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What would it take to eradicate health inequalities?

Testing the fundamental causes theory of health inequalities in Scotland

October 2013

NHS Health Scotland

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Summary

The continued and increasing inequality in morbidity and mortality, across Scottish society from the poorest and to the wealthiest, is a gross injustice. That periods of decreasing inequality have previously been observed in the UK and elsewhere suggests that this situation is not inevitable and underlines further the need for urgent action. The current approach in Scotland to reduce inequalities in mortality largely focuses on controlling and reducing immediately visible or proximal causes (such as tobacco and alcohol) and targeting professional support to those living in deprived areas. However, recent work undertaken by American sociologists Bruce Link and Jo Phelan suggests that this approach will ultimately fail to eliminate health inequalities. They have shown that new socially patterned threats to health continually emerge over time to fuel differences in mortality between social groups despite success in controlling prior risks. Phelan and Link propose that this continual reproduction of social gradients in mortality occurs because socioeconomic inequality is itself a root or 'fundamental cause' of health inequalities operating through an unequal distribution of multiple resources, including income, wealth and power, which can be variously mobilised to protect and improve health across a range of emergent threats. They hypothesise that if socioeconomic inequality is a fundamental cause of health inequality, there will be smaller mortality gradients where it is more difficult to mobilise resources to protect and improve health, such as is the case where little or nothing is known about how to prevent a cause of death.

We described trends in absolute and relative inequalities for 47 to 50 causes of death for men and women across Carstairs deprivation deciles between 1983 and 1999 and men aged 20-64 years across occupational social classes between 1976 and 1999 to determine whether new socioeconomic inequalities in mortality emerged for certain causes of death whilst declining for others in Scotland during this time. In addition, we tested Phelan and Link's theory by comparing socioeconomic gradients for avoidable and non-avoidable mortality and assessing whether inequalities in mortality increase with increasing preventability of cause of death.

We found that absolute and relative socioeconomic gradients for specific causes of mortality decreasing whilst others emerged. Reductions in socioeconomic inequalities across Carstairs deciles were seen for rheumatic heart disease (men and women), TB, hypertension and diabetes (women only). Over the same time period new socioeconomic gradients emerged for other causes of death including: oesophageal cancer, alcohol-related mortality and suicide for men and women across Carstairs deciles; and for ischaemic heart disease, diabetes, pulmonary embolism for men only. New socioeconomic gradients appeared for Human Immunodeficiency Virus (HIV)/Acquired Immunodeficiency Syndrome (AIDS) for men and women, and for leukaemia, bladder cancer, malignant melanoma, colorectal cancer and cardiomyopathy for men across social class. There was a clear socioeconomic gradient for avoidable causes of mortality, but not for non-avoidable causes of death. Where causes of death became more preventable, it is clear that relative inequalities in mortality increased.

The results have important policy implications for continued efforts to reduce health inequalities in Scotland. Evidence that all-cause socioeconomic inequalities in mortality persist despite reductions for some specific causes, and that inequalities are greater with increasing preventability, suggests that focussing on reducing individual risk and increasing individual assets will ultimately be fruitless in reducing inequalities and may even increase them. Elimination and prevention of inequalities in all-cause mortality will only be achieved if the underlying differences in income, wealth and power across society are reduced.

1. Introduction

Socioeconomic gradients in mortality have been observed in the UK for as long as records have existed (1), representing a substantial difference in years of life lived between the poorest and wealthiest members of society. That their magnitude and trends vary at different points in time with periods of decreasing as well as increasing gradients suggest that they are not inevitable (2,3). There is broad scientific consensus that socioeconomic gradients in mortality are caused by unequal access to resource and power (1,4-10)

Phelan and Link define fundamental causes of health inequalities as those which are persistently associated with health outcomes despite changing intermediate mechanisms and proximal causes (11). The provide evidence that socioeconomic status is a fundamental cause of health inequalities using data from the USA (i.e. socioeconomic status has been persistently associated with all-cause mortality despite the substitution of lifestyle-related diseases for infectious diseases as the major contributors to all-cause mortality (12,13)) They argue that any fundamental cause (other postulated fundamental causes include racism and stigma) will exhibit the following essential features (14):

- it will influence multiple outcomes;
- it will be mediated by multiple mechanisms;
- it will persistently display health outcome gradients over time despite a decline in the prevalence and gradient of some original mechanisms.

They further propose that fundamental causes are likely to operate through different levels of access to a broad range of resources such as power, status, professional and social connections, knowledge and wealth, which can be called upon in different ways to avoid harm and improve health. It is important to note that this differs from the recently critiqued 'general susceptibility' view of health inequalities (15) which postulates that some individuals are susceptible to most illness, often explained as the result of a single underlying factor such as poor nutrition or chronic stress. In contrast, the fundamental causes theory suggests that health outcome gradients are not automatic but rather emerge only when there is differential access to resource which can be mobilised to protect health. Consequently, there will be a range of intervening mechanisms between cause and outcome which will be context dependent. However, we should expect to see less of a gradient where inequalities in income, power and wealth are less, and for causes in which there is no ability to deploy resource for health advantage (e.g. for a fatal disease for which there is no known prevention or cure).

The fundamental causes theory has potentially important implications for action to reduce health inequalities. If correct, the current strategy to reduce health inequalities in Scotland, which has largely focused on understanding and eradicating gradients in the proximal causes of inequalities, such as tobacco, will be ultimately futile. New mediators will inevitably emerge to replace any successfully eliminated threats, and so the cycle of new knowledge benefiting first those with the resources to act upon it will continue to fuel inequalities gradients in overall outcomes (e.g. all-cause mortality).

We therefore aim to test whether socioeconomic status is a fundamental cause of health inequalities in a Scottish population sample by answering the following research questions:

1. Is the association between socioeconomic status and mortality reproduced over time by the substitution of new mechanisms for old?
2. Do avoidable causes of mortality have greater socioeconomic gradients than unavoidable causes?

3. Do socioeconomic mortality gradients for specific causes of mortality increase with increasing preventability?

2. Methods

The number of deaths by sex, five-year age band and Carstairs deprivation decile (16) for each year during the period 1981-2001 for all specific causes of avoidable mortality (17) was obtained from National Records of Scotland (NRS). A death is defined as avoidable by the Office of National Statistics (ONS) if it is deemed to be preventable and/or amenable to medical intervention. The number of deaths by five-year age band and occupational social class (18) were also obtained for men aged 20-64 years (hereafter referred to as working aged men in this paper) for each year during the period 1974-2001. Five categories of social class were used: Professional (I); Managerial/Technical (II); Skilled (III); Semi-skilled (IV) and Unskilled (V). Skilled non-manual and skilled manual categories were aggregated throughout as prior to 1979 deaths data for these categories were not available separately. In addition, the number of deaths for four causes of mortality *not* considered avoidable by the ONS (malignant neoplasm of brain; malignant neoplasm of pancreas ; malignant neoplasm of ovary and cardiomyopathy) was obtained for the sex, age, Carstairs deprivation decile and social class groups noted above. Census data from 1961, 1981, 1991 and 2001 (with linear interpolation between census years) were used to determine the at risk population for the relevant time periods. Data by age, sex and social class were not available for 1971 which necessitated the longer interpolation between 1961 and 1981. Carstairs deprivation deciles were based on 1991 Carstairs index scores for all years. The classification of socioeconomic status used in the census changed from occupational social class to National Statistics Socioeconomic Classification (NS-SEC) after 1991. The 2001 NS-SEC categories were therefore translated into the equivalent social class categories, following ONS methodology (19), to enable calculation of the population at risk between 1992 and 2001. Age-standardised mortality rates for each cause by sex, social class and Carstairs deciles were directly calculated using the 1976 European Standard Population (20).

Five-year centred moving average age-standardised mortality rates were calculated within socioeconomic groups separately for males and females for each cause of death for years 1976 to 1999 (e.g. 1976 refers to average for 1974-1978). Causes displaying and developing socioeconomic gradients were identified by plotting bar graphs for each year. We described trends in the Slope (SII) and Relative (RII) Indices of Inequality for causes of death displaying socioeconomic gradients. The SII was calculated using linear regression to give a measure of absolute inequalities across socioeconomic groups and the RII by dividing the SII by the mean mortality for the whole population (Web appendix 1).

We also classified causes of death as either avoidable or non-avoidable using the ONS categorisation (17) (Table 1) and calculated the mean, annual, age-standardised mortality rate for each socioeconomic group for this binary categorisation for the entire periods for which data were available. Finally, a simplified version of Phelan and Link's nine-point preventability ratings**,** derived by expert consensus (11),were used to create a four point ordinal typology (from 1being the least preventable and 4 being the most preventable) to compare the relative indices of inequality across preventability categories. Only 36 of the 52 causes of mortality included in the current study had been previously rated by Phelan and Link. Data for non-rated causes of mortality were excluded from the avoidability and preventability analyses. In addition, suicide and accidental injury were excluded from these two analyses as they were disaggregated into sub-types in the Phelan and Link preventability typology and therefore had multiple ratings. None of the specific causes of mortality included in this study were within Phelan and Link's two least preventable categories (categories 1 and 1.5 in the Phelan and Link Study – see table 1). The avoidability and preventability analyses were not directly comparable for men and women as cervical and ovarian cancer were included for women. All analyses were undertaken using SPSS version 19.

