 5, we demonstrated a higher mortality level of manual classes as compared to non-manual classes in 11 western European countries. For men 45-59 years, this mortality difference was about equally large in most countries; relatively large mortality differences could only be demonstrated for Finland and, especially, France.

Only a few studies have compared countries with respect to the cause-of-death pattern of socio-economic differences in mortality (e.g. Leclerc *et al.* 1983 & 1990). Valkonen (1987 & 1989), who compared Hungary to northern European countries, found that the association with educational level was relatively weak for cardiovascular disease mortality but relatively strong for other causes of death. This suggested that risk factors for cardiovascular disease (e.g. tobacco consumption) made a smaller contribution to mortality differences in Hungary than in northern Europe.

This chapter compares 11 countries from the northern and southern part of western Europe. A comparison is made with respect to occupational class differences in mortality from specific causes of death, and the contributions these causes make to class differences in total mortality among men 45-59 years.

## 6.3 Material and methods

Data on mortality by occupational class and cause of death were obtained from longitudinal studies and otherwise from cross-sectional studies. Longitudinal studies were available for Finland, Sweden, Norway, Denmark, England & Wales, France and Italy. All studies covered the period of circa

1980 to 1989. Data from cross-sectional studies were available for Ireland, Switzerland, Spain and Portugal. Each cross-sectional study was centred around the national population census of circa 1981.

The age group 45-59 years was distinguished for studies which classified men according to their age at death. For longitudinal studies with a follow-up period of about 10 years, the birth cohort aged 40-54 years at the start of follow-up was distinguished.

Nine causes of death were distinguished. As shown in Table 6.1, the share of these causes of death in the total number of deaths varies strongly between European countries. Ischaemic heart disease is the largest single cause of death in northern countries. Relatively important in France and more southern countries are non-lung cancer and gastro-intestinal diseases. Other causes of death have different international patterns.

**Table 6.1** Share of specific causes of death[a] among all deaths of men 45-59 years at death.

| Country | Share (%) in all deaths | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | lung cancer | other cancer | ischem heart | cerebro-vascul | other cardiov | respi-ratory | gastro-intest | other dis | extern causes |
| Finland | 7.3 | 13.4 | 35.6 | 6.2 | 6.1 | 3.4 | 4.6 | 5.3 | 18.1 |
| Sweden | 5.5 | 20.1 | 34.6 | 4.7 | 5.8 | 3.9 | 4.6 | 7.8 | 13.1 |
| Norway | 7.1 | 19.9 | 34.2 | 4.2 | 5.4 | 2.9 | 3.5 | 10.9 | 11.9 |
| Denmark | 9.5 | 19.8 | 26.3 | 4.1 | 5.2 | 3.8 | 5.8 | 14.0 | 11.6 |
| England/W | 11.4 | 20.2 | 38.2 | 5.5 | 5.1 | 5.7 | *[b]* | 8.0 | 5.8 |
| Ireland | 8.3 | 18.0 | 39.0 | 5.6 | 5.7 | 7.2 | 2.8 | 5.6 | 7.8 |
| France | 9.2 | 28.8 | 9.9 | 4.5 | 7.4 | 3.4 | 11.3 | 12.4 | 13.2 |
| Switzerland | 11.9 | 21.5 | 20.7 | 3.5 | 9.8 | 3.4 | 6.4 | 7.8 | 15.0 |
| Italy | *[c]* | 36.6 | *[d]* | *[d]* | 31.8 | 3.3 | 12.8 | 5.7 | 9.6 |
| Spain | 8.3 | 23.5 | 14.4 | 6.8 | 10.4 | 6.1 | 12.3 | 8.3 | 9.8 |
| Portugal | 4.2 | 18.7 | 11.3 | 11.4 | 6.2 | 6.2 | 13.2 | 13.4 | 15.4 |

[a] ICD-9 codes are, respectively, 162, other 140-239, 410-414, 430-438, other 390-459, 460-519, 520-579, other <800, and 800-999.
[b] Combined with other diseases.
[c] Combined with other cancers.
[d] Combined with other cardiovascular diseases.

A common occupational class scheme, the EGP scheme, was applied to as many countries as possible (Erikson and Goldthorpe 1992a, Bartley *et al.* 1996). These conversion schemes could not be applied to the data available for Denmark, Ireland, Italy, Spain and Portugal. Data from these countries could however be made comparable to the EGP scheme at the level of three broad classes: non-manual classes (including self-employed men), manual classes, and the class of farmers and farm labourers.

For most countries, there was insufficient information on the former occupation of economically inactive men, who therefore had to be excluded from the analysis. Their exclusion is likely to lead to an underestimation of mortality differences between occupational classes. Therefore, we applied a procedure that approximately corrects for this underestimation. With this procedure, which is described in the appendix for total mortality, we could make adjustments for each cause of death separately.

The magnitude of mortality differences by occupational class was quantified by rate ratios and rate differences. Rate ratios express the mortality level of manual classes as a ratio to that of non-manual classes. Rate ratios were estimated by means of Poisson regression. The regression model included a term on the contrast between manual and non-manual classes. A series of terms representing 5-year age groups were added in order to control for age.

Rate differences were calculated as the absolute difference between the death rates of manual and non-manual classes. Death rates were adjusted for age by the indirect method, with national age-specific death rates as the standard. The rate differences for specific causes of death add up to the rate difference for total mortality. Thus, dividing the rate difference for a specific cause of death to the one for total mortality yields a measure on the contribution that this cause makes to the rate difference for total mortality.

Two sources of data were used for France: a longitudinal study was used to estimate the rate ratio for all-cause mortality, whereas a cross-sectional study had to be used to estimate rate ratios for both all-cause mortality and for specific causes of death. The longitudinal study was found to yield a 1.196 times larger all-cause rate ratio than the cross-sectional study. This discrepancy was due to a strong 'numerator/denominator bias' in the cross-sectional study (Desplanques 1984, Kunst & Groenhof 1996c). In order to correct for this bias, all rate ratio estimates from the cross-sectional study were multiplied by the factor 1.196.

## 6.4 Results

Table 6.2 presents manual *versus* non-manual rate ratios for total mortality and broad cause-of-death groups. Rate ratios for total mortality are between 1.33 and 1.44 for most countries, except Finland (1.53) and France (1.71). More pronounced cross-national variations are observed for broad cause-of-death groups. Small from an international perspective are relative mortality differences for neoplasms in Sweden, Norway, Denmark, England & Wales and Portugal, for cardiovascular diseases in Switzerland and the Mediterranean countries, and for external causes of death in Norway, Denmark, Switzerland and Italy.

**Table 6.2** Mortality rate ratio comparing manual classes to non-manual classes. Men 45-59 years at death. Major groups of causes of death.

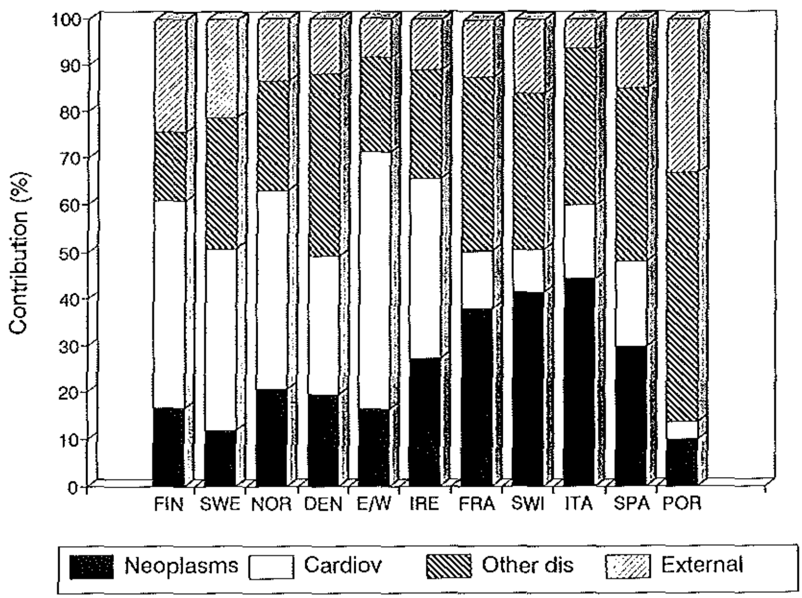
| Country | Rate ratio (95% CI) | | | | |
|---|---|---|---|---|---|
| | All causes | Neoplasms | Cardiovascular diseases | All other diseases | External causes |
| Finland | 1.53 (1.49-1.56) | 1.39 (1.32-1.47) | 1.48 (1.42-1.53) | 1.60 (1.48-1.70) | 1.76 (1.66-1.87) |
| Sweden | 1.41 (1.38-1.44) | 1.18 (1.13-1.23) | 1.36 (1.31-1.40) | 1.83 (1.72-1.93) | 1.76 (1.65-1.87) |
| Norway | 1.34 (1.30-1.39) | 1.25 (1.18-1.33) | 1.34 (1.27-1.40) | 1.51 (1.40-1.63) | 1.42 (1.29-1.54) |
| Denmark | 1.33 (1.30-1.36) | 1.21 (1.16-1.26) | 1.28 (1.23-1.33) | 1.62 (1.54-1.70) | 1.36 (1.27-1.45) |
| England/W | 1.44 (1.33-1.56) | 1.21 (1.05-1.39) | 1.52 (1.36-1.71) | 1.74 (1.40-2.16) | 1.74 (1.24-2.46) |
| Ireland | 1.38 (1.30-1.46) | 1.39 (1.24-1.55) | 1.27 (1.17-1.38) | 1.66 (1.43-1.93) | 1.66 (1.33-2.07) |
| France [a] | 1.71 (1.66-1.77) | 1.71 (1.61-1.82) | 1.35 (1.26-1.45) | 2.09 (1.97-2.22) | 1.72 (1.57-1.88) |
| Switzerland | 1.35 (1.29-1.39) | 1.44 (1.35-1.54) | 1.08 (1.01-1.15) | 1.75 (1.60-1.91) | 1.39 (1.26-1.53) |
| Italy | 1.35 (1.28-1.42) | 1.43 (1.31-1.55) | 1.17 (1.07-1.28) | 1.60 (1.43-1.80) | 1.22 (1.03-1.46) |
| Spain | 1.37 (1.34-1.39) | 1.33 (1.29-1.38) | 1.19 (1.15-1.22) | 1.52 (1.46-1.57) | 1.80 (1.68-1.93) |
| Portugal | 1.36 (1.31-1.40) | 1.12 (1.05-1.21) | 1.03 (0.97-1.10) | 1.65 (1.55-1.76) | 2.15 (1.94-2.38) |

[a] Confidence interval estimates for specific causes of death are approximate.

Table 6.3 presents manual *versus* non-manual rate ratios for specific causes of death. Mortality from ischaemic heart disease is strongly related to low occupational class only in England & Wales, Ireland and the Nordic countries. In France, Switzerland and Spain, on the other hand, large differences are observed for non-lung cancer. Large international variations were also observed for class differences in lung cancer (largest in Finland and Ireland), cerebrovascular disease (largest in England & Wales) and gastro-intestinal diseases (largest in France and Italy).

Figure 6.1 presents the contribution that broad cause-of-death groups make to the difference between manual and non-manual classes in total mortality. Neoplasms contribute about 30 percent or more to the mortality differences in Ireland, France, Switzerland, Italy and Spain. Cardiovascular diseases contribute about 30 percent or more to the mortality differences in England & Wales, Ireland and the Nordic countries. The contribution of external causes ranges from less than 10 percent in Italy and England & Wales to more than 20 percent in Finland, Sweden and Portugal.

**Figure 6.1** Contribution of broad cause-of-death groups to the difference between manual and non-manual classes in total mortality. Men 45-59 years at death.




The contributions made by specific causes of death are presented in Table 6.4. The north-south gradient in the contribution of cardiovascular diseases can be attributed to ischaemic heart disease. In southern countries, a large part of the mortality difference between manual and non-manual classes is due to non-lung cancer and gastro-intestinal diseases. Large international variations were also observed for the contributions made by lung cancer (largest in Ireland and Switzerland), cerebrovascular disease (largest in England & Wales, Ireland and Portugal) and respiratory diseases (largest in Ireland and Portugal).

**Table 6.3** Mortality rate ratio comparing manual classes to non-manual classes. Men 45-59 years at death. Specific causes of death.

| Country | Rate ratio (* : 95% CI does not include 1.00) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | lung cancer | other cancer | ischem heart | cerebro-vascul | other cardiov | respi-ratory | gastro-intest | other diseases |
| Finland | 2.20* | 1.14* | 1.47* | 1.55* | 1.52* | 2.37* | 1.37* | 1.50* |
| Sweden | 1.46* | 1.11* | 1.36* | 1.31* | 1.42* | 1.91* | 1.58* | 1.95* |
| Norway | 1.62* | 1.15* | 1.35* | 1.21* | 1.31* | 1.68* | 1.42* | 1.49* |
| Denmark | 1.51* | 1.09* | 1.28* | 1.28* | 1.28* | 2.30* | 1.65* | 1.48* |
| England/W | 1.54* | 1.07 | 1.50* | 1.74* | 1.46* | 2.13* | [a] | 1.49* |
| Ireland | 1.95* | 1.17* | 1.23* | 1.57* | 1.40 | 2.00* | 1.08 | 1.67* |
| France | 1.65* | 1.75* | 1.14 | 1.61* | 1.54* | 2.63* | 2.20* | 1.89* |
| Switzerland | 1.73* | 1.29* | 0.96 | 1.43* | 1.26 | 2.31* | 1.62* | 1.69* |
| Italy | | | [b] | | | 1.63* | 1.78* | 1.23 |
| Spain | 1.38* | 1.31* | 0.98 | 1.18* | 1.68* | 1.89* | 1.43* | 1.42* |
| Portugal | 1.07 | 1.15* | 0.76* | 1.44* | 1.14 | 2.13* | 1.59* | 1.54* |

[a] Combined with other diseases.
[b] No distinction could be made between different neoplasms, nor between different cardio-vascular diseases.

**Table 6.4** Contribution of specific causes of death to the difference between manual and non-manual classes in total mortality. Men 45-59 years at death.

| Country | Contribution (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | lung cancer | other cancer | ischem heart | cerebro-vascul | other cardiov | respi-ratory | gastro-intest | other diseases |
| Finland | 12.8 | 4.2 | 31.8 | 6.5 | 5.9 | 6.9 | 3.8 | 5.0 |
| Sweden | 5.9 | 6.0 | 30.1 | 3.5 | 5.3 | 6.7 | 5.6 | 15.0 |
| Norway | 11.7 | 9.3 | 34.7 | 2.9 | 5.0 | 4.8 | 4.0 | 14.9 |
| Denmark | 14.0 | 5.8 | 22.0 | 3.2 | 4.1 | 10.2 | 10.3 | 18.6 |
| England/W | 13.1 | 3.3 | 41.7 | 8.1 | 5.1 | 11.1 | [a] | 9.0 |
| Ireland | 18.7 | 8.3 | 25.4 | 7.4 | 5.7 | 14.7 | 0.8 | 8.1 |
| France | 8.6 | 29.2 | 2.7 | 3.9 | 5.8 | 6.0 | 16.7 | 14.7 |
| Switzerland | 22.8 | 19.1 | -0.3 | 4.2 | 7.4 | 9.1 | 10.7 | 13.7 |
| Italy | | | [b] | | | 5.1 | 24.4 | 3.8 |
| Spain | 8.9 | 20.8 | -0.1 | 4.0 | 17.0 | 11.7 | 15.2 | 9.7 |
| Portugal | 1.3 | 8.9 | -11.3 | 13.0 | 2.6 | 15.0 | 19.8 | 16.3 |

[a] Combined with other diseases.
[b] No distinction could be made between different neoplasms, nor between different cardiovascular diseases.

## 6.5 Discussion

*Evaluation of data problems*

In chapter 5, we identified three major problems with the reliability and comparability of the data that were available from different countries: the use of occupational class schemes other than the EGP scheme, (our approximate correction for) the exclusion of economically inactive men, and biases inherent to unlinked cross-sectional studies. In a series of evaluations, we quantified the potential effect that these data problems could have on manual *versus* non-manual rate ratios. The potential size of error was less than 20 percent in all countries, except Ireland, Spain and Portugal. The magnitude of error does not vary substantially by cause of death. These errors might explain some of our results, notably those for Ireland, Spain and Portugal, but cannot account for the large international variations that were observed for several causes of death.

Comparisons with respect to the cause-of-death composition of mortality differences can be biased if the above-mentioned data problems are differential to cause of death. The perhaps major problem relates to the exclusion of economically inactive men from the data sets from most countries (see Appendix). Their exclusion causes an underestimation of mortality differences by occupational class, and this underestimation is larger for diseases of a more chronic nature, e.g. respiratory diseases (Kunst and Groenhof 1996b). However, we have corrected for the exclusion of inactive men by means of correction factors that could be calculated for each cause of death separately (Kunst and Groenhof 1996b). It is highly unlikely that any remaining bias can explain the marked variations in the cause-of-death patterns that were observed in this study.

The comparability of cause-of-death registrations is another area of concern. European countries differ with respect to the design of death certificates, the way physicians fill in these certificates, and the way in which their information is coded at central statistical offices. In order to avoid comparability problems as much as possible, most of this study dealt with broad groups of causes of death. Some specific causes of death were nonetheless included because of their large share in the total number of deaths. Perhaps most problematic is the registration of deaths from ischaemic heart disease, a part of which may be assigned to other heart diseases, other cardiovascular diseases, or sudden death. If this misreporting occurs more frequently to deaths among lower occupational classes than to deaths among higher classes, the relatively mortality level of lower classes might be underestimated. Can this problem explain the fact that no differences in ischaemic heart disease mortality were observed in southern European countries? The answer should probably be no. With the data presented in Table 6.2 it can be estimated what the results would be if the group of other circulatory diseases (less cerebrovascular disease) would be added to ischaemic heart disease. The contribution of this more robust cause-of-death group to all-cause mortality differences would show the same marked north-south gradient as was found for ischaemic heart disease alone.

*Explanations*

The magnitude of socio-economic differences in total mortality was found to be approximately the same in most countries, with the exceptions of France and Finland (chapter 5). The relatively large mortality differences in France could be attributed to two cause-of-death categories: non-lung cancer and gastro-intestinal diseases. Data from a French study showed that these large differences can be attributed to, respectively, cancers of the upper digestive tract and liver cirrhosis (Desplanques 1984). The exceptionally large mortality differences for these two causes of death are illustrated in Table 6.5 with French data for the late 1970s. Cancers of the upper digestive tract and liver cirrhosis have excessive alcohol consumption as a common risk factor. This indicates that alcohol consumption makes an important contribution to class differences in mortality in France.

**Table 6.5** Mortality rate ratio of unskilled labourers *versus* higher-level employees and professionals. France, 1976-1980, men 55-64 years. Source: Desplanques (1984).

| Cause of death | Rate ratio | Cause of death | Rate ratio |
|---|---|---|---|
| Neoplasms | 1.85 | Cancer of lung | 1.74 |
| Circulatory diseases | 1.37 | Cancer of upper digestive tract | 5.23 |
| Respiratory diseases | 3.45 | Cancer of stomach | 2.93 |
| Liver cirrhosis | 4.68 | Cancer of colon | 1.30 |
| All causes | 1.84 | Other neoplasms | 1.22 |

Characteristic for Finland is that external causes of death make a relatively large contribution. This large contribution is probably also related to alcohol consumption. They can do so, not because they are more unequally distributed than in, for example, England & Wales, but because violent deaths have a large share in the national mortality level. This larger share is due to relatively high national death rates for both suicide, homicide, accidental fall and intoxications. This mortality excess is to a large extent related to alcohol consumption (Mäkelä 1997). Alcohol-related mortality has been estimated to account for at least 24 percent of the life expectancy difference between manual classes and upper non-manual classes in Finland (Mäkelä *et al.* 1997). Drinking patterns in Finland have probably increased the incidence of violent deaths rather than deaths from chronic diseases. Working classes in

Finland tend to concentrate their drinking in episodes of intoxication interspersed with periods of abstinence (Poikolainen 1983). This is likely to result in a higher incidence and mortality from alcohol poisoning, accidental falls, drowning and violence, rather than more deaths from liver cirrhosis.

Important to the situation in southern European countries is that ischaemic heart disease mortality rates hardly differed between manual and non-manual classes. This is probably related to the low national levels of ischaemic heart disease mortality in southern Europe (Uemura 1983). Specific factors have protected men from southern European countries against ischaemic heart disease, e.g. the traditional diet with frequent consumption of fresh vegetables, fruits and vegetable oil, and the traditionally moderate levels of alcohol consumption (Beaglehole 1990, Epstein 1989, Filiberti *et al.* 1995, Helsing 1995, Kushi *et al.* 1995, Verschuren *et al.* 1995). There is evidence that these factors have protected lower socio-economic groups in particular (Cavelaars *et al.* 1997d, Regidor *et al.* 1995b).

Smoking may have played an additional role. Whereas marked inverse social gradients in smoking emerged in northern Europe in the 1960s or before, in southern Europe these gradients emerged only during the 1980s (Borrell 1995, Cavelaars *et al.* 1997c, Regidor *et al.* 1995b, Sasco *et al.* 1994, La Vecchia *et al.* 1986). Inverse class gradients in smoking existed in Switzerland already in the early 1980s, but then seemed to be weaker than in northern Europe (La Vecchia *et al.* 1987).

Despite the lack of clear social gradients in smoking in southern Europe in the early 1980s, class differences in lung cancer mortality were about as large in France, Switzerland and Spain as they were in northern countries (Table 6.4). Other risk factors for lung cancer appear to have increased lung cancer mortality among manual workers men in southern countries, e.g. psychosocial factors or high exposure to carcinogenic substances at work (Hein *et al.* 1992, Loon *et al.* 1995, Marmot *et al.* 1984).

Despite the large international variations in class differences in mortality from specific causes of death, differences in total mortality were approximately equally large in most northern and southern countries. This might be purely coincidental, but perhaps there is more to it than that. There is a parallel with trends over time in northern Europe. Large socio-economic differences in total mortality existed when infectious diseases and other 'old' diseases dominated the mortality patterns of northern European societies (Stevenson 1923, Pamuk 1985, Reek 1993). Later, when 'diseases of affluence' and other non-communicable diseases became the major causes of premature death, the mortality advantage of higher occupational classes persisted. Higher classes seemed to have changed their life styles and living conditions in ways that protected them against the new causes of death. This adjustment process was most manifest with respect to ischaemic heart disease (Marmot *et al.* 1978, Kaplan and Keil 1993, Vågerö and Illsley 1995). This chapter shows that in southern countries higher occupational classes have equally been able to maintain over time a mortality advantage over lower occupational classes. They achieved this not so much by preventing death from ischaemic heart disease, but by preventing death from diseases that were more important in their own country, such as alcohol-related diseases. The nett result, smaller risks of dying prematurely, was the same in both parts of Europe.

*Implications*

Specific national circumstances seem to be able to strongly influence the magnitude, pattern and causes of socio-economic inequalities in mortality. Of particular importance appears to be the prevalence, at the national level, of risk factors that have the potential to strengthen the links between socio-economic disadvantage and premature mortality. This was illustrated by the alcohol consumption patterns in France and Finland. Conversely, mortality differences in Mediterranean countries seem to have been mitigated by the presence of, among other factors, dietary habits that traditionally protected men from manual classes against ischaemic heart disease.

The international variations observed here impose limits on the exchange of research findings from one country to another. This applies, for example, to the studies that have assessed empirically to what extent socio-economic differences in mortality can be attributed to risk factors for cardiovascular disease (Adler *et al.* 1994, Kaplan and Keil 1993, Pekkanen *et al.* 1995). The similarity that was observed among northern European countries provides support to the frequently made assumption that results of studies from one country apply to other northern countries. It is unwarranted, however, to use these results to fill in the gap in knowledge on the causes of health inequalities in France, Switzerland or Mediterranean countries. These countries need their own explanatory studies, which, lamentably, are very rare (Davey Smith 1994, Illsley and Svensson 1990, Mielck and Giraldes 1993).

The same caution is needed with the international exchange of experiences with interventions that aim at improving the health of disadvantaged groups by reducing the prevalence of specific risk factors for disease. Our results for smoking-related causes of death suggest that a reduction in smoking rates may have much larger effects on inequalities in mortality in England & Wales than in, e.g., Sweden or France. The prevention of alcohol abuse by men in manual classes deserves a higher priority in France and Finland than elsewhere.

We should finally warn against an exclusive focus on risk factors for specific diseases. Our cross-national comparisons underscore the impression from trend studies that higher occupational classes are consistently able to better avoid premature death, irrespective whether premature mortality is mainly caused by infectious diseases, cardiovascular diseases or other diseases such as those related to alcoholism. This prompts the question what resources or mechanisms enable higher occupational classes to better protect themselves against the main risk factors of their time and their country (Charlton and White 1995, Evans *et al.* 1994, Haan *et al.* 1989, House *et al.* 1992, Link and Phelan 1995, Vågerö and Illsley 1995, Wilkinson 1996). The answers have yet to be given. They are essential to explaining why inequalities in premature mortality persist throughout western Europe.

Chapter seven

# Mortality and occupational class in the United States: a comparison to England & Wales and Sweden

## 7.1 Summary

In chapter 5, we observed that in the 1980s mortality differences by occupational class among men 30-59 years are about equally large in both England & Wales, Sweden and in most other western European countries. In this chapter, England & Wales and Sweden are compared to the United States. The United States contrast strongly to England & Wales and, especially, Sweden with respect to the egalitarian character of socio-economic, health care and other policies. If egalitarian policies are able to substantially reduce socio-economic differences in mortality, this effect might become visible in a trans-atlantic comparison.

Data were obtained from the National Longitudinal Mortality Study (1979-1989) and from comparable longitudinal studies from England & Wales and Sweden. A common social class scheme was applied to each country. Distinctions were made between six occupational classes and nine causes of death.

Mortality rates varied strongly by occupational class. In each country, relatively high death rates were observed for skilled manual workers and, especially, unskilled workers. The class of routine non-manual workers had a large mortality excess in the United States, but not in England & Wales and Sweden. The mortality excess of skilled and unskilled manual classes was about equally large in each country. More variations between countries were observed for specific causes of death. The mortality excess of unskilled manual workers in the United States was relatively large for respiratory diseases, and relatively small for ischaemic heart disease, cerebrovascular disease, traffic accidents and suicide mortality.

Despite a long tradition of egalitarian socio-economic, health care or other policies, socio-economic differences in mortality in northern European countries are not smaller than in the United States. Several specific circumstances seem to have mitigated mortality differences by occupational class in the United States. A better understanding of the role that different circumstances play is strongly needed, both to predict the future course of health inequalities, and to estimate the extent to which alternative policy measures can change this course.

## 7.2 Introduction

Socio-economic differences in morbidity and mortality persist in both the United States and western Europe (Bucher and Ragland 1995, Davey Smith *et al.* 1996, Fox 1989, House *et al.* 1992, Illsley and Svensson 1990, Mielck and Giraldes 1993, Miller *et al.* 1993, Sorlie *et al.* 1995). Increasingly more attention is given, especially in England, to the question how to tackle socio-economic inequalities in health (Dahlgren and Whitehead 1991, Benzeval *et al.* 1995, Department of Health 1995). It has been forcefully argued that policies directed at specific risk factors for disease, such as smoking and diet, are likely to have modest effects only. Attention should also be given to the fundamental inequalities in education, work and income. As long as these socio-economic disparities persist undiminished, the generalised tendency of risk factors for disease to cluster among socio-economically disadvantaged groups is likely to continue (Link and Phelan 1995, Evans and Stoddart 1994, Wilkinson 1996).

In this view, the experience of northern European countries is interesting. Nordic countries, notably Sweden, have well established policies to improve the living conditions of the least advantaged sections of their population. The 'Scandinavian welfare model' (Esping Andersen 1990) resulted in generous unemployment and disability benefits (OECD 1991), high state expenditures on social affairs (Eurostat 1989, OECD 1986), relatively small income inequalities (Atkinson *et al.* 1995), slightly higher rates of social mobility (Erikson and Goldthorpe 1992a), and universal access to high-quality medical care (Doorslaer *et al.* 1992). In the United Kingdom, financial barriers to access to medical care were removed since the institution of the National Health Service in 1947 (Blaxter 1996). It appears plausible to expect that these countries, and especially the Nordic countries, have smaller socio-economic differences in morbidity and mortality than less egalitarian countries.

The results of the first comparative studies on health inequalities provided support to this expectation (Lynge *et al.* 1989, Minder 1991, Vågerö and Lundberg 1989, Valkonen 1987; see also chapters 3 and 4). However, these results were not confirmed in the more comprehensive, more reliable and more detailed cross-national comparison that is reported in chapter 5. Differences between manual and non-manual occupational classes in mortality among men 30-59 years were about as large in the Nordic countries as in most other European countries, with the sole exception of clearly larger differences in France.

These comparisons could, therefore, not provide support to the expectation that socio-economic differences in health were consistently and substantially smaller in countries with egalitarian socio-economic, health care, and other policies. The size of health differences in specific countries appeared to depend on other circumstances as well, and some of these circumstances seem to be so powerful so as to conceal a relationship, if any, with egalitarian policies. For example, socio-economic differences in mortality in Mediterranean countries were strongly mitigated by the absence of class gradients in ischaemic heart disease mortality (chapter 6). This situation, that has resemblance to the situation in northern Europe and the United States in the 1950s (Bainton and Peterson 1963, Mortensen *et al.* 1959, Pell and Fayerweather 1985, Rogot and Hrubec 1989), might reflect the influence of cultural rather than socio-economic factors.

*The present study*

In this chapter, a new attempt is made to assess a possible association between egalitarian policies and the magnitude of socio-economic differences in mortality. Sweden and England & Wales are compared to the United States with respect to differences between occupational classes in mortality among men 30 to 59 years.

Within the industrialised world, the United States and Sweden are opposite poles with respect to the size of income inequalities (Atkinson *et al.* 1995). Also in stark contrast to the situation in the United States is the free access, at least in financial terms, to high-quality medical care that is enjoyed by all citizens of England & Wales and Sweden (Doorslaer *et al.* 1992). If egalitarian socio-economic, health care and other policies are able to substantially reduce socio-economic differences in mortality, this effect might become visible in a trans-atlantic comparison.

Some support for this expectation comes from chapter 4, in which we analyzed mortality differences by educational level among men 35-64 years in the 1970s. These mortality differences were found to be larger for the United States than for any northern European country. The present chapter explores this preliminary result in more detail. It differs from the study of chapter 4 in three respects.

First, more recent data are used than in the previous study. Data for England & Wales and Sweden refer to the 1980s instead of 1970s. Data for the United States come from a 10-year follow-up of the National Longitudinal Mortality Study (1979-1989) instead of the 2-year follow-up period (1979-1981) that was used in the previous comparison.

Second, a distinction is made by cause of death. Relatively large mortality differences for specific causes of death point to the role of risk factors that are specific to these causes of death, like smoking and violence. This information might help, among others, to identify factors that act as confounders or effect modifiers in the association between egalitarian socio-economic policies and mortality differences. The large socio-economic differences in mortality that were observed for France provide an example (chapter 6). Causes of death related to alcohol abuse have been found to contribute much to the mortality excess of manual classes in France. This suggested that the effect of socio-economic disparities on mortality was strengthened in France by alcohol abuse, which could act there as a main vehicle through which poverty leads to premature death.

Third, further detail is added to our analyses by means of a distinction between several occupational classes. Previous comparisons of mortality by occupational class tended to focus on mortality differences between 'high' and 'low' classes, especially non-manual and manual classes. Although this one-dimensional view of occupational class may have considerable descriptive advantages, it obscures some of the differences between occupational classes that are of analytical interest. For example, the class position of lower non-manual workers is not unambiguously 'higher' than that of skilled manual workers (Erikson and Goldthorpe 1992a, Treiman 1977). The latter workers have on the average low levels of education, but their income levels are nearly as high as those of lower non-manual workers. Egalitarian policies in the field of income, education and access to health care can therefore affect these two classes in different ways.

## 7.3 Material and methods

*Material*

Data on mortality by occupational class and cause of death were obtained from national longitudinal studies. Data for the United States were available from a public use file of the National Longitudinal Mortality Study (Sorlie *et al.* 1995) covering the period 1979-1989. Data for England & Wales and Sweden were obtained from longitudinal studies for 1981-1989 and 1980-1986, respectively (Harding 1995, Vågerö and Lundberg 1995).

The data from the different countries had to refer to the same age group in terms of age at death. Men in the study from England & Wales were classified according to their age at death in the age groups 30-44 and 45-59 years. In the other studies, men were classified by their age at the start of follow-up. For the US study, with a follow-up period of 10 years, we distinguished the birth cohorts aged 25-39 and 40-54 years at baseline. For the Swedish study, with 6 years of follow-up, we distinguished men aged 25-39 and 40-59 years at baseline.

The number of deaths observed in the highest age group was 2,958 (United States), 2,703 (England & Wales) and 39,789 (Sweden). More deaths were observed in the Swedish study because it covers the entire resident population, whereas the other studies cover representative samples of circa 0.5 percent of the US population and 1 percent of that of England & Wales.

Nine causes of death were distinguished. Cause-specific analyses were only made for men 45-59 years, because of the small number of deaths by cause of death and occupational class among men 30-44 years. As shown in Table 7.1, the distribution of all deaths over specific causes was approximately the same in each country. Relatively small are the shares of lung cancer in Sweden, ischaemic heart disease in the United States, and external causes in England & Wales.

**Table 7.1** Distribution of all deaths over nine groups of causes of death. Men circa 45-59 years at death.

| Cause of death | Share (%) in total number of deaths | | |
|---|---|---|---|
| | United States | England & Wales | Sweden |
| Lung cancer | 12.4 | 11.4 | 5.5 |
| Other cancer | 16.6 | 20.2 | 20.1 |
| Ischaemic heart disease | 27.5 | 38.2 | 34.6 |
| Cerebrovascular disease | 3.5 | 5.5 | 4.7 |
| Other circulatory diseases | 11.2 | 5.1 | 5.8 |
| Respiratory diseases | 4.8 | 5.7 | 3.9 |
| Gastro-intestinal diseases | 5.7 | *[a]* | 4.6 |
| Other diseases | 8.2 | 8.0 | 7.8 |
| External causes | 10.2 | 5.8 | 13.1 |
| All causes | 100.0 | 100.0 | 100.0 |

[a] Combined with other diseases

*Measurement of occupational class*

A common occupational class scheme, the EGP scheme, was applied to each country (Erikson and Goldthorpe 1992a). This scheme was developed in order to facilitate international comparisons of social stratification and mobility, and is therefore particularly suited for our purposes. In this chapter, we use a condensed version which distinguishes six classes (see Table 7.2).

For England & Wales and Sweden, conversion schemes were available from the CASMIN project of Erikson and Goldthorpe (1992a). For the United States, we derived a conversion scheme from a standard schedule developed by Ganzeboom *et al.* (1989). Ideally, conversion schemes are applied to the following aspects of the jobs that men perform: occupational title (by 3 digit code), employment status (self-employed or not) and supervisory status (e.g. number of subordinates). In the data set available for the United States, however, information was available only on occupational titles. As a result, the class of self-employed men (other than large employers, self-employed professionals and farmers) could not be distinguished. In the section 7.5, we discuss to what extent the results for other occupational classes might have been biased.

The distribution of men by occupational class is highly similar in the three countries (Table 7.2). Most men belong to the classes of skilled or unskilled manual workers, or to the class of professionals, large employers, administrators and managers. The proportion of men in manual classes is smaller in Sweden than in the other countries.

