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Monitoring of trends in socioeconomic inequalities in mortality: Experiences from a European project

Anton E. Kunst, Vivian Bos, Otto Andersen, Mario Cardano, Giuseppe Costa, Seeromanie Harding, Örjan Hemström, Richard Layte, Enrique Regidor, Alison Reid, Paula Santana, Tapani Valkonen, Johan P. Mackenbach

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Demographic Research – Special Collection 2: Article 9
-- Determinants of Diverging Trends in Mortality --

Research Article

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Abstract

Background

Studies from several countries reported that the relative mortality gap between low and high socioeconomic groups widened during the 1970s and 1980s. While this well-known finding has important policy implications and prompted research on underlying causes, it also calls for more a detailed and accurate monitoring of past and current trends.

Objectives

The aim of this paper is to present new estimates of changes in socioeconomic inequalities in mortality between the 1980s and the 1990s in different European countries. The estimates are given with the specific aim to illustrate (i) large variations, both within and between countries, in the pace by which socioeconomic inequalities in mortality changed over time, and (ii) the considerable degree to which the observed trends may be sensitive to data problems and to the methodological choices made.

Data and methods

The paper is based on a EU sponsored project on monitoring of socio-economic inequalities in mortality and morbidity. Data were obtained on all-cause mortality by occupational class and educational level in nine western European countries both in the early 1980s and in early 1990s. Trends in mortality were analysed by assessing trends in (a) group-specific standardised mortality rates and (b) summary measures of the magnitude of mortality differences between socioeconomic groups.

Results

The weight of evidence from all countries points towards a widening of relative inequalities in mortality between the early 1980s and early 1990s, while the absolute gap remains about the same. However, important variations were observed in the pace of change, both between countries, and within countries (between men and women, and between age groups). In addition, a widening of relative inequalities was found to concur with decreasing life expectancies of the disadvantaged groups in some cases, but increasing life expectancies in many other cases.

A second series of analyses illustrate that, even though there may be little doubt that relative inequalities in mortality widened in many countries, data problems can often impede an accurate assessment of the precise rate of change. For example, trends in mortality differences between occupational classes can strongly depend on (a) the social class scheme used and (b) whether or not economically inactive persons are included in the analysis. The use of "unlinked" cross-sectional studies may suffer from subtle but influential biases.

Conclusion

Monitoring of trends in inequalities in mortality should go beyond the simple assessment such as "the gap is widening", and monitor in detail the pace of change, both for the national populations at large and for sub-populations such as specific age-sex groups. This monitoring needs to evaluate carefully the potential effects of data problems as well as the choice for specific methods and indicators.

1. Introduction

Studies that reported a widening of socio-economic inequalities in mortality have attracted much attention in the epidemiological and demographic literature. The interest in this issue was considerably enhanced by the Black Report, published in the summer of 1980, whose most important single observation was that mortality differences by occupational class in England and Wales increased during the 1950s and 1960s, despite the institution of the National Health Service (Townsend, 1988). This observation sparked a heated debate, which was further stimulated by new reports on a continued widening of the mortality gap during the 1970s (Marmot, 1986).

Most studies on trends in mortality differentials that have been carried out since then, both in England and elsewhere in Europe, focussed on the basic question whether socioeconomic inequalities in mortality widened or narrowed during the last decades. The accumulated evidence suggests that during the 1970s and 1980s socio-economic inequalities in mortality widened in many European countries (Borrell, 1997; Dahl, 1993; Diderichsen, 1997; Harding, 1995; Jozan, 1999; Mackenbach, 1997; Lang, 1995; Regidor, 1995; Shaw, 1999; Shkolnikov, 1998; Valkonen, 1993). The view that inequalities in mortality are generally increasing is now widely held. It implied that one cannot be confident that these inequalities would gradually fade away with further medical and economic progress. Instead, the observed widening underscores that policies are needed that explicitly aim at reducing socio-economic inequalities in mortality in the years to come.

In order to inform such policies, future descriptive studies will need to go beyond a simple characterisation of past trends in terms of “widening” or “narrowing”. Targeted policies may not be able themselves to revert the increase of the past into a decrease in the future. However, interventions may help to slow down an increase in inequalities or, if a decline started, to accelerate this decline. In order to be able to determine such effects, accurate estimates are needed on the *pace* of change, both before and after the intervention. For similar reasons, a more detailed monitoring of recent trends is also needed in order to set targets for equity-oriented health policies, and to be able monitor future progress towards reaching these targets.