Table 1. Preventability ratings of causes of mortality listed as avoidable by ONS and four additional non-avoidable causes of mortality.

Cause of Mortality	ICD codes included			Preventability		
	ICD 8	ICD 9	ICD 10	ONS classification* ^	Phelan & Link rating**	Rating for this study***
TB	010-019	010-018, 137	A15-A19, B90	A	5	4
Selected infections	034.1, 036, 038, 035, 320, 462, 034.0, 681, 682, O84.0-O84.4, O84.8, O84.9	034.1, 036, 038, 035, 320.0-320.3, 320.8-320.9, 322.0, 322.2, 322.9, 047.9, 462, 034.0, 681, 682, O84.0-O84.4, O84.6, O84.8	A38-A41, A46, G00, G03, J02, L03, A48.1, B50-54.	A	Not ranked	Not included
Hepatitis C			B17.1, B18.2	A	Not ranked	Not included
HIV/Aids		042-044, 279.1	B20-B24	A (all ages)	Not ranked	Not included
Head and neck cancers	140-149	140-149	C00-C14	A	4	3
Oesophogeal cancer	150	150	C15	A	3.5	2
Stomach cancer	151	151	C16	A	2.5	2
Colorectal cancer	153, 154.0-154.2	153, 154.0-154.3	C18-C21	A	4	3
Liver cancer	155	155	C22	A	3.5	2
Lung cancer	162	162	C33-C34	A	5	4
Malignant melanoma	172	172	C43	A	3.5	2
Mesothelioma			C45	A	Not ranked	Not included
Breast cancer	174	174, 175	C50	A	3.5	2
Cervical cancer	180	180	C53	A	5	4
Bladder cancer	188	188	C67	A	4	3
Thyroid cancer	193	193	C73	A	Not ranked	Not included
Hodgkin's disease	201	201	C81	A	Not ranked	Not included
Leukaemia	204, 205.0	204, 205.0	C91, C92.0	A (0-44 years)	Not ranked	Not included
Benign neoplasms	210-228	210-229	D10-D36	A	Not ranked	Not included
Brain cancer	191	191	C71	U (all ages)	2	1
Ovarian cancer	183	183	C56	U (all ages)	2	1
Pancreatic cancer	157	157	C25	U (all ages)	2	1
Diabetes mellitus	250	250	E10-E14	A (0-49 years)	4	3
Alcohol related diseases	303, 291, 571.0, 571.9	305.0, 303, 291, 357.5, 425.5, 535.5, 571.0-571.5, 571.9,	F10, G31.2, G62.1, I42.6, K29.2, K70, K73, K74 (excl. K74.3-K74.5) K86.0	A	4.5	3
Illicit drug use disorders	304.0-304.9, 294.3	304.0-304.3, 304.5-304.8, 305.3, 305.5, 305.6, 305.9, 292	F11-F16, F18-F19	A	4.5	3
Epilepsy and status epilepticus	345	345	G40-G41	A	3.5	2
Rheumatic and other valvular heart disease	391-398	391-398	I01-I09	A	Not Ranked	Not included
Hypertensive disease	400-404	401-405	I10-I15	A	4.5	3
Ischaemic heart disease (IHD)	410-414	410-414	I20-I25	A	4	3
Deep vein thrombosis with pulmonary embolism (DVT with PE)	450, 451	415.1, 451.1, 451.2, 451.9, 453.9	I26, I80.1-I80.3, I80.9, I82.9	A	Not ranked	Not included
Cerebrovascular disease	430-434, 436-438	430-434, 436-438	I60-I69	A	4	3
Aortic aneurysm and dissection	441	441	I71	A	3.5	2
Cardiomyopathy	425	425	I42	U	2	1
Influenza	470-474	487	J10-J11	A	4.5	3
Pneumonia	480-486	480-486	J12-J18	A	4.5	3

Cause of Mortality	ICD codes included			Preventability		
	ICD 8	ICD 9	ICD 10	ONS classification* ^	Phelan & Link rating**	Rating for this study***
Chronic obstructive pulmonary disorder (COPD)	490-492	490-492, 496	J40-J44	A	5	4
Asthma	493	493	J45-J46	A	Not ranked	Not included
Gastric and duodenal ulcer	531-534	531-534	K25-K28	A	5	4
Acute abdomen, appendicitis, Intestinal obstruction, Cholecystitis/lithiasis, Pancreatitis, Hernia (Acute Abdomen)	540-543, 550-553, 574-576, 577.0, 577.1, 577.9	540-543, 550-553, 574-576, 577.0-577.2, 577.8, 577.9	K35-K38, K40-K46, K80-K83, K85, K86.1-K86.9, K91.5	A	5	4
Nephritis and nephrosis	580-584, 789.3, 789.0	580-588, 589.9, 599.7, 791.0	N00-N07, N17-N19, N25-N27	A	3	2
Obstructive uropathy Prostatic Hyperplasia	591, 593.4, 593.3, 592, 594, 598, 600	591, 593.5, 593.3, 592, 594, 598, 600	N13, N20-N21, N35, N40, N99.1	A	Not ranked	Not included
Complications of the perinatal period	760-779	760-779, 771.3	P00-P96, A33	A (all ages)	Not ranked	Not included
Congenital malformations and chromosomal anomalies	740-759	740-759	Q00-Q99	A	Not ranked	Not included
Transport Accidents	E800-E845, E927	E800-E848	V01-V99	A (all ages)	4.5	3
Accidental injury	E850-E926, E928-E929	E850-E928	W00-X59	A (all ages)	3.5, 4.5&5	Unable to rank
Suicide and self-inflicted injuries	E950-E959, E980-E989	E950-E959, E980-E989	X60-X84, Y10-Y34, Y87.0, Y87.2	A (all ages)	3.5 & 4.5	Unable to rank
Homicide / Assault	E960-E969	E960-E969	X85-Y09	A (all ages)	4.5	3
Misadventures to patients during medical and surgical care (mortality related to health care)	E930-E936	E870 - E876, E878-E879	Y60-Y69, Y83-Y84	A (all ages)	5	4

*A = avoidable, U = unavoidable

^Ages 0-74 years unless otherwise specified

** 1 is the least preventable category and 5 is the most preventable category

***1 is the least preventable category and 4 the most preventable category. Phelan and Link ratings translated into higher integer for current study with the exception of that for stomach cancer. Although included in the 2.5 preventability category by Phelan and Link it was given an lower rating (2) in this study because it was listed as avoidable by ONS whilst all other causes of death included in the least preventable category in this study were not.

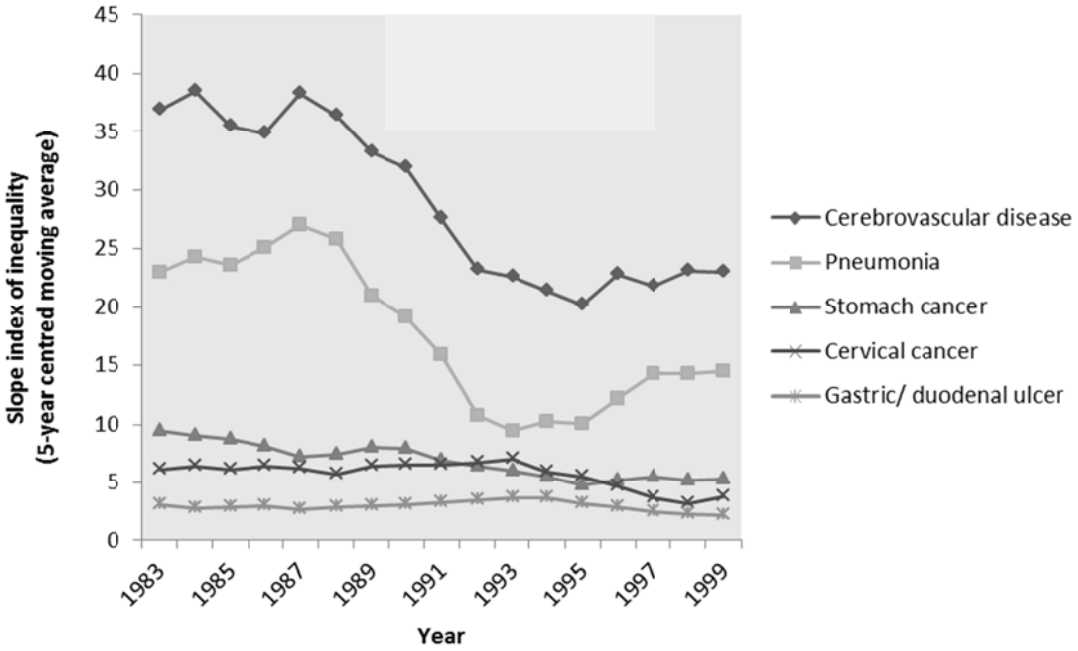
3. Results

3.1 Is the association between socioeconomic status and mortality reproduced over time by the substitution of new risks for old?