**Table 7.2** Distribution of population over occupational classes. Men 30-44 and 44-59 years.

| Age group / EGP class | Share (%) of all men with occupation known | | |
|---|---|---|---|
| | United States | England & Wales | Sweden |
| 30-44 | | | |
| Professional, manager, etc | 36.6 | 32.2 | 31.8 |
| Routine non-manual | 9.3 | 6.8 | 12.0 |
| Foremen, skilled manual | 25.6 | 25.2 | 23.2 |
| Unskilled manual | 24.3 | 23.2 | 21.1 |
| Farmer, farm labourer | 4.1 | 2.0 | 4.3 |
| Self-employed | *[a]* | 10.6 | 7.5 |
| Total | 100.0 | 100.0 | 100.0 |
| 45-59 | | | |
| Professional, manager, etc | 38.6 | 27.4 | 30.6 |
| Routine non-manual | 8.2 | 7.4 | 12.2 |
| Foremen, skilled manual | 25.0 | 26.0 | 19.2 |
| Unskilled manual | 22.9 | 27.9 | 21.0 |
| Farmer, farm labourer | 5.3 | 2.7 | 7.5 |
| Self-employed | *[a]* | 8.7 | 9.4 |
| Total | 100.0 | 100.0 | 100.0 |

[a] Not distinguished. A large part of self-employed men are assigned to the class of professionals, managers etc.

**Table 7.3** Differences between occupational classes in educational level and annual household income. United States, men 45-59 years.

| EGP class | % of men without High School grade 8 | % of men with annual income < $15,000 |
|---|---|---|
| Professional, manager, etc | 8 | 9 |
| Routine non-manual | 16 | 20 |
| Skilled manual | 37 | 23 |
| Unskilled manual | 50 | 35 |
| Farmer, farm labourer | 42 | 45 |
| Unknown | 49 | 61 |

In the United States, the distinguished classes largely differ in terms of education and household income (Table 7.3). Differences in educational levels are especially large between non-manual and manual classes. Income differences have a different class pattern. Whereas routine non-manual workers have on the average higher educational levels than skilled manual workers, the average income levels of these two classes are nearly the same. Similar patterns have been observed with survey data for Sweden and Great Britain (Kunst *et al.* 1996).

*Methods*

The relative mortality level of men in specific occupational classes was measured by means of Standardized Mortality Ratios (SMRs). With this measure, mortality levels are standardized by age according to the indirect method, with the national age-specific mortality rates as the standard. For the United States, mortality levels are in addition standardized by race (black *versus* non-black). Approximately equally large differences in mortality were observed when the analysis was restricted to whites only, or when addition control was made for Hispanic status.

In the studies from United States and Sweden, there was insufficient information on the former occupation of economically inactive men (retired, disabled, unemployed, etc). These men therefore had to be excluded from the analysis. Their exclusion is likely to lead to an underestimation of the SMRs of lower occupational classes. We therefore applied an adjustment procedure that approximately corrects for this underestimation (see Appendix).

The magnitude of variations in class-specific SMRs was quantified by the *Index of Dissimilarity (ID)* (see section 2.6). This index can be interpreted as follows: the percentage of all deaths that has to be redistributed among occupational classes in order to obtain the same mortality level for each class. One feature of the ID is that it takes into account the size of occupational classes: the more men are in occupational classes with extreme mortality levels, the higher the ID is.

SMRs and the ID do not take into account the national mortality level. This level might however be relevant from some perspectives. A SMR as high as, say, 1.50 implies a more important public health problem in countries with high national death rates than in countries with low death rates. In order to compare countries also from this point of view, SMRs were converted into estimates of absolute mortality levels. Unfortunately, our data did not provide internationally comparable data of national mortality levels, due to, among others, differences between the studies in length of follow-up. However, data published by the WHO (1988) could be used as an alternative source. National probabilities of dying between the ages 45 and 65 years were taken from this source, and they were multiplied by class-specific SMRs in order to estimate class-specific death probabilities.

## 7.4 Results

In Table 7.4, SMRs are presented for specific occupational classes. In the United States, the mortality rates of unskilled manual workers are about 2 times as high as those of the class of professionals and others. This mortality difference is at least as large in England & Wales, and even larger in Sweden among men 30-44 years. A special feature of the US mortality pattern is the high SMR for routine non-manual workers, and the low SMR for farmers 30-44 years.

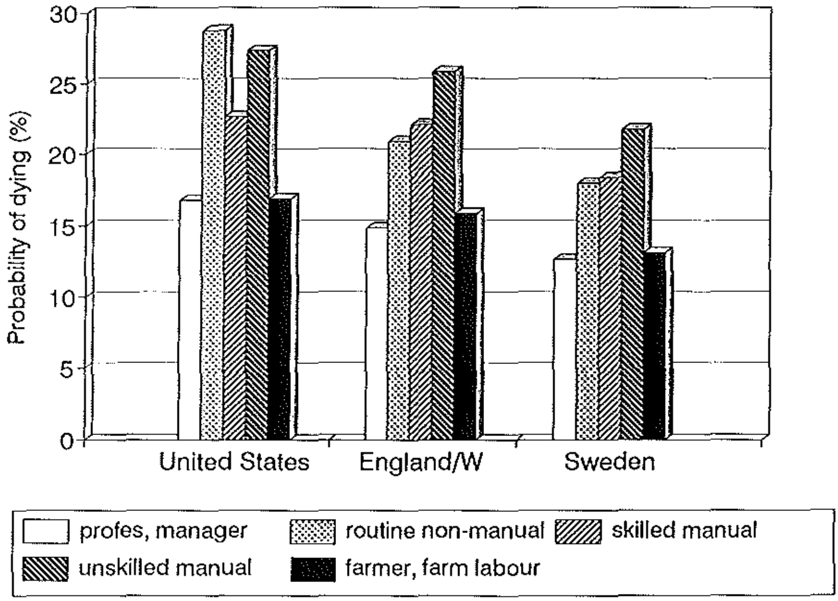
**Table 7.4** Mortality by occupational class. Men circa 30-44 and 45-59 years at death.

| Age group<br>EGP class | Standardised Mortality Ratio *[a]* | | |
|---|---|---|---|
| | United States | England & Wales | Sweden |
| 30-44 | | | |
| Professional, manager, etc | 0.71 | 0.80 | 0.60 |
| Routine non-manual | 1.34 | 0.94 | 1.10 |
| Foremen, skilled manual | 1.05 | 0.90 | 1.09 |
| Unskilled manual | 1.38 | 1.55 | 1.50 |
| Farmer, farm labourer | 0.78 | 1.01 | 1.34 |
| Self-employed | *[b]* | 0.78 | 1.05 |
| Total | 1.00 | 1.00 | 1.00 |
| 45-59 | | | |
| Professional, manager, etc | 0.78 | 0.73 | 0.77 |
| Routine non-manual | 1.34 | 1.03 | 1.09 |
| Foremen, skilled manual | 1.06 | 1.09 | 1.12 |
| Unskilled manual | 1.28 | 1.27 | 1.32 |
| Farmer, farm labourer | 0.79 | 0.78 | 0.79 |
| Self-employed | *[b]* | 0.92 | 0.91 |
| Total | 1.00 | 1.00 | 1.00 |

[a] Adjusted for the exclusion of men with occupation unknown, by multiplying the rate ratios with the adjustment factors given in table B of the appendix.
[b] Not distinguished.

In Figure 7.1, class differences in mortality among men 45-59 years are expressed in absolute terms. The pattern of mortality differences is highly similar in each country, with the exception of the routine non-manual class in the United States. Class differences in mortality in United States exist at a higher general level of mortality. This has two consequences. First, men from each occupational class in the United States have higher chances of premature death than their European counterparts. Second, class differences in mortality are slightly larger within the United States when expressed in absolute terms.

Figure 7.1 The probability of dying between the 45th and 65th birthday. Men in five EGP classes.




In Table 7.5, the magnitude of *relative* mortality differences is summarised by means of the Index of Dissimilarity. Differences in total mortality among men 30-44 years are slightly larger in Sweden than in the United States and England & Wales. Mortality differences in the age group 45-59 years are about equally large in each country. More cross-national variations are observed in the age group 45-59 years for specific causes of death. As compared to the European countries, mortality differences in the United States are relatively large for lung cancer, other cancers and gastro-intestinal diseases, but relatively small for ischaemic heart disease, the group of 'other diseases', and external causes of death.

In Table 7.6, cause-specific results are presented for routine non-manual workers. The all-cause SMR was found to be especially high in the United States. Table 7.6 shows that the same applies to nearly each cause of death. Particularly high in the United States are the SMRs for lung cancer, cerebrovascular disease, and external causes of death.

In Table 7.7, cause-specific results are presented for unskilled manual workers. Their all-cause SMR is about equally high in each country. More cross-national variations are observed for specific causes of death. The SMR of unskilled workers in the United States are relatively high for respiratory diseases, and relatively low for ischaemic heart disease, cerebrovascular disease and external causes of death.

**Table 7.5** Magnitude of class differences in all-cause and cause-specific mortality. Men circa 30-44 (all causes only) and 45-59 years (by cause) at death.

| Cause of death | Index of Dissimilarity (%) *[a]* | | |
|---|---|---|---|
| | United States | England & Wales | Sweden |
| All causes (30-44 years) | 12.4 | 12.2 | 13.9 |
| All causes (45-59 years) | 9.9 | 9.2 | 9.8 |
| Lung cancer | 17.6 | 12.0 | 13.2 |
| Other cancer | 6.9 | 3.4 | 4.1 |
| Ischaemic heart disease | 7.9 | 10.3 | 9.6 |
| Cerebrovascular disease | 14.4 | 13.0 | 9.4 |
| Other circulatory diseases | 9.2 | 13.1 | 9.4 |
| Respiratory diseases | 19.8 | 17.5 | 16.5 |
| Gastro-intestinal diseases | 17.1 | *[b]* | 12.4 |
| Other diseases | 10.9 | 15.1 | 17.8 |
| External causes | 10.7 | 13.4 | 13.0 |

[a] Adjusted for the exclusion of men with occupation unknown, by multiplying the rate ratios with the adjustment factors discussed in the appendix.
[b] Combined with other diseases.

**Table 7.6** Cause-specific mortality of routine non-manual workers. Men circa 45-59 years at death.

| Cause of death | Standardised mortality ratio *[a]* | | |
|---|---|---|---|
| | United States | England & Wales | Sweden |
| All causes | 1.34 | 1.03 | 1.09 |
| Lung cancer | 1.45 | 1.03 | 1.19 |
| Other cancer | 1.23 | 1.05 | 1.09 |
| Ischaemic heart disease | 1.38 | 0.95 | 1.12 |
| Cerebrovascular disease | 1.60 | 0.85 | 1.13 |
| Other circulatory diseases | 1.07 | 1.27 | 1.13 |
| Respiratory diseases | 1.01 | 0.87 | 0.59 |
| Gastro-intestinal diseases | 1.33 | *[b]* | 1.00 |
| Other diseases | 1.33 | 1.61 | 0.64 |
| External causes | 1.64 | 0.85 | 0.94 |

[a] Adjusted for the exclusion of men with occupation unknown, by multiplying the rate ratios with the adjustment factors discussed in the appendix.
[b] Combined with other diseases

**Table 7.7** Cause-specific mortality of unskilled manual workers. Men circa 45-59 years at death.

| Cause of death | Standardised mortality ratio *[a]* | | |
|---|---|---|---|
| | United States | England & Wales | Sweden |
| All causes | 1.28 | 1.27 | 1.32 |
| Lung cancer | 1.35 | 1.34 | 1.42 |
| Other cancer | 1.24 | 1.12 | 1.10 |
| Ischaemic heart disease | 1.18 | 1.28 | 1.29 |
| Cerebrovascular disease | 1.09 | 1.35 | 1.33 |
| Other circulatory diseases | 1.34 | 1.37 | 1.40 |
| Respiratory diseases | 1.94 | 1.58 | 1.63 |
| Gastro-intestinal diseases | 1.70 | *[b]* | 1.55 |
| Other diseases | 1.13 | 1.20 | 1.62 |
| External causes | 1.15 | 1.30 | 1.47 |

[a] Adjusted for the exclusion of men with occupation unknown, by multiplying the rate ratios with the adjustment factors discussed in the appendix.
[b] Combined with other diseases

Table 7.8 provides further information on external causes of death in the United States. The SMRs for suicide and traffic accidents are fairly low for unskilled manual workers, and remarkably high for routine non-manual workers. Unskilled manual workers do have high rates of homicide mortality. However, the absolute number of homicide deaths is small among men 45-59 years. As a result, homicide mortality rates do not sizeably influence the unskilled workers' rate of death from all external causes of death together.

## 7.5 Discussion

*Evaluation of data problems*

Differences between occupational classifications have traditionally constituted the Achilles' heel of international comparisons of health inequalities. During the last decade, however, sociologists have acquired much experience with the application of one common social class scheme, the EGP scheme, to both Europe and northern America (Erikson and Goldthorpe 1992a, Ganzeboom *et al.* 1989). This study builds upon that experience. For each country, we recoded original, individual-level data on the occupation of subjects according to the EGP scheme.

**Table 7.8** Class differences in mortality from specific external causes of death. United States, men 45-59 years at death.

| EGP class | Standardised Mortality Ratio *[a]* | | | |
|---|---|---|---|---|
| | All external | Suicide | Traffic accidents | Homicide |
| Professional, manager, etc | 0.73 | 0.90 | 0.62 | 0.93 |
| Routine non-manual | 1.64 | 2.21 | 2.16 | 0.48 |
| Foremen, skilled manual | 1.05 | 0.87 | 1.33 | 0.82 |
| Unskilled manual | 1.15 | 1.03 | 0.84 | 1.31 |
| Farmer, farm labourer | 1.30 | 0.48 | 1.27 | 1.52 |
| All classes | 1.00 | 1.00 | 1.00 | 1.00 |
| (total number of deaths) | (301) | (84) | (83) | (33) |

[a] Adjusted for the exclusion of men with occupation unknown, by multiplying the rate ratios with the adjustment factors discussed in the appendix..

Crucial to this coding exercise is to secure cross-national comparability when designing a recoding scheme for each data set separately. The comparability of the schemes applied to England & Wales and Sweden was secured by the use of schemes that Erikson and Goldthorpe (1992a) had developed jointly for these countries. We ourselves had to develop the recoding scheme for the United States data set. We took great care to maintain comparability with the two European schemes as well as an international scheme of Ganzeboom *et al.* (1989). However, we encountered three problems.

The first is that no information was available on the employment status (self-employed or not) of subjects. As a result, no mortality estimates could be made for the class of self-employed men (excluding farmers, professionals and large employers). However, a small part of all men are in this class, probably slightly more than 5 percent. Essential to our study is the question whether mortality estimates for other occupational classes, and the Index of Dissimilarity, have been substantially biased by misclassification of these men. This is unlikely. An evaluation could be made by applying the same EGP conversion scheme to the more complete individual-level data of the US Health Interview Survey of 1991 (these data were kindly provided by P Ellen Parsons, and they were analyzed by Adriënne Cavelaars). We evaluated to what extent the observed morbidity rates of occupational classes would change if information on employment status would not be used. This change was found to be small for each occupational class. Age-adjusted prevalence rates of 'less than good' perceived general changed by less than 2 percent in nearly all cases. The corresponding Index of Dissimilarity increased slightly by excluding information on employment status, from 12.0 to 12.5 percent. This evaluation thus suggests that our failure to use information on employment status in the mortality data may have caused no substantial bias, and, if any, resulted in an overestimation rather than underestimation of the magnitude of mortality differences in the United States.

The second problem is that no information was available on the number of subordinates. This information is especially important for an accurate distinction between routine non-manual workers and upper non-manual classes. If part of men from upper non-manual classes are misclassified as routine non-manual workers, the mortality level of the latter class is likely to be underestimated (the complementary effect, an overestimate of the death rate of upper non-manual class, is weaker due to the much larger population size of this class). If this bias is sizable, that would imply that the SMR of routine non-manual workers in the United States would in fact be even higher than was observed in this study.

A third potential data problem relates to distinction between skilled and unskilled manual workers. In an evaluation that we made with Swedish data, we observed that the mortality difference between skilled and unskilled manual workers can be strongly underestimated if these two classes are distinguished only crudely (Kunst and Groenhof 1996d). In the US data set, however, this distinction could probably be made with reasonable accuracy, thanks to a systematical distinction between 'craftsmen' (mostly skilled workers) and 'operatives' (unskilled workers) in the basic 3-digit occupational classification. A comparison to the 3-digit occupational classifications that were used in the Swedish and English data sets, suggested that the skilled *versus* unskilled distinction might have been even more accurate for the US data than for the European countries.

*Comparison to the previous literature*

We questioned the comparability of the occupational data because the study reported in chapter 4, which used educational level as the socio-economic indicator, did observe larger mortality differences for the United States than for England & Wales and Sweden. It should be noted, however, that older data were used in that study. Data for northern Europe referred to the about 1971-1980 instead of about 1981-1990. Data for the United States came from a follow-up of 2 years (1979-1981) instead of 10 years (1979-1989) of the National Longitudinal Mortality Study. Note, in addition, that the US data referred to a more recent period that the European data, which biases the cross-national comparisons to the extent that mortality differences by educational level increase over time.

This raises the question what results would have be observed with more recent and more comparable data on mortality differences by educational level. No such data are available for England & Wales and Sweden. There are data, on the other hand, for Norway and Finland in circa 1981-1990 (Kunst *et al.* 1996; see also Table 5.10). In Table 7.9, estimates of the magnitude mortality differences by educational level are presented for Norway, Finland and the United States. These estimates are about as large for the United States as for the Nordic countries. Thus, socio-economic differences in mortality in the United States in the 1980s are found be about equally large as in northern European countries, irrespective whether occupational class or educational level is used as the socio-economic indicator.

**Table 7.9** Magnitude of mortality differences by educational level. Men circa 30-44 and 45-59 years at death.

| Country | 30-44 years | | 45-59 years | |
|---|---|---|---|---|
| | RII *[a]* | 95 % CI | RII *[a]* | 95 % CI |
| United States [b] | 2.93 | (2.35- 3.64) | 2.41 | (2.10- 2.75) |
| Norway | 3.31 | (3.02- 3.63) | 2.09 | (1.98- 2.21) |
| Finland | 3.12 | (2.92- 3.31) | 2.41 | (2.30- 2.53) |

[a] The Relative Index of Inequality. For calculation and interpretation, see sections 2.6.3 and 4.3. Estimates for Norway and Finland are taken from Table 5.10.

[b] The RR is calculated is calculated on the basis of a distinction between six educational levels, and with control for 5-year age group and race/ethnicity (Hispanics, other white, black, other non-white).

*Explanations*

This similarity between the United States and northern Europe agrees with the results of intra-European analyses, which found that mortality differences by occupational class among men 30-59 years were about equally large in most countries from northern and southern Europe (chapter 5). These findings confirm the impression of trend studies that the association between occupational class and mortality is a persistent one. This association seems to be determined more by what industrialised countries have in common than by what distinguishes them.

The present study was a new attempt to detect a positive effect of egalitarian policies on the magnitude of socio-economic differences in mortality. We expected that, if egalitarian socio-economic, health care and other policies would mitigate socio-economic differences in mortality, this effect would become visible in a trans-atlantic comparison. However, this expectation was not supported by the results. This prompts the question why mortality differences between upper and lower occupational classes are not larger in the United States than in northern Europe. Perhaps some circumstances in the United States have prevented mortality differences between manual and non-manual classes from being as large as they otherwise would be. We discuss the possible influence of three types of circumstances: (1) class differences in income and other resources, (2) class differences in the exposure to specific risk factors for disease and injury and (3) the effects of social mobility.

*1. Class differences in income and other resources.* Even though income, health insurance and other material resources are less equally distributed among the US citizens than among citizens of England & Wales and Sweden, this does not imply that they are also less equally distributed between manual and non-manual classes. In the United States, incomes are perhaps not distributed along class lines to the same extent as in northern Europe but, instead, more along the lines of ethnicity, area of residence and household characteristics. One might therefore hypothesize that differences between manual and non-manual classes in income and other material resources are not much larger in the United States than in England & Wales and Sweden. However, available data do not provide support to this possibility: in the early 1980s, the ratio of the average income earned by employees as compared to that of manual workers was about 1.5 for the United States, and 1.3 for England. Similarly, the ratios comparing unskilled to skilled manual workers were about 1.5, 1.3 and 1.15 for, respectively, the United States, England & Wales and Sweden (OECD 1991).

An alternative explanation relates to the class distribution of non-material rather than material resources. Perhaps there is some truth in the popular view that the United States have a less class-ridden society than England & Wales. If so, it may imply that in the United States factors like prestige, power, interpersonal contacts and access to information are less structured by the traditional manual *versus* non-manual contrast than in England & Wales. If so, non-material resources might have contributed less to the manual *versus* non-manual mortality differences in the United States than they did in England & Wales and perhaps Sweden.

An interesting class in this respect is that of routine non-manual workers. This class is advantaged over manual classes in non-material terms rather than in material terms. For example, this class differs from skilled manual workers by its higher average educational level but not by a higher income level (see Table 7.3). In addition, social mobility studies reveal a high degree of social proximity between routine non-manual workers and higher non-manual classes (Ganzeboom *et al.* 1989). These social-cultural advantages may have benefited routine non-manual workers everywhere, but more so in the European countries if non-material resources are more important there than in the United States. In line with this finding is that the class of routine non-manual has moderate death rates in England & Wales and Sweden instead of the high rates they have in the United States.

*2. Exposure to specific risk factors for disease.* Another, complementary type of explanation is that the association between occupational class and specific risk factors for disease or injury is weaker in the United States than in northern Europe. Indications with respect to specific risk factors may be obtained from the analysis of specific causes of death. For four causes of death, the excess mortality of unskilled manual workers was found to be relatively small in the United States: ischaemic heart disease, cerebrovascular disease, suicide and traffic accidents.

The smaller class differences in cardiovascular diseases in the United States suggest that some risk factors for cardiovascular disease have no or even a positive association with socio-economic status. Until the 1950s, positive or weak associations existed for tobacco consumption and perhaps also for animal fat intake and overweight. Tobacco consumption is a well-documented example (Haynes *et al.* 1978, Kaplan and Keil 1993). It is unlikely, however, that this can explain the relatively small gradients in cardiovascular disease mortality in the United States. For tobacco consumption, strong inverse associations emerged already in the 1950s. In addition, positive gradients in tobacco consumption also existed in England & Wales and Sweden, and there they persisted about one decade longer than in the United States (Kunst and Mackenbach 1990, Marmot *et al.* 1978, Vågerö and Lundberg al 1989).

Research over the last 10 years has stressed the association between living conditions in early childhood and the risk of dying from ischaemic heart disease in later life (Baker 1991 & 1992, Baker *et al.* 1993, Ben-Shlomo and Davey Smith 1991, Elford *et al.* 1991 & 1992). To the extent that this is true, it may offer an explanation for the relatively small class differences in ischaemic heart disease mortality in the United States. Children born to parents in low occupational classes might have experienced more favourable rearing environments than their European counterparts. Between about 1925 and 1950, when most of the men included in the present study grew up, the United States had much higher national living standards and, in addition, wealth was not distributed as unequally as in later years (Hadden 1996, Taylor and Jodice 1983).

Another hypothesis relates to the situation in southern Europe, where class differences in ischaemic heart disease mortality are much smaller than in northern Europe (chapter 6). It is likely that specific cultural factors have contributed to this situation. In Mediterranean countries, traditional diet (with frequent consumption of fish and vegetable oil) and drinking patterns (which stimulated moderate alcohol consumption) probably protected men from lower socio-economic groups against ischaemic heart disease (Epstein 1989, WHO Monica 1991). Perhaps the situation in the United States bears some resemblance to that in southern European countries. Although the United States is culturally closer to northern Europe than to southern Europe, the cultural and ethnic origins of the US population is diverse. It would be no surprise, therefore, to find that diet and other culturally determined life styles are distributed differently across occupational classes in the United States than in northern Europe.

The low rates of suicide and traffic accident mortality might be related to a large number of specific factors. The mixed religious composition of the US population may be important with respect to suicide. Members of manual classes probably adhere in larger numbers and more intensively to Roman Catholicism or to other religions that protect their followers against recurring to suicide by imposing prohibitive norms, or fostering tight social bonds (Breault 1986, Pescosolido 1990).

*3. Social mobility.* A popular view is that social mobility rates are higher in the open US society than in England & Wales and perhaps other European societies as well. Persons who achieve upward social mobility are more likely to be better endowed with health, skills and other personal resources. Selection of persons with high health potential into upper occupational classes is likely to contribute to class differences in mortality. In Europe, this contribution is thought to be small by most but not all authors (Blane *et al.* 1993, Dahl and Kjaersgaard 1993a, Lundberg 1991a, Power *et al.* 1996, West 1991). In the United States, however, higher rates of social mobility might have increased mortality differences between occupational classes to a larger extent than in Europe.

However, this effect is likely to be modest. Comparative studies on social mobility do not support the view that US society is more open than most European societies. Erikson and Goldthorpe (1992a) observed that intergenerational mobility between occupational classes is higher in Sweden than in the United States and England & Wales, but that the difference between these countries is small.

In addition, high rates of mobility might not only increase mortality differences by means of selection effects, but it can also mitigate these mortality differences in other ways. High mobility rates imply that persons who are grown up in poor socio-economic conditions have more opportunities to escape from these conditions in later life. This would have the effect to weaken the association between adult occupational class and childhood living conditions, and thus reduce the extent to which childhood living conditions can contribute to mortality differences by occupational class in later life. Thus, if rates of social mobility would be higher in the United States than in Europe, the nett effect on the magnitude of class differences in mortality can be either positive or negative, and perhaps small indeed.

*Implications*

From the perspective of United States, northern European countries can be considered as 'natural experiments' in which attempts are made to tackle health inequalities by their roots. Especially interesting is Sweden, where social-democratic governments have made a determined effort for over 50 years to enhance the living conditions and social position of disadvantaged groups. There were good reasons to expect that egalitarian socio-economic, health care and other policies resulted in a substantial and lasting reduction of inequalities in health. However, comparative studies do not provide support to this expectation. Socio-economic differences in mortality in countries with more egalitarian policies are not small from an international perspective. Nor are they small from a historical perspective: since the 1960s, socio-economic differences in mortality have increased in northern Europe as well as in the United States (Dahl and Kjaersgaard 1993b, Goldblatt 1989, Harding 1995, Marmot and McDowall 1986, Pamuk 1985, Pappas *et al.* 1993, Preston and Elo 1995, Vågerö and Lundberg 1995, Valkonen 1993b).

These findings do *not* imply that egalitarian socio-economic policies cannot help to reduce socio-economic differences in mortality. It is more than likely that mortality differences in the Nordic countries would have been larger in the absence of egalitarian policies, or that mortality differences in the United States would have been smaller if income inequalities in this country would have been as small as in Nordic countries. None the less, the question prompts itself whether this reduction in mortality differences would be as large some authors have suggested. For example, House *et al.* (1992) stated that

> *"Reductions in absolute socioeconomic deprivation may in the end be necessary to produce significant and permanent reductions in the social stratification of ageing and health. [..] increasing the percentage of people completing high school or eliminating poverty would significantly reduce if not eliminate socioeconomic differentials in ageing and health."*

Unfortunately, the northern European 'natural experiments' provide little ground for believing in this optimistic scenario.

Our results further warn against an exclusive focus on socio-economic policies. The several explanations of the trans-atlantic variations that we suggested in the previous section, illustrate that a wide range of both socio-economic, cultural and other conditions together determine how large health inequalities are in different countries. The potential role of some circumstances, for example cultural factors, has been ignored too long in health inequalities research. A better understanding of the role that different circumstances play is strongly needed by policies that aim to reduce health inequalities in the near future. Without this understanding, it is difficult to predict the future course of health inequalities, and to estimate the extent to which alternative policy measures can change this course.

## Chapter eight

# Socio-economic differences in mortality in 3 countries of central and eastern Europe: a comparison to western countries

## 8.1 Summary

The high mortality rates of Central and Eastern European (CEE) countries in the late 1980s raise questions on the fate of lower socio-economic groups: were they affected disproportionately, or were they protected by egalitarian socio-economic, health care and other policies of the former socialist regimes? This study measures socio-economic differences in mortality among men 30-59 years in three CEE countries: the Czech Republic, Hungary and Estonia. The principal question is whether mortality differences in these countries were smaller or larger than those in the United States and western European countries.

National data sets with numbers of deaths by age, sex, educational level, occupational class and cause of death were created by national teams and analyzed centrally. Data from CEE countries were obtained from unlinked cross-sectional studies for circa 1990. The magnitude of mortality differences was measured by rate ratios which compared manual to non-manual classes, or lower to higher educational groups.

In each CEE country, men from lower socio-economic groups had substantially higher risks of premature death. Increased death rates were observed for all cause of death groups (neoplasms, cardiovascular diseases, all other diseases combined, and external causes of death) and also for more specific causes of death such as ischaemic heart disease. Mortality differences in the Czech Republic and Estonia were at least as large as in western countries. By far the largest were mortality differences in Hungary, and even more so when taking into account the exceptionally high national death rates of Hungary.

The socio-economic, health care and other policies of the former socialist rule had not resulted in relatively small socio-economic differences in mortality. Instead, lower socio-economic groups were affected disproportionately by the unfavourable high national mortality rates of CEE countries in the late 1980s. These results emphasize the need for continued attention to health inequalities in Central and Eastern Europe.

## 8.2 Introduction

In both the United States and western European countries, people with lower education, lower income and lower occupational status have been found to have higher risks of premature death (Bucher and Ragland 1995, Davey Smith *et al.* 1996, Fox 1989, House *et al.* 1992, Illsley and Svensson 1990, Mielck 1993, Miller *et al.* 1993, Sorlie *et al.* 1995). There is increasing evidence that socio-economic differences in mortality also exist in central and eastern European (CEE) countries (Bobak 1996, Bosma 1994, Bosma *et al.* 1995, Brajczweski 1993, Dennis *et al.* 1993, Janeckova and Hnilicova 1992, Klinger 1986, Kunst and Mackenbach 1994c, Mastilica 1990 & 1992, Orosz 1990, Rosolova *et al.* 1994, Sobotík and Rychtariková 1992, Wnuk-Lipinski 1990). Uncertain is, however, whether these mortality differences are larger or smaller than in western countries.

The situation in CEE at the end of the socialist era is of interest for several reasons. First, under the former socialist rule, socio-economic, health care and other policies had a distinct character and were alleged to be more egalitarian. A comparison to the United States and western Europe can show whether four decades of socialist rule had in the end brought substantially smaller differences in mortality.

A second reason for a special interest in CEE relates to the unfavourable mortality developments since the 1960s. Whereas since then the mortality decline accelerated in the West, it stagnated in CEE, especially among men at working age (Hertzman *et al.* 1996, UNICEF 1994, see also Figure 1). During the post-socialist era, which started in about 1990 in most CEE countries, mortality rates of these men even increased in several CEE countries. A comparison to western countries can show whether disadvantaged groups were affected disproportionately by the high national rates in the late 1980s.

Until recently, Hungary was the only CEE country for which estimates of socio-economic differences in mortality were available with the level of accuracy that is needed to compare these estimates to those made for western countries. Valkonen (1987 & 1989) compared mortality differences by educational level in Hungary in circa 1980 to those observed in England & Wales and the Nordic countries. He found that mortality differences were about equally large in each country. More diversity was observed for specific causes of death. Hungary had small differences in cardiovascular disease mortality, but relatively large differences in mortality from external causes of death.

The objective of this chapter is to make East-West comparisons for a more recent period and involving more countries. We will describe socio-economic differences in mortality in three CEE countries for which reliable and internationally comparable data are available: the Czech Republic, Hungary, and Estonia. The available data refer to circa 1990, that is, shortly after the end of the socialist era. These countries will be compared to five western countries: the United States, two of the largest countries of western Europe (England & Wales and France, no data were available for Germany) and two Nordic countries with data on mortality by both education and occupational class (Norway and Finland). The inclusion of Finland is of particular interest in view of its proximity to Estonia, both geographically, culturally and historically.

For western countries, we used data that have been acquired as a part of a large-scale project on socio-economic differences in morbidity and mortality in Europe (Kunst *et al.* 1996, Mackenbach *et al.* 1997). Previous analyses showed that Finland and, especially, France had larger mortality differences than any other western country for which data are available. Socio-economic differences in mortality in the United States, England & Wales and Norway were as large as in most other western countries (chapters 5 and 7).

This analysis focuses on mortality among men in the age groups 30-44 and 45-59 years. This restriction was demanded by problems with the availability and comparability of data for other age-sex groups, and it was motivated by the fact that recent mortality trends in CEE were especially worrisome for men at working age (Hertzman *et al.* 1996, UNICEF 1994).

## 8.3 Material and methods

*Material*

An overview of data sources is given in Table 8.1. Mortality data for the CEE countries were obtained from studies of the 'unlinked' cross-sectional type (see section 2.3). Each study was centred around the national population census of circa 1990. An exception is a Czech study for the period 1982-1985, which was added because data on mortality by educational level were not available for more recent years. Longitudinal studies were available for the United States and western European countries. In these studies (a nationally representative sample of) all persons enumerated during the census of circa 1980 were followed for a period of about 10 years.

Data from different countries had to refer to the same age group in terms of age at death. The age groups 30-44 and 45-59 years were distinguished for studies that classified men according to their age at death. For longitudinal studies with a follow-up period of about 10 years, the birth cohorts aged 25-39 and 40-54 years at the start of follow-up were distinguished.

Four groups of causes of death were distinguished: neoplasms (ICD-9 chapter II), circulatory diseases (VII), other diseases (rest of I to XVI) and external causes (XVII). In additional analyses, a few large single causes were distinguished, including lung cancer and ischaemic heart disease.

Cause-specific analyses were only made for men 45-59 years, because of the small number of deaths by cause of death and socio-economic group among men 30-44 years.

**Table 8.1** Overview of sources of data.

| Country | Design | Period | Sample size | SE-indicators[a] | Observed number deaths[b] |
|---|---|---|---|---|---|
| Czech Republic | cross-sectional | 1982-1985 | all men | E | 58,195 |
| Czech Republic | cross-sectional | 1990-1991 | all men | O | 20,239 |
| Hungary | cross-sectional | 1988-1992 | all men | E,O | 75,587 |
| Estonia | cross-sectional | 1987-1991 | all men | E | 10,001 |
| United States | longitudinal | 1979-1989 | ±0.5 % | E,O | 2,958 |
| England & Wales | longitudinal | 1981-1989 | 1 % | O | 2,703 |
| Norway | longitudinal | 1980-1990 | all men | E,O | 22,033 |
| Finland | longitudinal | 1981-1990 | all men | E,O | 39,090 |
| France | longitudinal | 1980-1989 | 5 % | E[c],O | 15,016 |

[a] Available socio-economic indicators. E=education, O=occupation.
[b] Observed number of deaths among men 45-59 years.
[c] No data on the association between education and cause-specific mortality.

**Table 8.2** National death rate, and distribution of deaths over four groups of causes of death. Men circa 45-59 years at death.

| Country | Share (%) in total number of deaths | | | | National death rate *[a]* |
|---|---|---|---|---|---|
| | Neoplasms | Cardiovasc diseases | All other diseases | External causes | |
| Czech Republic (90-91) | 31.4 | 45.7 | 16.0 | 7.0 | 12.03 |
| Hungary | 27.4 | 37.1 | 22.2 | 13.3 | 17.20 |
| Estonia | 26.4 | 42.3 | 13.1 | 18.3 | 16.73 |
| United States | 29.0 | 42.2 | 18.7 | 10.2 | 8.24 |
| England & Wales | 31.7 | 48.9 | 13.7 | 5.8 | 7.86 |
| Norway | 27.1 | 43.8 | 17.3 | 11.9 | 7.47 |
| Finland | 20.7 | 47.9 | 13.3 | 18.1 | 10.27 |
| France | 38.0 | 21.8 | 27.1 | 13.2 | 9.49 |

[a] Number of deaths among men 45-59 years per 1000 person years. In the middle of the study periods given in Table 8.1. Source: WHO (1988) and later years.

Table 8.2 presents the share of these causes of death in the total number of deaths among men 45-59 years. In most countries, between about 40 and 50 percent of all deaths is caused by cardiovascular diseases, and about 30 percent of all deaths is caused by neoplasms. The groups of other diseases and external causes of death account for less than about 25 percent of all deaths; their precise share strongly varies between countries.

The socio-economic status of men was measured by two indicators: occupational class and educational level. For each indicator, broad socio-economic groups were defined that could be measured in a comparable way in each country.