A more detailed monitoring of past trends in inequalities in mortality requires that the strength of the empirical evidence is assessed more carefully. Until now, data problems have usually been evaluated against the basic question whether these problems can explain the widening that is observed. The answer to this question, when made explicit, has usually been “probably not”. However, when trends in mortality differentials are to be described in more detail, different questions need to be addressed, such as (a) how reliable and precise are estimates of the exact pace of change? and (b) how sensitive are these estimates to the methodological choices made? Admittedly, these are questions that are difficult to answer in most cases. None the less, a critical reflection on the strength of the empirical evidence is needed, and this reflection may be aided by illustrations of specific cases.

This paper will present new estimates of changes in socioeconomic inequalities in mortality between the 1980s and the 1990s in nine European countries. The estimates are given with the specific aims to illustrate (i) the large variations, both within and between countries, in the pace by which socioeconomic inequalities in mortality changed over time, and (ii) the considerable degree to which the trends observed may be sensitive to data problems and to the methodological choices made. Our illustrations are based on data that were obtained and analysed in a recent European project on the monitoring of socio-economic inequalities in mortality and morbidity. Before the illustrations are given (in sections 3 and 4 respectively) we will first briefly describe the data and methods that were employed in this European project (Kunst, 2001).

2. Material and methods

Our project dealt with the monitoring of socioeconomic inequalities in health in the European Union. Its main objectives were to formulate guidelines for the monitoring of these inequalities, and to illustrate these guidelines by analyses of trends in socioeconomic inequalities in mortality and in self-reported morbidity.

For the illustrative analyses in the field of mortality, data on mortality by socioeconomic indicators were obtained for 8 European countries (Finland, Sweden, Norway, Denmark, England and Wales, Ireland, Spain and Portugal) and one city (Turin). Data were obtained for both the 1980s and the early 1990s. In six countries, data were obtained from two longitudinal studies that were based on the populations censuses of circa 1981 and circa 1991 respectively. In these longitudinal data sets, three sub-periods were distinguished, covering approximately the years 1981-1985, 1986-90 and 1991-95. For three other countries, data were obtained from ‘unlinked’ cross-sectional studies that were centred around the population censuses of circa 1981 and circa 1991. For nine countries, data were obtained on mortality among middle-aged men in relation to their occupational class. For four countries, additional data were available on mortality by educational level among men and women 30 to 74 years. Further details on the data obtained are given in the main report (Kunst, 2001).

Differences in mortality according to socio-economic indicators were analysed in two steps. First, directly age-standardised death rates were calculated for each occupational class or educational level, using the 1987 European Standard Population as the standard. Second, the magnitude of the mortality differences were summarised by inequality indices that facilitated comparisons over time (Mackenbach, 1997). In each illustration given in this paper, we will present only one inequality index. In most cases, similar results were obtained by using other inequality indices, such as indices that explicitly take into account the population size of the individual socio-economic groups (Kunst, 2001).

We will use both educational level and occupational class as socioeconomic measures. These measures are conceived as two complementary indicators of the broader concept of "socioeconomic status" (Kunst, 2001). For analyses of time trends in health inequalities, education and occupational class have both their strengths and weaknesses. A main advantage of educational level is that it can be applied to all age and sex groups, while an disadvantage is that changing educational compositions of subsequent generations may reduce comparability over time. The population distribution by occupational class is generally more stable over time. However, occupational data can in most countries only be applied to the male population of working age. Given these strengths and weaknesses, an overview of time trends may best be based on the complementary use of both socioeconomic indicators.

In the statistical analysis, it is important that the measurement of socioeconomic inequalities in mortality can be based on both measures of "relative inequalities" (such as Rate Ratios) and measures of "absolute differences" (such as Rate Differences). Relative measures are used in most analyses as they are generally considered to be of most analytical interest. These measures express the extent to which the mortality burden is unequally distributed between socio-economic groups. Such a distributional measure is a useful complement to measures of the overall level of mortality in a country. This emphasis on distributional measures corresponds to the distinction that underlies the many measures of relative income inequalities (e.g. the GINI coefficient) between the *size* of the total pie and the *share* of each group in this pie.

However, measures of absolute levels of mortality provide important complementary information, because these measures express what finally counts for the people themselves, i.e. their absolute chance of dying. Given this practical importance of absolute levels, in some analysis, we will also present (a) measures of "absolute differences" in mortality between socioeconomic groups and (b) measures of the mortality level of the lower socioeconomic groups. The latter measure is given explicit attention in section 3.3, where mortality levels are summarised in terms that are of most direct relevance to the people, i.e. in terms of life expectancies.