3.1.1 Diminishing threats 1: Causes of death with decreasing absolute socioeconomic inequalities

There were a number of causes of death for which socioeconomic inequalities in mortality decreased in absolute (although not relative[i]) terms. This was true of death from cerebrovascular disease, pneumonia, stomach cancer, cervical cancer and gastric and duodenal ulcers for women across Carstairs deciles (Figure 1); for cerebrovascular disease, lung cancer, COPD, pneumonia and TB for men across Carstairs deciles (Figure 2); and for COPD, accidental injury, stomach cancer and TB for working aged men across social classes (Figure 3).

Figure 1. Trends in absolute inequalities for causes of death with decreasing absolute inequalities across Carstairs deciles for women between 1983 and 1999.



[i]Absolute inequalities decreased as a result of progress in improving the average mortality rate, however, because declining rates in the most deprived groups were not proportionate to their higher baseline mortality rate, relative inequalities either stabilised or increased.

Figure 2. Trends in absolute inequalities for causes of death with decreasing absolute inequalities across Carstairs deciles for men between 1983 and 1999.

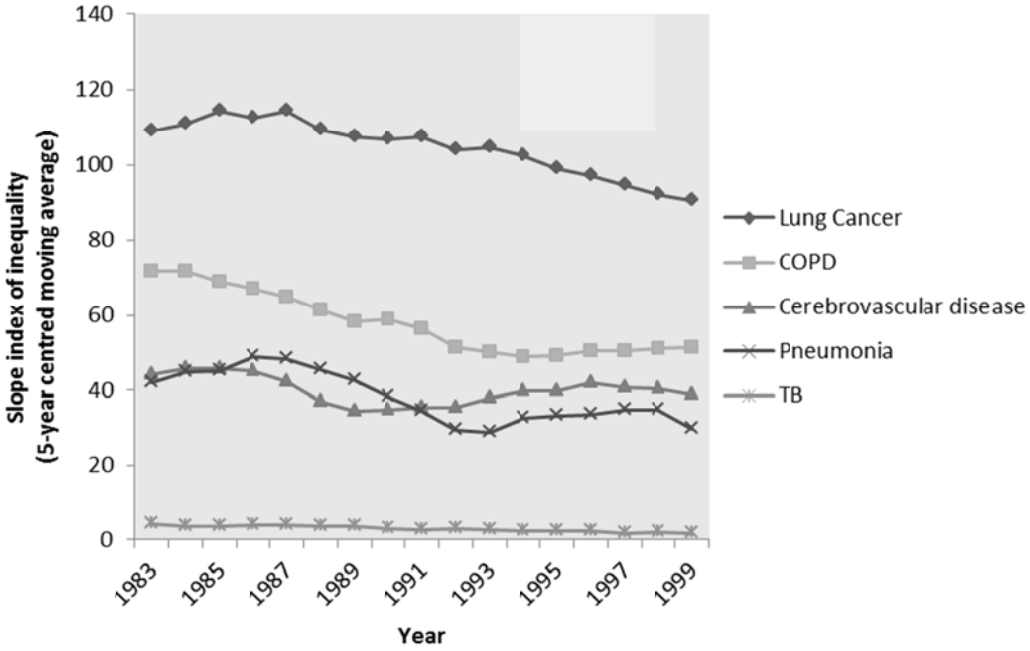
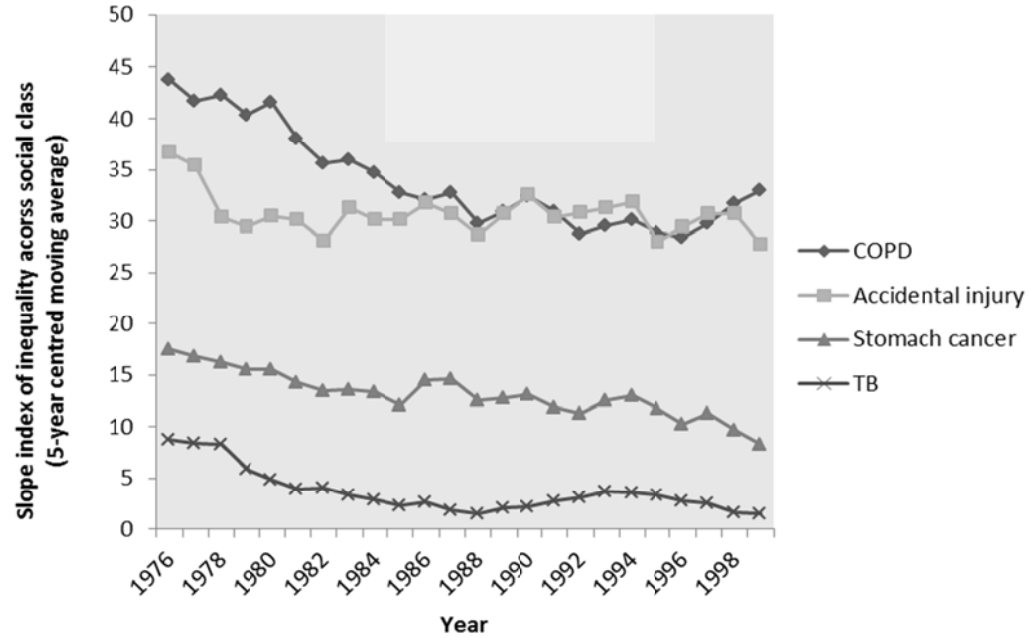


Figure 3. Trends in absolute inequalities for causes of death with decreasing absolute but static or increasing relative inequalities across social classes for men aged 20-64 years between 1976 and 1999.



3.1.2 Diminishing threats 2: Causes of death with decreasing absolute and relative socioeconomic inequalities

Socioeconomic inequalities in mortality decreased in both absolute and relative terms for rheumatic heart and other valvular heart disease for women and men across Carstairs deciles between 1983 and 1999 and in addition TB, Diabetes Mellitus, Hypertension and Homicide/assault for women across Carstairs deciles (figures 4-7). None of the considered causes of death displayed decreasing absolute and relative inequalities across social class for working aged men for during the period of observation.

Figure 4. Trends in absolute inequalities for causes of death with decreasing absolute and relative inequalities across Carstairs deciles for women between 1983 and 1999.

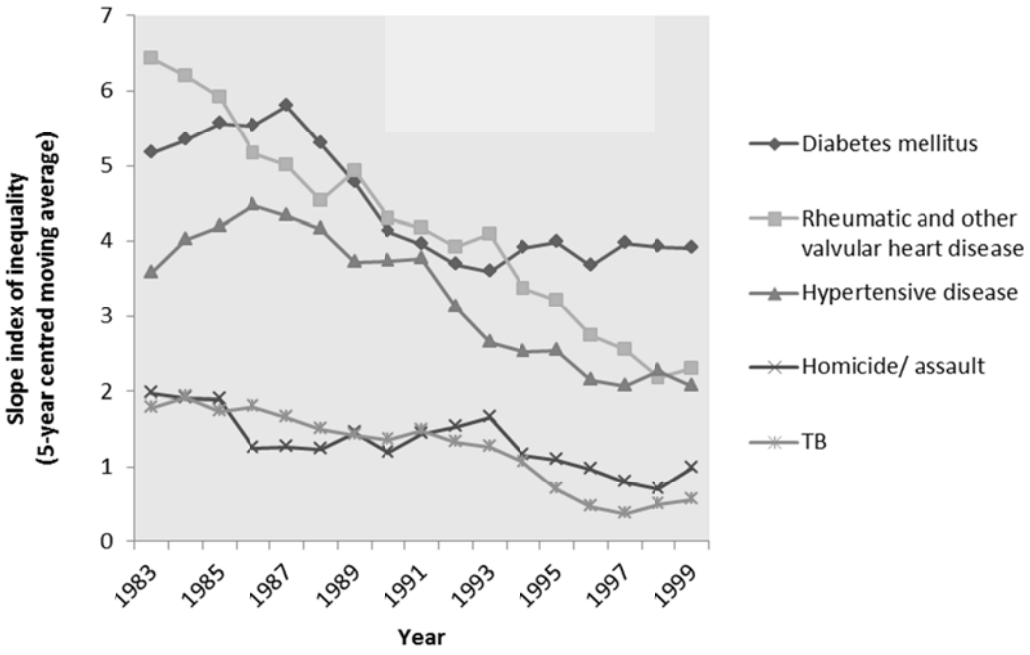


Figure 5. Trends in relative inequalities for causes of death with decreasing absolute and relative inequalities across Carstairs deciles for women between 1983 and 1999.