The educational level of subjects was measured as the highest level of education they completed. For the CEE countries, a distinction could only be made between men with at least upper secondary education and men with lower levels of education. The same distinction was made for the western countries, where possible. For the United States, a distinction is made between those with at least some college education, and those who have completed high school or less. Table 8.3 (last column) shows that about one third of men were assigned to the highest educational level in CEE countries. This share is higher for most western countries except France. The low share for France reflects particularities of the French educational system, which makes high requirements to completing upper secondary education with a diploma.

Three occupational classes were distinguished: non-manual classes (including self-employed men), manual classes, and agricultural classes (farmers and farm labourers). For western countries, these classes were measured in a highly comparable way by recoding detailed individual-level data on men's occupation according to a standard conversion scheme, the EGP scheme (Erikson and Goldthorpe 1992a, Bartley *et al.* 1996). For the Czech Republic and Hungary, an approximation to this classification could be obtained by combining the about eight occupational classes that were distinguished in the national data sets. The population distribution by broad occupational class is given in Table 8.3. In the Czech Republic and Hungary, about 30 percent of all men were assigned to non-manual classes, about 60 percent to manual classes, and about 10 percent to agricultural classes. In most western countries, non-manual classes are as large as manual classes.

For most countries, there was insufficient information on the former occupation of economically inactive men (retired, disabled, unemployed, etc), who therefore had to be excluded from the analysis. Their exclusion is likely to lead to an underestimation of mortality differences between occupational classes. We applied a procedure that approximately corrects for this underestimation (see Appendix).

**Table 8.3** Distribution of study population by occupational class, and by educational level. Men 30-44 and 45-59 years.

| Country | Age group | Share (%) in total population[a] | | | Share (%) with upper secondary education |
|---|---|---|---|---|---|
| | | Non-manual classes | Manual classes | Agricultural classes | |
| Czech Republic[b] | 30-44 | 28.4 | 64.4 | 7.2 | 31.1 |
| | 45-59 | 33.8 | 60.2 | 6.0 | 27.7 |
| Hungary | 30-44 | 27.7 | 65.2 | 7.1 | 37.3 |
| | 45-59 | 28.1 | 61.8 | 10.0 | 32.2 |
| Estonia | 30-44 | | *no data* | | 40.9 |
| | 45-59 | | | | 33.3 |
| United States | 30-44 | 45.9 | 49.9 | 4.1 | 48.7 |
| | 45-59 | 46.8 | 47.9 | 5.3 | 35.1 |
| England & Wales | 30-44 | 49.6 | 48.4 | 2.0 | *no data* |
| | 45-59 | 43.4 | 53.9 | 2.7 | |
| Finland | 30-44 | 39.1 | 51.5 | 9.4 | 59.9 |
| | 45-59 | 36.3 | 46.8 | 17.0 | 32.9 |
| Norway | 30-44 | 51.5 | 42.5 | 5.9 | 62.0 |
| | 45-59 | 48.4 | 42.3 | 9.3 | 45.1 |
| France | 45-59 | 46.6 | 42.2 | 11.2 | 18.4 |

[a] As % of the total population per age group, less men with occupation unknown.
[b] Data on occupation refer to 1990, those on education refer to 1983.

*Methods*

The magnitude of differences in mortality by educational level and occupational class was summarized by means of rate ratios. These rate ratios express the death rate of the lower socio-economic group (men with lower education, or men in manual classes) as a ratio of the death rate of the higher socio-economic group (men with higher education, or men in non-manual classes). Rate ratios and their 95% confidence intervals were estimated by means of Poisson regression analyses. The regression model included a term that represented the contrast between the lower and higher socio-economic group. A series of terms representing 5-year age groups were included in the regression model in order to adjust for age. Rate ratios for the Unites States were also adjusted for race/ethnicity (Hispanics, other white, black, other non-white).

Rate ratios do not take into account national mortality levels. This level might however be relevant from some perspectives. A rate ratio of, say, 1.5

implies a more important public health problem in countries with high national death rates than in countries with low death rates. In view of this, we also calculated absolute mortality levels for high and low socio-economic groups. From publications of the WHO (1988 and later years) we obtained estimates of national probabilities of dying between the ages 45 and 65 years. These probabilities were multiplied by class-specific SMRs in order to estimate class-specific probabilities of dying.

## 8.4 Results

Table 8.4 presents estimates of the magnitude of mortality differences between manual and non-manual classes. These mortality differences are larger in the Czech Republic than in each western country. Especially large are mortality differences in Hungary. The East-West contrast is most marked in the younger age group. Confidence intervals do not overlap, except those for men 45-59 years in the Czech Republic and in France.

**Table 8.4** Mortality rate ratio comparing manual classes to non-manual classes. Men 30-44 and 45-59 years at death.

| Country | 30-44 years | | 45-59 years | |
|---|---|---|---|---|
| | Rate ratio[a] | (95% CI) | Rate ratio[a] | (95% CI) |
| Czech Republic | 2.25 | (2.11 - 2.40) | 1.83 | (1.77 - 1.89) |
| Hungary | 2.89 | (2.80 - 2.98) | 2.65 | (2.60 - 2.70) |
| United States | 1.42 | (1.26 - 1.61) | 1.32 | (1.22 - 1.43) |
| England & Wales | 1.46 | (1.24 - 1.74) | 1.44 | (1.33 - 1.56) |
| Norway | 1.57 | (1.57 - 1.74) | 1.34 | (1.30 - 1.39) |
| Finland | 1.76 | (1.70 - 1.83) | 1.53 | (1.49 - 1.56) |
| France | | *no data* | 1.71 | (1.66 - 1.77) |

[a] Adjusted for the exclusion of men with occupation unknown, by multiplying the rate ratios with the adjustment factors given in table C of the appendix.

Table 8.5 presents estimates of the magnitude of mortality differences between lower and higher educational groups. Mortality differences are generally larger in CEE countries than in western countries. At ages 45-59 years, however, mortality differences in the Czech Republic and Estonia are smaller than those in France. As with occupation, especially large are the mortality differences that are observed for Hungary.

**Table 8.5** Mortality rate ratio comparing lower educational groups to higher groups. Men, 30-44 and 45-59 years at death.

| Country | 30-44 years | | 45-59 years | |
|---|---|---|---|---|
| | Rate ratio (95% CI) | | Rate ratio (95% CI) | |
| Czech Republic | 2.24 | (2.15 - 2.34) | 1.62 | (1.59 - 1.65) |
| Hungary | 2.94 | (2.85 - 3.03) | 2.20 | (2.16 - 2.24) |
| Estonia | 1.96 | (1.82 - 2.10) | 1.64 | (1.57 - 1.72) |
| United States | 1.66 | (1.45 - 1.91) | 1.52 | (1.41 - 1.64) |
| Norway | 1.72 | (1.64 - 1.80) | 1.40 | (1.36 - 1.44) |
| Finland | 1.68 | (1.63 - 1.74) | 1.52 | (1.48 - 1.56) |
| France | *no data* | | 1.75 | (1.70 - 1.81) |

Table 8.6 presents estimates of the magnitude of manual *versus* non-manual differences in mortality from specific cause-of-death groups. For each cause of death, mortality differences in the Czech Republic and Hungary are substantial, and they are larger than the differences observed in western countries. The East-West contrast is relatively weak for cardiovascular disease mortality.

**Table 8.6** Manual *versus* non-manual rate ratio for mortality from major groups of causes of death. Men 45-59 years at death.

| Country | Rate ratio (95% CI) [a] | | | |
|---|---|---|---|---|
| | Neoplasms | Cardiovasc diseases | All other diseases | External causes |
| Czech Republic | 1.76<br>(1.66-1.86) | 1.60<br>(1.52-1.68) | 2.75<br>(2.51-3.00) | 2.00<br>(1.81-2.22) |
| Hungary | 2.24<br>(2.16-2.33) | 2.27<br>(2.20-2.34) | 4.05<br>(3.88-4.23) | 2.97<br>(2.79-3.17) |
| United States | 1.42<br>(1.23-1.64) | 1.27<br>(1.13-1.43) | 1.34<br>(1.13-1.60) | 1.18<br>(0.93-1.51) |
| England & Wales | 1.21<br>(1.05-1.39) | 1.52<br>(1.36-1.71) | 1.74<br>(1.40-2.16) | 1.74<br>(1.24-2.46) |
| Norway | 1.25<br>(1.18-1.33) | 1.34<br>(1.27-1.40) | 1.51<br>(1.40-1.63) | 1.42<br>(1.29-1.54) |
| Finland | 1.39<br>(1.32-1.47) | 1.48<br>(1.42-1.53) | 1.60<br>(1.48-1.70) | 1.76<br>(1.66-1.87) |
| France | 1.71<br>(1.61-1.82) | 1.35<br>(1.26-1.45) | 2.09<br>(1.97-2.22) | 1.72<br>(1.57-1.88) |

[a] Adjusted for the exclusion of men with occupation unknown,as in Table 8.4.

**Table 8.7** Rate ratio comparing lower educational groups to higher groups for major groups of causes of death. Men 45-59 years at death.

| Country | Rate ratio (95% CI) | | | |
|---|---|---|---|---|
| | Neoplasms | Cardiovasc diseases | All other diseases | External causes |
| Czech Republic | 1.65 (1.59-1.72) | 1.42 (1.38-1.46) | 2.12 (2.00-2.24) | 2.06 (1.89-2.24) |
| Hungary | 1.88 (1.81-1.95) | 1.94 (1.88-2.00) | 2.81 (2.69-2.94) | 3.05 (2.88-3.24) |
| Estonia | 1.56 (1.42-1.70) | 1.50 (1.40-1.61) | 2.00 (1.74-2.29) | 1.94 (1.73-2.17) |
| United States | 1.52 (1.32-1.75) | 1.55 (1.38-1.74) | 1.54 (1.29-1.83) | 1.34 (1.05-1.71) |
| Norway | 1.23 (1.17-1.30) | 1.44 (1.38-1.51) | 1.54 (1.43-1.65) | 1.48 (1.36-1.61) |
| Finland | 1.37 (1.30-1.44) | 1.57 (1.51-1.62) | 1.51 (1.42-1.61) | 1.59 (1.51-1.68) |

**Table 8.8** Rate ratio comparing lower educational groups to higher groups for five specific causes of death. Men 45-59 years at death.

| Country | Rate ratio (95% CI) | | | | |
|---|---|---|---|---|---|
| | Lung cancer | Ischaemic heart dis | Cerebrovas-cular dis | Respira-tory dis | Liver cirrhosis |
| Czech Republic | 2.38 (2.23-2.54) | 1.31 (1.26-1.36) | 1.76 (1.64-1.89) | 3.13 (2.78-3.51) | 2.09 (1.85-2.36) |
| Hungary | 2.22 (2.08-2.36) | 1.63 (1.57-1.70) | 2.39 (2.23-2.57) | 4.25 (3.73-4.85) | 2.63 (2.47-2.80) |
| Estonia | 2.04 (1.74-2.40) | 1.46 (1.34-1.59) | 1.49 (1.28-1.75) | 3.38 (2.47-4.61) | 1.31 (0.88-1.96) |
| United States | 2.04 (1.65-2.52) | 1.61 (1.39-1.86) | 2.25 (1.51-3.35) | 2.18 (1.55-3.06) | 1.49 (1.01-2.18) |
| Norway | 1.59 (1.43-1.77) | 1.46 (1.39-1.53) | 1.39 (1.21-1.59) | 1.90 (1.60-2.27) | 1.36 [a] (1.17-1.58) |
| Finland | 2.16 (1.95-2.39) | 1.58 (1.52-1.64) | 1.51 (1.37-1.66) | 2.31 (1.99-2.68) | 1.24 [a] (1.12-1.38) |

[a] All gastro-intestinal diseases.

Table 8.7 presents estimates of the magnitude of cause-specific mortality differences by educational level. For each cause of death, mortality differences in Hungary are large from an international perspective. In the Czech

Republic and Estonia, relatively large mortality differences are only observed for the group of other diseases and for external causes of death.

Table 8.8 presents estimates of the association between educational level and mortality from five specific causes of death. Relatively large in the CEE countries are differences in mortality from lung cancer, liver cirrhosis and, especially, respiratory diseases. Differences in mortality from ischaemic heart disease and cerebrovascular disease are not consistently larger in the East than in the West.

**Figure 8.1** The probability of dying between the 45th and 65th birthday. Men in non-manual and manual classes.

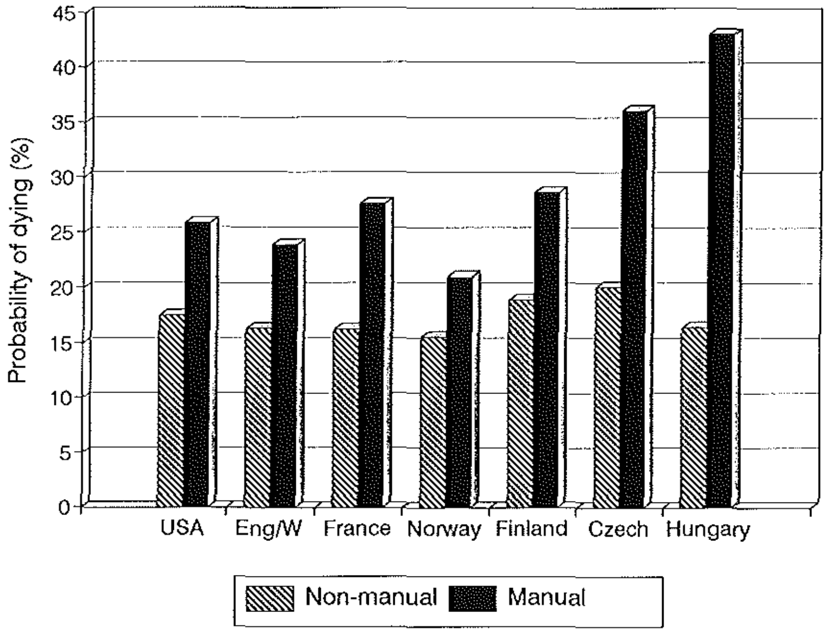
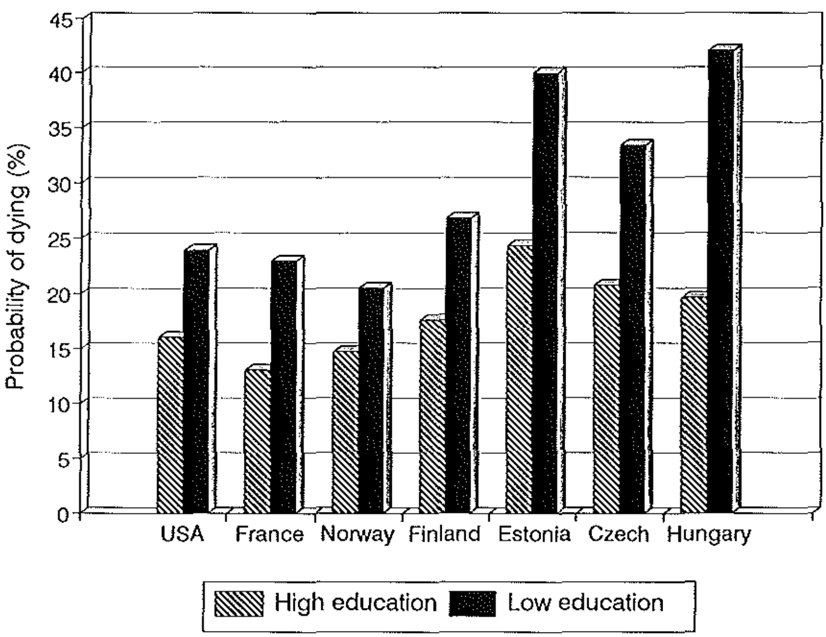



Figure 8.1 presents absolute mortality rates of non-manual and manual classes in the different countries. This figure is restricted to men in the older age group; a similar pattern was observed for men 30-44 years (not shown here). The death probabilities of men in non-manual classes are approximately equally high in each country. Much more variation is observed in the death probabilities of manual classes, which are almost two times as high in Hungary as in most western countries. As a consequence, the absolute mortality difference between manual and non-manual classes is relatively large in Hungary and, to a lesser extent, the Czech Republic.

Figure 8.2 presents the deaths probabilities of men in higher and lower educational groups. This figure is restricted to older age groups; a similar pattern was observed for men 30-44 years. Higher educational groups in CEE countries, especially Estonia, have higher mortality levels than their western counterparts. A more pronounced East-West contrast is observed, however, in the death probabilities for lower educational groups. As a consequence, the absolute mortality difference between lower and higher educational groups is larger is eastern countries than in the West.

**Figure 8.2** The probability of dying between the 45th and 65th birthday. Men in higher and lower educational groups.




## 8.5 Discussion

*Evaluation of data problems*

The results presented above were carefully evaluated against problems with the reliability and international comparability of data on mortality by occupational class. The most important data problems appeared to relate to the comparability of socio-economic indicators, and the unlinked cross-sectional nature of the data available for CEE countries.

We first discuss the comparability of data on educational levels. For the

CEE countries, a distinction could only be made between men with at least upper secondary education and men with lower levels of education. For the western countries, a distinction was made that approximately corresponded to this distinction. However, because there are large differences in the educational systems of the respective countries, optimal comparability is difficult to achieve. As a check to our results, we calculated for western countries rate ratios that correspond to alternative distinctions of high *versus* low educational levels. We found that these alternative rate ratios were, just as the ratios presented in Table 8.5, smaller than those for the Czech Republic and Estonia, especially for men 30-44 years.

Perhaps more problematic is the comparability of data on occupational class. A high degree of comparability was achieved among the western countries, thanks to the application of the EGP conversion scheme to individual-level data from each western country. There is more potential for error in the case of Hungary and the Czech Republic, where occupational classes could not be constructed in this detail. However, the potential size of error is likely to be modest when comparing countries on the basis of the manual *versus* non-manual distinction only. Manual and non-manual classes are fairly clearly delimited by the nature of the work that men perform, and borderline movements can be expected to have relatively small effects on the mortality rates for these broad classes.

Nonetheless, the potential problems with the measurement of occupational class should not be underscored. Hungary requires special concern. The proportion of Hungarian men 45-59 years with occupation unknown was exceptionally high. We had to apply a correction formula to adjust for their exclusion. This adjustment was large (see Appendix Table C). For example, for men 45-59 years, it increased the observed rate ratio of 1.98 to the 2.65 value presented in Table 8.4. Since this adjustment procedure is approximate only, it leaves room for residual error. However, the estimates for education may serve as a check. The fact that relatively large differences in mortality in Hungary were observed for educational level as well as occupational class, strongly suggests that this unfavourable record of Hungary is real.

Another data problem relates to the 'unlinked' cross-sectional nature of the data that were available for CEE countries. As explained in section 2.3, in this type of data, information on the socio-economic status of deceased is given at death certificates whereas information on the socio-economic status of the corresponding living population is obtained from the population census. If the measurement of socio-economic status is different in these two sources of information, this can bias estimates of the size of mortality differences by socio-economic group. In an evaluation of unlinked cross-sectional studies from Italy, Switzerland, France and England & Wales, we observed that manual *versus* non-manual rate ratios can be biased by at most 20 percent. This bias can be either upwards or downwards (chapter 5, Kunst and

Groenhof 1996c). According to the judgement of the CEE participants to this study, there are no reasons to suspect that the bias is larger in CEE countries. If this bias would indeed be of the same magnitude in CEE data sets, this bias would have only a modest effect on the results of the present study. The worst scenario is that the magnitude of mortality differences in CEE countries is overestimated by 20 percent, for both educational level and occupational class. If we assume such a large and consistent bias and therefore adjust inequality estimates downwards by the corresponding factor (100/120), the estimates for Estonia and the Czech Republic would be as large as in most western European countries, whereas Hungary would still have by far the largest inequality estimates of all countries.

An additional check is to compare the inequality estimates for CEE countries to estimates from western European countries that are based on unlinked cross-sectional data. In chapter 5, we used such data to measure mortality differences by occupational class in Ireland, Switzerland, Spain and Portugal in circa 1980. Manual *versus* non-manual mortality rate ratios for each of these countries were as small as those for England & Wales and Norway (see Tables 5.3 and 5.4) and thus clearly smaller than in CEE countries.

*Comparison to previous studies*

Valkonen (1987 & 1989) observed that the association between all-cause mortality and educational level in Hungary was as strong as in England & Wales, Norway and Finland. The international position of Hungary is considerably less favourable in our study. A possible explanation is that the previous study related to 1978-1981 instead of 1988-1992, and that socio-economic differences in mortality in Hungary have strongly increased during the 1980s. This possibility can be tested by applying to our data for about 1990 the inequality index that Valkonen (1987) applied to the data for about 1980. This index, the regression-based index of effect (see section 2.6.2) measures the percentage increase in mortality rates associated with one year decrease in education. For men 35-54 years in 1980 Valkonen estimated this index to be 8.2 percent. Our corresponding estimate for men 35-54 years in 1990 is 14.2 percent. Thus, mortality differences in Hungary seemed to have strongly increased during the 1980s. Socio-economic differences have widened especially for cardiovascular disease mortality, which had a weak association with educational level in about 1980 (Valkonen 1987), but a strong relationship in 1990 (Table 8.7). Thus, it seems that the unfavourable trends in Hungary in the 1980s have affected men from lower socio-economic groups much more than higher groups. This finding has parallels that of Hadju *et al.* (1995), who observed that practically the entire rise in death rates among middle-aged men between 1982 and 1990 was among the non-married (see also Watson 1996).

*Generalisability*

This study is restricted to deaths among men younger than 60 years, for reasons given at the end of the introduction. Since the magnitude of mortality differences can strongly vary by age and sex, the results presented here cannot be assumed to apply to women, or to men in other age groups than those considered in this study.

It is uncertain whether the three countries selected for this study can be considered to be representative for CEE in general. The Czech Republic and Hungary together represent the wide range of mortality levels and trends in CEE since the 1960s, with high and strongly increasing death rates among middle-aged men in Hungary, and a relatively favourable situation in the Czech Republic (Hertzman *et al.* 1996, see also Figure 1). With respect to the health and sanitary situation in general, however, the recent situation in both the Czech Republic, Hungary and Estonia is not as gloomy as in Bulgaria, Rumania, Ukraine and, notably, Russia (UNICEF 1994). Social disparities in mortality in the latter countries might perhaps be even larger than in Hungary.

*Explanation*

The egalitarian socio-economic, health care and other policies that have been pursued during four decades of socialist rule might be expected to have resulted in relatively small mortality differences in CEE countries. The available evidence (United Nations 1985) suggests that in the early 1980s, income inequalities were smaller in the East than in the West. This also applied to income differences between manual and non-manual classes. Many non-manual occupations (including medical professions) were considered to be 'unproductive' and therefore conferred incomes that were close to, or even below, national average. Relatively small was also the manual *versus* non-manual difference in job prestige, a measure that reflects the general standing in society that a citizen can derive from the exercise of a specific job (Treiman 1977).

Despite these smaller differences in income, status and other attributes that are enjoyed by men in high and low socio-economic groups respectively, their mortality difference is larger, or at least as large, in the three eastern countries than in western countries. This suggests that some other features of the former socialist society have overshadowed the positive effects, if any, of egalitarian socio-economic, health care and other policies.

The egalitarian character of these policies should not be emphasized too much. Under the socialist system, access to scarce goods and services did not depend as much on income as in western Europe, and relatively more on non-market resources such as privileges, political power and the ability to deal with state representatives and bureaucratic rules (Field 1990, Mezentseva and Rimachevskaya 1992). Not all citizens were equal in this respect, and having a high educational level or influential job might have entailed a significant advantage in socialist society.

Other counter-acting features of the former socialist societies are manifest in the high national death rates of CEE countries. At the end of the socialist era, the East-West difference in absolute death rates was relatively small for higher socio-economic groups, and large for lower socio-economic groups. This suggests that lower socio-economic groups had been affected disproportionately by the conditions that are responsible for the high national death rates in CEE in the late 1980s. These high national death rates are thought to be related to high levels of psychosocial stress (Hertzman *et al.* 1996), which in turn is due to, among others, the lack of a 'civil' society that provides citizens with norms, trust, networks and other features that buffer stress (Hertzman and Marmot 1996). There is little doubt this lack of 'social capital' (Wilkinson 1996) affects socio-economically disadvantaged groups in particular.

At the level of specific risk factors for disease, the causes of the high mortality rates of CEE countries are probably varied. Risk factors that are likely to have made a contribution are poor housing standards, hazardous working conditions, excessive alcohol consumption and more recently also smoking (Bobak and Marmot 1996, Lipaud *et al.* 1992, UNICEF 1994, WHO MONICA 1991). Some of these factors are likely to have contributed not only to the high national mortality rates of CEE countries, but also to the large socio-economic disparities in mortality.

An example is alcohol consumption. Alcohol abuse is very frequent in CEE, and more so in lower socio-economic groups (UNICEF 1994). The contribution that this probably made to mortality differences can be illustrated with liver cirrhosis mortality. We observed large differences between manual and non-manual classes in liver cirrhosis mortality in the Czech Republic and Hungary (Table 8.8). Further calculations we made showed that these differences accounted for 10 and 16 percent of the class difference in total mortality in, respectively, the Czech Republic and Hungary. Since alcohol abuse influences the risk of dying from several other causes of death as well, the total contribution is likely to be even much larger (cf. Mäkelä *et al.* 1997).

It is likely that inequalities with respect to health care have also contributed to the mortality differences in eastern countries, or at least failed to mitigate the existing differences (Boys *et al.* 1991, Velkova *et al.* 1997). Paradoxically, egalitarian health care policies were associated with large inequalities in access to high-quality care (Szalai 1986). The socialist health care system to which all people had equal access was of such a low quality that those who could afford it recurred to private health care of higher quality. Unequal access to high-quality health care might have contributed to differential mortality especially from diseases amenable to medical intervention, or at least it might have prevented health care from reducing socio-economic differences in mortality from these conditions. An example is cerebrovascular disease mortality, part of which could have been avoidable by adequate hypertension detection and control. Despite the fact that, at least in theory, CEE health care systems were in principle well equipped to apply hypertension detection and control on a massive scale (Forster 1996), socio-economic differences in stroke mortality were at least as large in these countries as in the West.

It is important to note that the data for CEE countries include the first years of post-socialist era (see Table 8.1). This raises the question to what extent the post-1989 developments have influenced the patterns observed in our study. There are strong reasons to fear that socio-economic differences in mortality have widened after 1989. Whereas the old system was unable to effectively reduce socio-economic differences in mortality, new forms of social integration and protection had yet to appear during this recent 'transition crisis' (Barr 1994, UNICEF 1994). In addition, this crisis was accompanied by declining standards of living, increasing income inequalities and a deterioration of public health services in most countries (UNICEF 1994). As a result, national mortality rates maintained their high levels and in some CEE countries even raised. This happened in Hungary, where national mortality rates per 1000 men 40-59 years rose from 13.85 in 1989 to 15.56 in 1992 (UNICEF 1994). In lower socio-economic groups, the mortality increase may have been well above this national increase of 12 percent, while no increase may have occurred among higher socio-economic groups. If this indeed happened, it would have contributed to an important extent to the large mortality differences that we observed for Hungary for the entire period 1988-1992.

*Implications*

The large socio-economic differences in mortality that we observed for CEE countries around 1990, and the likelihood that a further widening occurred since then, imply that a high priority should be given to improving the health situation of disadvantaged groups of CEE countries. Putting health inequalities high on the agenda of policy makers in CEE might be difficult, however, due to the connotations this has with the egalitarian ideology of the former socialist regimes. Without health care and other policies that are targeted at lower socio-economical groups, however, it will be hard to the close the mortality gap between advantaged and disadvantaged people in the East. These policies might in addition be vital to closing the mortality gap between East and West.

It is clearly necessary to monitor future health developments in central and eastern European countries not only for these nations at large, but also for disadvantaged population groups in particular.

Chapter nine

# Ischaemic heart disease mortality and occupational class in 11 western European countries and the United States

## 9.1 Summary

The United States and 11 western European countries are compared with respect to differences between occupational classes in ischaemic heart disease mortality, in order to identify circumstances that are associated with smaller or larger mortality differences.

Data on mortality by occupational class were obtained from the National Longitudinal Mortality Study (1979-1989) and from a large data base created in a European project. The data refer to deaths among men 30 to 64 years in the 1980s. The magnitude of mortality differences was measured by rate ratios that compare manual to non-manual classes.

A north-south contrast existed within Europe. In England & Wales, Ireland and Nordic countries, manual classes had higher mortality rates than non-manual classes. In France, Switzerland and Mediterranean countries, manual classes had mortality rates as low as, or lower than, non-manual classes. The United States occupied an intermediate position.

This study underlines the highly variable nature of class differences in ischaemic heart disease mortality. There is no evidence for a positive association with the size of income inequalities. Social gradients in ischaemic heart disease mortality seem to be conditioned by cultural rather than socio-economic circumstances.

## 9.2 Introduction

Much attention in health inequalities research has been given to ischaemic heart disease (IHD) mortality (Kaplan and Keil 1993, Marmot and Mustard 1994, National Heart, Lung, and Blood Institute, 1996). The interest in this disease was stimulated by the observation that differences between socio-economic groups in IHD mortality have strongly increased during the last decades, and that this increase has contributed much to the widening of the gap in all-cause mortality (Feldman *et al.* 1989, Kunst *et al.* 1990, Lang and Ducimetière 1995, Marmot *et al.* 1978 & 1986, Pappas *et al.* 1993, Regidor *et al.* 1995a & 1996, Valkonen *et al.* 1993, Vågerö and Lundberg 1995).

The increasing differences in IHD mortality raise questions on variations across regions or countries. Is a strong variability observed over space as well as over time? If so, which circumstances are associated with smaller or larger differences in IHD mortality? Studies addressing these questions might identify circumstances that are liable to change through intervention, and thus show possibilities to reverse the unfavourable trends over the past decades.

A comparison between European countries is especially interesting because there is much diversity between these countries with respect to both living standards, socio-economic policies, and health care systems. Even larger contrasts are obtained by comparing European countries to the United States. Comparative studies have demonstrated that both income inequalities and inequalities with respect to medical care were larger in the United States than in western European countries (Atkinson *et al.* 1995, Doorslaer *et al.* 1992).

No previous study has compared countries with respect to socio-economic differences in IHD mortality, but a few studies have looked at mortality from all cardiovascular diseases (e.g. Leclerc 1989, Leclerc *et al.* 1990). Valkonen (1987 & 1989) compared England & Wales, Denmark, Norway, Finland, and Hungary with respect to mortality differences by educational level in the 1970s. Differences in cardiovascular disease mortality among men and women circa 35-54 years were about equally large in the four northern European countries and relatively small in Hungary. No comparative studies on differences in cardiovascular disease mortality included the United States.

The objective of this chapter is to compare 11 western European countries and the United States with respect to socio-economic differences in IHD mortality. For the United States, we used the data from the National Longitudinal Mortality Study for the period 1979-1989 (Sorlie *et al.* 1995). For Europe, we used data that have been acquired as a part of a large-scale project on socio-economic differences in morbidity and mortality in Europe (Kunst *et al.* 1996, Mackenbach *et al.* 1997). The analysis is restricted to deaths among men in the age groups of 30-44, 45-59 and 60-64 years respectively.

## 9.3 Material and methods

*Material*

Data on mortality by occupational class and cause of death were obtained from longitudinal studies and otherwise from cross-sectional studies. Longitudinal studies were available for Finland, Sweden, Norway, Denmark, England & Wales and the United States. All studies covered the period of circa 1980 to 1989. Data from cross-sectional studies could be obtained for Ireland, France, Switzerland, Spain and Portugal. Each cross-sectional study was centred around the national population census of about 1981, and covered the period of about 1980 tot 1982.

In chapters 5 and 6, we assessed mortality differences in Italy with data from a national longitudinal study. Unfortunately, data on IHD mortality were not available from this study. In order to include Italy in this chapter, we used data from a 9-year (1981-1989) mortality follow-up of all residents of Turin, a large city in northern Italy (Costa and Segnan 1988). We assessed whether this study may be assumed to represent Italy at large. Support comes from a preliminary analysis in which we found that the Turin study and the national study showed about equally large class differences in mortality from all cardiovascular diseases together.

Data from different countries had to refer to the same age group in terms of age at death. The age groups 30-44 and 45-59 years were distinguished for studies that classified men according to their age at death. For longitudinal studies with a follow-up period of about 10 years, the birth cohorts aged 25-39 and 40-54 years at the start of follow-up were distinguished. With a follow-period of 10 years, it was in addition possible to study mortality differences at the age of about 60-64 years by following men aged 55-59 years at the start of follow-up.

A common occupational class scheme, the EGP scheme, was applied to as many countries as possible (Erikson and Goldthorpe 1992a). These conversion schemes could not be applied to the data available for Denmark, Ireland, Italy, Spain and Portugal. Data from these countries could however be made comparable to the EGP scheme at the level of three broad classes: non-manual classes (including self-employed men), manual classes, and the class of farmers and farm labourers.

For most countries, there was insufficient information on the former occupation of economically inactive men, who therefore had to be excluded from the analysis. Their exclusion is likely to lead to an underestimation of mortality differences between occupational classes. Therefore, we developed a procedure that approximately corrects for this underestimation. With this procedure, which is described in the appendix for total mortality, we could make adjustments for IHD mortality specifically.

*Methods*

The relative mortality level of men in specific occupational classes was measured by means of Standardized Mortality Ratios, with the national age-specific mortality rates as the standard. The magnitude of inequalities in mortality was quantified by a summary index with a straightforward interpretation: the rate ratio that compares the mortality rate of manual classes to the mortality rate of non-manual classes (including self employed men).

**Table 9.1** Ischaemic heart disease mortality by occupational class. Men, 30-44, 45-59 and 60-64 years at death.

| Country | Age group | Share (%) of IHD in all deaths | Standardized Mortality Ratio (SMR) [a] | | |
|---|---|---|---|---|---|
| | | | Non-manual classes | Manual classes | Agricultural classes |
| Finland | 30-44 | 12.1 | 0.67 | 1.27 | 1.23 |
| | 45-59 | 35.6 | 0.80 | 1.17 | 0.97 |
| | 60-64 | 40.7 | 0.88 | 1.11 | 0.96 |
| Sweden | 30-44 | 7.8 | 0.76 | 1.34 | 1.00 |
| | 45-59 | 34.6 | 0.87 | 1.19 | 0.77 |
| Norway | 30-44 | 14.4 | 0.76 | 1.34 | 0.97 |
| | 45-59 | 34.2 | 0.87 | 1.17 | 0.86 |
| | 60-64 | 37.4 | 0.90 | 1.14 | 0.84 |
| Denmark | 30-44 | 9.3 | 0.85 | 1.26 | 0.65 |
| | 45-59 | 26.3 | 0.93 | 1.19 | 0.65 |
| | 60-64 | 30.1 | 0.97 | 1.12 | 0.72 |
| England & W | 30-44 | 21.9 | 0.75 | 1.26 | 0.88 |
| | 45-59 | 38.2 | 0.80 | 1.21 | 0.60 |
| | 60-64 | 37.6 | 0.88 | 1.10 | 0.87 |
| Ireland | 30-44 | 19.7 | 0.91 | 1.29 | 0.66 |
| | 45-59 | 39.0 | 1.00 | 1.23 | 0.75 |
| France | 30-44 | 4.9 | 0.95 | 1.13 | 0.59 |
| | 45-59 | 9.9 | 1.06 | 1.03 | 0.72 |
| Switzerland | 30-44 | 9.1 | 1.00 | 1.03 | 0.80 |
| | 45-59 | 20.7 | 1.06 | 1.02 | 0.65 |
| Italy (Turin) | 30-44 | 10.0 | 0.86 | 1.15 | [b] |
| | 45-59 | 20.4 | 0.97 | 1.04 | |
| | 60-64 | 17.5 | 1.07 | 0.91 | |
| Spain | 45-59 | 14.4 | 1.07 | 1.06 | 0.83 |
| Portugal | 30-44 | 5.6 | 1.03 | 0.83 | 1.48 |
| | 45-59 | 11.3 | 1.21 | 0.93 | 0.84 |
| United States | 30-44 | 10.0 | 0.88 | 1.18 | 0.45 |
| | 45-59 | 27.5 | 0.88 | 1.14 | 0.89 |
| | 60-64 | 28.8 | 0.90 | 1.10 | 1.07 |

[a] National average in each age group is 1.00.
[b] No estimates are made for the few agricultural workers living in the city of Turin.