3. Variations in trends

The main purpose of this section is to illustrate that, even though for most countries with reliable data we observe a widening of relative inequalities in mortality together with stability in the absolute mortality differences, there are important variations in the pace of change, both between countries and within countries (between men and women, and between age groups). Also, there are important variations in the extent to which the absolute mortality levels of the lowest groups increased or decreased.

3.1. Variations between countries

In tables 1a and 1b, we present estimates of class differences in mortality among middle aged-men in six countries or cities. Estimates are given for three periods ranging from early 1980s to the early 1990s. All estimates are based on longitudinal studies using death registries linked to the last population census. The measures presented in tables 1a and 1b compare the mortality rate of manual classes to the rate of non-manual classes. Adjustment is made for the exclusion of economically inactive men from the data that were available for Norway, Denmark and Sweden (cf. section 4.2).

In the early 1980's, manual classes had a higher mortality level than non-manual classes in every country included (table 1a). The excess mortality was about 40 percent in most countries, but somewhat larger in Sweden and especially in Finland. These mortality differentials increased in the subsequent 10 years in each country. In most countries, rate rations increased by 0.10 to 0.15 units. The increase was considerably larger in Finland (0.32 units) while it was negligible in Denmark (0.03 units). Thus, even though a widening of relative inequalities was observed in all countries, the pace of increase showed important variations between these countries.

In table 1b, mortality differences are expressed in absolute terms. The absolute difference in mortality rates between manual and non-manual classes remained about stable in most countries. In Finland, however, a much stronger decline of mortality rates in non-manual classes resulted in a widening of the mortality difference with manual classes. Variations between other countries are relatively small.

Table 1a: *The magnitude of relative inequalities in mortality between manual and non-manual classes: men 30-59 years*

Country	**Rate Ratio (95% confidence interval)**			**Change (first to last period)**
	1980-84	**1985-1989**	**1990-94**	
Finland	1.63 (1.58-1.68)	1.85 (1.79-1.90)	1.95 (1.90-2.01)	0.32
Sweden	1.51 (1.47-1.55)	1.53 (1.49-1.58)	1.64 (1.59-1.68)	0.13
Norway	1.42 (1.37-1.47)	1.48 (1.43-1.53)	1.56 (1.50-1.62)	0.14
Denmark	1.46 (1.41-1.51)	1.46 (1.41-1.50)	1.49 (1.44-1.53)	0.03
England & Wales	1.36 (1.24-1.49)	1.49 (1.42-1.65)	1.51 (1.36-1.67)	0.15
Turin	1.33 (1.25-1.42)	1.27 (1.19-1.36)	1.43 (1.33-1.54)	0.10

Table 1b: *The magnitude of absolute mortality differences between manual and non-manual classes: men 30-59 years*

Country	**Rate Difference**			**Change (first to last period)**
	1980-84	**1985-1989**	**1990-94**	
Finland	2.75	3.19	3.28	0.53
Sweden	1.66	1.64	1.57	-0.09
Norway	1.50	1.60	1.48	-0.02
Denmark	1.84	1.89	1.81	-0.03
England	1.40	1.65	1.54	0.14
Turin	1.27	1.02	1.33	0.06

3.2. Variations by age and gender

In table 2, estimates are presented of educational differences in mortality among men and women in two countries (Finland and Norway) and one city (Turin). These estimates are also based on longitudinal studies linked to population censuses. Three age groups are distinguished in each area, including an age group (60-74 years) which is usually ignored when occupational class is used as socio-economic indicator.

The magnitude of mortality differences by educational level is measured by means of the Relative Index of Inequality (RII). This is a regression-based index that measures the systematic association between mortality and relative socioeconomic position across all educational groups (Mackenbach, 1997). This measure is especially useful when three or more hierarchically ordered groups are distinguished, as in the case of educational level. A main advantage of the RII is that it yields estimates that are comparable both over time and between generations

Table 2: *The magnitude of educational differences in mortality in specific age groups*

Gender Country	Age-group	Relative Index of Inequality 1980-1984	 1990-94	 Change	 [a]
Men					
Finland	30-44	2.87	3.36	0.49	*
	45-59	2.16	2.22	0.06	
	60-74	1.72	1.80	0.08	
Norway	30-44	3.16	3.85	0.69	
	45-59	1.87	2.48	0.61	*
	60-74	1.43	1.70	0.27	*
Turin	30-44	1.92	3.02	1.10	
	45-59	1.44	2.03	0.59	*
	60-74	1.35	1.43	0.08	
Women					
Finland	30-44	2.13	3.29	1.16	*
	45-59	1.63	1.92	0.29	*
	60-74	1.67	1.61	-0.06	
Norway	30-44	1.46	2.45	0.99	*
	45-59	1.63	2.01	0.38	*
	60-74	1.49	1.78	0.29	*
Turin	30-44	1.05	1.62	0.57	
	45-59	1.12	1.24	0.12	
	60-74	1.45	1.36	-0.09	