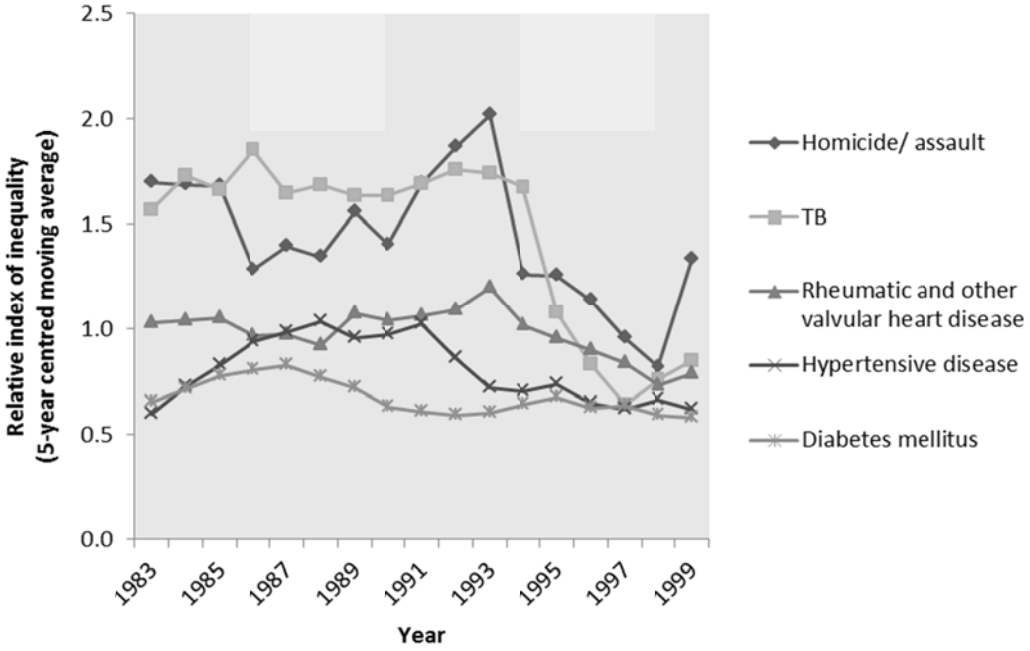


Figure 6. Trends in absolute inequalities for causes of death with decreasing absolute and relative inequalities across Carstairs deciles for men between 1983 and 1999.

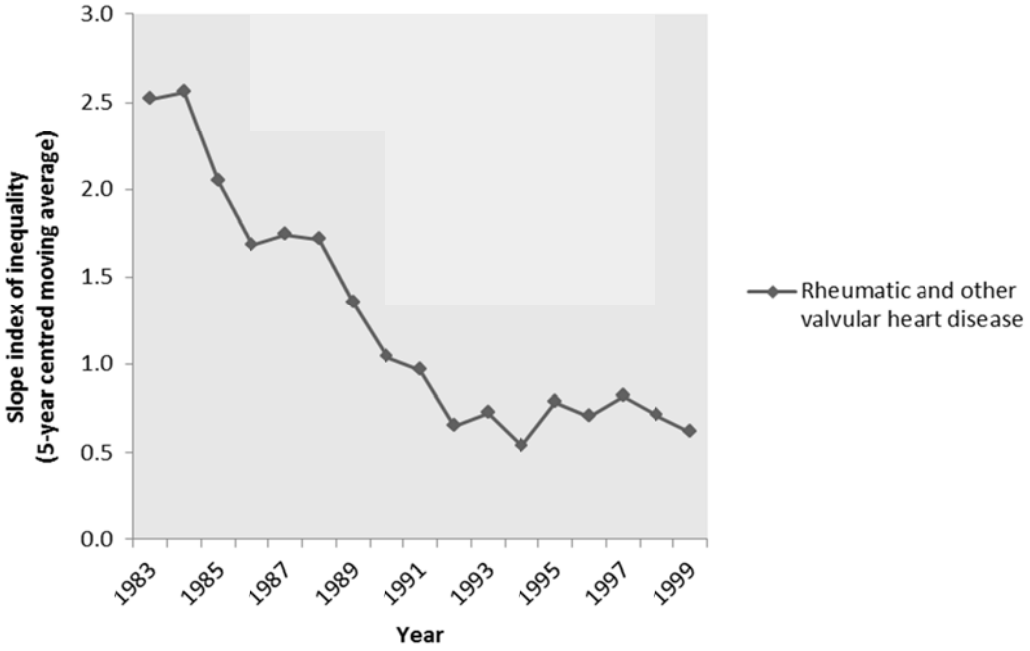
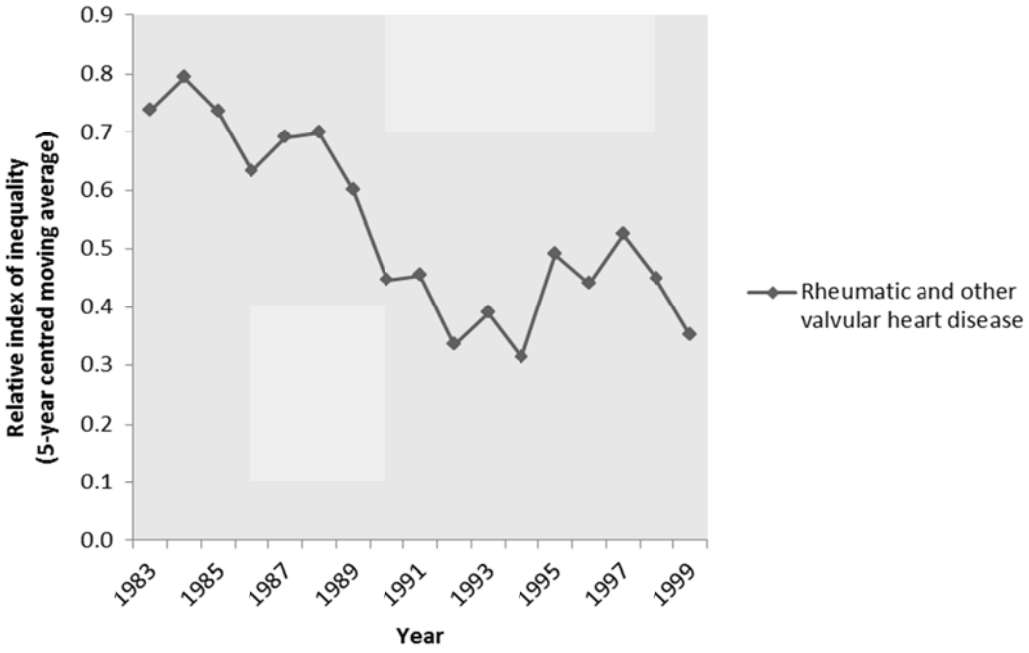


Figure 7. Trends in relative inequalities for causes of death with decreasing absolute and relative inequalities across Carstairs deciles for men between 1983 and 1999.



3.1.3 Substitution 1: Causes of death with increasing absolute and relative socioeconomic inequalities

Despite the progress in reducing socioeconomic inequalities for some individual causes of death, absolute and relative socioeconomic inequalities in all-cause mortality remained high or increased (Figures 8-10) because of increases in inequalities for a number of other cause of death. Socioeconomic inequalities in mortality increased in absolute and relative terms for lung cancer, alcohol-related disorders, suicide, selected infections and oesophageal cancer for women across Carstairs deciles between 1983 and 1999 (Figures 11-12). The male Carstairs analysis showed that absolute and relative inequalities in mortality increased for: ischaemic heart disease; alcohol related mortality; suicide; oesophageal cancer; head and neck cancers; Diabetes mellitus; deep vein thrombosis with pulmonary embolism (DVT with PE); nephritis/nephrosis; acute abdomen conditions; epilepsy; and selected infections (Figures 13-14). Finally for working age men across social class absolute and relative inequalities in mortality increased for ischaemic heart disease, alcohol related mortality, suicide, cerebrovascular disease, pneumonia, oesophageal cancer, transport accidents, head and neck cancers, diabetes mellitus, hypertension, DVT with PE and selected between 1976 and 1999 (Figures 15-16).

Figure 8. Trends in absolute inequalities for all-cause mortality across Carstairs deciles for women and men between 1983 and 1999.