The manual *versus* non-manual distinction is not entirely hierarchical because, according to most criteria, some manual workers have a higher socio-economic position than routine non-manual workers or self-employed men (Erikson and Goldthorpe 1992a). A clearly hierarchical distinction can however be obtained by comparing manual classes to the class of professionals, large employers, administrators and managers (classes I and II in the EGP scheme). We will therefore include a rate ratio that corresponds to this distinction.

Rate ratios and their 95 percent confidence intervals were estimated by means of Poisson regression analysis. The regression model included a term that represented the contrast between manual and (upper) non-manual classes. A series of terms representing 5-year age groups were included in the regression model in order to control for different age compositions of manual and (upper) non-manual classes. Rate ratios for the Unites States were also adjusted for race/ethnicity (Hispanics, other white, black, other non-white).

## 9.4 Results

Data on the contribution of IHD to all-cause mortality are presented in column 1 of Table 9.1. Of all deaths among men 45-59 years, the part that is attributable to IHD is between 34 and 39 percent in most northern European countries, and between about 10 and 20 percent in southern European countries. The United States and Denmark are in-between with about 27 percent. In most countries, IHD caused a smaller part of deaths among men 30-44 years, and a slightly larger part of deaths among men 60-64 years.

The right part of Table 9.1 presents the pattern of variation in IHD mortality by occupational class. In the four Nordic countries, England & Wales and the United States, the mortality rates of non-manual classes are lower than the national average, whereas the rates of manual classes are higher than average. This mortality difference decreases with rising age. In Ireland and southern European countries, the mortality rates of non-manual classes are not consistently lower than the national average. Manual classes in most of these countries have also mortality rates close to the national average.

In several countries, workers in agriculture have IHD mortality rates lower than the rates of the manual and non-manual classes. Relatively high IHD mortality rates are observed for agricultural workers 30-44 years in Finland and Portugal, and for those 60-64 years in the United States.

Table 9.2 presents the rate ratios that quantify the size of the mortality differences between manual and non-manual classes. We first discuss the estimates for men 45-59 years, which could be made for all countries. Mortality differences are consistently larger in northern European countries than in southern countries. In the latter countries, rate ratios are close to 1, implying a near-equality in the mortality levels of manual and non-manual classes. In Portugal, the highest mortality rates were even observed for non-manual classes. The rate ratio for the United States is close the ones for Sweden, Norway, Denmark and Ireland. Larger rate ratios are observed for England & Wales and Finland. The difference with the United States is however not statistically significant.

The north-south contrast is more marked for mortality differences among men 30-44 years. Large rate ratios are observed for Finland, Sweden, Norway and England & Wales. The United States occupy an intermediate position between the northern and southern part of Europe. At ages 60-64 years, class differences in IHD mortality are small in the northern European countries. A rate ratio smaller than 1 is observed with the only longitudinal study from southern Europe. The rate ratio for the United States is close to the ones for northern Europe.

**Table 9.2** IHD mortality rate ratio comparing manual classes to non-manual classes. Men, 30-44, 45-59 and 60-64 years at death.

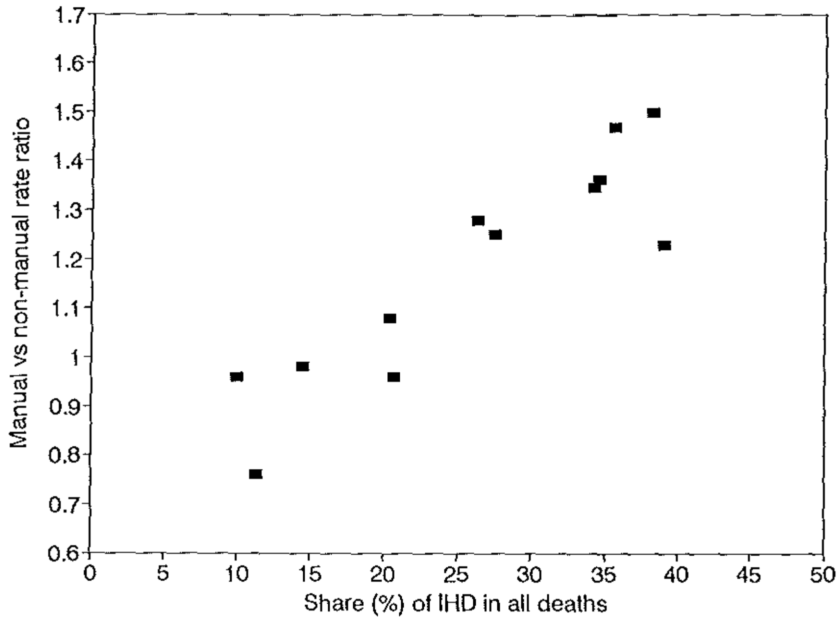
| Country | 30-44 years | | 45-59 years | | 60-64 years | |
|---|---|---|---|---|---|---|
| | Rate ratio | 95% CI | Rate ratio | 95% CI | Rate ratio | 95% CI |
| Finland | 1.91 | (1.72-2.12) | 1.47 | (1.41-1.53) | 1.26 | (1.19-1.33) |
| Sweden | 1.80 | (1.52-2.15) | 1.36 | (1.31-1.41) | | [a] |
| Norway | 1.77 | (1.55-2.03) | 1.35 | (1.28-1.43) | 1.26 | (1.19-1.33) |
| Denmark | 1.52 | (1.35-1.71) | 1.28 | (1.22-1.34) | 1.16 | (1.10-1.22) |
| England & Wales | 1.68 | (1.16-2.44) | 1.50 | (1.32-1.71) | 1.26 | (1.10-1.45) |
| Ireland | 1.42 | (1.12-1.80) | 1.23 | (1.12-1.35) | | [a] |
| France | 1.18 | (1.08-1.30) | 0.96 | (0.92-1.00) | | [a] |
| Switzerland | 1.03 | (0.83-1.29) | 0.96 | (0.89-1.04) | | [a] |
| Italy (Turin) | 1.35 | (0.97-1.88) | 1.08 | (0.95-1.22) | 0.85 | (0.69-1.06) |
| Spain | | [a] | 0.98 | (0.94-1.03) | | [a] |
| Portugal | 0.82 | (0.66-1.03) | 0.76 | (0.69-0.84) | | [a] |
| United States | 1.32 | (0.91-1.92) | 1.25 | (1.08-1.44) | 1.22 | (1.03-1.45) |

[a] No data were available for these age groups.

Table 9.3 presents rate ratios in which manual classes are not compared to all non-manual classes, but only to the class of professionals, large employers, administrators or managers. These estimates are only made for those countries where occupational classes could be defined with reference to the EGP scheme. Nearly each rate ratio in Table 9.3 is larger than the corresponding manual *versus* non-manual rate ratio given in Table 9.2. More importantly, this more discriminatory inequality measure shows the same north-south contrast within Europe as the one observed in Table 9.2. The United States again occupy an intermediate position, especially in the age group 30-44 years.

The size of inequalities in IHD mortality appeared to be strongly correlated to the contribution that IHD makes to all-cause mortality. Figure 9.1 illustrates this. The manual *versus* non-manual difference is small in all countries where IHD causes 20 percent or less of all deaths among men 45-59 years. The largest inequalities in IHD mortality are observed in countries where IHD causes more than about 35 percent of all deaths. If this association with the national rates of IHD mortality would be taken into account, e.g. by calculating the absolute difference between death rates for manual and non-manual classes, the north-south contrast within Europe would be even more marked.

**Figure 9.1** The association between manual *versus* non-manual mortality rate ratios and the share of ischaemic heart disease in all deaths. Men 45-59 years at death. Sources: Tables 9.1 and 9.2.



## 9.5 Discussion

*Evaluation of data problems*

These results should be carefully evaluated against problems with the reliability and international comparability of data on mortality by occupational class. In chapter 5, we quantified the potential effect that the three major data problems had on estimates of the magnitude of all-cause mortality differences. The potential size of error in the estimates for Sweden and England & Wales was 10 percent or less. This implies that a rate ratio of, say, 1.40 is under- or overestimated by maximally 0.14 units. The potential size of error is also modest for Finland, Norway, Denmark and the United States (15 percent or less), slightly larger for France, Switzerland and Italy (circa 20 percent or less) and the largest for Ireland, Spain and Portugal (circa 35 percent or less).

This evaluation shows that the evidence for relatively small class differences in mortality in France, Switzerland, and Italy is strong. The rate ratios for these three countries were substantially and consistently smaller than the rate ratios for northern European countries. It is therefore unlikely that this difference is attributable to data problems alone. The poorly comparable data for Spain and Portugal could not provide strong evidence for their international position, but the similarity between the results for all five southern European countries makes it highly likely that these countries share a common pattern of class variations in IHD mortality.

Unexpected was the finding that class differences in IHD mortality in the United States were generally smaller than in northern European countries. The differences that we observed between the rate ratios for the United States and those for northern European countries were in most cases within the margin of uncertainty of about 15 percent. Therefore, we cannot exclude the possibility that class differences in IHD mortality in the United States are as large as, instead of smaller than, in northern Europe.

The comparability of cause-of-death registrations is another area of concern. A part of deaths due to IHD may be assigned to other causes of death like other heart diseases, other cardiovascular diseases, or sudden death. If this misreporting occurs more frequently to deaths among lower occupational classes than to deaths among higher classes, the relatively mortality level of lower classes would be underestimated. Can this problem explain the fact that no differences in IHD mortality were observed in southern European countries? A test to this was obtained by adding all other cardiovascular diseases to IHD and assessing class differences in mortality from this more robust cause-of-death group. The results showed the same north-south contrast as were observed for IHD alone: manual *versus* non-manual rate ratios for men 45-59 years were between 1.03 and 1.18 in southern Europe, between 1.25 and 1.52 in northern Europe, and 1.21 in the United States.

*Generalisability of the results*

One restriction of this study relates to the choice of occupational class as the socio-economic indicator. Perhaps the manual *versus* (upper) non-manual distinction is more relevant to some societies than to others. This raises the question whether the same international pattern of socio-economic differences in IHD mortality would be observed with the use of other socio-economic indicators. Unfortunately, nationally representative data on the association between education level and IHD mortality are only available for Finland, Norway, Denmark, Italy and the United States. The results are summarised in Table 9.4. This table shows that the relative position of countries was about the same for education as for occupational class. There is, however, one exception. Whereas mortality differences by occupational class were smaller in the United States than in northern Europe, differences by educational level were found to be equally large.

**Table 9.4** The size of IHD mortality differences associated with educational level. Men, 20-44 and 45-59 years at start of follow-up.

| Country | 20-44 years | | 45-59 years | |
|---|---|---|---|---|
| | RII *[a]* | 95 % CI | RII *[a]* | 95 % CI |
| Finland | 3.62 | (3.19 - 4.12) | 2.12 | (1.98 - 2.27) |
| Norway | 3.63 | (3.06 - 4.31) | 2.05 | (1.91 - 2.21) |
| Denmark | 3.32 | (2.79 - 3.96) | 1.83 | (1.69 - 1.98) |
| Italy | 3.48 | (1.82 - 6.64) | 1.51 | (1.13 - 2.02) |
| United States | 3.35 | (2.13 - 5.26) | 2.21 | (1.81 - 2.70) |

[a] The Relative Index of Inequality. For calculation and interpretation, see section 2.6.3, section 4.3, and Table 7.9.

*Explanations*

The large variability observed in this study implies that there are circumstances that are able to strongly influence the class distribution of IHD mortality. Which circumstances?

Much attention in the British health inequalities debate has been given to the egalitarian character of socio-economic, health care and other policies (Carroll *et al.* 1996, Davey Smith 1996, Davey Smith and Egger 1993, Townsend *et al.* 1988a, Wilkinson 1992a, 1994a & 1996). More egalitarian policies can be expected to result in smaller socio-economic differences in morbidity and mortality. In this view, it is surprising to find that differences in IHD mortality in the United States are not larger than in European countries. Equally surprising is that within Europe, more egalitarian countries do not have relatively small differences in IHD mortality. This can be illustrated with a familiar outcome indicator of the egalitarian socio-economic policies: the size of income inequalities (Atkinson *et al.* 1995). Where income inequalities are smallest (Finland, Sweden, Norway and Denmark) class differences in IHD mortality are large, and where income inequalities are largest (Ireland, Switzerland, Italy, Spain and Portugal) class differences in IHD mortality are small. This implies that international patterns in IHD mortality differences cannot be explained only with reference to the egalitarian character of socio-economic policies. The size of mortality differences in a specific country appears to depend on other circumstances as well, and some of these circumstances seem to be so powerful so as to conceal a beneficial effect, if any, of egalitarian socio-economic policies.

Intriguing is the positive gradient in Portugal, and the absence of class differences in IHD mortality in the rest of southern Europe. This reminds us of the situation that existed in the United States and northern Europe some decades ago. Until about 1950, US studies on IHD mortality and incidence among men at working age observed no or even positive associations with income, educational level or occupational status (Kunst and Mackenbach 1990). The first studies that reported inverse gradients referred to the 1950s (Bainton and Peterson 1963, Mortensen *et al.* 1959, Pell and Fayerweather 1985, Rogot and Hrubec 1989). Inverse gradients in northern Europe were first reported for the 1960s (Marmot *et al.* 1978, Vågerö and Lundberg 1995, Valkonen 1982, Kristofersen 1979, Lynge 1979, Doornbos 1990). Recent studies from France and Spain suggest that inverse gradients emerged there in the 1980s (Lang and Ducimetière 1995, Regidor *et al.* 1995a & 1996). The evidence from the latter countries suggests that the situation in southern Europe can in part be understood as a delay in the transitions that occurred first in the United States and somewhat later in northern Europe. Consistent with the hypothesis of delayed transition is our observation that positive gradients existed in southern European countries among older birth cohorts (those aged 45 years and over in the early 1980s) but generally not among younger cohorts.

The delayed transition hypothesis suggests that the situation in southern Europe in the early 1980s may to some extent be explained in the same way as the situation in the United States and northern Europe some decades before. The latter situation is not fully explained, but without doubt part of that explanation lays in the fact that higher socio-economic groups pursued a 'modern' life style that implied tobacco consumption, high animal fat intake, and physical inactivity. Tobacco consumption is a well-documented example (Haynes *et al.* 1978, Kaplan and Keil 1993, Marmot *et al.* 1978, Pierce 1989, Reek and Adriaanse 1988, Vågerö and Norell 1989). In the 1950s, there were no clear social gradients, or even positive gradients, in tobacco consumption in the United States and in northern Europe. Inverse gradients emerged in the late 1950s or in the 1960s, when higher socio-economic groups stopped smoking on a massive scale. One might hypothesize that the old situation has longer persisted in southern European countries. Some support comes from an analysis of data from health interview and similar surveys from the late 1980s (Cavelaars *et al.* 1997c). We found that tobacco consumption was unrelated to socio-economic status in Portugal. Inverse gradients existed in all other European countries, but were weaker in southern countries than in northern countries.

Several authors have raised the question why IHD mortality and associated risk factors were not associated with low socio-economic status in the United States and northern Europe in the middle of this century. Among the circumstances that may have played a role are: low living standards of lower socio-economic groups; absence of scientific information on the health hazards of smoking and other behaviours; and values, tastes and social norms related to these behaviours. For each of these explanations, we will evaluate whether they apply to southern Europe in the early 1980s.

1. Low living standards. Positive gradients in IHD mortality might have existed until the middle of this century because lower socio-economic groups were too poor to afford high levels of tobacco consumption and animal fat intake, or to lead a sedentary way of life. The fact that the United States were the first country where the initially positive gradients in IHD mortality disappeared (in the 1950s) might in part be related to the fact that the living standards of lower socio-economic groups in United States were probably much higher than those in Europe.

If low living standards still had protective effects in Europe in the 1980s, these effects should be manifest in the three western European countries where low national incomes combined with large income inequalities: Ireland, Spain and Portugal (Atkinson *et al.* 1995, Commission of the European Communities 1991). Low living standards seemed to have protected lower socio-economic groups in these countries against at least one risk factor for IHD mortality. Overweight is more prevalent among lower socio-economic groups in each western European country, but not in Ireland, Spain and Portugal (Cavelaars *et al.* 1997d, Kunst *et al.* 1996). It is perhaps no coincidence that Ireland and Portugal are precisely the two countries in, respectively, northern and southern Europe where the relative IHD mortality rates of manual classes are more favourable than in any other country in these parts of Europe. The positive gradient in IHD mortality in Portugal is unique in western Europe, but is also observed in studies from low-income countries elsewhere in the world (NG 1988, Kunst 1989, Rumel 1988, Sorlie and Garcia-Palmieri 1990).

It is difficult to explain in this way, however, why inverse gradients existed in 1980s in all northern European countries but not in equally rich countries like France and Switzerland.

2. Absence of scientific information on IHD risk factors. Until the 1950s,

higher socio-economic groups may have adhered to life styles that implied increased risks of IHD because the health hazards of tobacco consumption, high animal fat intake, obesity and physical inactivity had yet to be discovered. When this information became available, higher socio-economic groups were probably the first to be informed and to modify their life styles and living conditions accordingly (cf. Rogers 1962). This differential diffusion of new knowledge and related changes may have been reinforced by health education and promotion programs, whose 'middle class' messages may have reached higher socio-economic groups earlier and more effectively than lower groups (Hart 1986).

If this new information on the knowledge of risk factors would have diffused unequally not only across the social ladder, but also across countries, that may have contributed to the longer persistence of non-negative IHD mortality gradients in southern Europe. It is difficult to explain along these lines, however, that differences in IHD mortality emerged about 30 years earlier in the United States than in southern Europe. In the United States, inverse IHD gradients started to appear in the 1950s, that is, when the evidence on the health hazards of smoking and other habits was just beginning to accumulate. In southern Europe, inverse IHD gradients emerged in the 1980s, that is, when higher socio-economic groups already must have been aware of the risk factors for IHD for 10 years of more. It is likely that other conditions had to be fulfilled before these groups were to change their life styles accordingly.

3. Values, tastes and social norms. Higher socio-economic groups must have adhered to a 'modern' life style because this life style was positively valued until the middle of this century. An example are the values and social norms related to overweight (Wilkinson 1994b). As long as undernutrition was a major cause of disease and ill health, overweight was viewed as beneficial to health. In addition, it may have been a status symbol: the rich were fat and the poor were thin. Later, when rising living standards eliminated undernutrition and enabled the poor to be fat, overweight gradually lost these positive connotations and became a physical state to be avoided. And, as usual, higher socio-economic groups were better able to avoid it. Parallel changes may have occurred with other 'modern' risk factors for IHD, such as tobacco consumption, animal fat consumption, and physical inactivity.

In order to explain the north-south contrast in Europe along these lines, one should assume that values, tastes and social norms changed later or more slowly in southern Europe than in northern Europe. It this likely? The closer cultural affinity between United States and northern Europe might have been decisive. Hard evidence does not exist, but it is conceivable that the cultural changes that started in the United States have diffused more rapidly across northern Europe than to France and more southern countries.

We should warn that the parallel between southern Europe in the 1980s and the former situation in the United States and northern European countries should not be pursued too far. National IHD mortality rates have always been relatively low in southern European countries (Beaglehole 1990, Uemura 1988, Verschuren *et al.* 1995, WHO MONICA 1991). Specific factors have protected men from southern European countries against IHD, e.g. frequent consumption of fish and vegetable oil, and moderate alcohol consumption by most men (Epstein 1989, Filiberti *et al.* 1995, Helsing 1995, Kushi *et al.* 1995, La Vecchia 1995, Rimm and Ellison 1995). If these factors protected men from lower classes as much as men from higher classes, that would have contributed to the small class differences in IHD mortality in southern countries. There are indications that dietary habits do not differ in southern Europe to the same extent as in northern Europe. Socio-economic differences in the consumption of fresh fruit and vegetables existed among men in northern European countries, but not in southern European countries (Cavelaars *et al.* 1997d). In Spain, total fat intake was higher in upper socio-economic groups until the 1980s (Regidor *et al.* 1995b).

*Conclusion*

This study confirms the impression of trend studies that socio-economic differences in IHD mortality are highly variable. Cultural as well as socio-economic factors underlie variations over time and across countries. The lack of an association with egalitarian socio-economic policies should not be taken to suggest these policies are irrelevant to health inequalities. A more equal distribution of income, wealth, education and other resources may be essential for an enduring reduction in socio-economic differences in morbidity and mortality (Carroll *et al.* 1996, Davey Smith 1996, House *et al.* 1992, Townsend *et al.* 1988a, Whitehead and Dahlgren 1991). At least with respect to differences in IHD mortality, however, a broader set of circumstances needs to be considered in order to explain why they are as large as they are in specific countries, and to predict how they will develop in the near future.

Chapter ten

# Cerebrovascular disease mortality and occupational class in 11 western European countries and the United States

## 10.1 Summary

Several studies have demonstrated that men and women from lower socio-economic groups have higher chances to die from stroke before reaching old age. There are reasons to expect, however, that socio-economic differences in stroke mortality do not exist in southern European countries, or that they are relatively small in Nordic welfare states. In the present study, data from national death registries of twelve countries were used to describe differences between occupational classes in stroke mortality.

Data on mortality by occupational class were obtained from the National Longitudinal Mortality Study (1979-1989) and from a large data base created in a European project. The data refer to deaths among men 30 to 64 years in the 1980s. The magnitude of mortality differences was measured by comparing manual to non-manual classes in relative terms (rate ratios) and absolute terms (rate differences).

In all countries, manual classes had higher mortality rates than non-manual classes. Stroke mortality differences were relatively large in England & Wales, Ireland and Finland, and relatively small in Sweden, Norway, Denmark, Italy and Spain. In-between were the United States, France and Switzerland. In Portugal, mortality differences were close to the international average in relative terms, but large in absolute terms. In most countries, differences in stroke mortality were substantially larger than those in ischaemic heart disease mortality.

Socio-economic differences in stroke mortality are a generalised phenomenon in the industrialised world. The causes of the higher stroke mortality rates in lower socio-economic groups might differ from country to country, with tobacco consumption perhaps being more important in the United States and northern Europe, and alcohol consumption being more important in southern Europe. The contribution that medical services can make to reducing socio-economic differences in stroke mortality is not yet certain. The experience of England & Wales illustrates that the removal of financial barriers is not sufficient.

## 10.2 Introduction

Several studies have demonstrated that men and women from lower socio-economic groups have higher chances to die from stroke. Associations between stroke mortality and socio-economic status have been observed for both the United States, England & Wales and Nordic countries (Bennett 1996, DiPietro *et al.* 1994, Howard *et al.* 1995, Khaw *et al.* 1984, Modan and Wagener 1992, Polednak 1990, Rogot and Hrubec 1989, Salonen 1982, Siegel *et al.* 1987 & 1993, Tyroler 1989, Valkonen *et al.* 1993).

Higher stroke mortality rates of lower socio-economic groups are probably related to several factors. As a general rule, lower socio-economic groups are more frequently exposed to risk factors for stroke incidence, including hypertension, alcohol consumption, tobacco consumption and overweight (Kaplan and Keil 1993). In addition, it has been suggested that lower socio-economic groups have less access to, or make less effective use of, services that are important to the early detection and control of hypertension (Casper *et al.* 1992, O'Brian *et al.* 1982).

Uncertain is whether the association between socio-economic status and stroke mortality is generalised across the industrialised world. There are a number of countries where this association might be weaker and perhaps even virtually absent.

Until now, the international literature does not include reports on socio-economic differences in stroke mortality in France, Switzerland or Mediterranean countries. Particular to these countries is that, in the 1980s, ischaemic heart disease mortality among men 30 to 64 years was not clearly related to low socio-economic status (chapter 9). This situation is probably due to the lack of clear social gradients in, among others, tobacco consumption and some dietary factors (Borrell 1995, Cavelaars *et al.* 1997c & 1997d, Regidor *et al.* 1995b, La Vecchia *et al.* 1987). Since stroke shares some of its risk factors with ischaemic heart disease, socio-economic differences in stroke mortality might also be small or even absent in southern European countries. If so, there would be a parallel with situation in the United States and the northern part of Europe in the 1950s, when both ischaemic heart disease and stroke mortality rates were not yet clearly higher among lower socio-economic groups (Breslow and Buell 1960, Guralnick 1963, Kunst *et al.* 1990, OPCS 1958, Vågerö and Lundberg 1989).

Another group of countries of interest are the Nordic welfare states. Characteristic of these countries is the highly egalitarian character of their socio-economic, health care and other policies (Atkinson *et al.* 1995, Doorslaer *et al.* 1992, Esping Andersen 1990). Egalitarian policies in these countries might have diminished differences between socio-economic groups in exposure to risk factors for stroke incidence, and perhaps remedied a part of the remaining inequalities by securing that lower socio-economic groups have free access to high-quality medical services.

The experience of these Nordic countries is especially interesting in the light of findings from the Hypertension Detection and Follow-up Program of the United States (HDFP group 1985 & 1987). This program demonstrated the potential benefits of directing hypertension detection and control services to lower socio-economic groups. Optimal access to, and compliance with, hypertension detection and control services by low as well as high socio-economic groups was found to have resulted in diminishing socio-economic differences in hypertension and hypertension-related mortality in the stepped care intervention group (HDFP group 1987). A comparable hypertension control program among 2222 hypertensive patients in Finland observed that reductions in hypertension prevalence took place uniformly in all socio-economic groups (Nissinen *et al.* 1986). The experience of the Nordic countries at large can show whether similar outcomes are attainable not only within specific interventions groups, but within entire national populations as well.

*The present chapter*

The purpose of this chapter is to present an international overview of socio-economic differences in stroke mortality in the 1980s. Until recently, such a comparison would not be feasible, due to poor accessability and poor comparability of data from different countries. However, an extensive data base of internationally comparable data was created recently in a large-scale international project (Kunst *et al.* 1996, Mackenbach *et al.* 1997). This data base has been used to provide international overviews of socio-economic differences in all-cause mortality and mortality from ischaemic heart disease. This chapter presents an overview for stroke. We will assess how large inequalities in stroke mortality in each country are, and whether these inequalities are smaller in some countries than in others.

This analysis focuses on mortality among men in the age group 30 to 64 years. The restriction to these men was necessitated by problems with the availability and comparability of data for women, and for men in other age groups (Kunst *et al.* 1996, Mackenbach *et al.* 1997). The restriction to a young age group was also motivated by the fact that below the age of 65 years, stroke deaths are more often, even though not always, avoidable by adequate use of hypertension detection and control services (Rutstein *et al.* 1976, Mackenbach *et al.* 1990).

## 10.3 Material and methods

*Material*

National data sets on stroke mortality by occupational class were created by national teams according to a standardised protocol, and analyzed centrally. Data from longitudinal studies were available for the United States, England & Wales, Finland, Sweden, Norway, Denmark and Italy. Data from cross-sectional studies could be obtained for Ireland, France, Switzerland, Spain and Portugal. All studies covered the period of circa 1980 to 1989. Cross-sectional studies were centred around the national population census of about 1981.

Most studies include the entire adult national population. Longitudinal studies from the United States and England & Wales refer to a representative sample of the adult national population (sample sizes circa 0.5 and 1 percent respectively). Data for Italy were available from a 9-year (1981-1989) mortality follow-up of all residents of Turin, a large city in northern Italy (Costa and Segnan 1988).

Data from different countries had to refer to the same age group in terms of age at death. The age groups 30-44 and 45-59 years were distinguished for studies that classified men according to their age at death. For longitudinal studies with a follow-up period of about 10 years, the birth cohorts aged 25-39 and 40-54 years at the start of follow-up were distinguished. For most longitudinal studies, it was in addition possible to study mortality differences at the age of about 60-64 years.

A common occupational class scheme, the EGP scheme, was applied to as many countries as possible (Erikson and Goldthorpe 1992a, Bartley *et al.* 1996). These conversion schemes could not be applied to the data available for Denmark, Ireland, Italy, Spain and Portugal. Occupational data from these countries could however be made comparable to the EGP scheme at the level of three broad classes: non-manual classes (including self-employed men), manual classes, and the class of farmers and farm labourers.

For most countries, there was insufficient information on the former occupation of economically inactive men, who therefore had to be excluded from analysis. Their exclusion is likely to lead to an underestimation of mortality differences between occupational classes. Therefore, we developed a procedure that approximately corrects for this underestimation. With this procedure, which is described in the appendix for total mortality, we could make adjustments for IHD mortality specifically.

*Methods*

Mortality differences by occupational class were assessed by three measures. First, the *relative* mortality level of each occupational class was measured by Standardized Mortality Ratios (SMRs), which express class-specific mortality rates as a ratio of the national mortality rates. SMRs adjust for age by the indirect method, with national age-specific mortality rates as the standard.

Second, the magnitude of mortality differences by occupational class was summarised by a rate ratio that compares manual classes to non-manual classes. Rate ratios and their 95 percent confidence intervals were estimated by means of Poisson regression analysis. The regression model included a term that represented the contrast between manual and non-manual classes. A series of terms representing 5-year age groups were included in the regression model in order to control for age. Rate ratios for the Unites States were also adjusted for race/ethnicity (Hispanics, other white, black, other non-white).

Third, these relative measures were complemented with an *absolute* measure that takes into account the large variations between countries in national stroke mortality rates. By multiplying SMRs with national rates of stroke mortality, we obtained class-specific absolute death rates standardized for age. Estimates of national stroke mortality rates were obtained from WHO (1988) statistics that are based on national mortality registrations with a complete coverage of every country's population.

The manual *versus* non-manual distinction applied in this chapter is not entirely hierarchical because many manual workers have a socio-economic position similar to that of routine non-manual workers or self-employed men. A clearly hierarchical distinction is obtained, however, by comparing manual workers only to upper non-manual workers, including professionals, large employers, administrators and managers. For a number of countries, we could also calculate rate ratios based on this comparison (cf. Tables 5.6 and 9.3). This more discriminatory distinction was found to show larger socio-economic differences in stroke mortality than those reported that will in this chapter. As compared to upper non-manual workers, manual workers had in general about 2 times the risk of dying from stroke at ages 30-44 years and at least 1.5 times the risk of dying from stroke at ages 45-59 years. Most important to the present study, however, is that the relative position of countries was found to be the same as the positions that are shown below by using the manual *versus* non-manual rate ratio.

## 10.4 Results

Table 10.1 presents the relative mortality level of each occupational class, as measured by Standardized Mortality Ratios. In nearly all instances, the death rates of non-manual classes are lower than the national average, whereas the death rates of manual classes are higher than average. The only exceptions relate to men 30-44 years in Switzerland, and to men 60-64 years in Italy and the United States.

In most countries, the class of farmers and farm labourers has stroke mortality rates lower than the national average. A main exception to this general rule is Portugal, where farmers and farm labourers have much higher stroke death rates than the rest of the population.

**Table 10.1** Stroke mortality by occupational class: Standardised Mortality Ratios. Men, 30-44, 45-59 and 60-64 years at death.

| Country | Age group | Standardized Mortality Ratio (SMR) [a] | | |
|---|---|---|---|---|
| | | Non-manual classes | Manual classes | Agricultural classes |
| United States | 30-44 | 0.79 | 1.23 | 1.01 |
| | 45-59 | 0.75 | 1.26 | 1.14 |
| | 60-64 | 1.01 | 1.04 | 0.56 |
| England & Wales | 30-44 | 0.40 | 1.67 | 0.00 |
| | 45-59 | 0.72 | 1.26 | 1.11 |
| | 60-64 | 0.81 | 1.20 | 0.53 |
| Ireland | 30-44 | 0.94 | 1.25 | 0.64 |
| | 45-59 | 0.79 | 1.26 | 0.96 |
| Finland | 30-44 | 0.71 | 1.23 | 1.07 |
| | 45-59 | 0.79 | 1.21 | 0.89 |
| | 60-64 | 0.84 | 1.12 | 0.96 |
| Sweden | 30-44 | 0.83 | 0.90 | 1.30 |
| | 45-59 | 0.88 | 1.16 | 0.85 |
| Norway | 30-44 | 0.71 | 1.40 | 0.86 |
| | 45-59 | 0.93 | 1.11 | 0.80 |
| | 60-64 | 0.93 | 1.10 | 0.86 |
| Denmark | 30-44 | 0.79 | 1.30 | 0.73 |
| | 45-59 | 0.94 | 1.19 | 0.58 |
| | 60-64 | 0.98 | 1.04 | 0.87 |
| France | 30-44 | 0.86 | 1.17 | 1.00 |
| | 45-59 | 0.86 | 1.16 | 1.02 |
| Switzerland | 30-44 | 1.05 | 1.01 | 0.55 |
| | 45-59 | 0.84 | 1.20 | 0.99 |
| Italy (Turin) | 30-44 | 0.93 | 1.08 | [b] |
| | 45-59 | 0.90 | 1.12 | |
| | 60-64 | 1.06 | 0.88 | |
| Spain | 45-59 | 0.90 | 1.07 | 1.02 |
| Portugal | 30-44 | 0.73 | 0.98 | 1.89 |
| | 45-59 | 0.70 | 1.01 | 1.30 |

[a] National average in each age group is 1.00.
[b] No estimates are made for the few agricultural workers living in the city of Turin.

Table 10.2 presents the rate ratios that quantify the size of the mortality differences between manual and non-manual classes. Estimates for men 45-59 years could be made for all countries. In this age group, the mortality difference between manual and non-manual classes is statistically significant for nearly all countries. These differences are relatively large in England & Wales, Ireland and Finland, and relatively small in Sweden, Norway, Denmark, Italy and Spain. Nearly all confidence intervals overlap, implying that variations between countries cannot be demonstrated with statistical significance.

The difference between manual and non-manual classes in stroke mortality is generally larger for men 30-44 years, and smaller for men 60-64 years. About the same international pattern is observed for each age group. The strong age-dependencies that are observed for Norway and the United States might be due to the chance fluctuations.

**Table 10.2** Stroke mortality by occupational class: manual *versus* non-manual rate ratios. Men, 30-44, 45-59 and 60-64 years at death.

| Country | 30-44 years | | 45-59 years | | 60-64 years | |
|---|---|---|---|---|---|---|
| | Rate ratio | 95% CI | Rate ratio | 95% CI | Rate ratio | 95% CI |
| United States | 1.56 | (0.65-3.74) | 1.42 | (0.95-2.20) | 1.02 | (0.63-1.70) |
| England & Wales | 4.23 | (1.53-12.3) | 1.74 | (1.23-2.48) | 1.51 | (1.10-2.10) |
| Ireland | 1.33 | (0.85-2.13) | 1.57 | (1.23-2.03) | | [a] |
| Finland | 1.75 | (1.50-2.06) | 1.55 | (1.40-1.71) | 1.33 | (1.15-1.55) |
| Sweden | 1.18 | (0.86-1.63) | 1.31 | (1.18-1.45) | | [a] |
| Norway | 2.01 | (1.49-2.73) | 1.21 | (1.04-1.41) | 1.19 | (1.02-1.38) |
| Denmark | 1.66 | (1.35-2.06) | 1.28 | (1.14-1.43) | 1.06 | (0.93-1.20) |
| France | 1.36 | (1.21-1.53) | 1.35 | (1.27-1.43) | | [a] |
| Switzerland | 0.97 | (0.62-1.52) | 1.43 | (1.18-1.74) | | [a] |
| Italy (Turin) | 1.16 | (0.69-2.00) | 1.24 | (1.00-1.54) | 0.82 | (0.61-1.17) |
| Spain | | [a] | 1.18 | (1.10-1.27) | | [a] |
| Portugal | 1.34 | (1.03-1.77) | 1.44 | (1.29-1.61) | | [a] |

[a] No data were available for these age groups.

Table 10.3 presents estimates of absolute levels of stroke mortality among men 45-59 years. Countries are ordered by their national stroke death rate, which is between about 30 and 50 per 100,000 persons years in most countries, but lower in Switzerland (22) and higher in Finland (68) and Portugal (100). The death rates of manual classes are higher in each country; they are between 37 and 57 per 100,000 persons years in most countries, but smaller in Switzerland (26) and higher in Finland (82) and Portugal (101).