[a] * = difference between the RII's for the two periods is statistically significant ($p<0.05$)

Among Finnish men 30-44 years, the RII was estimated to be 2.87 in the early 1980s, implying that the mortality level at the lower end of the educational hierarchy was 2.87 times the level at the upper end. Ten years later, this mortality excess had increased to 3.36, i.e. a moderate rise of 0.49 units. Increases are also observed among men in other age groups, both in Finland and in Norway and Turin. However, the rate of increase strongly varies by age group, with generally smaller increases among older men.

A similar pattern is observed for women, but with some exceptions. Among women 30-44 years, inequalities in mortality strongly increased over time. In Turin, this increase implied the emergence of mortality differentials that were almost non-existent in the early 1980s. Much smaller increases were observed for women in older age groups. Even a slight narrowing of mortality differentials is observed for women 60-74 years in both Finland and Turin.

Thus, large variations are observed in the pace by which mortality differentials changed in different age-sex groups. Even though the situation in each of the three countries may perhaps be summarised by the statement that “relative inequalities in mortality widened”, the reality is much more diverse than this statement would suggest.

3.3. Variations with respect to trends in absolute mortality levels

For the same populations included in table 2, table 3 presents information on the absolute level of mortality per gender and educational group. Mortality rates for the age groups 30-34 to 70-74 years were summarised by means of partial life expectancies. This measure can be interpreted as the number of years that persons at their 30th birthday can on average expect to live before the 75th birthday. The maximum value is (75 minus 30=) 45 years. This measure of absolute mortality levels (per socioeconomic group) complements the measures of relative inequalities (between socioeconomic groups) that are presented in tables 1 and 2.

For Finnish men with high education, the partial life expectancy increased from 40.37 years in the early 1980’s to 41.39 years in the early 1990’s, i.e. an increase of about 1 year. A much smaller gain in life expectancy was achieved by those with mid or low level of education. A similar pattern, with smaller gains in lower groups, is observed among men in Norway and Turin. This pattern can also be observed among women. Thus, also in terms of life expectancies, inequalities appear to have widened over time.

At the same time, it is important to note that there are large variations in trends in the life expectancies among those with low education. On the one side, life expectancies increased among low educated men in Finland, and among low educated men and women in Turin. On the other side, the life expectancies of low educated women in Finland and Norway slightly declined. Thus, even though inequalities in life expectancies widened among men and women in all countries, important variations appear when these trends are judged in terms of what they implied for the life expectancy of disadvantaged groups.

Table 3: *Partial life expectancy according to educational level. Men and women between 30th and 75th birthday*

Gender		**Partial life expectancy**		
Country	**Educational level**	**1980-1984**	**1990-94**	**Change**
Men				
Finland	High	40.37	41.39	1.02
	Mid	39.08	39.54	0.46
	Low	37.48	38.01	0.53
Norway	High	41.27	41.83	0.56
	Mid	40.28	40.67	0.39
	Low	39.22	39.32	0.10
Turin	High	40.80	41.71	0.91
	Mid	39.67	40.62	0.95
	Low	38.99	39.39	0.40
Women				
Finland	High	42.79	43.08	0.29
	Mid	42.54	42.70	0.16
	Low	41.92	41.89	-0.03
Norway	High	42.97	43.16	0.19
	Mid	42.64	42.76	0.12
	Low	42.08	42.01	-0.07
Turin	High	42.31	43.19	0.88
	Mid	42.36	42.78	0.42
	Low	42.05	42.46	0.41

4. Sensitivity to data problems and methodological choices

The purpose of this section is to illustrate that, even though there may be little doubt that relative inequalities in mortality tended to widen in many European countries, data problems can often impede an accurate assessment of the precise rate of change. In addition, the trends observed can be sensitive to methodological choices such as the use of a specific social class scheme.

4.1. Problems inherent to the use of unlinked cross-sectional data

The illustrations given in section 3 are all based on longitudinal studies. In this section, we illustrate the potential biases that are inherent to using another type of studies: cross-sectional studies of the 'unlinked' type. Table 4 presents estimates of mortality by occupational class in Ireland. The estimates presented in table 4 illustrate our experience that the use of this kind of study can easily lead to biased results due to the so-called 'numerator/denominator' bias.