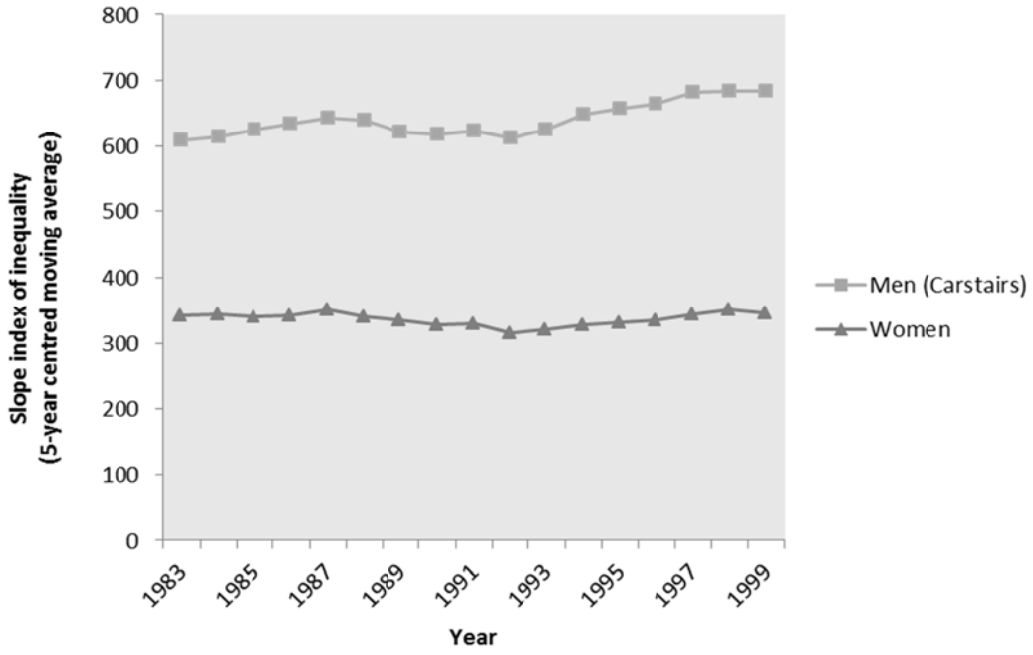


Figure 9. Trends in absolute inequalities for all-cause mortality across social class for men aged 20-64 years between 1976 and 1999.

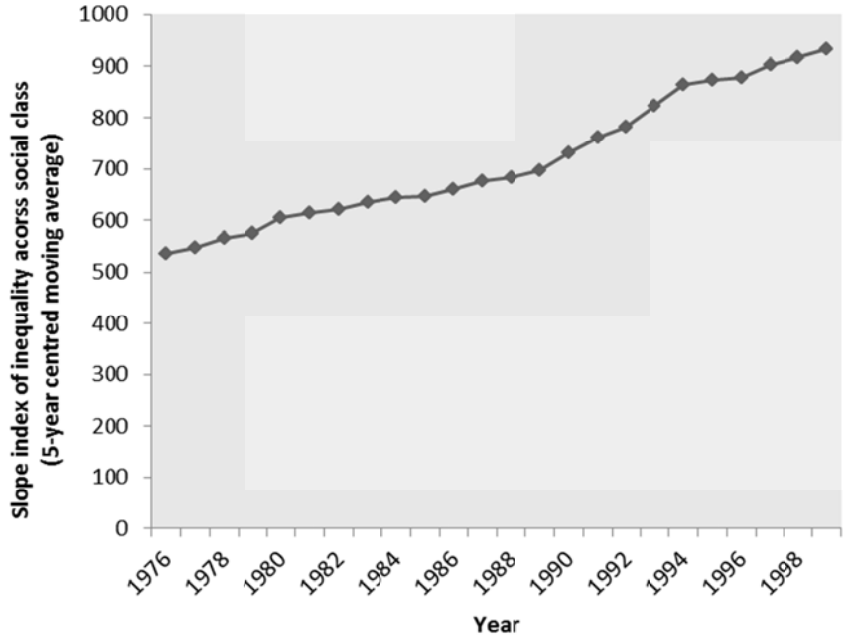


Figure 10. Trends in relative inequalities for all-cause mortality across Carstairs deciles for men and women between 1983 and 1999 and social class for men aged 20-64 years between 1976 and 1999.

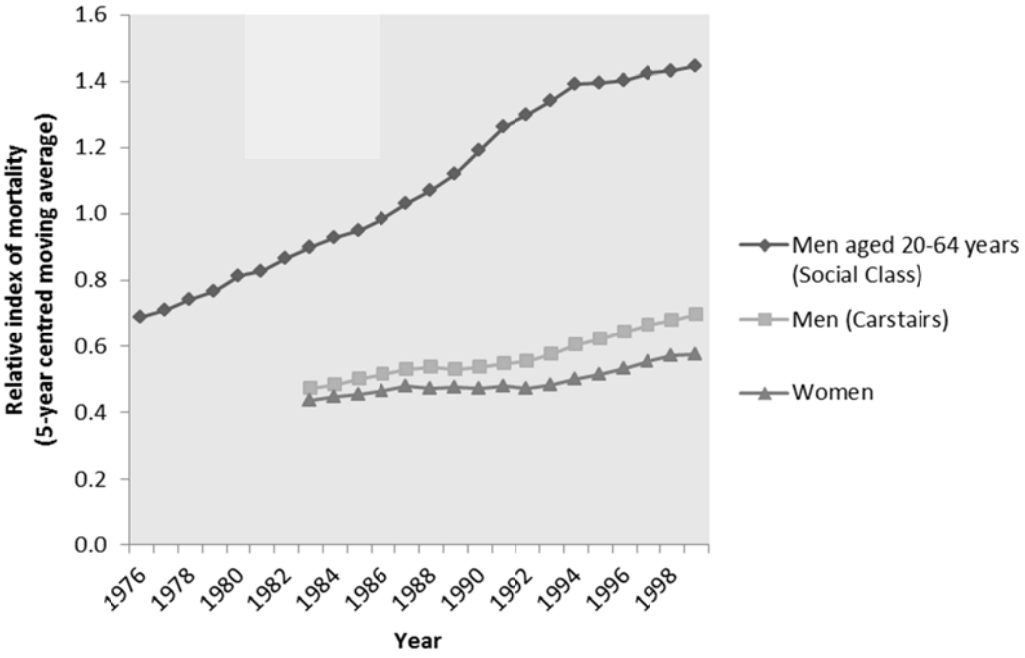


Figure 11. Trends in absolute inequalities for causes of death with increasing absolute and relative inequalities across Carstairs deciles for women between 1983 and 1999.

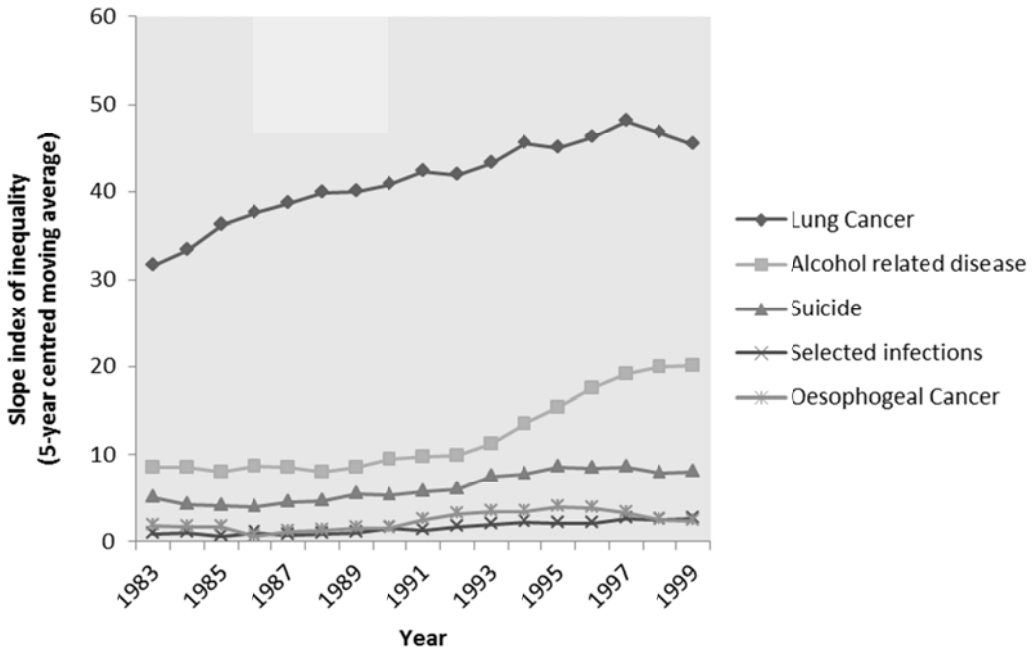


Figure 12. Trends in relative inequalities for causes of death with increasing absolute and relative inequalities across Carstairs deciles for women between 1983 and 1999.

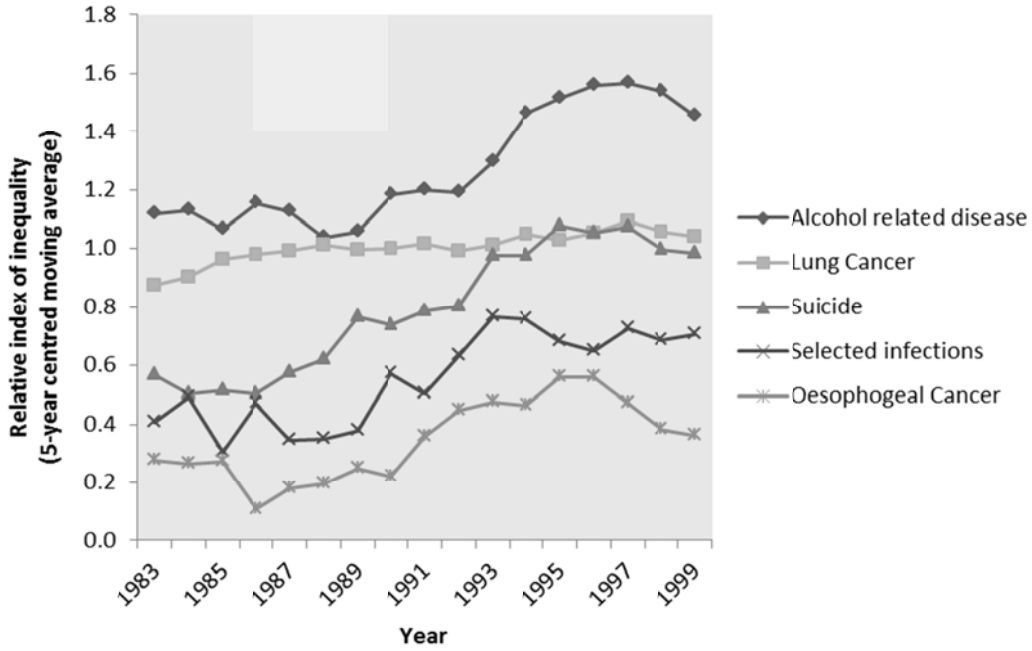


Figure 13. Trends in absolute inequalities for causes of death with increasing absolute and relative inequalities across Carstairs deciles for men between 1983 and 1999.