Within Portugal, farmers and farm workers the highest death rate (130, not given in the table). This rate is more than 3 times the average death rate for western European countries (circa 40). Most important for the present analysis is the absolute difference between manual and non-manual classes, given in column 4. The largest differences are observed for Ireland, England & Wales, Finland and Portugal.

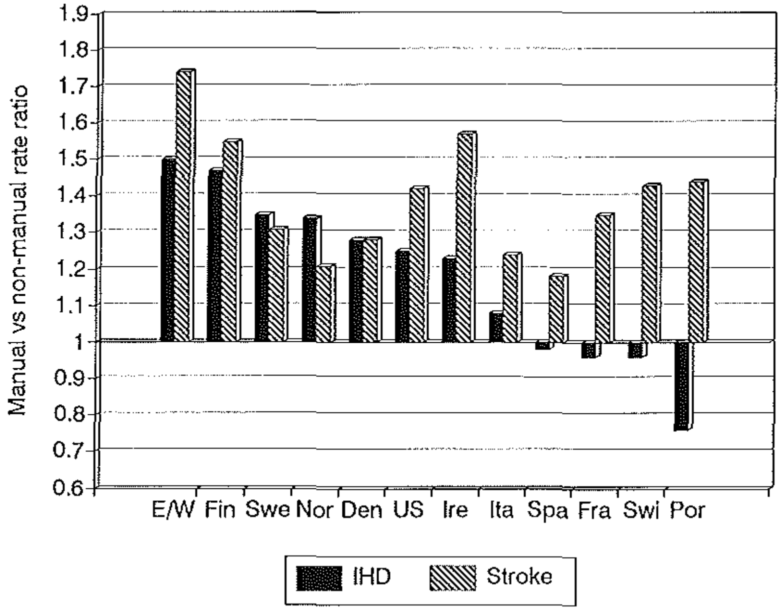
**Table 10.3** Stroke mortality rates by occupational class, men 45-59 years at death.

| Country | Death rate per 100,000 person years | | | Absolute manual *vs* non-manual difference |
|---|---|---|---|---|
| | National population [a] | Non-manual classes [b] | Manual classes [b] | |
| Switzerland | 22 | 18 | 26 | 8 |
| Sweden | 32 | 28 | 37 | 9 |
| Norway | 32 | 30 | 36 | 6 |
| United States | 33 | 27 | 39 | 12 |
| Denmark | 35 | 33 | 42 | 9 |
| Ireland | 40 | 32 | 51 | 19 |
| France | 43 | 36 | 49 | 13 |
| England & Wales | 45 | 33 | 57 | 24 |
| Spain | 49 | 45 | 53 | 8 |
| Italy | 51 | 46 | 57 | 11 |
| Finland | 68 | 54 | 82 | 28 |
| Portugal | 100 | 70 | 101 | 31 |

[a] Source: WHO (1988), own calculations.
[b] Estimated by multiplying national rates with the SMRs presented in Table 10.1.

In Figure 10.1, a comparison is made between stroke and ischaemic heart disease. Countries are ordered from high to low rate ratios for ischaemic heart disease. Socio-economic differences in ischaemic heart disease mortality showed a strong north-south gradient within Europe, with a clear mortality excess of manual classes in northern European countries but not in France and more southern countries. In Portugal, ischaemic heart disease mortality was even higher among non-manual classes. Such a north-south gradient cannot be clearly observed for stroke mortality. However, if we would take into account the small mortality differences that were observed for Swiss men 30-44 years (Table 10.2) a weak north-south gradient might be discerned. A main difference with ischaemic heart disease is that socio-economic differences in stroke mortality are observed for all countries. In nearly all countries, socio-economic differences are substantially larger for stroke mortality than for ischaemic heart disease mortality. The only exception to this rule are Sweden, Norway and Denmark.

**Figure 10.1** Manual *versus* non-manual rate ratios for stroke mortality compared to those for ischaemic heart disease mortality. Men, 45-59 years at death.




## 10.5 Discussion

*Evaluation of data problems*

In a series of evaluations, we quantified the potential effect that three data problems could have on manual *versus* non-manual rate ratios (see chapter 5). The potential size of error was less than 20 percent in all countries, except Ireland, Spain and Portugal. For the latter three countries, the precise magnitude of socio-economic differences in stroke mortality could not be determined with reasonable accuracy.

For all countries, data were obtained from studies that are based on national death registries. The use of this source of information is necessary if one wants to estimate the magnitude of socio-economic differences in stroke mortality at ages below 65 years with as much precision (small confidence intervals) as possible. A potential problem with national death registries relates to the quality of the registration of the underlying cause of death. Countries differ with respect to the design of death certificates, the way physicians fill in these certificates, and the way in which information on causes of death is coded at central statistical offices. A part of deaths with stroke as the underlying cause may be assigned to other cardiovascular diseases or perhaps vague categories like sudden death. Conversely, deaths from other causes may be coded with stroke as the underlying cause of death. Registration errors would bias our estimates of stroke mortality differences by occupational class only if the degree of misreporting varies by occupational class. Some differential misreporting might be possible, but it is unlikely that this has substantially biased our inequality estimates.

*Generalisability of the results*

One restriction of this study relates to the choice of occupational class as the socio-economic indicator. Occupation is among the several indicators that can be used to define a person's socio-economic status (Liberatos *et al.* 1988, Kunst and Mackenbach 1994c). Another often used indicator is educational level. Nationally representative data on the association between education level and stroke mortality were only available for Finland, Norway, Denmark, Italy and the United States. The results are summarised in Table 10.4. This table shows that the relative position of countries was about the same for education as for occupational class. There is, however, one exception. Whereas mortality differences by occupational class in the United States were not larger than in northern Europe, differences by educational level were much larger (although not with statistical significance).

It should be born in mind that this study is restricted to men and that it cannot be assumed that the results reported in this chapter apply to women as well. Mortality differences by occupational class among women were difficult to assess due to problems with the classification of housewives and other women not gainfully employed (Kunst *et al.* 1996). Much more easier is it to classify women according to their educational level. For the five countries mentioned above, we observed that stroke mortality differences by educational level were about as large among women as among men. The main exception relates, again, to the United States, where differences between women in stroke mortality were smaller than in European countries.

*Explanations*

One of the reasons to make this international overview was the possibility that, parallel to what has been observed for ischaemic heart disease, socio-economic differences in stroke mortality would be consistently smaller or even absent in southern European countries. However, substantial socio-economic differences in stroke mortality were observed for some southern countries, notably France, Switzerland and Portugal. Socio-economic differences in stroke mortality existed in these countries in the early 1980s despite weak social gradients in tobacco consumption and possibly other risk factors that stroke shares with ischaemic heart disease, such as hypertension and overweight (Borrell 1995, Cavelaars *et al.* 1997c & 1997d, Regidor *et al.* 1995b, Sasco *et al.* 1994, La Vecchia *et al.* 1986 & 1987).

A particular feature of southern European countries are the traditionally high levels of alcohol consumption (Rimm and Ellison 1995, La Vecchia 1995). Moderate alcohol consumption is a risk factor for some forms of cerebrovascular disease but is protective to ischaemic heart disease. This factor might have increased stroke mortality rates and at the same time reduced ischaemic heart disease mortality in southern Europe. In both Switzerland, France and Portugal, moderate alcohol consumption is traditionally more frequent in lower socio-economic groups than in higher groups (Cavelaars *et al.* 1997d, Kunst *et al.* 1996) and therefore might have increased stroke mortality rates of lower socio-economic groups in particular.

Characteristic of Portugal and, to a lesser extent, Finland is that large mortality differences by occupational class (in relative terms) coincide with high national stroke mortality rates. This suggests that some of the risk factors that are specific to these countries have affected lower socio-economic groups disproportionately. The most dramatic example is the class of farmers and farm labourers in Portugal. A study of the associates of stroke incidence and mortality in these particular population groups might be able to reveal the contributions made by, among other factors, alcohol consumption and natrium intake.

Another group of countries which are especially interesting are the Nordic welfare states. Previous studies from these countries have demonstrated socio-economic differences in stroke mortality (Nissinen *et al.* 1986, Rosengren *et al.* 1988, Salonen 1982, Valkonen *et al.* 1993), but still uncertain was whether these differences were large or small from an international perspective. With the exception of Finland, we observed small differences for each Nordic country. These differences were small especially when expressed in absolute terms (Table 10.3) or in comparison to ischaemic heart disease mortality (Figure 10.1).

These relatively small differences might in part reflect the success of health policies in Nordic countries that aimed explicitly at reducing mortality rates of disadvantaged groups. Since part of stroke deaths at ages below 65 years is avoidable through hypertension detection and control, optimal use by lower socio-economic groups of medical services might have reduced the incidence and case-fatality of stroke among these groups. Egalitarian policies with respect to health care have removed financial barriers to the access of these services (Doorslaer *et al.* 1992), while the egalitarian character of Nordic societies in general might have diminished social, cultural or psychological barriers to the effective use of hypertension detection and control services (Friedman 1994).

A wider international perspective shows, on the other hand, that the magnitude of stroke mortality differences is not clearly associated with the egalitarian character of health care systems. Socio-economic differences in stroke mortality were relatively large in England & Wales in the 1980s, despite four decades of National Health Service. On the other extreme are the United States, where many disadvantaged people are not, or only partially, insured for medical care (Doorslaer *et al.* 1992). This has led, among others, to 'reverse targeting' in hypertension detection and control: those who would benefit most are least attended by the relevant medical services (Woolhandler and Himmelstein 1988). Despite these inequalities in access to health care, stroke mortality differences in the United States do not appear to be consistently larger than in European countries.

*Implications*

Socio-economic differences in stroke mortality among men 30 to 59 years were observed for each country for which data are available. This strongly suggests that, contrary to what has been observed for ischaemic heart disease mortality, socio-economic differences in stroke mortality are a generalised phenomenon in the industrialised world in the 1980s.

The causes of the higher stroke mortality rates in lower socio-economic groups might differ from country to country, with tobacco consumption perhaps being more important in the United States and northern Europe, and alcohol consumption being more important in southern Europe. The role of behavioral factors should however not be overemphasized. Remarkable is that, despite large differences between countries in cultural patterns and behavioral risk factors, stroke mortality differences persists throughout the industrialised world. This persistency raises the question whether the high stroke mortality rates are due to factors that lower socio-economic groups from all countries have common, such as higher rates of psycho-social stress (Adler *et al.* 1994, Evans *et al.* 1994, Kaplan and Keil 1993).

The contribution that medical services can make in reducing socio-economic differences in stroke mortality is not yet certain. The experience of England & Wales illustrates that the removal of financial barriers is not sufficient to achieve mortality differences that are small from an international perspective. The fact that, on the other hand, stroke mortality differences are relatively small in most Nordic countries might perhaps in part reflect the effects of removing not only financial barriers, but also cultural and other barriers to the effective use of medical services.

The hypertension detection and follow-up program research group (HDFP group 1985 & 1987) demonstrated the potential benefits of making hypertension detection and control services available to lower socio-economic groups. Thanks to an intensive approach to all participants of the stepped care group, this program achieved a reduction in socio-economic differences in hypertension and hypertension-related mortality (HDFP group 1987). A major challenge to physicians and other health professionals is to achieve similar reductions not only within specific interventions groups, but among the general population as well.

Chapter eleven

# Discussion: a persistent but variable association

## 11.1 Summary

This chapter consists of five main sections. Following an introductory section, section 11.3 provides a systematical overview of the results of the international comparisons that have been carried out in chapters 3 to 10. Section 11.4 evaluates the potential effects of problems with the reliability and comparability of the available data. The combined evidence shows that socio-economic differences in mortality in developed countries are a persistent but variable phenomenon.

In section 11.5, we make a systematical attempt to explain the international patterns of socio-economic differences in mortality that are observed in this study. Explanations are offered for (1) the persistency of socio-economic differences in mortality across both time and place and (2) the observed variations between countries in the magnitude of mortality differences. A large number of factors are identified that have the potential to modify the association between occupational class and mortality. With the available evidence, it is difficult to assess the role of individual factors, such egalitarian social and economic policies.

In section 11.6, we discuss the relevance of the results for the research and policies with regards to socio-economic differences in mortality. It was found that the results are relevant because (1) they provide a yardstick against which to judge socio-economic differences in mortality in individual countries, (2) they provide indications on the contributions that specific intermediate factors make to the explanation of socio-economic differences in mortality, (3) they offer the opportunity to study individual countries as 'natural experiments' in reducing mortality differences, and (4) they provide background information to the exchange of research findings across countries, and international concertation of future health inequalities research.

In section 11.7, we give recommendations for future comparative studies. We address two questions that are pertinent to any new study. First, which contributions can this study be expected to make to research and policies with regards to socio-economic inequalities in health? Second, how can these aims be achieved despite the several problems that are inherent to comparative research? Suggestions are made to cope with problems of data acquisition, problems of data comparability, and problems related to explaining the observed cross-national variations.

## 11.2 Introduction

Socio-economic differences in mortality are found to persist in all industrialised countries for which data are available (Adler *et al.* 1994, Fox 1989, Illsley and Svensson 1990, Mielck and Giraldes 1993). In each country, citizens who are disadvantaged in terms of education, income or position at the labour market, are found to be disadvantaged in length of life as well. There are no indications that socio-economic differences in mortality decrease over time; instead, studies from several countries suggest a widening of mortality differences since about the 1960s (Costa and Faggiano 1995, Dahl and Kjaersgaard 1993b, Harding 1995, Kunst *et al.* 1990, Lang and Ducimetière 1995, Preston and Elo 1995, Regidor *et al.* 1995a, Vågerö and Lundberg 1995, Valkonen 1989 & 1993b).

Several authors have addressed the question whether socio-economic differences in mortality in their own country are large, not only from a historical perspective, but also from an international perspective (Kagamimori *et al.* 1983, Leclerc *et al.* 1984, 1989 & 1990, Minder 1991, Neumann and Liedermann 1981, Vågerö and Lundberg 1989, Valkonen 1987 & 1989, Wagstaff *et al.* 1991). If socio-economic differences in a country would indeed appear to be larger than elsewhere, this would stress that these differences can be smaller than they are now, and that a closer look into the situation in other countries can yield suggestions on how to achieve that reduction.

In chapters 3 to 10, a broad range of countries were compared with regard to socio-economic differences in mortality among middle-aged men. Included in these chapters are both the United States and countries from the northern, southern and eastern parts of Europe. The results confirmed the impression that socio-economic differences in mortality are persistent, but at the same time they revealed an important degree of variability. The persistency was stressed by the finding that substantial socio-economic differences in mortality existed in each country for which data were available. Remarkable was it to find that no country could claim to have socio-economic differences that are small from an international perspective. The variability, on the other hand, was stressed by the finding that a few countries, for example France, appeared to have much larger mortality differences than most other countries. A large degree of variability was observed when countries were compared with respect to ways in which socio-economic differences in mortality varied by age group or cause of death. For example, difference in ischaemic heart disease mortality were found to be substantial in both northern and eastern Europe, but virtually absent in France and more southern countries.

These results have important implications for research and policies with regard to health inequalities. For example, the fact that socio-economic differences in mortality are not relatively small in Sweden and other Nordic countries, raises questions on the potential effects of egalitarian socio-economic policies. Carroll *et al.* (1996) voiced a widely held opinion when they stated "as inequalities in income have increased in societies such as the USA and the UK, so, too, have health inequalities [..]. We submit that it is only through social and economic policies which counter gross material division that this trend will be reversed" (1996, p. 36). At first glance, however, our results do no seem to support the latter statement.

It would be a premature, however, to conclude from our results that socio-economic differences in mortality are insensitive to egalitarian social and economic policies. Before conclusions on subjects like this can be drawn, we need a better understanding of (1) the persistency of socio-economic differences in mortality across both time and place and (2) the observed variations between countries in the magnitude and patterns of mortality differences. Only if we better understand why socio-economic differences are as large as they are in different countries, we might be able to assess the role of individual factors such as the egalitarian character of socio-economic policies.

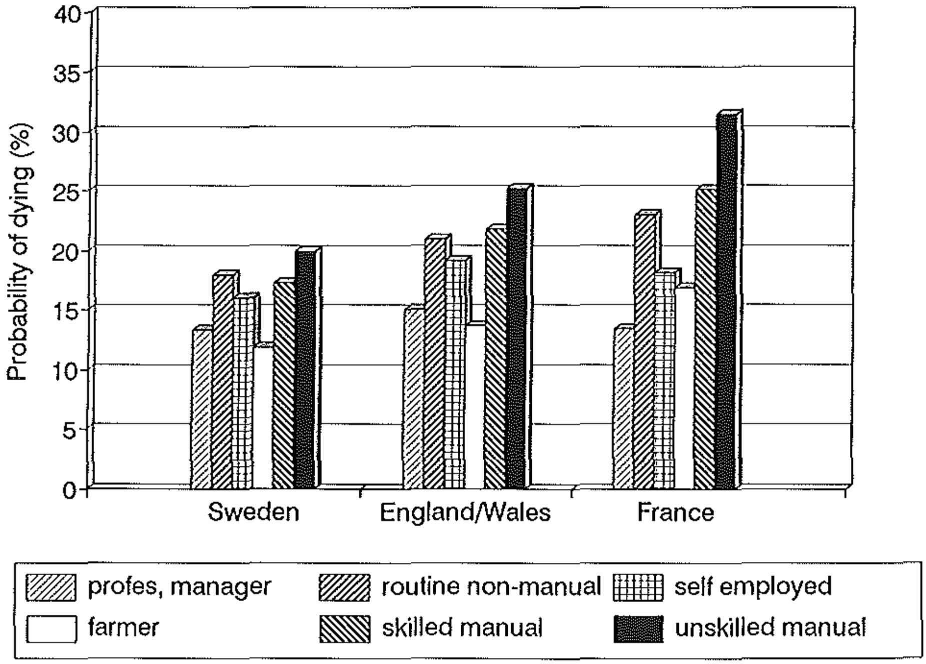
The purposes of this chapter are: to summarize the findings from chapters 3 to 10 (section 11.3), to evaluate the potential effect of data problems (section 11.4), to suggest explanations for both the persistency and variability that was observed in this study (section 11.5), and to discuss the implications for research and policies with regards to inequalities in health (section 11.6). We end this chapter with suggestions for future comparative research (section 11.7).

## 11.3 Overview of the results

Common to the studies presented in chapters 3 to 10 is that they focused on two research questions. First, can socio-economic differences in mortality among men circa 30 to 64 years be demonstrated for each country for which data were available? Second, can it be demonstrated that these mortality differences are larger in some countries than in others? The different studies focused on different periods (1970s or 1980s), different socio-economic indicators (educational level or occupational class) and on either total mortality or specific causes of death. A few studies focused on specific countries. In total 16 countries were included in one or more studies.

We will start this section with an overview of mortality differences by occupational class in the 1980s, which could be estimated for nearly all countries. We will then proceed to include the results for, respectively, the 1970s, educational level, and specific causes of death.

**Figure 11.1** The probability of dying between the 45th and 65th birthday. Men in six EGP classes, 1980s. Sources: Kunst et al (1996a) and WHO (1988).




*Mortality by occupational class in the 1980s*

A few countries could be compared with respect to a detailed distinction between occupational classes. An example is given in Figure 11.1. It shows that the pattern of mortality variations by occupational class is highly similar in England & Wales and Sweden. Relatively large are the mortality variations in France, but the relative position of different occupational classes is the same as in England & Wales and Sweden. However, the relative mortality level of the class of farmers and farm labourers varied between these three countries, as it was found to vary between other western European countries as well (Tables 5.3 to 5.5).

Fourteen countries could be compared with respect to the difference between manual and non-manual classes in mortality among men 45 to 59 years at death in the 1980s. The mortality rate of manual classes was higher than that of non-manual classes in each country for which data are available (Tables 5.4 and 8.4). Remarkably, the rate ratios for most countries are in a narrow range that goes from 1.32 to 1.44. Relatively large mortality differences were observed for France, the Czech Republic and, especially, Hungary. Finland was found to have slightly larger mortality differences than the other Nordic countries.

Approximately the same international pattern was observed for men 30-44 years as for men 45-59 years (Table 5.3). An exception is that mortality differences among men 30-44 years are relatively large in three Nordic countries. French data were available only for men 45-59 and 60-64 years; in both cases the manual *versus* non-manual mortality difference was larger than in northern European countries (Tables 5.4 and 5.5).

When national mortality levels were taken into account and mortality differences were expressed in absolute terms, Finland and Ireland appeared to have a more unfavourable position than they had on the basis of relative measures (Figure 5.2). However, also in absolute terms, France, the Czech Republic and Hungary lead the international league table (Figures 8.1 and 8.2).

A measure that took into account the population distribution over occupational classes, the Index of Dissimilarity, showed approximately the same relative position of different countries. The main exception is that mortality differences in Switzerland, Italy and Spain were slightly smaller than in other European countries (Figure 5.1).

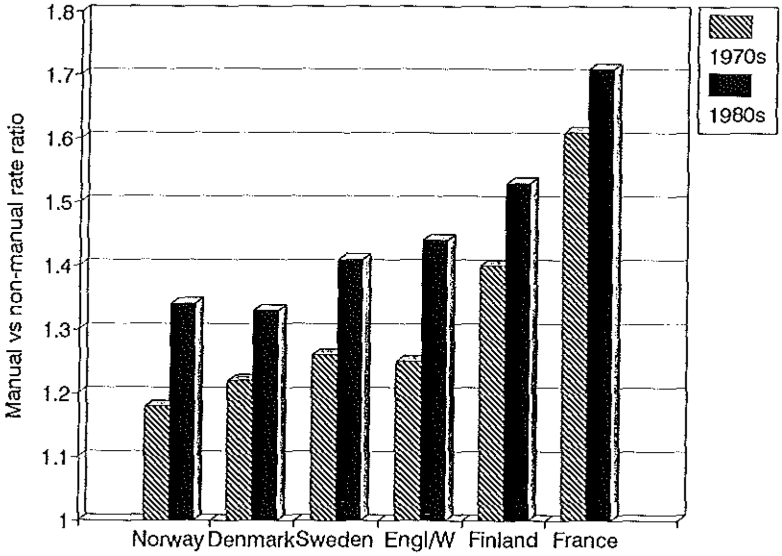
*Comparison to the 1970s*

For six western European countries, the magnitude of mortality differences by occupational class could be assessed for both the 1970s and the 1980s (Figure 11.2). The relative positions of these countries have remained approximately the same during these two decades, with relatively large inequalities for Finland and, especially, France. The analysis for the 1970s included a seventh county, the Netherlands (chapter 3). Socio-economic differences in this country were found to be of the same magnitude as in Sweden, Norway and Denmark.

The analysis for the 1970s showed the same age dependency as was observed for the 1980s: mortality differences in Nordic countries decreased more rapidly with rising age than in England & Wales (Figure 3.2). France was again found to have the largest mortality differences, not only for ages above 45 years, but also for younger ages (Figure 3.2).

The comparison between the 1970s and 1980s (Figure 11.2) further suggests that countries are highly similar with regard to trends over time. In each country, the manual *versus* non-manual mortality difference seemed to have increased substantially between the 1970s and the 1980s. The available data on mortality differences in the early and late 1980s suggest that socio-economic differences in mortality have continued to increase in both Finland, Norway, France, Italy (Torino) and the United States (see Appendix Tables D and E).

**Figure 11.2** Mortality rate ratio comparing manual classes to non-manual classes in the 1970s and 1980s. Men 45-59 years at death. Source: Table 5.11.

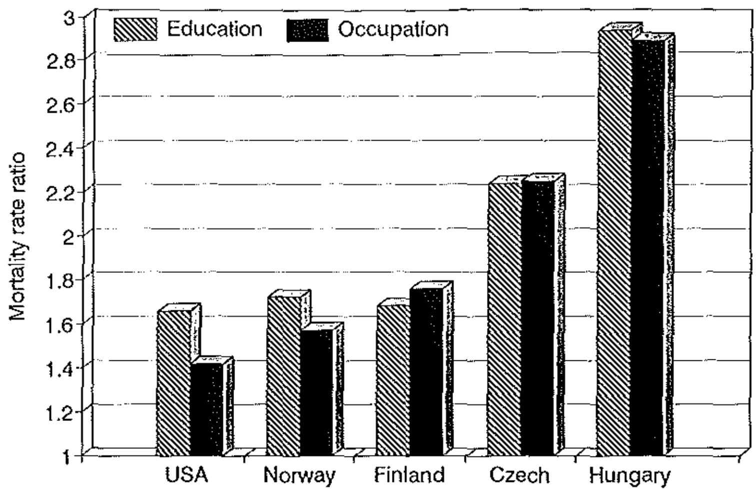



*Education*

In the different international comparisons on mortality by occupational class in the 1980s, similar results were obtained when educational level instead of occupational class was used as the socio-economic indicator. An example of these checks is given in Figure 11.3. In most countries, the rate ratio that compares manual classes to non-manual classes is close to the rate that compares low to high educational levels. This figure illustrates that Hungary and the Czech Republic have large mortality differences both by education and occupational class. Estonia, for which there are no data on mortality by occupational class, appeared to have mortality differences by educational level in-between Finland and the Czech Republic.

A study on mortality differences by educational level in the 1970s (chapter 4) partly confirmed the results of the study on mortality by occupational class (chapter 3). These studies observed the same rank order of countries from large to small mortality differences. The study on education, however, observed relatively small cross-national variations. To this we should add that our re-analysis of the data on mortality by occupational class in the 1970s also showed fairly small variations between countries (Table 5.11). Similarities rather than dissimilarities were also suggested by Valkonen's (1985 & 1987) international comparison of mortality differences by educational level in six countries in the 1970s, which can be considered as the most reliable and comprehensive international comparison that was performed before our studies started.

**Figure 11.3** Mortality rate ratios comparing manual classes to non-manual classes, and low to high educational levels. Men 30-44 years at death. Sources: Tables 8.4 and 8.5.




Chapter 4 also included data for Italy and the United States. Since, however, these data refer to the early 1980s rather than the 1970s, they were re-used in our analyses for the 1980s (Table 5.10 on Italy, and Table 7.9 on the United States). The newest results suggested that in both countries mortality differences by educational level are close to the international average.

*Specific causes of death*

International comparisons were made for nine causes of death. A higher mortality of manual classes as compared to non-manual classes was observed for nearly each cause of death in each country. The only exception to this generalised association relates to ischaemic heart disease mortality (chapter 9). No class differences were observed in France, Switzerland and Mediterranean countries, whereas strong inverse class differences were observed in both northern Europe, eastern Europe and the United States. The less regular international patterns that were observed for other causes of death can be illustrated for stroke mortality (chapter 10). Although manual classes had relatively high stroke mortality rates in each country, the manual *versus* non-manual difference was much larger in some countries than in others. The results for stroke strongly deviated from those for ischaemic heart disease, despite the fact that these two causes of death share smoking and hypertension as important risk factors.

The relatively large differences in total mortality in France and central European countries appeared to be due, at least in part, to large socio-economic differences in diseases related to excessive alcohol consumption. Excessive drinking by manual classes resulted in large class differences in mortality from diseases of the digestive tract, including liver cirrhosis (chapters 6 and 8). The relatively large mortality differences in Finland were also in part attributable to alcohol abuse by manual workers, although there it increased the incidence of violent deaths rather than fatal diseases.

*Conclusion*
Socio-economic differences in mortality are persistent but variable. The persistency is evidenced by the finding that in no country socio-economic differences in mortality are small from an international perspective. Nor are they small from a historical perspective. The fact that a mortality excess of lower classes is observed consistently for a wide array of causes of death underlines their generalised nature. Even though socio-economic differences are a common theme in industrialised countries, it is a theme with major variations. Some countries have socio-economic differences in total mortality well above the international average. In addition, patterns by age and cause of death vary considerably between countries, suggesting that approximately equally large differences in total mortality are formed along different pathways in different countries.

## 11.4 Evaluation of potential data problems

International comparisons can be treacherous if no extensive attention is paid to problems with the reliability and comparability of the data that are available from different countries. This warning is underlined by our experience that some of the conclusions that were drawn in our studies for the 1970s had to be revised in the light of the results for the 1980s.

The studies for the 1980s achieved a higher degree of reliability and comparability than any previous study, thanks to the close cooperation between several national teams. Data sets were created in each country according to standard protocol, and these data sets were analyzed centrally. Large efforts were made with respect to, among others, the application of a common occupational class scheme to data sets from different countries. It should however be acknowledged that in any comparative research, including ours, complete comparability is attainable. All one can hope for it to achieve a degree of comparability that is sufficient to perform analyses with the detail that is aspired, and the reliability that is required. A critical question is to what extent the observed international patterns can be explained by remaining comparability problems. We will discuss in this section the potential effect of different data problem.

*The measurement of mortality by occupational class*

We concentrate on the evaluation of potential problems with data on mortality by occupational class, which were available for much more countries than data on mortality by educational level. In chapter 5, three problems were found to have the potential to substantially bias estimates of the magnitude of mortality differences by occupational class: (1) poor comparability of the occupational class schemes that were used in different countries, (2) the effect of excluding economically inactive men from analysis, and differences between countries in the size and direction of this effect, and (3) the so-called numerator/denominator bias that is inherent to unlinked cross-sectional studies, and differences between countries in the size of this bias. The potential effect of these problems on the observed international patterns were evaluated in detail and, if possible, this effect was quantified. These evaluations led to the following conclusions.

First, the combined effect of the three data problems could also be considerable in the case of Ireland, Spain and Portugal. We cannot exclude the possibility that mortality differences by occupational class in these countries are seriously underestimated and that they in fact are as large as in France.

Second, the combined effect of the three data problems could be considerable in the case of Hungary and the Czech Republic. However, our conclusion that mortality differences by occupational class are relatively large in these countries is supported by the fact that similar conclusions were reached for education. In addition, the mortality differences that we observed for Hungary were so much larger than elsewhere, that is was difficult to attribute this finding to data problems alone.

Third, more certain is the precise magnitude of socio-economic differences in mortality in other countries. Inequality estimates for these countries can to some extent be biased by the above-mentioned data problems. However, the results for these countries are generally confirmed by those for education or those for the 1970s. For example, supportive for our conclusion that mortality differences by occupational class in the 1980s were large in Finland and, especially, France, is that similar conclusions were reached with data on mortality by education and in the studies for the 1970s.

Fourth, it is unlikely that the above-mentioned data problems are responsible for the large international variations that were observed for patterns of mortality differences by age or by cause of death. Important to note is that the three data problems mentioned above are not strongly differential to cause of death.

In conclusion, it is unlikely that problems with the comparability of occupational class data are largely responsible for the international variations in the magnitude and patterns of mortality differences that were highlighted in the section 11.3. On the other hand, we should recognise that the true extent of international variability remains uncertain. If socio-economic differences in mortality in Ireland, Spain and/or Portugal would indeed be as large as in France, there would be more variability. If, on the other hand, socio-economic differences in Hungary would in fact be only slightly larger than in western Europe, there would be less variability.

*Other problems*

Of special concern to cause-specific analyses are cause-of-death registrations. European countries differ with respect to the design of death certificates, the way physicians fill in these certificates, and the way in which their information is coded at central statistical offices. In order to avoid comparability problems as much as possible, most analyses reported in this study dealt with broad groups of causes of death. Of the specific causes of death, the registration of ischaemic heart disease as an underlying cause of death is perhaps most problematic. We cannot exclude the possibility that misclassification of ischaemic heart disease is differential to occupational class, and that this differential misclassification is more frequent in some countries than in others. However, as argued in chapter 9, it is difficult to explain in this way the remarkable absence of socio-economic differences in ischaemic heart disease mortality in southern Europe.

We have given relatively little attention to the problem of confounding. In all statistical analyses, control was made for confounding by 5-year age group. Analyses for the United States in addition controlled for race and ethnicity. It was not possible with the available data to include more confounders in the standard analysis applied to each country. Evidence from a Finnish study suggests that confounding by socio-demographic factors like language group, place of birth, and area of residence is small (Valkonen and Martelin 1988). An inventory among national participants pointed to one possibly serious confounder: region of birth in Italy. However, control for this confounder appeared to hardly alter inequality estimates for Italy (chapter 5).

One might question whether analyses should also include controls for personal factors like intelligence and personality traits, or cultural factors like class-specific values and traditions. If the answer is positive, the next question is whether our disregard for these factors could have biased the results. Both questions are highly difficult to answer. Instead of giving a tentative answer at this place, we will, in the next section, consider these factors when making a systematical attempt to explain the international patterns observed in this study.

## 11.5 Explanations

### 11.5.1 Explaining the persistence

The persistence of socio-economic differences in mortality across countries is remarkable in view of the large variations between countries in risk-factor profiles and cause-of-death patterns. The contribution of causes of death like lung cancer, ischaemic heart disease, and accidents and violence greatly vary from country to country. Yet, socio-economic differences in mortality exist in each country, mostly with the same order of magnitude.

There is a parallel with trends over time. The contribution of specific causes of death to total mortality has changed profoundly during the epidemiological transition, and so have the associated risk factors. In the 1960s and early 1970s it was expected that socio-economic differences in mortality would cease to exist as soon as 'diseases of poverty' would be entirely replaced by 'diseases of affluence' or degenerative diseases (e.g. Kadushin 1964). However, studies in the 1970s and early 1980s discovered that socio-economic differences had remained undiminished during the latest phases of the epidemiological transition.

Several authors have raised the question to how to explain this persistency over time (Charlton and White 1995, Evans *et al.* 1994, House *et al.* 1992, Link and Phelan 1995, Vågerö and Illsley 1995, Wilkinson 1996). Logically, the explanation cannot refer to the transient risk factors, but should refer to the wider forces that determine social gradients in whatever risk factors are most important in specific countries and specific periods. Why are higher socio-economic groups consistently better able to avoid premature death whatever disease and associated risk factors are the main causes of premature death?

A similar question was faced by comparative research on social mobility. Erikson and Goldthorpe (1992a) observed that patterns of intergenerational social mobility were fairly constant over time and place. In other words, in different historical periods and different countries, higher socio-economic groups were consistently better able to secure for their offspring a good social position, as they were better able to secure a long life for themselves. In explaining this ability, Erikson and Goldthorpe (1992a) referred to Lieberson's work (1985). His ideas have recently also been introduced in health inequalities research. When explaining the persistency of socio-economic inequalities in mortality over time, House *et al.* (1992) referred to Lieberson's concept of 'equifinality' and Link and Phelan (1995) referred to his concept of 'fundamental cause'. The fact that we observed persistency not only over time, but also across countries, stresses the importance to elaborate these concepts.

*Socio-economic status as a fundamental cause of disease*
Characteristic of socio-economic status, but of several other social variables as well, is that its association with disease and death is maintained independently of the specific pathways by which this association is maintained. When the importance of specific risk factors for premature death change over time, e.g. poor housing and working conditions are replaced by smoking and obesity as the major risk factors for disease and death, the new proximal risk factors tend to become the new mediators by which socio-economic status is linked to disease and death. Socio-economic status acts as a 'fundamental cause' that is able to exert an influence on person's health whatever intermediary mechanisms are available (Link and Phelan 1995).

The question is to what properties socio-economic status owes this capacity. Link and Phelan (1995) refer to 'resources' and 'disadvantage' although do not further elaborate these concepts. Following the recent literature (Blane *et al.* 1993, Carroll *et al.* 1996, Davey Smith *et al.* 1994, Vågerö and Illsley 1995), we will stress the importance of accumulation of disadvantages over a person's life course. This cumulative process results in a clustering of disadvantages among persons in low socio-economic positions, while advantages accrue to those in high positions.

A key variable in this cumulative process is occupation. When developing their socio-economic index based on occupation, Ganzeboom *et al.* (1992) regarded occupation as the means by which a person's principal resource (education) is converted into the principal reward (income). More generally, the exercise of occupation links two sets of advantages: the resources that are needed to achieve a specific occupational position and the rewards that accrue to those who have attained this position. It is characteristic for occupation that it leads to the clustering of a wide array of resources and rewards. Those in high occupational class have more resources as well as rewards, whereas those in low occupational classes have less of both. This clustering process is visualised in the scheme given in Figure 11.4.