The first column presents our estimates for 1980-82. The distribution of the 'denominator' population according occupational class is given in the first three rows. The next three rows give the death rates estimated for the three classes. The magnitude of these differences is summarised in the last row by the rate ratio comparing manual to non-manual classes, estimated to be 1.35 for the period 1980-82. The second column presents our initial estimates for the period 1990-92. According to these estimates, the manual vs. non-manual rate ratio was 1.81, which implies an increase of 0.46 units during the preceding decade. From this estimate, one would conclude that mortality differentials in Ireland increased considerably, and that this increase is much larger than observed in any other northern European country (cf. table 1).

Table 4: *Estimates of class-differences in mortality from 'unlinked' cross-sectional data: sensitivity to changes in the denominator data. Ireland, men 30-59 years.*

	1980-82	**1990-92**	
		initial estimate	**final estimate**
Population distribution (%)			
- non-manual	39.5	52.2	48.8
- agricultural	22.5	17.3	15.6
- manual	38.1	30.5	35.6
Death rate (per 1000 p-years)			
- non-manual	4.7	3.0	3.2
- agricultural	4.3	3.5	3.9
- manual	6.2	5.4	4.6
RR manual vs. non-manual	1.35	1.81	1.45
change compared to 1980-82	--	+0.46	+0.10

However, as we were uncertain whether this trend estimate was correct, we critically reviewed the available data. While the data for 1980-82 were found to be reliable, we found out that available data on the population-at-risk (the denominator) in 1990-92 excluded those who were "seeking for work". Given this potential problem, additional data were obtained on the numbers of those "seeking for work" in 1990-92 by age and occupational class, and available estimates of the population-at-risk were corrected accordingly. The last column of table 4 shows estimates corresponding to this new source of data. The percentage of the population belonging to the class of manual workers increased (from 30.5 to 35.6 percent) because this population was over-represented among those "seeking for work". This increase resulted in a decrease in the death rates of manual workers (from 5.4 to 4.6) and a decrease in the mortality rate ratio comparing manual to non-manual workers (from 1.81 to 1.45). Even though this new and more reliable estimate confirms that relative inequalities in mortality increased over time, the pace of increase now appears to be much more modest (0.10 units), and fairly similar to for example the 0.15 increase that was observed for England and Wales (cf. table 1).

While we judged that we were able to obtain fairly reliable estimates for Ireland, this was much less true for most other European countries. An example is given in table 2, which presents estimates from "unlinked" studies for Spain and Portugal (with Ireland included for reference). Although the Spanish results might be considered plausible, they are somewhat surprising. Even though the two periods differ by only 8 years in time, and no major crisis hit Spain during that time (Regidor, 1995), rate ratios for all-cause mortality increased to a much larger extent than observed in any other European country (from 1.43 to 1.95). It is even more difficult to believe that a large increase in rate ratios (from 1.39 to 1.67) also occurred for cancer mortality, which is a cause-of-death group for which overall levels and social inequalities tend to change only gradually. The estimates for Portugal are even less plausible. Our best estimates from the available data for the early 1990s suggested that class differences in total mortality disappeared in the preceding decade, while even a reversal occurred in inequalities in both cancer mortality and cardiovascular mortality.

Table 5: *The magnitude of class differences in cause-specific mortality in three countries with 'unlinked' cross-sectional studies. Men 30-59 years.*

Country	Cause of death	Manual vs. non-manual rate ratio (95 % confidence interval)				
		1980-82		1990-92 (1988-90 in Spain)		Change
Ireland	All causes	1.35	(1.28-1.43)	1.45	(1.36-1.54)	0.10
	Neoplasms	1.34	(1.20-1.50)	1.43	(1.29-1.60)	0.09
	Circulatory diseases	1.28	(1.18-1.39)	1.42	(1.29-1.56)	0.14
Spain	All causes	1.43	(1.36-1.51)	1.95	(1.84-2.07)	0.52
	Neoplasms	1.39	(1.26-1.53)	1.67	(1.52-1.84)	0.28
	Circulatory diseases	1.21	(1.10-1.33)	1.78	(1.58-2.00)	0.57
Portugal	All causes	1.45	(1.40-1.50)	1.04	(1.01-1.09)	-0.33
	Neoplasms	1.16	(1.09-1.24)	0.95	(0.90-1.01)	-0.21
	Circulatory diseases	1.05	(0.98-1.12)	0.82	(0.77-0.87)	-0.23

Closer inspection of the Spanish and Portuguese data suggested that the results may be biased due to subtle differences between the data obtained from the mortality registry (numerator) and the data available from the population census or other surveys (the denominator). This applies especially to the second period. In Spain, differential non-response in the population survey may have resulted in an under-estimation of the population size of manual workers, and thus in an over-estimation of their mortality rate. In Portugal, the results for the second period may be biased because slightly different occupational classifications were applied in the mortality registry and in the population census. Unfortunately, it was impossible to quantify and remedy these possible biases.