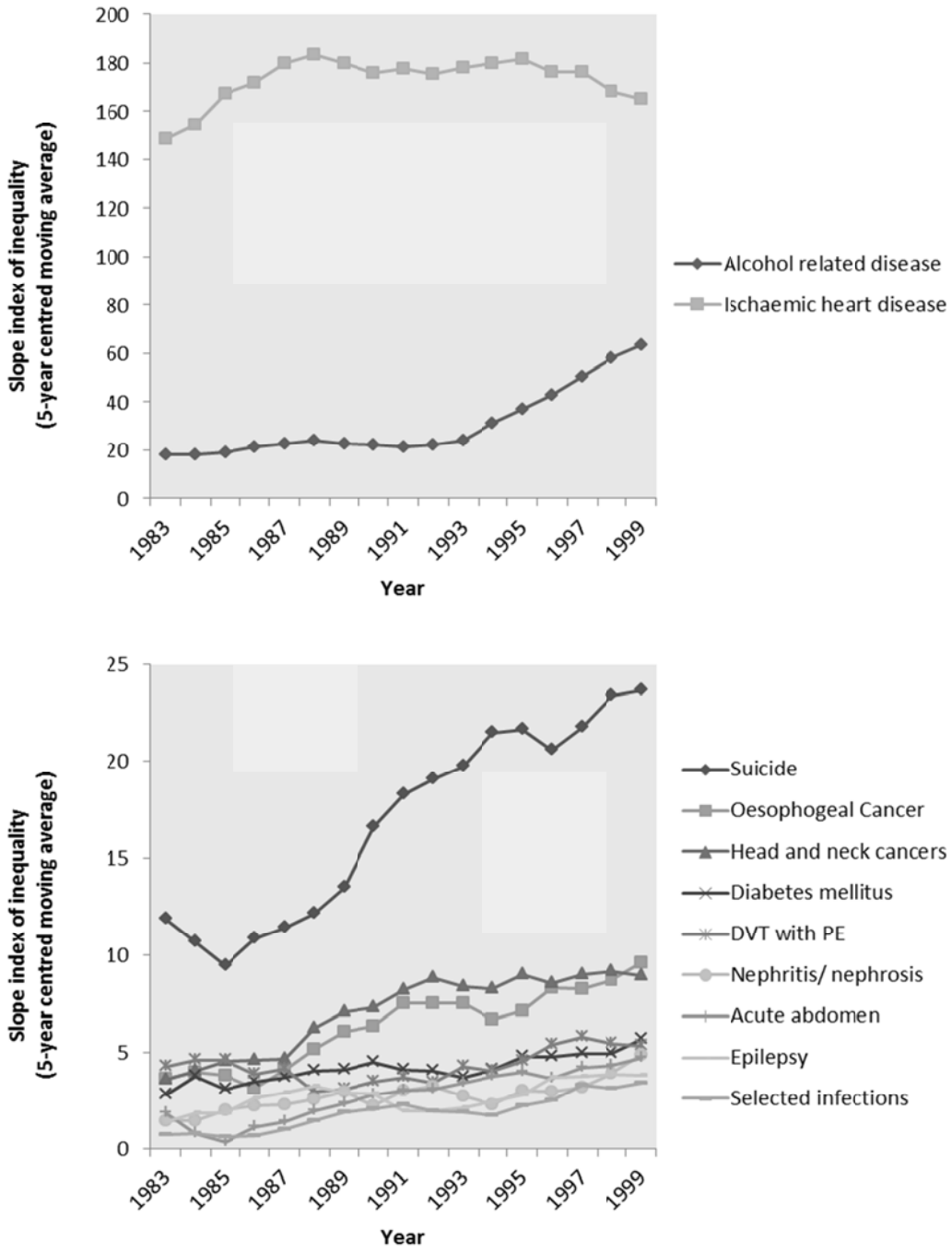


Figure 14. Trends in relative inequalities for causes of death with increasing absolute and relative inequalities across Carstairs deciles for men between 1983 and 1999.

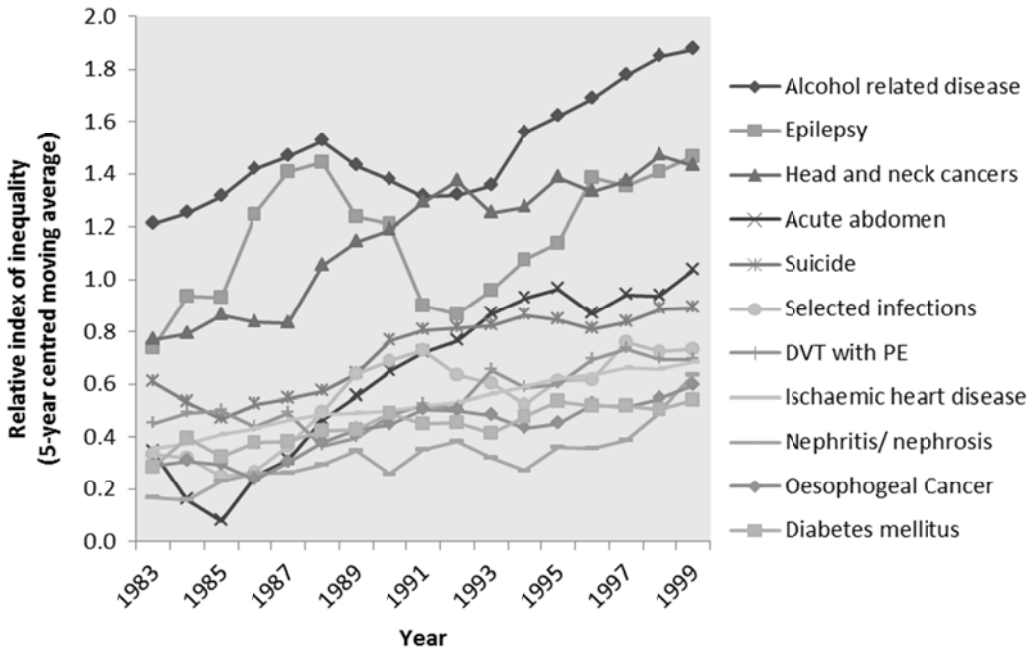


Figure 15. Trends in absolute inequalities for causes of death with increasing absolute and relative inequalities across social class for men aged 20-64 years between 1976 and 1999.