Although educational level is the main resource and income the main reward, they are not the exclusive ones. The attainment of a high occupational class is, either via education or more directly, influenced by a person's socio-economic background (i.e. the parents' socio-economic status), familial environment (parent's rearing styles, number of siblings and other conditions that distinguish between families in the same socio-economic stratum), and personal characteristics (birth order, intelligence, perseverance and other characteristics that distinguish between siblings). Rewards are more varied than income alone, and may include access to health care, job security, good career perspectives, privileges and power. Psychosocial factors that are thought to be essential in linking class and health (Kaplan and Keil 1993), such as self esteem and sense of mastery (Siegrist *et al.* 1990, Syme 1989), can function as non-material rewards that are more often enjoyed by those in higher occupational classes.

Some rewards may reinforce initially available resources. For example, the social or intellectual skills that are needed for the attainment of a specific job are likely to be strengthened by the exercise of this job. Similarly, attitudinal resources like status control (Siegrist *et al.* 1990) may be reinforced by the experience of high level of autonomy and authority at work. Finally, persons who are prepared to invest in future (and health!) may be more likely to attain higher jobs, and once having a job with high job security and favourable career perspectives, their future orientation is likely to be reinforced. These feedback mechanisms are likely to strengthen the crucial role of occupational class in determining an individual's command over a wide array of resources and rewards.

**Figure 11.4** Causal paths linking occupational class to mortality.

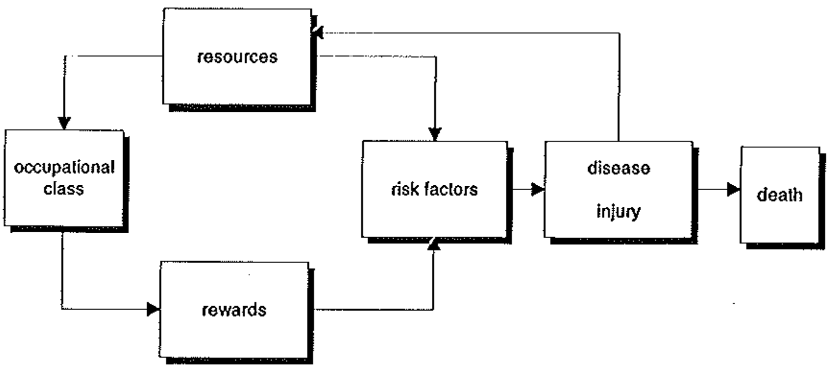



Figure 11.4 visualises that this complex of rewards and resources is linked to health via two pathways. First, a better command over resources and rewards protects a person against exposure to a wide range of risk factors for disease, including unhealthy housing and working conditions, psychosocial stress, and unhealthy consumption patterns. Second, health itself can act as a resource that influences an person's opportunity to attain a high occupational class. Health problems (disease, disability, handicap) may frustrate the attainment of high class positions and in some cases lead to downward drift. Similarly, high levels of positive health (energy, vitality) and related physical aspects (physical attractiveness, length) may facilitate the attainment of desired jobs (West 1991).

Implicit in Figure 11.4 is the crucial role of time. Often the command over resources and rewards gradually accumulates over the life course of fortunate persons. The reverse process, referred to as 'accumulation of disadvantage', can also endure many years and even entire lives (Carroll *et al.* 1996, Davey Smith *et al.* 1994). The mutual reinforcement of health and class position also evolves gradually over a person's life, a process coined 'co-evolution of health and social achievement' by Vågerö and Illsley (1995). A considerable time delay is further introduced by the fact that the exposure to some risk factors for disease (e.g. smoking) influences the risk of death until many years thereafter (Wadsworth 1996). It is therefore no surprise that the links between mortality and occupational class, once they have developed over an individual's life course, attain a highly persistent character.

*Equifinality*

The flow diagram of Figure 11.4 (as any other causal scheme applied in health inequalities research) suggests a mechanical causality in the effect of occupational class on health. For example, higher occupational class smoke less and, as a result, have lower risks of dying from lung cancer before reaching old age. Although this is entirely true, it does not explain *why* higher socio-economic groups smoke less. They might have smoked more. Indeed, there are situations where higher socio-economic groups smoke more than lower groups, especially among women (Graham 1996, Cavelaars *et al* 1996c). However, these are exceptions to the general rule that socio-economically advantaged people are better protected against risk factors for disease, injury and death. How can this general rule be explained? A better understanding of this rule is needed for two reasons. First, this might help us to better understand the persistency of socio-economic differences in mortality over both time and place. Second, it might help us to predict under what conditions this general rule might fail, for example, under which conditions smoking might be more prevalent among higher socio-economic groups.

The concept of 'equifinality' (Lieberson 1985, House *et al.* 1992) might be helpful here. This concept is familiar to social scientists but is hardly used by those studying mortality. The idea is simple. Although it is true that advantaged socio-economic groups are healthier because they smoke less, there is also some truth in the assertion that they smoke less because this makes them healthier (and they are better positioned to pursue healthy behaviours). More generally, the equifinality principle states that a causal chain should be understood from its outcome, which in our case is the prevention of disease and premature death. Even though health considerations might not direct human behaviour to an important extent, behaviour is often driven by goals that are closely related to health, such as shelter, safety, physical comfort, and emotional well being. In addition, people may pursue health and fitness as a means to other goals, such as physical attractiveness, strength and the ability to perform demanding jobs.

The equifinality principle states that the same goal (prevention of disease and premature death) can be achieved along different ways. In countries where ischaemic heart disease is a major cause of premature disease and death, the avoidance of risk factors like smoking and fatty diet is essential to preventing premature death. Where alcohol-related health problems are the major killers, other preventive actions are more important. It is perhaps no coincidence that, as shown in Figure 9.1, social gradients in ischaemic heart disease mortality existed in all European countries except in those countries where ischaemic heart disease was responsible for less than 20 percent of all premature deaths. It seems that wherever ischaemic heart disease becomes a major killer, higher socio-economic groups start to use their resources and rewards to prevent this disease, and are more successful in this respect than lower groups. Albeit this example is somewhat speculative, it underlines that the equifinality principle might not only explain why socio-economic differences persist in each country, but it also helps us to understand that about equally large differences in total mortality are formed along different pathways in different countries.

Obviously, the rationality that is implied in the equifinality principle should not pursued too far. Rationality of human behaviour is bounded by at least two types of constraints (Bee 1974). First, the lack of knowledge on risk factors for disease can impede the deliberate prevention of exposure to these risk factors. Second, the presence of competing incentives, such as specific tastes and traditions, might induce people to adopt life styles or create living conditions that are known to imply an increased risk of disease or injury. In situations where lack of knowledge or conflicting incentives strongly influence people's health-related behaviour, the usual inverse association between socio-economic status and exposure to risk factors for disease can be weakened and even reversed.

A historical example is offered by tobacco consumption in northern Europe and the United States in the 1950s (Haynes *et al.* 1978, Kaplan and Keil 1993, Marmot *et al.* 1978, Pierce 1989, Reek and Adriaanse 1988, Vågerö and Norell 1989). By then, men in more advantaged socio-economic positions more often smoked than men in less advantaged positions. Contributing to this situation was the fact that smoking was positively valued until then, and that information on the health hazards of smoking had yet to appear. When, in the 1960s, people were informed about these health hazards and smoking became less positively valued, higher socio-economic groups were the first to quit smoking on a massive scale. This example illustrates that the usual association between socio-economic disadvantage and exposure to risk factors for disease might be weakened or even reversed under specific circumstances. This implies that there is a potential for socio-economic differences in both total and cause-specific mortality to vary, not only over time but also between countries.

### 11.5.2 Explaining the variations

Socio-economic differences in mortality in France, Finland and eastern European countries were found to be larger than elsewhere. In addition, patterns by age and cause of death varied considerably between countries, suggesting that approximately equally large differences in total mortality are formed along different pathways in different countries. These variations suggest that the persistent association between socio-economic status and mortality among middle-aged men can to an important extent be modified by the national context. In this section, we will discuss the different ways in which the national context can exert its influence. By means of this discussion, we intend to demonstrate that many possible factors should be considered when explaining why socio-economic differences in mortality in individual countries are as large as they are.

The conceptual scheme given in Figure 11.4 shows five points at which the national context can modify the association between occupational class and mortality. This contact can influence:

1. the national prevalence of specific resources and rewards
2. the relative importance of different resources to class attainment
3. the distribution of rewards over occupational classes
4. the national prevalence of risk factors
5. the association of risk factors with resources and rewards.

These five points will be discussed separately in the rest of this section. We should stress the preliminary nature of this discussion. With the available data, we cannot yet provide firm evidence on the possible role of individual factors. Instead, our aim will be to generate a number of hypotheses for future comparative research.

*1. National prevalence of resources and rewards*

There are large variations between countries in both average educational levels and in average income levels, i.e. in the major resource and the major reward associated with occupational class (Eurostat 1990, OECD 1986 & 1995). Can national living standards or educational levels be expected to influence the magnitude of class differences in mortality? There may be an analogy with the expectation, widely held in the 1960s and early 1970s, that socio-economic differences in mortality would soon be a phenomenon of the past (Kadushin 1964). This expectation was based on the view that absolute poverty can strongly increase mortality risks of disadvantaged socio-economic groups. If absolute poverty indeed strengthened the link between occupational class and mortality, rising national living standards could be expected to result in smaller mortality differences according to occupational class. However, these differences were found to persist over time despite rapidly rising living standards.

A parallel observation can be made when comparing countries: the magnitude of mortality differences in different countries does not seem to be related to national income levels (Eurostat 1989). For example, mortality differences in the three poorest countries of the European Union, Ireland, Spain and Portugal, are not clearly larger than in nearby countries with higher living standards.

Our findings bear a parallel to the observation of Wilkinson (1996) and many others (e.g. Mackenbach and Looman 1994) that variations between European countries in national life expectancies are unrelated to variations in the gross domestic product. Wilkinson (1996) argued that national life expectancies are largely determined, instead, by the amount of social capital. Societies are said to have much social capital when they are socially cohesive, have no deep social cleavages, have a fully developed civic life, and can provide their citizens with the norms, trust and social networks that buffer everyday stress. (For the comparable theory of 'accumulation of health assets' see Murray and Chen, 1993). Wilkinson's thesis can logically be extended to the hypothesis that in socially cohesive societies rates of premature mortality not only are low, but also are distributed less unevenly over socio-economic groups.

In line with this type of explanation is our observation that in CEE countries, which are characterised by a low level of social capital as meant above (Hertzman *et al.* 1996, UNICEF 1994, Wilkinson 1996), socio-economic differences in mortality are exceptionally large. Less certain is whether the patterns that we observed for western Europe and the United States can be explained along these lines. To test this thesis, one would need quantitative measurements of the amount of social capital. It would be equally interesting to compare the situation in western countries to that in Japan, which is usually referred to as a country where a high amount social capital led to an unprecedented increase in life expectancies (Wilkinson 1996, Marmot and Davey Smith 1989). Socio-economic differences in mortality have been observed for Japan in the early 1970s (Kagamimori *et al.* 1983) but might be relatively small by now. This is not for sure, however. A comparison that we made with respect to morbidity as reported in national health surveys did not support the expectation that health differences between income groups are smaller in Japan than in western Europe (Kunst *et al.* 1992).

*2. Relative importance of different resources to class attainment*

The resources that are required to attain a high occupational class might differ between countries. Popular view tells that some societies are more 'open' than others. To the degree that a society is more open (i.e. social mobility rates are higher) class attainment depends less on socio-economic background and more on individual characteristics like intelligence, perseverance and health potential. There is no empirical evidence for large differences between countries in the degree to which they are open. Erikson and

Goldthorpe (1992a) observed an approximate similarity between countries in the degree of intergenerational social mobility, with slightly higher rates in Sweden, Hungary and Poland than in, among others, England & Wales, France, Italy, Germany and the United States. Other studies observed more variability between countries (Ganzeboom *et al.* 1989 & 1995, Treiman and Yip 1987). However, no consistent international pattern emerges from these studies. Taken the evidence as a whole, there do not seem to be large cross-national variations in rates of social mobility between occupational classes. The variations that do exist are probably insufficient to cause substantial cross-national variations with respect to class differences in mortality.

Even though countries do not seem to differ largely in rates of social mobility, the specific resources that are needed to achieve upward mobility or to prevent downward mobility might differ between countries. Especially interesting is the possibility that health itself is more important in one country than in another. Evidence from England & Wales and some Nordic countries strongly suggest that the effect of ill-health on downward social mobility is modest and does not contribute much to socio-economic differences in morbidity or mortality (Blane *et al.* 1993, Dahl and Kjaersgaard 1993a, Lundberg 1991a, Power *et al.* 1996). Perhaps health-related downward mobility is more much important in other countries, but we find this difficult to believe. Uncertain is to what extent positive aspects of health (energy, fitness) and related physical characteristics (attractiveness, length) stimulates upward social mobility in different European countries (West 1991). There is little reason to expect, however, that positive health promotes upward mobility in some countries much more than in others.

Countries could also vary in the relative importance of resources other than health. The occupational class that people attain is to a considerable extent determined by the educational level that they have completed (Graaf and Luijkx 1995). In England & Wales and France, however, educational level might be less important than elsewhere in western Europe. In these two countries, class attainment is determined to a larger extent during the labour career, that is, by *intra*-generational mobility (Erikson and Goldthorpe 1992a). One could envisage that some personal characteristics, especially those related to success at the work place, are more relevant to class attainment in England & Wales and France than they are elsewhere. Uncertain is, however, what these characteristics precisely are, and whether they make an important contribution to socio-economic differences in premature mortality in different countries.

Over the last ten years, it has often been argued that socio-economic differences in ill health and mortality find their origin in early life, starting with the prenatal period (Power *et al.* 1996, Wadsworth 1996). Living conditions in early life may exert a decisive influence on the formation of people's health capital (Barker 1992) and their socio-economic position in adult life

(Wadsworth 1996). If mortality differences among middle-aged men in a specific country are large or small from an international perspective, the causes for this situation might go back to the living conditions of these men when they were children.

This might offer an explanation, for example, for our unexpected finding that socio-economic differences in mortality among middle-aged men in the United States are not larger than in northern Europe. Perhaps some of the childhood factors that contributed to socio-economic mortality differences in northern Europe were less prevalent in the United States, or were distributed less unequally. It might be significant in this respect that until the middle of the 20$^{th}$ century, when most of the men that were included in the present study grew up, the United States had much higher national living standards and, in addition, wealth was not distributed as unequally as in later years (Hadden 1996, Taylor and Jodice 1983).

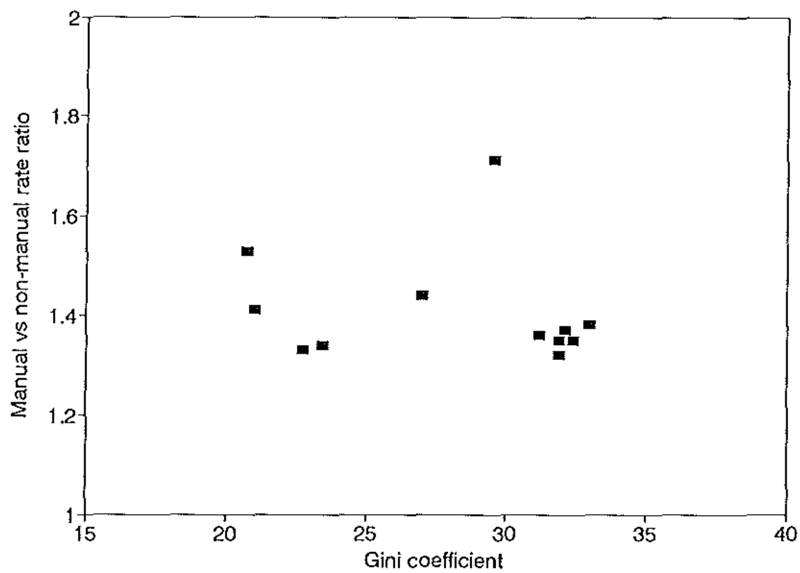
*3. Distribution of rewards over occupational classes*

The national context could influence the extent to which income and other scarce rewards are distributed over occupational classes. Egalitarian socio-economic, health care and other policies are relevant here, because they might be expected to result in a more equal class distribution of among others income, job security, and access to health care. This seemed so obvious that it was a surprise to find that our study could not provide empirical support to the idea that egalitarian socio-economic policies are associated with smaller mortality differences by occupational class. In comparisons between western European countries (chapter 5) or with the United States (chapter 7) no association was observed between the magnitude of mortality differences and the egalitarian character of social and economic policies. This lack of association is illustrated in Figure 11.5, where the size of income inequalities is used as a gross outcome indicator of the egalitarian character of social and economic policies.

The situation in the former socialist countries of eastern Europe is especially interesting. Differences between manual and non-manual classes in terms of rewards were less pronounced in these countries than in most western countries. Income differences between these classes were relatively small, not only thanks to egalitarian income policies but also because many non-manual occupations were considered to be 'unproductive' and therefore not conferred high incomes. Also in terms of job prestige, the difference between manual and non-manual workers was relatively small in the former socialist countries (Treiman 1977). Despite this smaller difference between manual and non-manual classes in many of the rewards they enjoyed, their mortality difference was larger than in most western European countries.

The situation in eastern Europe can perhaps better be understood with reference to class differences in other types of rewards. Under the socialist system, access to scarce goods and services did not depend as much on income as in western Europe, and relatively more on privileges and political power (Field 1990, Mezentseva and Rimachevskaya 1992). Non-manual classes might be much more advantaged in this situation than manual workers, among others thanks to their affinity with, and proximity to, bureaucrats and politicians. In addition, their higher educational level might have entailed considerable advantages in a society where information is scarce, as is evidenced by the lack of health education campaigns (Orosz 1990, Janeckova and Hnilicova 1992, Mastilica 1992, UNICEF 1994).

**Figure 11.5** Mortality differences in the 1980s (manual *versus* non-manual rate ratios for deaths among men 45-59 years) and inequalities in income in the early 1980s (GINI for household equivalent income). Eleven western European countries and the United States. Sources: Tables 5.4 and 8.4, and Luxembourg Income Study results compiled by Kunst et al (1996a, Table 22).




The situation in the former socialist countries illustrates our point that the class distribution of different kinds of rewards depends not only on egalitarian socio-economic policies, but on other country-specific features as well. There are more examples, although they are more tentative. There is perhaps some truth in the popular view that the United States have a less class-ridden society than have England & Wales and other European countries. If so, this might imply that rewards like prestige, power, interpersonal contacts and access to information are distributed according to occupational class more in Europe than in the United States (but perhaps more by ethnicity in the latter country). If so, this could be one the circumstances that have prevented socio-economic differences in mortality in the United States from being as large as they otherwise would be.

Specific to southern European countries are strong family bonds and higher levels of intra-familial solidarity (Akker *et al.* 1994). One might hypothesize that, to the extent that these strong bonds generates a transfer of income, power and information from more advantaged to less advantaged family members, this helps to reduce socio-economic disparities, and perhaps also the associated differences in mortality. If so, this might help to explain our finding that class differences in mortality are not larger in southern Europe than in northern Europe, despite the less generous national welfare systems of the South.

*4. National prevalence of risk factors*

Countries vary with respect to the national prevalence of specific risk factors (Epstein 1989, WHO MONICA 1991). Especially important to our study are risk factors that have a strong tendency to cluster in lower socio-economic groups. In countries where these risk factors are more prevalent, their presence tend to strengthen the link between occupational class and disease.

An example is alcohol abuse in France and Finland. The relatively large mortality differences in these countries seem to be largely due to high levels of alcohol-related mortality among lower occupational classes (chapter 6). What distinguishes these two countries from other western European countries was that alcohol abuse was present at the national level as a main risk factor by which socio-economic disadvantage could lead to premature death (Desplanques 1984, Mäkelä *et al.* 1997). If alcohol-related mortality in France and Finland would not be so high at the national level, class differences in all-cause mortality would probably have been much smaller, certainly in absolute terms but probably also in relative terms.

This type of explanation might perhaps also be relevant to explaining the large socio-economic differences in mortality in the three eastern European countries. These large mortality differences coincide with high national mortality rates for middle-aged men. Factors which are believed to have contributed to these high national mortality rates are, among others, high levels of alcohol consumption, hazardous working conditions and high levels of psycho-social stress (Bobak and Marmot 1996, UNICEF 1994). It is likely that manual classes have been most exposed to some of these risk factors, or that they were least able to cope with them. To the extent that this is true, these risk factors have strengthened the effects of socio-economic disadvantage on premature mortality in the eastern European countries.

Other factors for which national prevalence rates strongly vary between countries relate to dietary habits. The traditional diet of the United States and most northern and eastern European countries increases the risk of contracting ischaemic heart disease, among other because of high levels of animal fat intake (Gaziano and Manson 1996, Renaud and Langerit 1994, Verschuren *et al* 1995). As a general rule, lower occupational classes in these countries were more exposed to dietary risk factors for heart disease (Bingham *et al.* 1981, Bolton-Smith *et al.* 1991, Fehily *et al.* 1984, Fortmann *et al.* 1982, Khoury *et al.* 1981, Kushi *et al.* 1988, Leino *et al.* 1996, Nourjah *et al.* 1994, Viikari *et al.* 1990), at least since the time that higher occupational classes adjusted their diet in response to health education campaigns (Calnan 1986, Jones 1977, Morgan *et al.* 1989). Therefore, dietary factors probably contributed to the substantial class differences in ischaemic heart disease mortality that existed in the 1980s in both the United States and in northern and eastern European countries.

In sharp contrast to these countries stand the southern European countries, where the traditional, Mediterranean diet protects against ischaemic heart disease, thanks to among others the frequent consumption of fish and vegetable oil (Epstein 1989, Filiberti *et al.* 1995, Helsing 1995, Kushi *et al.* 1995, La Vecchia 1995, Rimm and Ellison 1995). For this reason, dietary factors could not increase class differences in ischaemic heart disease mortality in southern Europe to the extent that they could in other parts of Europe.

*5. Association of risk factors with resources & rewards*

As a general rule, members of more advantaged occupational classes are generally less exposed to the major risk factors for disease. However, as discussed at the end of section 11.5.1, specific conditions can weaken this generalised association, or even reverse it. The first condition relates to the absence of knowledge on risk factors for disease, and the second condition relates to the presence of values, tastes and traditions that induce man to adopt live styles or create living conditions that are known to be hazardous to health.

We found evidence for variations between European countries in social gradients for some risk factors for disease (Cavelaars *et al.* 1997d, Kunst *et al.* 1996). Smoking among men 45 years and older was unrelated to socioeconomic status in France and more southern countries, whereas inverse gradients existed in northern European countries (Cavelaars *et al.* 1997c). It is likely that this has contributed to the absence of class differences in ischaemic heart disease mortality in southern countries, and the positive gradient that still existed in Portugal in the early 1980s. In chapter 9, we discussed why inverse social gradients in smoking and probably some other cardiovascular risk factors existed in northern Europe and not in southern Europe. Basically, the situation in southern Europe seems to represent a delay in the transition from positive to inverse gradients that occurred in northern European countries during about the 1960s. We concluded that positive values attached to smoking probably persisted longer in southern countries than they did in northern countries.

One can only speculate why these values persisted longer in the South. Perhaps there is an association with the occurrence of the epidemic of ischaemic heart disease and other smoking-related diseases in the North. In the northern countries, ischaemic heart disease mortality increased dramatically during this century and is still responsible for a large part of premature deaths among men. This modern epidemic and the necessity to halt it may have contributed to changing attitudes towards tobacco consumption and other behaviours that were found to increase the risk of ischaemic heart disease and other 'diseases of affluence'. And, as is documented for tobacco consumption (Haynes *et al.* 1978, Kaplan and Keil 1993, Marmot *et al.* 1978, Pierce 1989, Reek *et al.* 1988, Vågerö and Norell 1989), higher socio-economic groups were the first to adjust their life styles effectively (cf. Rogers 1962). In southern Europe, on the other hand, ischaemic heart disease has never become a major killer and remained less important than, for example, deaths related to alcohol abuse. Under these circumstances, positive connotations of tobacco consumption might have persisted until more recently.

Overweight is another risk factors with varying social gradients. Elsewhere (Cavelaars *et al.* 1997d, Kunst *et al.* 1996), we observed inverse gradients (more obesity among low educated men) in most countries of the European Union, but positive gradients in Ireland, Spain and Portugal. It is perhaps no coincidence that these countries were the least developed countries of the European Union (Eurostat 1989). Income inequalities were relatively large in these countries (Atkinson *et al.* 1995). From this, one might infer that men from lower occupational classes had low levels of purchasing power. In addition, they perhaps more often had to fulfil physically heavy work than manual workers in other western European countries. All this may have protected these men -albeit unintentionally- against overweight.

The last example relates to dietary habits. We observed that dietary habits of men, as measured by the frequency of consumption of fresh vegetables, are strongly related to socio-economic status in northern countries, but not in France and more southern countries (Cavelaars *et al.* 1997d). It is likely that tastes and culinary traditions play an important role here, with traditional low-class diets containing more vegetables in southern countries than in northern countries.

It should finally be noted that the latter explanation illustrates that socio-economic groups also differ in cultural factors that seem to bear little or no direct relationship with their situation of socio-economic advantage or disadvantage. This is significant because it implies that not all socio-economic differences in mortality would reflect the effects of socio-economic disadvantage and, therefore, that not all differences should be considered as unfair. However, one should not over-emphasize this type of explanation, because it cannot explain the persistency of socio-economic differences in mortality over time and across countries, nor can it explain the fact that higher death rates among less advantaged groups are observed consistently for a wide range of causes of death.

*Conclusion*
National contexts determine the magnitude and pattern of socio-economic differences in highly diverse ways. We identified a large number of factors that have the potential to modify the association between occupational class and mortality among middle-aged men. In addition, as we stressed in section 7.2, it is likely that the different factors combine and intersect in highly complex ways to determine the magnitude and pattern of socio-economic differences in mortality in specific countries. This observation has important implications.

First, it is difficult, with the available evidence, to assess the role of individual factors. It remains uncertain, for example, to what extent mortality differences in Nordic countries are influenced by the egalitarian social and economic policies that have been pursued in most of these countries for many decades. The precise role of individual factors can only be assessed in new and more focused comparative studies.

Second, the magnitude and pattern of socio-economic differences in specific countries is difficult to predict. Mortality differences in individual countries are modified by the combined effect of several specific features of these countries. It would be much too simplistic to predict these mortality differences as a function of a few variables such as the national living standard and the size of income distribution.

The difficulty to predict the magnitude of mortality differences was illustrated recently by developments in Finland during the deep economic crisis of the early 1990s. During these years, class differences in premature mortality did not increase, as one might expect, but even showed a tendency to decline (Valkonen *et al.* 1997b).

## 11.6 Implications

In section 1.2, we identified four different contributions that international comparisons can make to research and policies with regards to socio-economic differences in mortality. Four each type of contribution, the present section discusses the implications that can be drawn from the present study.

### 11.6.1 Judgement

A main motive for previous researchers to perform international comparisons was to assess whether socio-economic differences in mortality in their own country were larger or smaller than in adjacent countries or other countries of interest. If socio-economic differences in mortality in their own country would appear to be larger than elsewhere, this would underscore the importance of these differences, since these differences would appear to be larger than they could be.

Our study identified a few countries to which this reasoning applies. Most alarming appeared to be the situation in eastern European countries. The fact that mortality differences were clearly larger than in western countries is a strong reason for these countries to put socio-economic inequalities in health high on the agenda of researchers and policy makers. Reducing these inequalities would not only be a purpose in itself, but in addition might provide a major route to closing the East-West gap in life expectancy.

Equally significant is the finding that in no country socio-economic differences are small from an international perspective. This constancy, combined with the increase in mortality differences over time, underscores that for no countries there are reasons for complacency, nor with health inequalities themselves, not with the social inequalities that are manifested in these health inequalities. No country can claim to have had more success in tackling the lamentable situation that people who have less in life, have moreover less years to live.

### 11.6.2 Explanation

Socio-economic differences in mortality cannot be properly understood as long as the specific risk factors that mediate the association between socio-economic status and health have not been identified. Unravelling the many ties between socio-economic status and health is a formidable research task (Stronks 1997). This task can most properly be faced by means of individual-level studies in which socio-economic indicators, health indicators and intermediary factors are combined at the individual level. Examples are studies which assess to what extent socio-economic differences in morbidity or mortality are reduced by controlling for a number of well-known risk factors (e.g. Lundberg 1991b, Pekkanen *et al.* 1995, Stronks *et al.* 1996). In most studies until now, socio-economic differences in mortality could be explained by less than one half with reference to well-known risk factors such as smoking and hypertension (Adler *et al.* 1994, Davey Smith *et al.* 1994, Kaplan and Keil 1993, Pekkanen *et al.* 1995). This leaves yet open the question how large the contribution is that these and other risk factors make to socio-economic differences in mortality.

What can international comparisons contribute to answering this question? Interesting is that both the national prevalence and social gradients of several risk factors strongly vary from country to country (e.g. Cavelaars *et al.* 1997d, Epstein 1989, WHO MONICA 1991). For risk factors that have the potential to strongly contribute to socio-economic differences in mortality from associated causes of death, one might expect that these mortality differences tend to be larger in countries with larger socio-economic differences in the absolute prevalence of these risk factors.

Interesting is in this respect tobacco consumption, for which social gradients in the 1980s were steeper in northern Europe than in southern Europe (Cavelaars *et al.* 1997d). Remarkable is that we observed no similar north-south gradients for socio-economic differences in lung cancer mortality or stroke mortality (chapters 6 and 10). Although smoking is an important risk factor for both causes of death, substantial socio-economic differences in mortality from these causes were observed for some southern countries as well as for northern countries. This observation supports the indications from individual-level studies from northern Europe, that control for smoking can explain only a modest part of socio-economic differences in mortality from smoking-related diseases (Hein *et al.* 1992, Kaplan and Keil 1993, Loon *et al.* 1995, Marmot *et al.* 1984). These results point to the potential importance of other risk factors for lung cancer, such as dietary factors and exposure to carcinogenic substances at work.

There are several indications that, on the other hand, excessive alcohol consumption can make a substantial contribution to socio-economic differences in mortality. Its potential contribution is manifest in countries where excessive alcohol consumption is more common than elsewhere. For example, the fact that socio-economic mortality differences in France are about two times as large as in most other western European countries, seems to be largely due to excessive alcohol consumption by many manual workers. It seems that up to one half of the class differences in total mortality in France can be attributed to class differences in alcohol abuse. Even though alcohol consumption is probably less important to mortality differences in other countries (with perhaps the exception of Hungary and the Czech Republic) the French case underlies the harmful effects that alcohol abuse might have among disadvantaged people.

The absence of social gradients in ischaemic heart disease mortality in southern European countries underscores the potential importance of behavioral factors more in general. It is still not well understood why these gradients are absent, but probably this has to do with both the traditionally moderate levels of alcohol consumption and the traditional Mediterranean diet. This suggests that specific life-styles have the potential to strongly modify the association between socio-economic disadvantage and ischaemic heart disease mortality. There is parallel with trends over time, which showed a strong variability in social gradients in ischaemic heart disease mortality, probably in response to changing social gradients in a number of risk factors related to a 'modern' life style (chapter 9).

Equally important is our observation that, despite cross-national variations in risk-factors profiles and cause-of-death patterns, socio-economic differences in mortality persist throughout Europe and extend to the United States. This persistency implies that socio-economic differences in mortality cannot be fully understood with reference to specific risk factors for disease alone. Explanatory studies should be prepared to move beyond proximate risk factors for disease and also consider the more distal factors that are called 'upstream factors' by some (Kaplan 1995) or 'fundamental causes' by others (Link and Phelan 1995). Studies should address the question which resources and rewards enable higher socio-economic groups to better avoid premature death whatever diseases and associated risk factors are the main causes of premature death.

Our international comparison gives some evidence with respect to some of these distal factors. The potential importance of material rewards has been stressed in much of the British literature ever since the Black Report (Townsend *et al.* 1988a, Davey Smith *et al.* 1994). In Black's tradition, mortality variations by occupational class are interpreted as largely reflecting the effect of 'material deprivation'. If material circumstances would indeed be crucial to explaining the link between occupational class and mortality, one would expect this link to be weaker in countries with high national incomes and small income inequalities. The fact that this expectation is not supported by our comparative studies does not deny a possible role of material deprivation. None the less, it underlines that other factors, i.e. non-material rewards and resources, can be largely responsible for the persistence of mortality differences according to occupational class.

Finally, a comparative study like this makes us aware of the importance to look beyond individual-level associations and to study the broader context within which associations between socio-economic status, health and mediating factors develop. These associations are not shaped in some vacuum, but they are formed and patterned within specific national, regional and local contexts. Identification of contextual factors that modify the individual-level associations between socio-economic status and health are essential for understanding why inequalities in health are as large as they now, and under which conditions they would become smaller in the future. Since this type of questions is closely related to policies that aim at reducing health inequalities in the near future, we will discuss them in the next section.

### 11.6.3 Policy

Lieberson (1985) mentioned the insights that can be gained by more often asking 'what if' questions. This type of question certainly becomes useful when the interest shifts from explanations of health inequalities to an exploration of their future course and possibilities to reverse the unfavourable trends over the past. 'What if' questions could be asked to evaluate the likely developments in the near future in the face of current socio-economic, health care and other developments. In addition, 'what if' questions have to be answered when alternative interventions are evaluated for their potential effect on future inequalities in health.

Experimental research is the most appropriate strategy to find answers to these questions (Benzeval *et al.* 1995, Department of Health 1995, Gepkens and Gunning-Schepers 1996, Mackenbach and Gunning-Schepers 1997). Evaluations of controlled experiments are especially suited to evaluate what would happen to socio-economic differences in the short-term if some small-scale interventions are introduced. More difficult to evaluate in an experimental design, however, are the long-term effects of these interventions, or the effects of interventions that are too profound for experimental application (e.g. restructuring the national health care finance system). In these cases, international comparisons might offer some of the empirical evidence that is searched for. From the perspective of policy makers in one specific country, other countries represent a series of 'natural experiments' in the field of socio-economic policies, health care systems, behavioral changes, etcetera. International comparisons can help to estimate the effects that these experiments have had on the magnitude and patterns of socio-economic differences in mortality.

The situation in most western European countries suggests an encouraging answer to the question 'what would happen to socio-economic differences in mortality in France if interventions would succeed to reduce the prevalence of excessive alcohol consumption among lower socio-economic groups?' Conversely, the situation in France warns that socio-economic differences in mortality in other western European countries could substantially widen if the prevalence of excessive alcohol consumption under lower socio-economic groups would increase.

Optimistic expectations with regard to the effects of interventions directed at tobacco consumption should probably be tempered. The situation in southern European countries cautions that large socio-economic differences in lung cancer mortality could persist even if interventions would succeed to nullify class differences in smoking. More ground for optimism give the results for ischaemic heart disease. The situation in southern Europe shows to northern European countries that socio-economic differences in ischaemic heart disease mortality can be reduced if interventions succeed to weaken class differences in behavioral factors like dietary habits.

Equally interesting are the differences between industrialised countries in health care systems and, more specifically, the degree to which these systems pose financial or other barriers to disadvantaged socio-economic groups. In the early 1980s, there were important differences between European countries in the degree to which health care was accessible to lower socio-economic groups (Doorslaer *et al.* 1992). Financial barriers were generally larger in France, Switzerland and Spain than in more northern countries. If reduced access to health care would affect the survival of lower socio-economic groups, that effect would be most clearly visible for causes of death that are amenable to medical intervention (Rutstein 1976). An example is cerebrovascular disease mortality, part of which is avoidable by adequate hypertension detection and control. However, as observed in chapter 10, class differences in stroke mortality were not clearly associated with the egalitarian character of health care systems. The experience of England & Wales illustrates that the removal of financial barriers is not sufficient to substantially reduce socio-economic differences in stroke mortality.

The Nordic countries are interesting for their egalitarian social and economic policies. Especially Sweden can be regarded as an 'natural experiment' in which a determined effort was made for over 50 years to reduce social inequalities and to improve the living conditions of the least advantaged groups. The perhaps most surprising finding from our study was that socio-economic differences in mortality in Sweden and other Nordic welfare states were not smaller than in most other European countries, and not even smaller than in the United States.