These illustrations show that "unlinked" cross-sectional studies on mortality by occupational class may suffer from numerator/denominator bias (cf. Kunst, 1998). Even though these biases may be difficult to detect, they may seriously affect estimates of class differences in mortality, as well as trends in these inequalities.

4.2. The effects of excluding economically inactive people

In many studies on mortality differences by occupational class, the occupation of economically inactive men (e.g. retired, work disabled) is not known. Unfortunately, their exclusion from analysis is likely to lead to an underestimation of class differences in mortality, because these men not only have high mortality rates but they in addition originate mostly from lower occupational classes. This problem raises the question to what extent their exclusion may not only affect estimates of class differences in mortality in one period, but also affect estimates of changes over time in these differences (Kunst, 1998; Kunst, 1998; Martikainen, 1999).

Table 6 shows an evaluation that we made with unpublished data on Finland. The upper and middle parts of the table give relevant basic information. Both in 1981-85 and in 1991-95, (a) the proportion of men who were economically inactive was more than 2 times higher among manual classes than among non-manual classes and (b) the risk of dying of inactive men is much higher than the risks of dying of active men, both within manual classes and within non-manual classes. The lower part of the table 6 shows how exclusion of inactive men would affect inequality estimates. In the total population (active and inactive combined) the manual vs. non-manual mortality rate ratio increased over time from 1.63 to 1.95. When the rate ratios would be estimated for the active population only, they would seem to be much lower: 1.34 and 1.64. However, most important for the present paper is that, even after excluding inactive men, one would observe a strong increase in inequalities in mortality in Finland.

Table 6: *The effect of excluding men who were 'economically inactive' at the last census. Finland, men 30-59 years.*

	1981-85	1991-95	Change
Percentage (of all person years) of men that were inactive at census			
- in manual class (a)	19.0	22.7	-
- in non-manual class (b)	8.0	9.5	-
Mortality rate ratio: inactive vs. active men			
- in manual class	3.30	3.35	-
- in non-manual class	3.54	4.19	-
Mortality rate ratio: manual vs. non-manual			
- in total population	1.63	1.95	0.32
- among active men only	1.34	1.64	0.30

Table 7 presents a similar evaluation that we could make with unpublished, longitudinal data on England and Wales. The upper and middle parts of the table give the same basic information as was given for Finland, although this information is given for the total population only. The lower part of the table shows mortality rate ratios comparing manual to non-manual classes. When all men are included in the study, these rate ratios are found to increase over time from 1.35 to 1.51. This estimate includes men who were 'unclassified' at the last census but who could be classified thanks to the availability of additional information, e.g. from death certificates. When these 'unclassified' men would have been excluded from the estimates, the rate ratios would be lower (1.32 and 1.33). Because this effect is larger in the second period (where a much larger proportion of men is 'unclassified') estimates of trends over time would be biased as well. More specifically, the increase over time in relative inequalities in mortality would be considerably underestimated, or even concealed, when 'unclassified men' would be left out from the analysis.

Table 7: *The effect of excluding men who were 'unclassified' at the last census. England and Wales, men 35-59 years.*

	1981-85	1991-95	Change
Percentage (of all person years) of men that were 'unclassified'			
- in total population	4.1	7.3	
Mortality rate ratio: 'unclassified' vs. rest			
- in total population	2.48	2.86	
Mortality rate ratio: manual vs. non-manual			
- in total population	1.35	1.51	0.16
- only among men 'classified' at census	1.32	1.33	0.01

To conclude, these two examples illustrate the potentially strong effects of excluding economically inactive men on estimates of trends in inequalities. In section 3 above, these men were included in our estimates of mortality differences by occupational class. But if most of these men would have been excluded (as happens in many other studies), the results may produce a misleading impression of the magnitude of mortality differentials, and of trends in this magnitude.

4.3. The effects of applying different social class schemes

Due to lack of clear theoretical guidelines (e.g. Scott, 2002) and due to limitations posed by national data collection systems, there is inevitably some arbitrary variation between countries, and over time, in the social class schemes used and in the occupational information that is available to construct these schemes. This variability raises the question to what extent the choice for a specific class scheme would influence the observed trends in class differences in mortality.