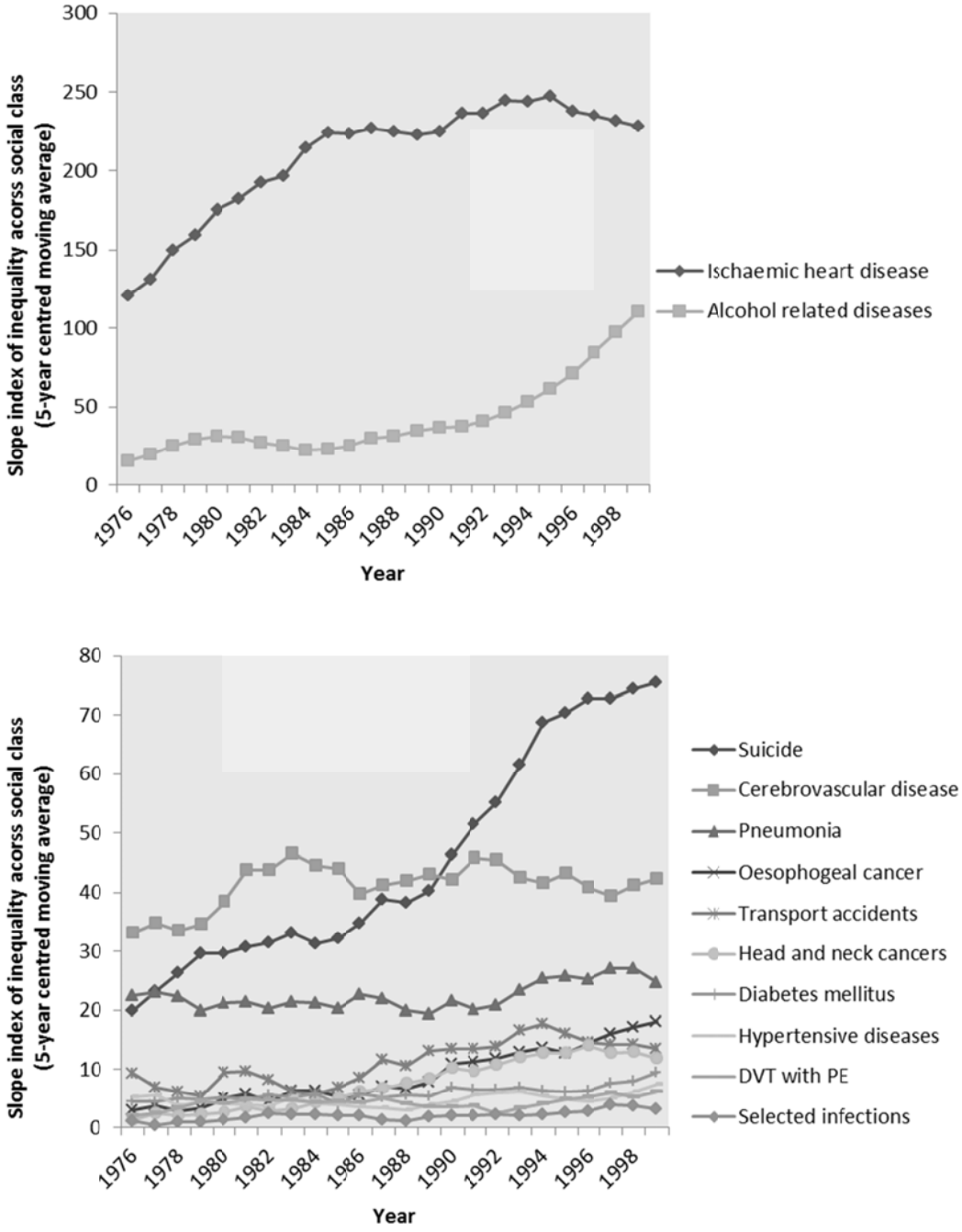
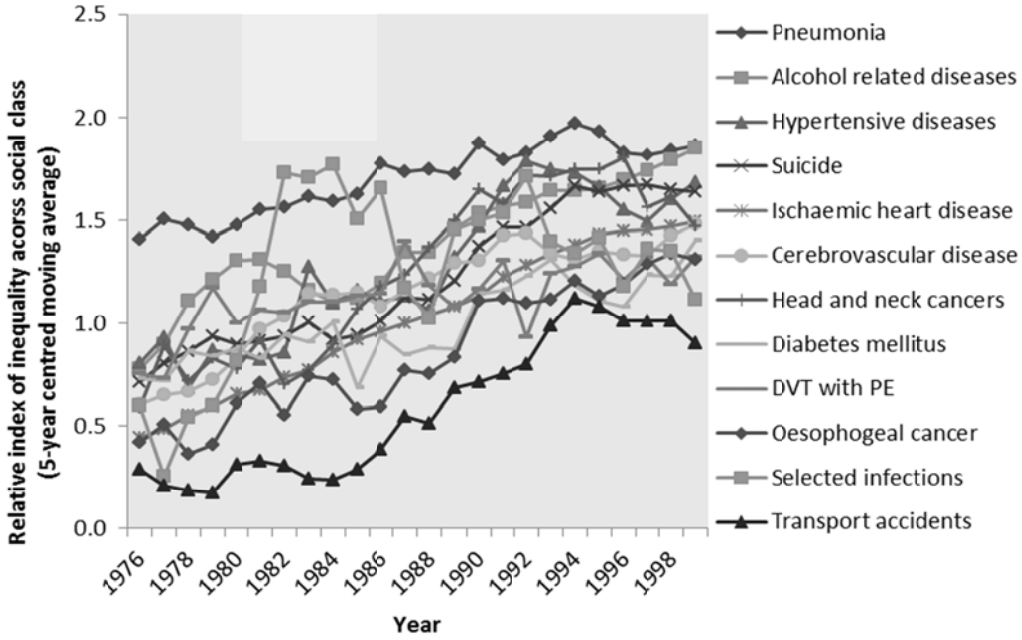


Figure 16. Trends in relative inequalities for causes of death with increasing absolute and relative inequalities across social class for men aged 20-64 years between 1976 and 1999.

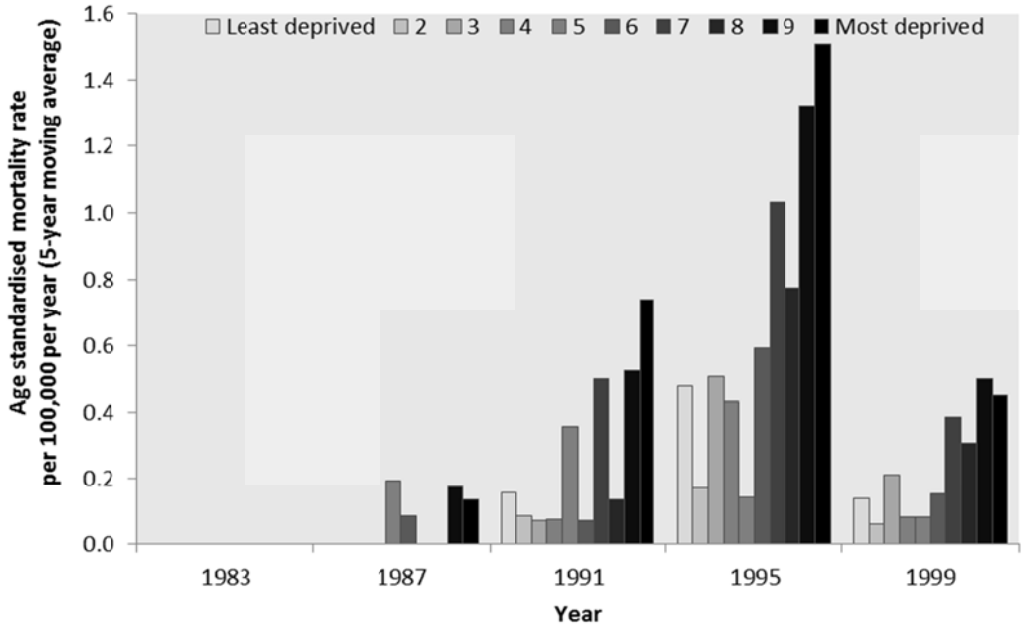


3.1.4 Substitution 2: Emergence of new socioeconomic gradients in mortality

In addition to increasing socioeconomic inequalities for some causes of death, new socioeconomic gradients in mortality emerged during the observation periods to contribute to rising inequalities for all-cause mortality. Emergence took two main forms. In some instances it involved the appearance of a new cause of death which rapidly became socially patterned (e.g. Figure 17) but in most cases it manifest as the development of a socioeconomic gradient in mortality for a cause of death which previously did not display one (e.g. Figures 18-19). Furthermore, reversal of the socioeconomic gradient in mortality for a cause of death which previously displayed higher mortality rates in the least deprived was also observed (e.g. Figure 20)[ii].

HIV/AIDs emerged in this time as a new cause of death which quickly became socially patterned for all three subgroups. In addition new socioeconomic gradients emerged for perinatal complications and health care related mortality for men across Carstairs deciles and leukaemia, acute abdomen conditions (see Table 1), bladder cancer, aortic disease, malignant melanoma, cardiomyopathy and colorectal cancer for working aged men across social class (Web appendix 2).

Figure 17. HIV/AIDs age standardised mortality rate within Carstairs deciles for women in Scotland 1983-1999.



[ii]Bar charts are used to display emerging socioeconomic gradients as summary indices cannot be used for those years were gradients do not exist.

Figure 18. Male perinatal complications age standardised mortality rate within Carstairs deciles in Scotland 1983-1999.