We should stress that it cannot be concluded from this finding that egalitarian socio-economic policies as those in Sweden have no beneficial effects on socio-economic inequalities in mortality. There is little doubt, for example, that socio-economic differences in mortality in the United States would become smaller in the visionary case that income inequalities in this country would gradually become as small there as in Nordic countries. Egalitarian socio-economic policies are likely to have beneficial effects, but these effects might not visible in an international comparison because of the large potential for confounding (see section 11.5.2). Nonetheless, the results of the 'Nordic experiments' allow to draw two lessons.

First, they warn against optimism. Socio-economic differences in mortality appear to be so persistent that even a long tradition of dedicated egalitarian socio-economic policies cannot bring socio-economic differences in mortality close to their elimination. Sympathetic statements about the importance of tackling inequalities in health at their roots (e.g. House *et al.* 1992) should therefore be taken with some reserve. However, it is equally important to recognise that, given the magnitude of the problem, even a modest reduction in socio-economic differences in mortality can save a lot of human misery.

Second, the persistence of socio-economic differences in mortality even in highly developed welfare states calls for the evaluation of alternative social and economic policies for their effect on the health of disadvantaged people. It is increasingly recognised that generous social security and welfare systems are not sufficient to help people get out of the vicious circle of accumulating disadvantages. New policies are searched for. One might ask what would happen to the health of these people if new ways would be found to help disadvantaged people to improve their living conditions, their position in society and their well being. This question can only be answered if health will be a central outcome measure in the evaluation of alternative social and economic policies.

### 11.6.4 International exchange and concertation

As with nearly any other field of research, exchange of the findings of studies from different countries is common practice in health inequalities research. Researchers from specific countries often use research findings from other countries to fill in the gaps in the information from their own country. Researchers who construct an international overview on a specific topic, either for an international readership or for an international organisation as the European Union or the World Health Organisation, need to combine research findings coming from different countries (e.g. Davey Smith *et al.* 1994, Illsley and Svensson 1990, Kaplan and Keil 1993, Mielck and Giraldes 1993, Pearce *et al.* 1996).

Usually, the implicit assumption is made that research findings from a specific country apply also to one's own country, or that research findings from different countries can be pooled into a single international knowledge base. In one respect there is a sound basis for international exchange. Our results strongly support the impression from the international literature that socio-economic differences in mortality are substantial throughout the industrialised world. When the data that are available for a specific country are of low quality but in agreement with this general rule, it is warranted to assume that socio-economic differences in mortality are substantial in this country as well.

Unfortunately, extrapolations cannot be pursued much further. The variations observed in this study seriously warn against a thoughtless exchange of research findings across countries. The magnitude of socio-economic differences in mortality in specific countries is highly unpredictable. The same applies to patterns by age or cause of death, for which we observed large and unexpected variations between countries. For detailed and reliable descriptions of socio-economic differences in mortality, each country needs to derive its estimates from own national data. This requirement makes it even more lamentable that detailed, reliable and nationally representative estimates of mortality differences are available for only a handful of European countries.

The same caution is required with the results of explanatory studies, and especially if these results are expressed in terms of the proportional contribution that specific risk factors for disease make to socio-economic differences in morbidity or mortality (e.g. Lundberg 1991b, Pekkanen *et al.* 1995, Stronks *et al.* 1996). The generalisability of these estimates are limited geographically. Researchers should usually view the results of foreign studies as hypotheses that wait for testing with data from their own country. International overviews of descriptive or explanatory studies should take into account the possibility that results from specific studies are strongly modified by the national or local context.

International variability is not only an impediment to the accumulation of scientific knowledge; it also offers new opportunities for explanatory research. This applies especially to countries with risk factors gradients that are different from those in northern Europe and the United States. The absence of strong social gradients in some behavioral risk factors for ischaemic heart disease in southern European countries makes it especially feasible for these countries to assess the contribution that, for example, psycho-social working conditions (Siegrist *et al.* 1990, Theorell 1992) make to socio-economic differences in ischaemic heart disease mortality. Because of the absence of marked social gradients in smoking in southern European countries, it might be easier to assess in these countries the contribution that carcinogenic exposures at work can make to socio-economic differences in lung cancer mortality. Finally, studies from countries with low national living standards and large income inequalities can more easily assess the potential effects of material deprivation on the health of people at the bottom end of the social hierarchy.

These examples emphasize the need for international concertation of research efforts. Not only would this increase the productivity of research in individual countries, it would in addition facilitate the creation of an international knowledge base on socio-economic differences in health.

## 11.7 Future comparative research

This study represents the until now most extensive attempt to utilise the comparative method for the study of socio-economic inequalities in health. It is not difficult to identify several opportunities for analyses that wait for future research. For example, other sources of information on health inequalities might be used to provide a more complete and a more accurate international overview. A rich and up-to-date source of data with respect to morbidity are national health interview and level-of-living surveys. These surveys include several questions on the health status and on the socio-economic status of respondents. These surveys are increasingly more often used to describe international patterns of socio-economic differences in self-reported morbidity (Bosma *et al.* 1995, Cavelaars *et al.* 1997a & 1997b, Doorslaer *et al.* 1992 & 1997, Kunst *et al.* 1992, 1995 & 1996, Lahelma and Arber 1994, Lahelma *et al.* 1994, Lundberg 1986, Wagstaff *et al.* 1991).

It should be acknowledged, however, that international comparisons usually require a large research effort. Without this effort, there looms a large risk that researchers obtain biased results and draw mistaken conclusions. Because of the large effort that is often required, two questions should be asked with respect to any new comparative project. First, which contributions can this project be expected to make to research and policies with regards to socio-economic inequalities in health? Second, how can these aims be achieved despite the several problems that are inherent to comparative research? The first question is discussed in section 11.7.1. In the three sections that follow, we discuss the same three problems that we faced at the onset of our study: problems with acquisition of data, problems with the comparability of data, and problems with explaining the observed cross-national variations. On the basis of the experiences with the present study, we will make suggestions to cope with these problems in future studies.

### 11.7.1 Why comparing countries?

The several contributions that comparative research can be expected to make to research and policies with regards to socio-economic inequalities in health were explored in this study. Four types of contributions were distinguished in section 1.2, and the contributions that this study in fact made were summarised in section 11.6. What might be expected from future comparative studies? As a general rule, new studies would increase their efficiency considerably if they direct their efforts to making a few pre-specified contributions. Below, we discuss the different contributions that might motivate researchers to embark upon a new comparative study on socio-economic differences in mortality.

1. Judgement. Researchers may want to compare the situation is their own country to that in other countries in order to have a yardstick against which to judge socio-economic differences in mortality in their own country. To our experience, the present study called wide interest among others because it intended to position each country within an *international inequality league* based on the magnitude of socio-economic differences in mortality. In our study, however, countries could only be compared with respect to mortality differences by educational level and occupational class among men circa 30 to 64 years. A more balanced judgement of each country's international position would be possible if new studies include estimates of mortality differences among women, other age groups, and additional countries. In addition, researchers may want to attempt to include new socio-economic indicators, e.g. on material deprivation.

2. Explanation. Researchers may apply the comparative method in order to obtain clues for the explanation of socio-economic differences in mortality with reference to intermediary factors. Comparative research can provide clues for the role of a specific factor if socio-economic differences in the

absolute prevalence of this factor varies between countries. In this study, indications were obtained on the contributions made by specific risk factors for disease (e.g. alcohol consumption) and more distal factors (e.g. material deprivation). It should be clear that these are no more than indications, and that stronger evidence can in principle be obtained from individual-level explanatory studies. However, as long as such studies have a poor coverage in terms of both the countries that are included and the type of intermediary factors that are studied, supplementary evidence is welcome. Comparative research can provide some of this evidence, probably also in the future, by exploiting the fact that both the national prevalence and social gradients of several factors strongly vary from country to country.

3. Policy. Researchers and policy makers who are searching for ways to reduce health inequalities may view other countries as 'natural experiments'. The international comparisons made in this study provide some information on possible effects of the welfare state, and in particular the Scandinavian model, as an experiment in reducing social inequalities and related health inequalities. The great diversity between countries in Europe and elsewhere offers many other natural experiments that wait for future exploration. It is interesting to assess, for example, whether countries with highly egalitarian health care systems and policies have achieved smaller socio-economic differences in some or most of the conditions that are considered amenable to medical intervention (Rutstein 1976, Mackenbach *et al.* 1990). Comparisons that are focused on these and other 'natural experiments' cannot give strong empirical evidence, but the indications they produce may stimulate thinking about alternative ways to reduce inequalities in health.

4. Exchange and concertation. It frequently happens that researchers from a specific country use results from descriptive or explanatory studies from other countries in order to fill in the gaps in the information from their own country. In these cases, some formal comparisons are needed in order to judge whether the results of other countries may be assumed to apply to their own country. Our study showed that comparisons with respect to causes of death help researchers to judge whether they are allowed to exchange estimates of the contributions that risk factors for specific diseases make to socio-economic differences in total mortality.

Information from different countries is also exchanged when researchers construct international overviews for a specific aspect of health inequalities, e.g. for a specific group of diseases (e.g. Pearce *et al.* 1996). These overviews can be made, either for the international research community or for international policy organisations, in order to summarize the state-of-the-art and to set priorities for further research. Some kind of formal comparison may help these researchers to judge whether the results of studies from different countries can simply be pooled, or whether variations between countries should explicitly be included in the international overview and in the planning for future research.

### 11.7.2 Acquisition of data

Contrary to the impression that is given by the large number of international publications on health inequalities, data on socio-economic differences in mortality are still fragmentary. The experience of this study is that only a few countries have detailed, reliable and nationally representative data on socio-economic differences in mortality. This situation seriously restricts the possibility to make comparisons between a large number of countries, or to make cross-national comparisons with potentially interesting countries from the Mediterranean or from central and eastern Europe. How can this situation be improved? As discussed in section 2.3, information on socio-economic differences in mortality can come from differences sources. In this section, we will assess for each source of information its potential to generate estimates of socio-economic differences in mortality that can be used in cross-national comparisons.

Our quantitative evaluations of several sources of error (Table 5.8) underscore the fact that national longitudinal studies are the most reliable source of data for assessing socio-economic differences in mortality. In countries where population census records and the death registry can be linked, the entire national population can be followed up for mortality after each census. Unfortunately, national longitudinal studies are available for only a few countries. Without the availability of personal identification numbers, as in the Nordic countries, linkage between population census records and the death registry is a costly operation. It is therefore unlikely that this type of information will become available for many more countries in the near future.

An alternative are small-scale longitudinal studies that are carried out in some specific regions or cities, or among a small sample of the national population. Where epidemiological follow-up studies are carried out, the inclusion of socio-economic indicators might be an easy way to generate new data on socio-economic differences in mortality. We used this type of information in our analyses for the 1970s, by including data from epidemiologic studies from Rotterdam (Bosma *et al.* 1995), Oslo (Holme *et al.* 1980) and Gothenburg (Rosengren *et al.* 1988). Especially interesting for future comparative studies are internationally coordinated epidemiological studies. We explored the possibility to use data from one of the best known projects of this type, the MONICA study (Tunstall-Pedoe *et al.* 1994). Unfortunately, this project was found to be of little use to our comparative study because socio-economic indicators were not included in the standard protocol. The increasingly larger number of internationally coordinated epidemiological studies offers new possibilities.

Other longitudinal studies are panel studies or similar surveys in which reasons for exit (death or otherwise) is registered. For example, with data from a German socio-economic panel study, which were supplied to the coordinating centre by Andreas Mielck, we were able to demonstrate the existence of mortality differences by educational level in West Germany in the 1980s. Unfortunately, our experience with this and several other small-scale studies is that the observed number of deaths is often too small to estimate the magnitude of mortality differences in a country with sufficient precision. Large confidence intervals impede international comparisons.

A national source of data that is available for several European countries are unlinked cross-sectional studies. These studies have the important advantage that, thanks to the inclusion of the entire national population, socio-economic differences in mortality can be described with much detail and high levels of precision (small confidence intervals). An important drawback of these studies is the so-called numerator/denominator bias, which can bias inequality estimates substantially (see sections 2.3 and 5.3). However, this bias is not always prohibitive to international comparisons. In Hungary and the Czech Republic, the simultaneous registration of both occupation and educational level on death certificates provided us with the opportunity to cross-check the results obtained with either indicator. Fairly high levels of reliability could be attached to the data for Switzerland, thanks to a death certificate study which assessed the comparability of the registration of occupation on death certificates and in population census records (Beer *et al.* 1986, Kunst and Groenhof 1996c). Further methodological work can considerably improve the informative value of unlinked cross-sectional studies in many of the European countries without national longitudinal data.

It is often possible to obtain useful data on socio-economic differences in mortality by small-area studies. In these studies, the association between mortality and socio-economic status is studied by comparing the mortality levels of small areas, e.g. urban districts, with socio-economic characteristics of these areas. These studies have several advantages: the necessary data are available for many countries and cities; the year-to-year availability of these data allows the timely study of trends; and socio-economic differences in mortality can be assessed for all age-sex groups separately. In addition, residence in poor neighbourhoods indicates a form of socio-economic disadvantage that is not captured by individual-level indicators of education, occupation or income. This latter feature, however, raises the question whether the association between socio-economic disadvantage and mortality at the area level reflects the association at the individual level. The 'ecological fallacy' problem warns against a thoughtless cross-level inference (Susser 1994). Therefore, international comparisons based on ecological data should be accompanied by research that compares area-based estimates to individual-level estimates of the association between mortality and socio-economic disadvantage.

We found that the international comparability of the results from small-areas studies have that until now been published is low (Kunst and Mackenbach 1992 & 1996). However, the comparability of future small-area studies can considerably be improved when international efforts are made to harmonise their methodology.

### 11.7.3 Enhancing the comparability of data

Any cross-national comparison of socio-economic differences in mortality should take care to achieve as much comparability as possible in terms of age, period and possibly other general population characteristics. This requirement can usually be met with access to basic data, careful analysis and an evaluation of the potential effects of remaining discrepancies. More difficult is it to achieve optimal comparability in the measurement of socio-economic indicators. Below, we make recommendations for enhancing the comparability of the two socio-economic indicators that were used in this study: education and occupation. Of the general guidelines for their measurement that were given in section 2.5, the experiences in the present study lead us to stress a few aspects.

*Education*

When researchers are in the position to determine the registration of educational level in the basic data, they should secure that distinctions are made between lower and intermediate levels of education, for example, between elementary school and lower secondary school. Unfortunately, this distinction was not made in many of the countries for which data that were available, especially England & Wales and the Nordic countries. This resulted in highly skewed educational distributions for older birth cohorts (see Table 4.2 and Kunst *et al.* 1996). As a result, for the older birth cohorts of these countries, we could make only approximate estimates of the magnitude of mortality differences across the educational hierarchy.

Other recommendations refer to the classification of men or women into educational groups. We recommend the classification of levels according to the standard scheme of ISCED levels as distinguished by the OECD (1995). We should warn, however, that differences between countries in educational systems may be too large, or the data available for some countries too crude, to achieve high levels of comparability. This problem is exemplified by the unlikely low proportion of men who completed upper secondary education according to the French data (Table 8.3). However, these problems are not unsurmountable. We should stress that countries need not to be compared with respect to mortality levels per educational category, but that comparisons can be based on a summary measure of the association between educational level and mortality. As shown in Table 2.2, different summary measures make different requirements to the comparability of the data, and often a summary measure is available (e.g., the *Relative Index of*

*Inequality*) that can be applied to all countries in a comparable way.

*Occupation*
Researchers who are in the position to determine the registration of occupation in the basic data might follow the recommendations of a recent report on instruments for health interview surveys (Statistics Netherlands/WHO-EURO 1995). This report recommends the registration of three aspects of the job a person performs: the job title (coded into a national 3-digit classification), the employment status (self-employed or not) and the number of subordinates (or size of company).

It is essential that for men who are not gainfully employed, this information is obtained for their last occupation or their occupation at some specific moment in life such as the previous population census. Chapter 5 and the Appendix show that, if this information is lacking and economically inactive men have to be excluded from analysis, this could result in a large underestimate of the magnitude of mortality differences according to occupational class.

During the second project we observed that, much to our regret, European countries strongly differ with respect to the measurement of women's class. Due to this large heterogeneity, it was judged to be impossible to compare countries with respect to occupational class differences in women's mortality. A main task for future studies is to harmonise methods so that at least a few countries can be compared with respect to the association between occupational class and women's mortality. Harmonisation in the registration of women's occupational class is vital to this. As argued in section 2.5, women can be classified on the basis of their own occupation or the occupation of their husband or other household member. There is no clear theoretical preference for either choice of the reference person. In addition, the choice between own and the partner's occupation may depend on a woman's marital status and her activity status. In order to maintain maximal flexibility in the face of this choice, it is preferable to register, wherever possible, both a woman's own (last) occupation and the occupation of her husband.

A second set of recommendations refers to the classification of men and women into occupational classes or other socio-economic groups. This usually involves the application of a social class scheme. Many efforts were made by us to apply a common class scheme, the EGP scheme, to as many countries as possible. In social mobility research, a high degree of comparability between several countries was achieved on the basis of this scheme (Erikson and Goldthorpe 1992a). In our analysis, however, international comparability was only achieved at the level of the broad distinction between manual classes, non-manual classes and the class of farmers and farm labourers. In some comparisons we could make further distinctions, most often between routine non-manual workers and higher non-manual classes. Other distinctions were not possible in most comparisons, because the basic information that was needed to apply EGP conversion algorithms was not available or, when this information was available, no original EGP conversion algorithm was available. We used a standard 'GLT' algorithm (Ganzeboom *et al.* 1989) in the latter cases. However, a sensitivity analysis showed that the observed mortality differences between specific classes, especially between skilled and unskilled manual workers, were highly sensitive to the choice of this standard instead of an original EGP algorithm (Kunst and Groenhof 1996d).

In view of these experiences, we cannot recommend the exclusive use of the EGP scheme in future comparative research on mortality according to occupational class. In past research, researchers from Sweden and Switzerland have had favourable experiences with the application of the British Registrar General's (RG) scheme to national mortality data from their own country (Minder 1991, Vågerö and Lundberg 1989). Since the RG scheme is now considered outdated (Rose 1995), it cannot be recommended for future comparative research. An alternative is the Socio-Economic Index (SEI) of Ganzeboom *et al.* (1992). This international index ranks each occupation on the basis of a weighted score of the average educational level and the average income level of all men with that occupation. Theoretically, this score fits closely to our conceptualisation, presented in Figure 11.4, of occupation as a link between resources (with education as the main resource) and rewards (with income as the main reward). In addition, this index only requires the availability of information on occupational title by 3-digit code. We therefore recommend its application in individual countries and, if found sufficiently informative and robust to data problems, its use in international comparisons.

The choice for a specific social class scheme or occupational scale in future studies also depends on the preference for either a hierarchical or a nominal approach. Hierarchical schemes as the RG scheme enjoy a considerable popularity in health inequalities research, presumably because it satisfies the wish of many researchers to have a straightforward measure of the degree of socio-economic disadvantage. This perspective is most consistently developed in the SEI. To this index, schemes of occupational classes add the perspective that socio-economic advantage can take many forms and that some occupational classes are advantaged in some terms (e.g. income or authority) and other classes more in other terms (e.g. education or autonomy). That this is not just a theoretical issue, but also of potential relevance to mortality, is evidenced by the particular mortality profiles of specific occupational classes such as self-employed men (Table 7.4), farmers and farm workers (Table 5.3, Figure 11.1), and routine non-manual workers (Table 7.4). New cross-national comparisons that are based on the EGP scheme or similar schemes should attempt to further exploit this multidimensional nature. Potentially interesting for analytic purposes are the large differences that exist within the middle and upper non-manual classes between those with economic capital and those with cultural capital (Ward 1994, Bordieu 1984).

### 11.7.4 Explaining cross-national variations

Nearly any comparative study will face the task not only to compare countries with respect to socio-economic differences in mortality, but also to make steps towards the explanation of the patterns that are observed. Two situations can be distinguished. The first situation was met in our study. Our principal aim was to describe cross-national differences in socio-economic differences in mortality. Once the results were obtained, we found it difficult to draw meaningful implications without first making an attempt to explain the observed patterns. The task we faced was, then, to distinguish among the alternative explanations that can be given to the cross-national variations that were observed.

Another situation will be more common to future studies. New studies might be designed with a view to assess the potential effect of specific national characteristics on the magnitude and pattern of socio-economic differences in mortality. Future studies might have a particular interest in the association with, e.g., social gradients in specific risk factors or contextual determinants like health care systems. A main task to these studies will be to control in the analysis for other national characteristics, at least those characteristics that can be considered as confounders to the characteristic of interest.

These tasks are by no means simple. As we concluded in section 11.5.2, the magnitude and pattern of mortality differences in specific countries can be influenced by many circumstances. This can easily create a serious 'degrees of freedom' problem (Ganzeboom *et al.* 1995): when the number of potential determinants exceeds the number of countries included in the analysis, it becomes hard to distinguish among these factors. In section 1.4, we identified basically two research strategies by which one can move from description to explanation: the empirically *in*tensive strategy and the empirically *ex*tensive strategy (Kohn 1987, Ragin 1987). Both strategies were explored in this thesis.

In the empirically *ex*tensive research strategy, as many as countries as possible are included in order to determine whether mortality differences are consistently associated with a specific national characteristic across a wide range of countries. The relatively large number of countries might make it possible to control for the effect of some other characteristics, in particular those which are quantitatively measurable. This strategy was applied most systematically in our international overviews on ischaemic heart disease and stroke mortality. In chapter 9, we concluded that socio-economic differences in ischaemic heart disease mortality were consistently related to cultural instead of economic characteristics of countries. In chapter 10, we observed that socio-economic differences in stroke mortality were not systematically associated with social gradients in smoking. Further progress with this type of research depends primarily on the acquisition of comparable data on socio-economic differences in mortality across a wide range of countries.

In the empirically *in*tensive strategy, a few specific countries are selected and these countries are compared in more detail than is possible for a larger number of countries. The intensive strategy was applied in the detailed comparison between United States and England & Wales and Sweden. In chapter 7, results for specific causes of death and specific occupational classes suggested that socio-economic differences in total mortality are determined in somewhat different ways in the United States than in the northern European countries. There are ample opportunities for further development of this strategy. Other pairs of countries can be chosen, preferable countries that strongly contrast with respect to the national characteristic of interest, but not with respect to some of the potential confounders. In order to assess the possible effect of other confounders, one might include different age-sex groups, analyze trends over time (possible by birth cohort), and make separate analyses of key causes of death (e.g. specific cancers, liver cirrhosis, traffic accidents, suicide) and associated risk factors. Data on mortality by occupational class might be complemented with data for socio-economic indicators that focus on more specific forms of disadvantage. Finally, one might combine the results of quantitative analyses with qualitative information on the societies that are compared.

We should stress the complementarity of the two research strategies. *In*tensive research is best suited to study the complex ways in which socio-economic differences in mortality are determined and patterned in specific countries. If associations are detected in this way, *ex*tensive research is needed to assess whether this association holds across several countries. The application of both strategies is the best route towards a better understanding of the ways in which national contexts modify the persistent association between socio-economic status and adult mortality.

## Appendix

# A rule for adjusting inequality estimates for the effects of excluding of economically inactive men

In many studies, the last occupation of economically inactive men is unknown and these men therefore have to be excluded from the calculation of mortality rates by occupational class. Since economically inactive men have higher-than-average mortality rates, their exclusion results in an underestimation of mortality rates of working populations (the "healthy worker effect", Goldblatt *et al.* 1991, Sorlie and Rogot 1990). Since, in addition, economically inactive men originate predominantly from lower working classes, their exclusion is likely to result in an underestimation of mortality differences by occupational class. This section presents a rule that we have developed in order to be able to adjust for this underestimation. In a working document given elsewhere (Kunst and Groenhof 1996b), we describe in detail the development and application of this rule, and a number of tests that we made to assess the performance of this rule. This document is summarised in this appendix.

*Developing the adjustment rule*

The observed mortality rates ($rate_{class\ x}^{active\ members}$) need to be increased by a specific factor in order to approach the mortality rates that would have been observed when inactive men would have been included in the analysis ($rate_{class\ x}^{all\ members}$). This adjustment factor equals to:

$$rate_x^{all} / rate_x^{active}$$

$$= \quad ((P_x^{active} * rate_x^{active}) + (P_x^{inactive} * rate_x^{inactive})) \ / \ rate_x^{active} \qquad (1)$$

where $P_x^{active}$ and $P_x^{inactive}$ represent the proportion of all person-years lived in class x that is lived by those who are, respectively, economically active and economically inactive. Dividing numerator and denominator by $rate_x^{active}$, and substituting $P_x^{active}$ by $(1-P_x^{inactive})$ yields:

$$= \quad 1 + P_x^{inactive} * (RR_x^{inactive/active} - 1) \qquad (2)$$

where $RR_x^{inactive/active}$ represents a mortality rate ratio: $rate_x^{inactive} / rate_x^{active}$.

Thus, an adjustment factor can be calculated if estimates are available for the values of two parameters:

$P_x^{inactive}$ the share of economically inactive men in all person-years lived in class x

$RR_x^{inactive/active}$ the mortality rate ratio comparing inactive men of class x to active men of class x.

Estimates for these class-specific values were obtained as follows.

Values of $P_x^{inactive}$ were estimated by multiplying the national averages with a constant:

$$P_x^{inactive} = constant_x * P_{all\ classes}^{inactive}.$$

Approximate estimates of these constants could be derived from unpublished survey data that were available from most countries included in our study (Kunst *et al.* 1996). For most of these countries, the value of $constant_x$ was found to be close to 1.40 for manual classes, with a standard deviation of about 0.10 units. The average values for non-manual and agricultural classes were 0.70 and 0.80 respectively. The available evidence suggested that the values for the Nordic countries are less extreme and that a better approximation to the constants for manual and non-manual classes in these countries is 1.25 and 0.75, respectively. Data from a Hungarian survey yielded estimates for the constants for manual and non-manual classes of 1.22 and 0.40, respectively.

Values for $RR_x^{inactive/active}$ were estimated by assuming that:

$$RR_x^{inactive/active} = RR_{all\ classes}^{inactive/active}.$$

This assumption states that there is no interaction between occupational class and activity status in their relationship to mortality. Data on the magnitude of this interaction were available from published studies from England & Wales, Norway and Finland (Dahl and Kjaersgaard 1993a, Goldblatt 1989, Valkonen *et al.* 1990a). In each study, $RR^{inactive/active}$ values were found to be fairly constant between occupational classes. For example, in the OPCS Longitudinal study for 1981-1985, the RR values were 1.98, 2.01, 2.09 and 2.09 for, respectively, Registrar-General class I & II, class IIIN, class IIIM, and class IV & V (Goldblatt 1989).

Approximately constant RR values were also observed in our own data on Finland, Norway, France, Italy and the United States when educational levels instead of occupational classes were compared. For the United States, for example, about equally large $RR^{inactive/active}$ values were observed for men with at least some college education (RR=3.21) and men with lower levels of education (RR=2.51).

With these modifications, formula (2) can be used to estimate the extent to which the observed mortality rates for a specific economically active population should be adjusted in order to obtain an estimate of their 'true' mortality rate:

$$1 + \text{constant}_x * P_{all}^{inactive} * (RR_{all}^{inactive/active} - 1), \tag{3}$$

with

| | |
|---|---|
| $RR_{all}^{inactive/active}$ | the inactive/active mortality rate ratio observed for the total population; |
| $P_{all}^{inactive}$ | the proportion of all person-years that is lived by economically inactive men; |
| $\text{constant}_x$ | survey estimates of the proportion of men in class *x* that are economically inactive, divided by the proportion for all classes. |

*Applying the adjustment rule*

The occupational classes that are distinguished most often in the book are manual classes, non-manual classes and agricultural classes. The adjustment factors for these classes were calculated as:

$$1 + 1.4 * P_{all}^{inactive} * (RR_{all}^{inactive/active} - 1) \quad \text{for manual classes} \tag{4a}$$

$$1 + 0.7 * P_{all}^{inactive} * (RR_{all}^{inactive/active} - 1) \quad \text{for non-manual classes} \tag{4b}$$

$$1 + 0.8 * P_{all}^{inactive} * (RR_{all}^{inactive/active} - 1) \quad \text{for agricultural classes} \tag{4c}$$

For the Nordic countries, the value 1.4 in (4a) is replaced by 1.25, and 0.7 in (4b) is replaced by 0.75. For Hungary and the Czech Republic these values were replaced by 1.22 and 0.40, respectively. Dividing the adjustment factor for a specific occupational class (4a, 4b or 4c) by the adjustment for all active men ($\text{constant}_x = 1$) yields the adjustment factor for the SMR of that occupational class. Dividing the adjustment factor for manual classes (4a) by the adjustment factor for non-manual classes (4b) yields the adjustment factor for the manual *versus* non-manual mortality rate ratio.

Table A presents the adjustment factors that were calculated for manual and non-manual classes in the 11 mortality data sets that were used in the comparison between western European countries (chapter 5). The first two columns give the input parameters for that were used for adjustment formula (4a), (4b) and (4c). The resulting adjustment factors are small for England & Wales, France and Switzerland. In these countries, information on the occupational class is lacking for only a minor part of the study population thanks to the availability of information on previously held occupations (England & Wales and Switzerland) and long follow-up periods (France). The adjustment factor for Italy is relatively high because of the high mortality rates of inactive men. These high rates are related to the short follow-up period of the Italian longitudinal study (during which the high initial mortality rates of inactive men do not yet wear off (Goldblatt *et al.* 1991)).

Formula (3) can also be applied to more specific occupational classes than the three broad groups. Table B presents the input parameters that were used to calculate correction factors for the six specific EGP classes that were distinguished in the comparison between the United States and northern European countries (chapter 7). Dividing the resulting adjustment factors for a specific class by the adjustment for all classes combined yields the adjustment factor for the SMR of that occupational class. These factors are given in the lower part of Table B.

Table C presents the adjustment factors that were calculated for manual and non-manual classes in the mortality data sets that were used to compare East and West (chapter 8). Adjustment factors are small not only for England & Wales and France, but also for the Czech Republic. In the Czech Republic, as England & Wales, information on former occupations is lacking for only a minor part of the study population thanks to the availability of information on previously held occupations.

*Testing the adjustment rule*

In several tests, we evaluated the performance of adjustment factors that are calculated by means of formula (3) (Kunst and Groenhof 1996b). Table D summarizes the results of some of these tests. For studies from four western European countries, estimates are presented of the size of mortality differences by educational level and by occupational class. In each study, the measures of educational level (elementary and lower secondary *versus* higher) and occupational status (manual *versus* non-manual) are strongly correlated (Kunst and Groenhof 1996b). Therefore, a high correspondence in their rate ratios, and their trends over time, might be expected.

Column 1 shows the size of mortality differences by educational level as observed for the total population. The moderate increase in rate ratios over time is in agreement with the results of Finnish and French studies on trends in mortality differences during the 1980s (Valkonen 1993b, Lang and Ducimetière 1995). Exclusion of inactive men (column 2) substantially reduces the rate ratios. This reduction is largest during the first 5 years of follow-up, thereby creating the impression that mortality differences have dramatically increased during the study period. Application of adjustment factors (column 3) consistently brings the biased rate ratios closer to the values given in column 1 for the total population.

Column 4 shows estimates of the size of mortality differences by occupational class, with exclusion of economically inactive men. The rate ratios are as low as the those given in column 2 for education (active men only), with again an increase over time that is unlikely strong. Application of the adjustment factor (column 5) results in a close correspondence to the rate ratios given in column 1 for education (for all men), with the same moderate increase over time.

Table E summarizes the results of a test we made for United States. Row 1 shows the size of mortality differences between extreme educational groups. The increase over time in rate ratios by about 10 percent suggests that socio-economic mortality differences in the United States increased during the 1980s. This would imply a continuation of the trend that was observed for the foregoing decades (Feldman *et al.* 1989, Pappas *et al.* 1993, Preston and Elo 1995). Exclusion of inactive men (row 2) substantially reduces the rate ratios. This reduction is smaller for the last 5 years of follow-up, because the 'healthy worker effect' generally wears off with increasing follow-up (Goldblatt *et al.* 1991). This differential underestimation artificially raises the pace by which mortality differences seemed to have increased during the 1980s.

The next rows show estimates of the size of mortality differences by occupational class. In order to maintain comparability with the estimates for education, a distinction is made between two extreme classes. As with education, rate ratios from which inactive men are excluded (row 3) again suggest a strong increase over time. Application of the adjustment factor (row 4) results in a larger adjustment for the first 5 years of follow-up than for the second period. The adjusted inequality estimates suggest a more moderate increase over time. However, this increase is still larger than that observed for education (row 1). It might imply that our adjustment procedure is not able to fully correct for the effects of excluding economically inactive men.

These tests, together with several other tests we made (Kunst and Groenhof 1996b), suggested that by applying the correction rule, estimates of mortality differences by occupational class that were made while excluding (a part of) economically inactive men are brought close to the inequality estimates that would be observed when all men would be included. The residual bias is likely to be small.

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# Samenvatting

Deze eeuw liet een indrukwekkende stijging zien van de levensverwachting van de bevolkingen van geïndustrialiseerde landen. Ondanks deze stijging overlijden nog steeds veel vrouwen en vooral ook veel mannen vóór het bereiken van de oude dag. Een verdere afname van vroegtijdige sterfte is daarom nog steeds een belangrijke doelstelling van het gezondheidsbeleid van geïndustrialiseerde landen.

In elk land waarvoor gegevens beschikbaar zijn, blijken kansen op vroegtijdige sterfte groter te zijn onder mensen met een lager opleidingsniveau, een lager inkomen of een lage positie op de arbeidsmarkt. Sociaal-economische verschillen in sterfte zijn gedurende de afgelopen decennia niet alleen blijven voortbestaan, maar mogelijk zelfs toegenomen. Het verkleinen van sterfteverschillen in een belangrijke uitdaging voor gezondheidsbeleid, niet alleen omdat deze verschillen als onrechtvaardig kunnen worden beschouwd, maar ook omdat het verbeteren van de overlevingskansen van lagere sociaal-economische groepen een mogelijkheid vormt om de levensverwachting van de bevolking als geheel te doen toenemen.

Verschillende auteurs hebben onderzoek verricht naar de vraag of sociaal-economische verschillen in sterfte in hun eigen land groot of klein zijn vanuit een internationaal perspectief. In het bijzonder zou het interessant zijn, waar te nemen dat sterfteverschillen in een bepaald land groter zijn dan elders. Dit zou de urgentie van het probleem in dat land onderstrepen. Immers, andere landen laat zien dat de verschillen kleiner kunnen zijn dan ze nu zijn. Bovendien kan een nadere bestudering van de situatie in andere landen suggesties opleveren voor wijzen waarop gezondheidsverschillen in het betreffende land kunnen worden verkleind.

Internationale vergelijkingen die tot circa 1990 zijn uitgevoerd, hebben inderdaad waargenomen dat sociaal-economische verschillen in sterfte in sommige landen groter zijn dan in andere. Helaas kende elk van de oudere studies ernstige beperkingen. Ten eerste betroffen de meeste vergelijkingen slechts enkele landen. Dit maakte het niet goed mogelijk sterfteverschillen in een land in een breed internationaal perspectief te plaatsen. Ten tweede kunnen problemen met de betrouwbaarheid en vergelijkbaarheid van de beschikbare gegevens hebben geleid tot ernstige vertekeningen in de resultaten, en mogelijk tot verkeerde conclusies. Ten derde worden door de oudere studies geen verklaringen aangedragen voor de internationale patronen die men had waargenomen. Het beschikbare materiaal was te fragmentarisch om bijvoorbeeld de verwachting te toetsen dat sterfteverschillen relatief klein zijn in landen met een meer egalitair sociaal-economisch beleid, zoals Zweden, andere Scandinavische landen en Nederland.