Table 8: *Evaluation of alternative social classifications. Turin, men 35-59 years.*

		1982-86	1992-96	Change
National	Population distribution (%)			
class	- non-manual	34.1	42.0	7.9
scheme	- self-employed	15.7	17.5	1.8
	- manual	50.1	40.4	-9.7
	RR manual vs. non-manual	1.33	1.43	0.10
Esping	Population distribution (%)			
Andersen	- non-manual	32.2	30.4	-1.8
scheme	- self-employed	17.5	25.4	7.9
	- manual	50.2	44.2	-6.0
	RR manual vs. non-manual	1.36	1.39	0.03

One evaluation is presented in table 8. In the Turin study, two data sets were created referring to the same population but applying two different class schemes: a national, Italian class scheme and an international scheme (Esping Andersen, 1990). For 1982-86, the two class schemes produced nearly identical results, both in terms of population distribution and in terms of class differences in mortality. The rate ratios that compare manual to non-manual classes were 1.33 and 1.36 for the two class schemes. For 1991-96, however, the two class schemes produced less consistent results. Population distributions differed, mainly because of different ways of assigning men to the class of self-employed. Although rate ratios were about similar and they did not differ from each other with statistical significance, the two schemes produced different estimates of trends over time. Rate ratios calculated under the national class scheme suggest that mortality differentials increased in a similar pace as in most northern European countries (by 0.10 units), while the rate ratios under the international class scheme would probably lead the analyst to conclude that relative inequalities in mortality were stable over time.

A second evaluation is made in table 9. In all analyses presented above, no distinctions were made within the broad classes of manual and non-manual workers respectively. This raises the question whether similar trends would be observed when using a finer stratification of the population into several social classes. Table 9 contains illustrative data from the national longitudinal study on England and Wales. The British Registrar General’s class scheme is used. For three periods, the mortality level of each class is expressed as a ratio to the mortality level of the upper non-manual class (I/II).

In order to secure comparability over time with this more detailed social classification, all estimates are based on a 15-year follow-up to the 1981 cohort. Thanks to the use of this finer classification, two new phenomena can be observed. First, lower non-manual workers and skilled manual workers appear to have about similar mortality levels, and similar trends over time. Second, the class of un/semi-skilled workers (IV/V) has by far the highest mortality rates, and the least favourable trends over time. This example illustrates that even though a simple manual versus non-manual distinction may be useful to summarise trends in mortality differentials in general, it may conceal important details, and fail to identify the groups that fared particularly bad.

Table 9: *Taking into account mortality differences within the manual and non-manual classes. England and Wales, men 35-59 years.*

Occupational class	**Relative mortality risk (change since 1981-85)**				
	1981-85	**1986-90**		**1991-95**	
Class I, II (upper non-manual = reference)	1.00	1.00		1.00	
Class III N (lower non-manual)	1.26	1.20	(-0.06)	1.32	(0.11)
Class III M (skilled worker)	1.32	1.37	(0.05)	1.44	(0.12)
Class IV,V (un/semi-skilled worker)	1.61	1.72	(0.11)	1.80	(0.19)
Manual as compared to non-manual	1.35	1.43	(0.08)	1.46	(0.11)

These two examples thus illustrate our more general experience with using different social class schemes, and also of using different ways to measure and classify socioeconomic indicators such as education and income. Although the use different measurements and classifications will often produce the same general tendencies, the precise magnitude of (changes in) socio-economic inequalities in mortality can strongly differ according to the precise measure applied.

5. Discussion

The results presented in this paper support the impression from the literature that relative inequalities in mortality in European countries tended to widen during the last decades of the 20th century. In nearly all situations observed, relative inequalities became larger, meaning that the existing burden of mortality became more unequally distributed across socioeconomic groups. Important to add, however, is that the absolute difference in mortality rates between higher and lower groups remained about stable during this period.

At the same time, the examples given here showed important variations in the pace of change. Increases in relative inequalities in some countries contrasted with a near-stability in other countries. Similarly, within individual countries, important variations were observed between age groups, and between men and women, in the pace by which relative inequalities increased. Finally, we observed that a similar degree of widening can be accompanied by either an increase or a decrease in the life expectancy of men and women with lower education. Thus, while the developments in some countries can be judged as 'unfavourable' in most respects, other countries present a less gloomy picture.

Often, however, the degree of change cannot be determined accurately. A number of examples in section 4 showed that data problems may seriously bias estimates of changes in inequalities in mortality. Previous studies also found that often it might be problematic to make comparisons of inequalities over time, as it is difficult to compare countries (Kunst, 1998). To this experience, we can add that the magnitude of bias may often be difficult to assess. For example, the use of unlinked cross-sectional data seemed to produce reliable results in the Irish case, but produced unlikely trends in the case of both Spain and Portugal. Similarly, the effect of excluding economically inactive men would have been small in our Finnish example, but substantial in the example of England and Wales. These discrepancies could perhaps be explained *ad-hoc*, but they would be difficult to predict *a priori*.