*Dit proefschrift*

Het doel van dit proefschrift was geïndustrialiseerde landen te vergelijken met betrekking tot de omvang van sociaal-economische verschillen in sterfte onder mannen van circa 30-64 jaar. De centrale onderzoeksvraag was of sociaal-economische verschillen in sterfte ongeveer even groot zijn in alle landen, of dat deze verschillen aanmerkelijk groter zijn in sommige landen dan in andere.

Dit proefschrift verschilde van eerdere publikaties in verschillende opzichten. Ten eerste werden veel meer landen vergeleken, te weten elk land uit Europa en Noord-Amerika waarvoor nationale gegevens beschikbaar waren over sterfteverschillen naar beroepsklasse of opleidingsniveau. Ten tweede werd een aanzienlijke inspanning geleverd om problemen met de betrouwbaarheid en vergelijkbaarheid van de beschikbare gegevens te evalueren en, waar mogelijk, op te lossen. Ten derde werden verklaringen aangedragen voor de waargenomen internationale patronen. Speciale aandacht werd besteed aan de mogelijkheid dat egalitair sociaal-economisch beleid gepaard gaat met kleinere verschillen in vroegtijdige sterfte.

De gegevens die in dit proefschrift werden geanalyseerd zijn afkomstig uit twee onderzoeksprojecten die tussen 1991 en 1996 zijn uitgevoerd. Het eerste, kleinschalige project had betrekking op de jaren '70. Dit project had tot doel om verschillende landen, en in het bijzonder Nederland, te vergelijken voor wat betreft de omvang van sociaal-economische verschillen in sterfte. Voor Nederland waren gegevens beschikbaar over verschillen naar beroepsklasse en opleidingsniveau in sterfte onder mannen 35-64 jaar. Vergelijkbare gegevens waren beschikbaar voor acht andere landen.

Het tweede project betrof de jaren '80. Het was een door de Europese Unie gefinancierde project waarin teams deelnamen uit 15 landen. Dit project had onder meer tot doel een internationaal overzicht op te stellen van sociaal-economische verschillen in sterfte. Dat overzicht beoogde veel gedetailleerder en betrouwbaarder te zijn dan voor eerdere studies mogelijk was. Bovendien werden pogingen ondernomen aanwijzingen te verkrijgen omtrent de omstandigheden die van invloed zijn op de omvang van sociaal-economische verschillen in sterfte. Die aanwijzingen werden vooral ontleend aan gegevens over sterfte naar specifieke doodsoorzaken, zoals longkanker en ischemische hartziekten. De gewenste gegevens waren beschikbaar voor 11 West-Europese landen, de Verenigde Staten en drie landen uit Oost-Europa. Helaas kon Nederland niet in het tweede project worden opgenomen, vanwege het ontbreken van nationale gegevens over sociaal-economische verschillen in sterfte in de jaren '80.

De volgende twee secties geven een samenvatting van de methoden en de resultaten van de internationale vergelijkingen die in dit proefschrift werden gemaakt met de gegevens die voor de jaren '70 respectievelijk de jaren '80 beschikbaar waren.

*Vergelijkingen voor de jaren '70*
Gegevens over sterfte naar beroepsklasse waren beschikbaar uit longitudinale studies uit 7 landen. Gegevens over sterfte naar opleiding waren voor 9 landen beschikbaar. De gegevens betroffen sterfte onder mannen 35-64 jaar in perioden tussen 1970 en 1982. Voor de meeste landen werd gebruik gemaakt van ongepubliceerde gegevens. De omvang van sociaal-economische verschillen in sterfte werd gemeten aan de hand van samenvattende indices die waren gebaseerd op regressie-analyse.

In hoofdstuk 3 werden landen vergeleken met betrekking tot sterfteverschillen naar beroepsklasse. Deze verschillen bleken aanmerkelijk groter te zijn in sommige landen dan in andere. De kleinste sterfteverschillen werden waargenomen voor Nederland, Denemarken, Noorwegen en Zweden. Iets groter waren de verschillen in Engeland en Wales. Het grootst waren de sterfteverschillen in Finland en vooral in Frankrijk. Opvallend was onder meer dat het verschil tussen Zweden en Engeland en Wales, waar in de literatuur tot dan toe veel aandacht aan werd besteed, vrij gering was vanuit een breder internationaal perspectief.

In hoofdstuk 4 werden landen vergeleken met betrekking tot sterfteverschillen naar opleidingsniveau. Deze verschillen bleken opnieuw relatief klein te zijn in Nederland, Denemarken, Noorwegen en Zweden. De verschillen waren groter in Engeland en Wales en meer nog in Finland. De grootste verschillen werden waargenomen voor Frankrijk, Italië en de Verenigde Staten. Dezelfde rangorde van landen werd waargenomen in een vergelijking van sociaal-economische verschillen in sterfte in steden uit Nederland (Rotterdam), Noorwegen, Zweden en Finland. Interessant was dat het vóórkomen van kleine sterfteverschillen sterk bleek samen te hangen met het bestaan van egalitair sociaal-economisch beleid.

*Vergelijkingen voor de jaren '80*
Nationale gegevens over doodsoorzaak-specifieke sterfte naar beroepsklasse of opleidingsniveau werden verkregen uit longitudinale en cross-sectionele studies uit 11 West-Europese landen, de Verenigde Staten en drie Oost-Europese landen. De gegevens betroffen sterfte onder mannen 30-64 jaar in de periode tussen 1979 en 1991. Gegevensbestanden werden aangemaakt door nationale teams en centraal geanalyseerd door het coördinerende centrum te Rotterdam. Grote inspanningen werden geleverd om de vergelijkbaarheid van de beschikbare gegevens zo veel als mogelijk te verbeteren. In verschillende landen werden beroepsgegevens op individueel niveau opnieuw gecodeerd volgens een standaard beroepsklassenschema. Van gegevensproblemen die niet langs deze weg konden worden opgelost, werd geëvalueerd in hoeverre zij de resultaten konden beïnvloeden. De omvang van sterfteverschillen werd gemeten aan de hand van een aantal elkaar aanvullende maten. De resultaten die werden verkregen met beroepsgegevens werden, waar mogelijk, vergeleken met de resultaten voor opleiding.

In hoofdstuk 5 werden West-Europese landen vergeleken met betrekking tot sterfteverschillen naar beroepsgroep. De resultaten van deze analyse onderstrepen niet zozeer de verschillen tussen landen als wel hun overeenkomsten. In elk land hadden handarbeiders ('manual classes') een hogere sterfte dan employees ('non-manual classes'). Het verschil in sterfte onder mannen 45-59 jaar was bij benadering even groot in zowel Engeland en Wales, Ierland, Denemarken, Noorwegen, Zweden, Zwitserland, Italië, Spanje en Portugal. Relatief grote verschillen werden alleen waargenomen voor Finland en vooral voor Frankrijk. Hetzelfde internationale patroon werd waargenomen voor mannen 60-64 jaar, maar niet voor mannen 30-44 jaar. In het laatste geval was er bewijs voor relatief grote sterfteverschillen in Noorwegen, Zweden en vooral in Finland (er bestonden geen gegevens over Franse mannen 30-44 jaar). Wanneer de bevolkingsomvang van de verschillende beroepsklassen in de berekeningen werd meegewogen, werden de kleinste sterfteverschillen waargenomen voor Zwitserland, Italië en Spanje. In tegenstelling tot de resultaten voor de jaren '70 gaven deze resultaten voor de jaren '80 geen steun voor de verwachting dat sterfteverschillen kleiner zijn in landen met een meer egalitair sociaal-economisch beleid.

In hoofdstuk 6 werden dezelfde West-Europese landen vergeleken voor wat betreft verschillen in sterfte aan specifieke doodsoorzaken. Een onderscheid naar doodsoorzaak werd gemaakt teneinde in meer detail na te kunnen gaan in hoeverre de situaties in de verschillende landen met elkaar overeenstemmen, en teneinde verklaringen te kunnen aandragen voor de gevonden verschillen. Alle analyses betroffen mannen 45-59 jaar. Voor sommige doodsoorzaken werd een noord-zuid gradiënt waargenomen. Sterfte aan ischemische hartziekten hing sterk samen met beroepsklasse in Engeland en Wales, Ierland, Denemarken, Noorwegen, Zweden en Finland, maar niet in Frankrijk, Zwitserland, Italië, Spanje en Portugal. De zuidelijke landen kenden daarentegen grotere verschillen in sterfte aan kanker (behalve longkanker) en aandoeningen van het spijsverteringsgestel. De grote sterfteverschillen die in hoofdstuk 5 werden waargenomen voor Frankrijk, konden grotendeels worden toegeschreven aan uitzonderlijk grote verschillen in sterfte aan levercirrhose en aan kankers van de maag, slokdarm en monden keelholte. Het feit dat deze aandoeningen overmatig alcoholgebruik als gemeenschappelijke risicofactor hebben, vormt een sterke aanwijzing dat alcoholconsumptie een belangrijke bijdrage heeft geleverd aan de uitzonderlijk grote sterfteverschillen in Frankrijk.

In hoofdstuk 7 werd de analyse uitgebreid naar de Verenigde Staten. Het sociaal-economische beleid in dit land is veel minder egalitair in vergelijking tot Zweden en ook, zij het in mindere mate, in vergelijking tot Engeland en Wales. Indien egalitair beleid zou leiden tot een aanzienlijke verkleining van sociaal-economische verschillen in sterfte, zou dit effect zichtbaar kunnen worden in een trans-atlantische vergelijking. Teneinde zulk een effect te kunnen traceren, werden de Verenigde Staten in detail vergeleken met Engeland en Wales en Zweden. Voor elk van deze drie landen werden verschillen tussen beroepsklassen in de sterfte onder mannen 30-59 jaar beschreven. Een onderscheid werd gemaakt tussen 2 leeftijdsgroepen, 6 beroepsklassen en 9 doodsoorzaken. De belangrijkste bevinding was dat verschillen in de totale sterfte bij benadering groot waren in elk van deze landen. Meer variatie tussen deze landen werd echter waargenomen bij een onderscheid naar beroepsklasse en doodsoorzaak. De klasse van lagere employees ('routine non-manual') had een relatief hoge sterfte in de Verenigde Staten, maar niet in de Europese landen. Het sterfteniveau van ongeschoolde handarbeiders was even hoog in elk van deze landen. In Verenigde Staten was de sociaal-economische gradiënt in sterfte relatief groot voor luchtwegaandoeningen, en relatief klein voor onder meer ischemische hartziekte, verkeersongevallen en zelfmoord. Deze resultaten laten zien dat de Verenigde Staten niet duidelijke grotere sterfteverschillen hadden, ondanks een veel minder egalitair beleid op sociaal-economische terrein en ten aanzien van de gezondheidszorg. Vermoedelijk zijn sterfteverschillen in de Verenigde Staten minder groot dan men mocht verwachten dankzij een aantal uiteenlopende factoren van onder meer culturele aard.

In hoofdstuk 8 werd de analyse in oostwaartse richting uitgebreid. Aan het eind van de jaren '80 lag het nationale sterfteniveau van landen in Oost-Europa beduidend hoger dan in West-Europese landen. Dit gold met name voor mannen van circa 30-65 jaar. Dit hoge sterfteniveau roept de vraag op of de sterfte in het bijzonder verhoogd was onder de lagere sociaal-economische groepen, of dat lagere groepen tot 1989 tot op zekere hoogte werden beschermd door het (in naam) egalitaire beleid van de communistische regimes. Internationaal vergelijkbare gegevens over sociaal-economische verschillen in sterfte onder mannen 30-59 jaar waren beschikbaar voor drie Oost-Europese landen: de Tjechische Republiek, Hongarije en Estland. De sterftegegevens kwamen van cross-sectionele studies van circa 1990. In elk Oost-Europees land bleken, net als in West-Europa, mannen uit lagere sociaal-economische groepen een hogere kans te hebben op vroegtijdige sterfte. Sociaal-economische verschillen in zowel de totale sterfte als de sterfte aan specifieke doodsoorzaken waren minstens zo groot in de Tjechische Republiek en Estland als in West-Europa. Bijzonder groot waren de sterfteverschillen in Hongarije. Deze resultaten tonen aan dat in het voormalige Oostblok het daar gevoerde beleid, dat verondersteld werd meer egalitair te zijn dan in het Westen, niet heeft geresulteerd in relatief kleine sterfteverschillen. De resultaten doen vermoeden dat de factoren die verantwoordelijk zijn voor het hoge sterfteniveau van Oost-Europese landen, zoals sociale desintegratie, psychosociale stress en schadelijke levenswijzen, de lagere sociaal-economische groepen meer dan evenredig hebben getroffen.

Hoofdstuk 9 besteedde speciale aandacht aan ischemische hartziekten (waaronder het hartinfarct). In de Verenigde Staten en Noord-Europa is de sociaal-economische gradiënt in sterfte aan deze ziekte snel veranderd.

Was het vroeger een 'managers-ziekte', thans is ischemische hartziekte een 'volksziekte'. Deze variaties over de tijd doen vragen rijzen ten aanzien van variaties tussen landen: wordt dezelfde veranderlijkheid waargenomen over ruimte als over de tijd? Zo ja, welke omstandigheden zijn op deze veranderingen van invloed? In hoofdstuk 9 werden de Verenigde Staten en 11 West-Europese landen vergeleken met betrekking tot sterfteverschillen onder mannen 30-64 jaar. Binnen West-Europa werd hetzelfde Noord-Zuid gradiënt waargenomen als in hoofdstuk 6, met grote sterfteverschillen in het noordelijke deel van Europa, maar niet in Frankrijk en meer zuidelijke landen. De Verenigde Staten bleken een tussenliggende positie in te nemen. De geringe sterfteverschillen in Zuid-Europa houden waarschijnlijk verband met kleine sociaal-economische verschillen ten aanzien van onder meer roken en voedingsfactoren. De Zuid-Europese situatie kan voor een deel worden begrepen in termen van 'vertraagde transitie': de omslag van 'managersziekte' naar 'volksziekte' die zich voltrok in de Verenigde Staten in de jaren '50, gevolgd door Noord-Europa in de jaren '60, voltrok zich in meer zuidelijke landen pas in de jaren '80 of later. Deze omslag, en de langzame diffusie van noord naar zuid, wordt vermoedelijk meer bepaald door culturele invloeden dan door sociaal-economische omstandigheden.

Hoofdstuk 10 besteedde speciale aandacht aan cerebrovasculaire aandoeningen (onder meer hersenbloeding). Verschillende studies hebben waargenomen dat mensen uit lagere sociaal-economische groepen een hogere kans hebben om aan cerebrovasculaire aandoeningen te overlijden vóór het bereiken van de oude dag. Onzeker is echter of hier sprake is van een verband dat algemeen geldt in de geïndustrialiseerde wereld. Het is mogelijk dat, net als bij sterfte aan ischemische hartziekten, sociaal-economische verschillen in sterfte aan cerebrovasculaire aandoeningen relatief klein of zelfs afwezig zijn in sommige landen. Hoofdstuk 10 bracht deze verschillen in kaart voor de Verenigde Staten en 11 West-Europese landen. Dit hoofdstuk betrof mannen 30-64 jaar. In alle onderzochte landen bleek sterfte aan cerebrovasculaire aandoeningen aanzienlijk hoger te zijn onder handarbeiders dan onder employees. De grootste verschillen werden waargenomen voor Engeland en Wales, Ierland en Finland. Relatief kleine verschillen werden waargenomen voor Denemarken, Noorwegen, Zweden, Italië en Spanje. Hoewel sociaal-economische verschillen in cerebrovasculaire aandoeningen in elk land bleken te bestaan, was het waarschijnlijk dat de oorzaken van deze sterfteverschillen van land tot land verschilden. Vermoedelijk zijn sociaal-economische gradiënten in roken van grote invloed op sterfteverschillen in noordelijke landen van Europa, terwijl alcoholconsumptie meer van invloed is op de sterfteverschillen in de zuidelijke landen. De relatief grote sterfteverschillen in Engeland en Wales illustreren dat het wegnemen van financiële drempels in de toegang tot gezondheidszorg, verre van voldoende is om een aanzienlijke reductie in sterfte aan cerebrovasculaire aandoeningen te bewerkstelligen.

*Beschouwing*
In hoofdstuk 11 werden de bovengenoemde resultaten uitvoerig besproken. Een samenvatting (11.1) en inleiding (11.2) op hoofdstuk 11 werd gevolgd door vijf secties.

Sectie 11.3 gaf een systematisch overzicht van de resultaten van de internationale vergelijkingen die voor de jaren '70 en '80 zijn uitgevoerd. In hun geheel genomen laten de resultaten zien dat sociaal-economische verschillen in sterfte een hardnekkig maar veranderlijk fenomeen zijn. De hardnekkigheid blijkt uit de bevinding dat er geen land is waar sociaal-economische verschillen in sterfte klein zijn vanuit een internationaal perspectief of vanuit een historisch perspectief. Het feit dat sociaal-economische verschillen bestaan voor een breed scala van doodsoorzaken, onderstreept hun algemeen karakter. De veranderlijkheid die daar tegenover staat, bleek uit de bevinding dat in sommige landen sociaal-economische verschillen in totale sterfte duidelijker groter zijn dan het internationale gemiddelde. Bovendien bleek dat het patroon van sterfteverschillen naar doodsoorzaak en naar leeftijd aanzienlijk van land tot land varieert.

In sectie 11.4 werd geëvalueerd in hoeverre de bevindingen vertekend kunnen zijn door problemen met de betrouwbaarheid en de vergelijkbaarheid van de beschikbare gegevens. De studies voor de jaren '80 bereikten een veel grotere mate van vergelijkbaarheid dan voorgaande studies, mede dankzij intensieve samenwerking tussen nationale teams en het coördinerende centrum. Een getalsmatige evaluatie van de resterende gegevensproblemen maakte het waarschijnlijk dat die gegevensproblemen niet de verklaring vormen van de internationale patronen die hierboven zijn samengevat. Onduidelijk is nog wel in hoeverre de situaties in de verschillende landen met elkaar overeenstemmen dan wel verschillen. Met name moet vermeld worden dat het mogelijk is dat in Ierland, Spanje en Portugal de verschillen in werkelijkheid zo groot zijn als in Frankrijk.

Sectie 11.5.1 beoogde een verklaring te geven van de gebleken hardnekkigheid van sociaal-economische verschillen in sterfte. Deze hardnekkigheid ondersteunt de idee dat beroepsklasse een 'fundamentele' oorzaak van vroegtijdige sterfte is: beroepsklasse kan een invloed op de overlevingskansen van mensen uitoefenen, ongeacht de precieze aandoeningen en geassocieerde risicofactoren waarlangs die invloed zal lopen. Betoogd wordt dat beroepsklasse deze flexibiliteit ontleent aan het feit dat het een breed scala van hulpbronnen aan zich bindt. Het betreft aan de ene kant de hulpbronnen die een persoon nodig heeft om een hoge beroepspositie te bereiken, en aan de andere de hulpbronnen die toevloeien aan de personen die een hoge positie in het beroep daadwerkelijk hebben bereikt.

Ondanks de hardnekkigheid van sociaal-economische verschillen in sterfte, bleken er aanzienlijke variaties te bestaan tussen landen in hun precieze omvang en in het patroon naar onder meer doodsoorzaak. In sectie 11.5.2 kwam de vraag aan de orde welke factoren in staat zijn de hardnekkige verbanden tussen beroepsklasse en vroegtijdige sterfte te modificeren. Het ontbreken van een verband met egalitair sociaal-economisch beleid betekent dat ook andere factoren van invloed zijn op de omvang van sterfteverschillen, en dat sommige van deze factoren zo sterk zijn, dat zij een effect van egalitair beleid verhullen. Door middel van een systematisch overzicht werden een groot aantal factoren geïdentificeerd die van invloed kunnen zijn op de omvang van sociaal-economische verschillen in sterfte. Het is van belang te onderkennen dat de maatschappelijke verdeling van inkomen en andere schaarse materiële hulpbronnen niet alleen wordt bepaald door de mate waarin egalitair sociaal-economische beleid wordt gevoerd. Sterfteverschillen in een land worden bovendien beïnvloed door onder meer (a) specifieke patronen van sociale mobiliteit, (b) het nationale vóórkomen van risicofactoren zoals overmatige alcohol-consumptie en specifieke voedingsgewoonten en (c) sociaal-culturele omstandigheden die van invloed zijn op sociale gradiënten in deze risicofactoren. Uit het overzicht werd geconcludeerd dat een breed scala van factoren tezamen bepalen hoe groot sociaal-economische verschillen in sterfte in individuele landen zijn. Met het huidige bewijsmateriaal is het moeilijk de rol te bepalen van afzonderlijke factoren. Dit geldt ook voor de rol van egalitair sociaal-economisch beleid.

Sectie 11.6 besprak de relevantie van de bevindingen voor onderzoek en beleid ten aanzien van sociaal-economische verschillen in sterfte. Deze sectie illustreerde dat internationaal vergelijkend onderzoek voor verschillende doeleinden kan worden aangewend. Dit type onderzoek kan (a) een maatstaf verschaffen aan de hand waarvan men zich een oordeel kan vormen van de situatie in een afzonderlijk land, (b) bijdragen tot de verklaring van sociaal-economische verschillen in sterfte door aanwijzingen te geven omtrent de rol van individuele risicofactoren, (c) bijdragen tot beleid door afzonderlijke landen te bestuderen als 'natuurlijke experimenten' in het reduceren van sociaal-economische verschillen in sterfte, en (d) achtergrondinformatie te verschaffen bij de uitwisseling van resultaten van onderzoek tussen verschillende landen, en bij de internationale coördinatie van toekomstig onderzoek.

Sectie 11.7 beëindigde het proefschrift met aanbevelingen voor toekomstig vergelijkend onderzoek. Deze sectie begon met een bespreking van de 4 bovengenoemde doelen, die elk op zich een reden kunnen zijn voor onderzoekers om een nieuwe internationale vergelijking te starten. Vervolgens werden de drie problemen besproken die ook toekomstige onderzoekers zullen tegenkomen: (a) problemen met de beschikbaarheid van gegevens uit individuele landen, (b) problemen met de internationale vergelijkbaarheid van de beschikbare gegevens, en (c) problemen met de verklaring van de waargenomen internationale patronen. Op basis van de ervaringen die in dit onderzoek zijn opgedaan, werden verscheidene suggesties gedaan voor het omgaan met deze problemen.

# List of publications

This thesis is based on the following publications:

1. Kunst AE, Mackenbach JP. Measuring socio-economic inequalities in health. Copenhagen: World Health Organization, 1994.
   Re-used in chapter 2.

2. Kunst AE, Mackenbach JP. Measuring socio-economic inequalities in mortality. In: Masuy-Stroobant G, Gourbin C, Buekens P (eds). *Santé et mortalité des enfants en Europe: inégalités sociales d'hier et d'ajourd'hui.* Louvain-la-Nueve, Belgium: Academia-Bruylant l'Harmattan, 1996: 97-127.
   Re-used in chapter 2, with permission of Academia Bruylant (copyright holder).

3. Mackenbach JP, Kunst AE. Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Social Science & Medicine* 1997; 44: 757-771.
   Parts of this paper are re-used in chapter 2.

4. Kunst AE, Mackenbach JP. (1996) International comparison of socio-economic inequalities in mortality. In: Evolution or revolution in European population: contributed papers to sessions V-VII of the 1995 European Population Conference at Milano. Milano: Franco Angeli, 1996, p.95-116.
   Parts of this paper are re-used in chapters 3 and 11.

5. Kunst AE, Mackenbach JP. International variation in the size of mortality differences associated with occupational status. *Int J Epidemiol* 1994; 23: 742-750.
   Re-used in chapter 3, with permission of the American Public Health Association (copyright holder)

6. Kunst AE, Mackenbach JP. The size of mortality differences associated with educational level in nine industrialized countries. *Am J Public Health* 1994; 84: 932-937.
   Re-used in chapter 4, with permission of International Epidemiological Association (copyright holder)

7. Kunst AE, Groenhof F, Mackenbach JP, the EU Working Group on Socio-economic Inequalities in Health. Occupational class and mortality among men 30-64 years in 11 European countries. Submitted.
   Re-used in chapter 5.

8. Kunst AE, Groenhof F, Mackenbach JP, the EU Working Group on Socio-economic Inequalities in Health. Occupational class and cause-specific mortality in 11 European countries. Submitted.
   Re-used in chapter 6.

9. Kunst AE, Groenhof F, Mackenbach JP, the EU Working Group on Socio-economic Inequalities in Health. Mortality by occupational class in the United States: a comparison to England & Wales and Sweden. Submitted.
   Re-used in chapter 7.

10. Kunst AE, Groenhof F, Mackenbach JP, the EU Working Group on Socio-economic Inequalities in Health. Socio-economic inequalities in mortality East and West: three former socialist countries compared to the United States and to western Europe. Submitted.
    Re-used in chapter 8.

11. Kunst AE, Groenhof F, Mackenbach JP, the EU Working Group on Socio-economic Inequalities in Health. Differences between occupational classes in cardiovascular disease mortality: a comparisons of 11 European countries. In: National Heart, Lung, and Blood Institute. *Report to the Conference on Socio-economic Status and Cardiovascular Health and Disease, November 6-7, 1995.* Bethesda, Maryland: NHLBI, 1996: 49-56.
    Re-used in chapters 9 and 10.

12. Kunst AE, Groenhof F, Mackenbach JP, the EU Working Group on Socio-economic Inequalities in Health. Occupational class and ischemic heart disease mortality in the United States and 11 European countries. Submitted.
    Re-used in chapter 9.

13. Kunst AE, Rios M del, Groenhof F, Mackenbach JP, the EU Working Group on Socio-economic Inequalities in Health. Socio-economic inequalities in stroke mortality in the United States and 11 European countries. Submitted.
    Re-used in chapter 10.

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Several participants to the second project, and researchers in other fields of comparative social science, have asked me how we have managed to complete these complex and laborious cross-national comparisons in only a few years of time.

Part of the answer lies in the Department of Public Health, which offers a highly stimulative and supportive environment for scientific research. The excellent secretarial and automatization support services at the Department protected me against many of the day-to-day nuisances that would otherwise distract my attention from scientific work. I would like to thank especially Else van den Engel for the secretarial support that she always was glad to provide. Thanks to the documentation centre on health inequalities that is run by Hanneke van Trirum and Karien Stronks (JECH 1996;50:5) I could always instantaneously identify and obtain most of the relevant publications on inequalities in health. No less enriching than all this literature were the many times that I could discuss with Karien Stronks the wide range of issues that touch upon the study of health inequalities.

Three persons have made essential contributions to the success of the comparative projects. Adriënne Cavelaars formed part of the coordinating centre of the second project. She was primarily responsible for analysis of socio-economic differences in self-reported morbidity, on which she will publish a thesis in 1998. Notwithstanding her focus on morbidity, Adriënne was always ready to provide the helping hand (and maintain the good temper) that is needed to keep a large-scale project running smoothly. Chapters 5 to 10 of this thesis benefitted from her detailed comments.

It is not without reason that Feikje Groenhof acts as the second author to the papers that are re-used in chapters 5 to 10. During the second project, she faced the huge task to process mortality data sets from no less than 18 countries (including the two Germanies and Canada), to analyze these data sets in a comparable way, and to solve the many data problems that emerged during the analysis. She was able to face this task thanks to the combination of orderliness, accuracy and perseverance that characterizes her work. If there is any person with whom I would like to share the credits of this completing thesis, it is Feikje.

Without Johan Mackenbach, this thesis would never have been written. He took the initiative to both the first and second project and succeeded in acquiring the necessary funds. His supervision secured that both projects were carried out efficiently and well directed towards pre-defined scientific goals. His ability to quickly detect any error in analysis or flaw in reasoning greatly stimulated me to work conscientiously, and assured me that any paper that had his approval met high scientific standards. Above all, I thank Johan for having taught me the ever challenging craft of empirical research.

This thesis attests my strong desire to end up with a text that is both transparent in thoughts and firmly based on facts, like a crystal pyramid. Now that I am ready, I realise that whether or not you enjoy this pyramid depends on where it stands, the colours it reflects. From my position I see, inevitably, the colours of Blanca. She did not contribute to the thesis itself, but she nonetheless was present all the time. Whenever I felt sad because I achieved much less than I planned, her encouragements made me feel proud of what I did achieve and made me go ahead. When things did not get clear, however hard I was thinking, her humorous observations made me stop thinking and let clarity appear for itself. It is above all the warm colour of her love that makes me feel so happy to see this thesis being completed.

# About the author

Anton Kunst was born on 31 August 1960 in Eelde, a suburban village in the north of the Netherlands. He was sixth in a protestant family of finally seven children. His mother was housewife, his father was sales manager (social class II).

After completing his secondary education (Athenaeum) at the St. Augustine College at Groningen, he started in 1978 with the study of social geography at the University of Groningen. There he obtained the Bachelor's degree in social geography in 1981, and the Master's degree in demography in 1985. His interest in public health and medical demography awakened in 1983 during a visit of seven months to El Colegio de México, where he performed a study on area variations in infant mortality within Mexico-City.

Since 1985 he is affiliated with the Department of Public Health of the Erasmus University Rotterdam, first as full-time researcher and since 1996 as associate professor. The main research projects in which he was involved dealt with regional mortality differences (1985-1988), trends in socio-economic mortality differences (1988-1989), seasonal and daily mortality fluctuations (1989-1991), competing causes of death and cause-elimination life tables (1992-1994), and cross-national comparisons of socio-economic differences in mortality and self-reported morbidity (1991-1996).

He is married with Blanca Estela Cano González. They have three lovely children, Laura (1991), Elisa (1993) and Arjan (1995).

**Appendix tables D and E**
Evaluations of the adjustment procedure.

**Table D** Evaluations for four Western European countries.
Low *versus* high mortality rate ratios for two follow-up periods (*ca.* 1981-85 and 1986-90) or three (plus 1976-80).
Men 50-59 years at the start of each period.

| Country / Follow-up period (years) | Low *versus* high education | | | Manual *vs.* non-manual | |
|---|---|---|---|---|---|
| | All men | Excluding inactive | Idem, adjusted[a] | Excluding inactive | Idem, adjusted[b] |
| Finland | | | | | |
| 0-4 | 1.42 | 1.21 | 1.47 | 1.18 | 1.41 |
| 5-9 | 1.52 | 1.34 | 1.53 | 1.39 | 1.56 |
| Norway | | | | | |
| 0-4 | 1.31 | 1.15 | 1.32 | 1.13 | 1.28 |
| 5-9 | 1.37 | 1.27 | 1.39 | 1.23 | 1.33 |
| France | | | | | |
| 0-4 | 1.51 | 1.29 | 1.42 | 1.32 | 1.49 |
| 5-9 | 1.54 | 1.48 | 1.55 | 1.42 | 1.51 |
| 10-14 | 1.75 | 1.72 | 1.78 | 1.64 | 1.71 |
| Italy (Turin) | | | | | |
| 0-4 | 1.21 | 1.02 | 1.16 | 0.98 | 1.16 |
| 5-8 | 1.33 | 1.24 | 1.32 | 1.18 | 1.28 |

[a] By adjustment formula (3). Input parameters measured per subperiod. As constants are assumed 1.2 (low education) and 0.6 (high education).
[b] By adjustment formula (4a,b). Input parameters measured per subperiod.

**Table E** Evaluation for the United States.
Low *versus* high mortality rate ratios in two follow-up periods (1979-1984 and 1985-1989).
Men 40-54 years at the start of each period.

| Socio-economic indicator *[a]* | Rate ratio (95% CI) | | % increase in rate ratio |
|---|---|---|---|
| | 0-4 yr follow-up | 5-9 yr follow-up | |
| Education: | | | |
| - all men | 1.87 (1.61 -2.18) | 2.06 (1.70 -2.49) | 10.2 |
| - excluding inactive men | 1.66 (1.39 -1.98) | 1.98 (1.61 -2.44) | 19.3 |
| Occupation: | | | |
| - excluding inactive men | 1.31 (1.12 -1.53) | 1.67 (1.41 -1.97) | 27.5 |
| - adjusted *[b]* | 1.52 (1.30 -1.77) | 1.81 (1.53 -2.14) | 19.0 |

[a] Education: elementary only *versus* college 1-3 or more.
Occupation: unskilled manual *versus* professional, manager etc.
[b] By adjustment formula (3). Input parameters measured per period.

**Appendix tables A, B and C**

Factors for adjusting standardised mortality ratios (SMRs) for the exclusion of (part of) economically inactive men. Men 45-59 years at death.

**Table A** Adjustment factors used in chapters 4 and 5

| Country | Input parameters: % of person-years at risk lived by excluded men | Input parameters: mortality RR of excluded inactive men *vs.* other men | Adjustment factor: SMR non-manual *[a]* | Adjustment factor: SMR manual *[a]* | Adjustment factor: Rate ratio *[b]* |
|---|---|---|---|---|---|
| Finland | 14.2 | 3.15 | -5.9 | 5.9 | 12.4 |
| Sweden | 12.3 | 3.31 | -5.5 | 5.5 | 11.7 |
| Norway | 18.6 | 2.27 | -4.8 | 4.8 | 10.0 |
| Denmark | 6.6 | 3.45 | -3.5 | 3.5 | 7.2 |
| England/Wales | 5.6 | 1.78 | -1.2 | 1.7 | 3.0 |
| Ireland | 7.2 | 1.96 | -1.9 | 2.6 | 4.6 |
| France | 2.6 | 3.23 | -1.6 | 2.2 | 3.9 |
| Switzerland | 5.1 | 1.33 | -0.5 | 0.7 | 1.2 |
| Italy | 10.6 | 4.86 | -8.7 | 11.6 | 22.3 |
| Spain | 13.2 | 3.05 | -6.4 | 8.5 | 15.9 |
| Portugal | 17.3 | 1.78 | -3.6 | 4.8 | 8.7 |

**Table C** Adjustment factors used in chapter 7

| Country | % of person-years at risk lived by excluded men | mortality RR of excluded inactive men *vs.* other men | SMR non-manual *[a]* | SMR manual *[a]* | Rate ratio *[b]* |
|---|---|---|---|---|---|
| Czech Republic | 0.8 | 4.19 | -1.6 | 0.6 | 2.3 |
| Hungary | 25.1 | 3.90 | -26.0 | 9.0 | 34.0 |
| United States | 7.7 | 2.87 | -3.8 | 5.0 | 9.1 |
| England/Wales | 5.6 | 1.78 | -1.2 | 1.7 | 3.0 |
| Norway | 18.6 | 2.27 | -4.8 | 4.8 | 10.0 |
| France | 2.6 | 3.23 | -1.6 | 2.2 | 3.9 |
| Finland | 14.2 | 3.15 | -5.9 | 5.9 | 12.4 |

**Table B** Adjustment factors used in chapter 6

| | United States | England & W | Sweden |
|---|---|---|---|
| Input parameters | | | |
| - Mortality RR of excluded men *versus* included men | 2.87 | 1.78 | 3.31 |
| - % of person-years-at-risk lived by excluded men | 7.66 | 5.57 | 12.26 |
| - Constant *[c]* | | | |
| professional, manager, etc | 0.65 | 0.65 | 0.77 |
| routine non-manual | 0.96 | 0.96 | 0.97 |
| foremen, skilled manual | 1.39 | 1.39 | 1.26 |
| unskilled manual | 1.59 | 1.59 | 1.39 |
| farmer, farm labourer | 0.71 | 0.71 | 0.81 |
| self-employed | *n.a.* | 0.51 | 0.68 |
| Adjustment factor *[a]* | | | |
| - Professional, manager, etc | -4.4 | -1.5 | -5.1 |
| - Routine non-manual | -0.5 | -0.2 | -0.6 |
| - Foremen, skilled manual | +4.9 | +1.6 | +5.7 |
| - Unskilled manual | +7.4 | +2.5 | +8.6 |
| - Farmer, farm labourer | -3.6 | -1.2 | -4.2 |
| - Self-employed | *n.a.* | -2.1 | -7.1 |

[a] Represents the % by which the class-specific SMRs should be decreased (-) or increased (+) in order to approach the SMRs that would have been observed when all inactive men with unknown occupation would have been included.

[b] Adjustment factor for the manual *versus* non-manual rate ratio.

[c] Survey estimates of the proportion of men in class *x* that are economically inactive, divided by the proportion for all classes.