The unpredictable nature of these biases warn that there are no simple rules-of-thumb to deal with these problems. Instead, a critical attitude is needed, including the willingness to evaluate expected or 'positive' results against potential bias, and a reluctance to discard any data problem without supporting evidence.

To conclude, the best of the available evidence, given in section 2, showed widening inequalities in mortality for each country for which reliable estimates could probably be made. The evidence also suggested that the precise patterns of change varied strongly between and within countries. However, it may be difficult to accurately assess the trends in specific situations when the available data may be subject to an unknown but potentially large degree of bias. In many cases, even approximate estimates are lacking. For example, little is known about trends in mortality differentials among the elderly, among women, and among children. In addition, almost nothing is known about trends in inequalities in mortality in relation to income or other indicators of material wealth, even though the widening income inequalities of the 1980s and 1990s may have affected in particular those who have to live in absolute or relative poverty (Shaw, 1999; Dalstra, 2002).

Ever since the Black report, reports of widening relative inequalities in mortality has been used for advocacy purposes, as they served to stress the need for policies aimed at reducing inequalities in health. But there is much more to do than advocacy. Once that equity-oriented policies are put into practice, targets for reducing inequalities in mortality need to be set and progress towards reaching these targets needs to be monitored (Health, 2001; Mackenbach, 2002). In this new situation, descriptive studies should go beyond answering the question 'widening or narrowing' and try to produce an accurate and detailed description of recent trends in inequalities in mortality.

Renewed efforts are therefore needed to facilitate the monitoring of trends in socio-economic inequalities in mortality, not only in order to fill in the gaps in the evidence for the 20th century, but also to keep track of changes that are underway in the 21st century. Substantial progress in the monitoring of trends in socio-economic inequalities in mortality will basically depend on improvements of the available data. The challenges to be faced in this field vary between different parts of Europe. Grossly three groups of countries can be distinguished.

To the first group belong countries north of Rostock, but also includes isolated regions elsewhere such as the Turin region (Cardano, 1999). In these areas, data linkage between the population censuses, cause-of-death registries and possibly other databases has been possible since about the 1970s, and extensive experience has been developed with the longitudinal analysis of inequalities in cause-specific mortality. One of the main challenges to be faced in these regions is to further develop socioeconomic classifications and to apply these classification to mortality analyses. This challenge includes (a) the development and validation of new occupational class schemes, with particular attention to the classification of unemployed and inactive people, (b) the development of wealth indicators and other socio-economic indicators that can be used across the entire life course, including old age, and (c) the combination of information at both the individual level, household level and area level in the description of each person's socioeconomic position.

The second group of countries mainly lie south-west of Rostock. In these countries, the main challenge is to move towards the situation now represented by the Nordic countries. A crucial step is to establish a linkage between population census records and cause-of-death registries. Fortunately, since about the mid 1990s, this linkage has become possible in increasingly more countries. As a result, longitudinal studies of socio-economic inequalities in mortality in the general population have already been carried out for Belgium (Gadeyne, 2001), Switzerland, Austria (Doblhammer, 1998), and Barcelona and Madrid (Borrell, 1997; Borrell, 1999). Other countries are likely to follow on a short or medium term, including the Netherlands and France (where past longitudinal studies were limited to all-cause mortality). The first task faced by analysts in these countries is to start with descriptive overviews of trends in inequalities in cause-specific mortality, thereby utilising and improving the methodologies developed in the north.

Most of the countries in the third group are found south-east of Rostock. Linkage between population censuses and cause-of-death registries has yet not been achieved in most of these countries, with Bulgaria being one of the few exceptions (Kohler, 2002). In most countries, large-scale linkage-based data systems cannot be expected to develop on a short term. None the less, monitoring of trends in socio-economic inequalities in mortality is urgently needed in central and eastern Europe, as there are reasons to fear that the mortality crisis of the 1980s and 1990s affected the disadvantaged groups in particular (Marmot, 2000). Analyses based on "unlinked" cross-sectional data suggested a rapid widening of educational differences in mortality in Russia during the 1980s (Shkolnikov, 1998), and in Estonia during the 1990s (Kunst, 2002). Similar trends were observed in Hungary during the 1980s in an ecological study comparing urban districts within Budapest (Jozan, 1999). Even though such study designs were important for monitoring trends in inequalities in mortality in the past, new investments in data sources are required for a more reliable and detailed monitoring of trends in the future.

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