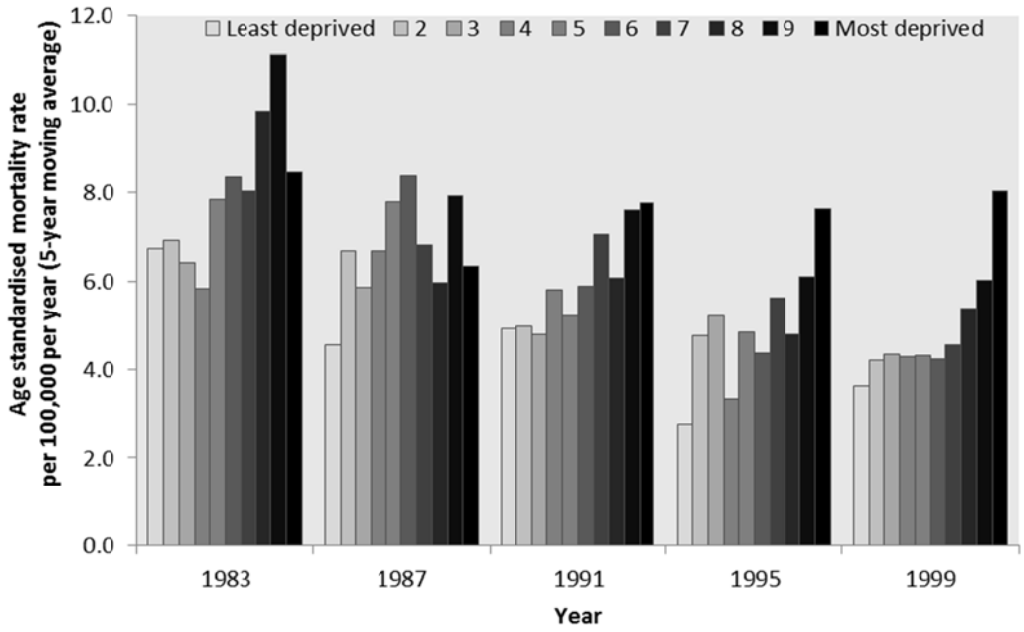


Figure 19. Colorectal cancer age standardised mortality rate within social class for men aged 20-64 years in Scotland 1976-1999.

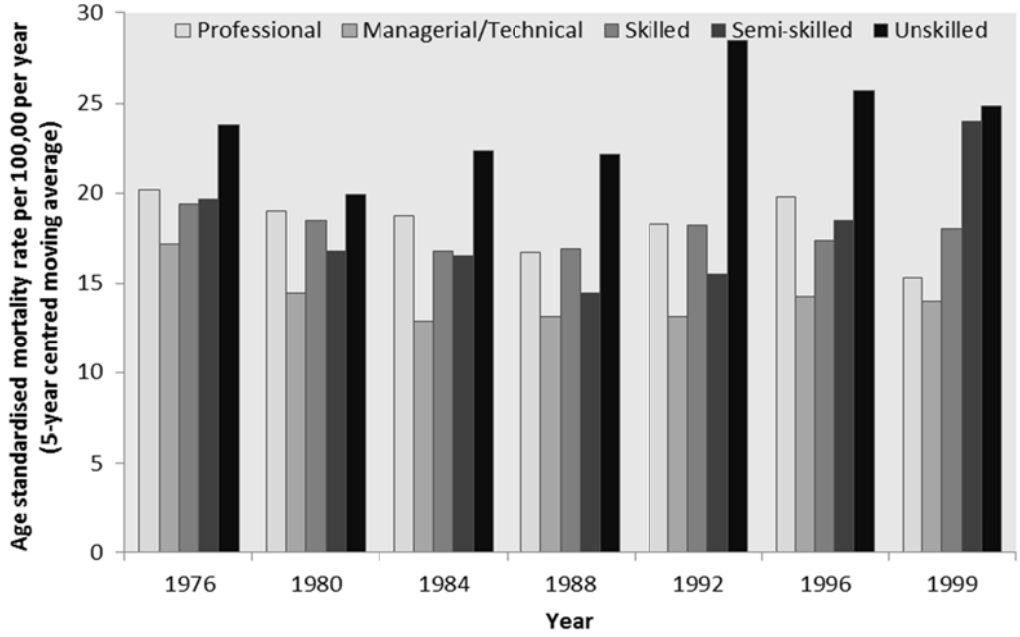
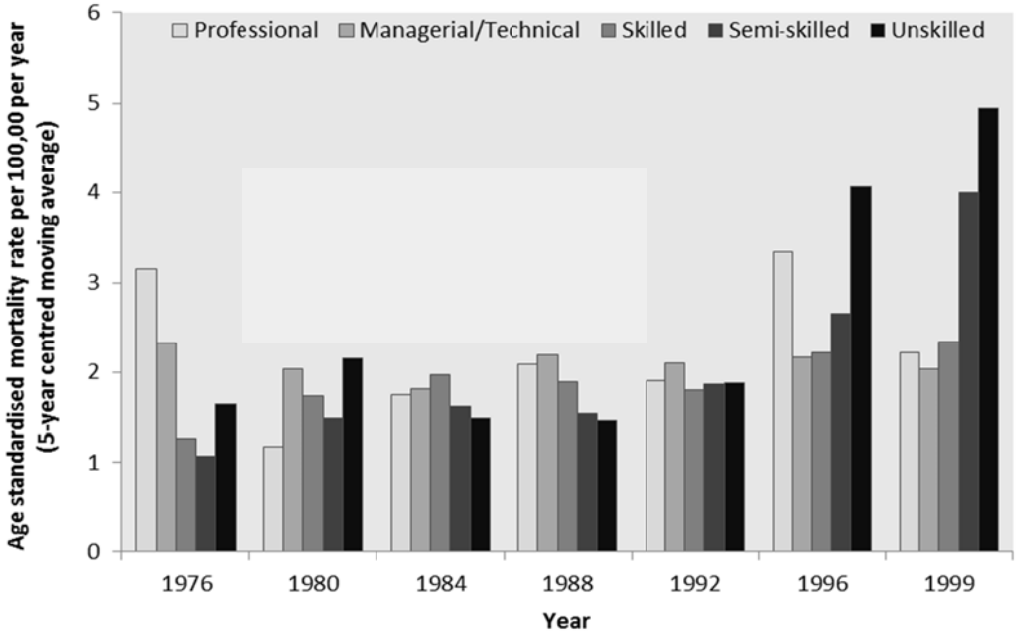


Figure 20. Malignant melanoma age standardised mortality rate within social class for men aged 20-64 years in Scotland 1976-1999.



3.2 Do avoidable causes of mortality have greater socioeconomic gradients than unavoidable?

Socioeconomic gradients were evident for avoidable causes of mortality for men and women across Carstairs deciles and for working age men across social class. The mean SII for avoidable causes of death the period 1981-2001 was 662 for working aged men across social class; 460 for men across Carstairs deciles and 231 for women across Carstairs deciles. The equivalent relative indices of inequality were 1.1, 0.8 and 0.7respectively. In contrast linear socioeconomic gradients were not clearly observed for non-avoidable causes of mortality (Figures 21-23)

Figure 21. Age standardised mortality rate for avoidable (left axis) and non-avoidable (right axis) causes of mortality by Carstairs deciles for women 1981-2001.

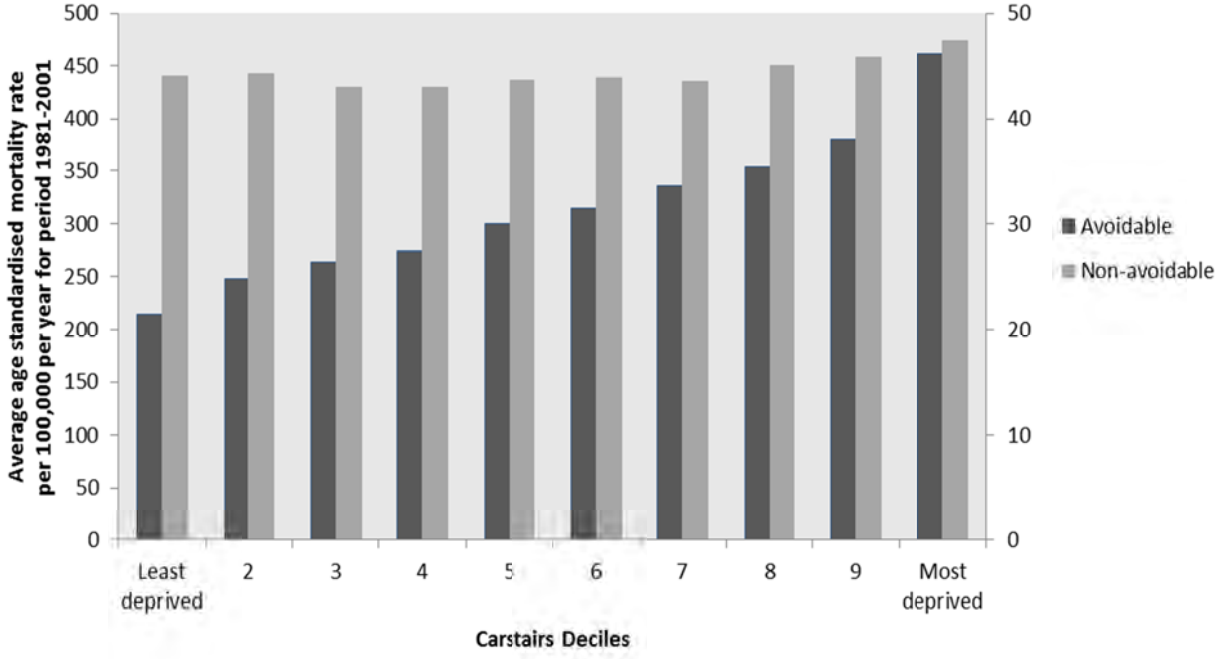


Figure 22. Age standardised mortality rate for avoidable (left axis) and non-avoidable (right axis) causes of mortality by Carstairs deciles for men 1981-2001.

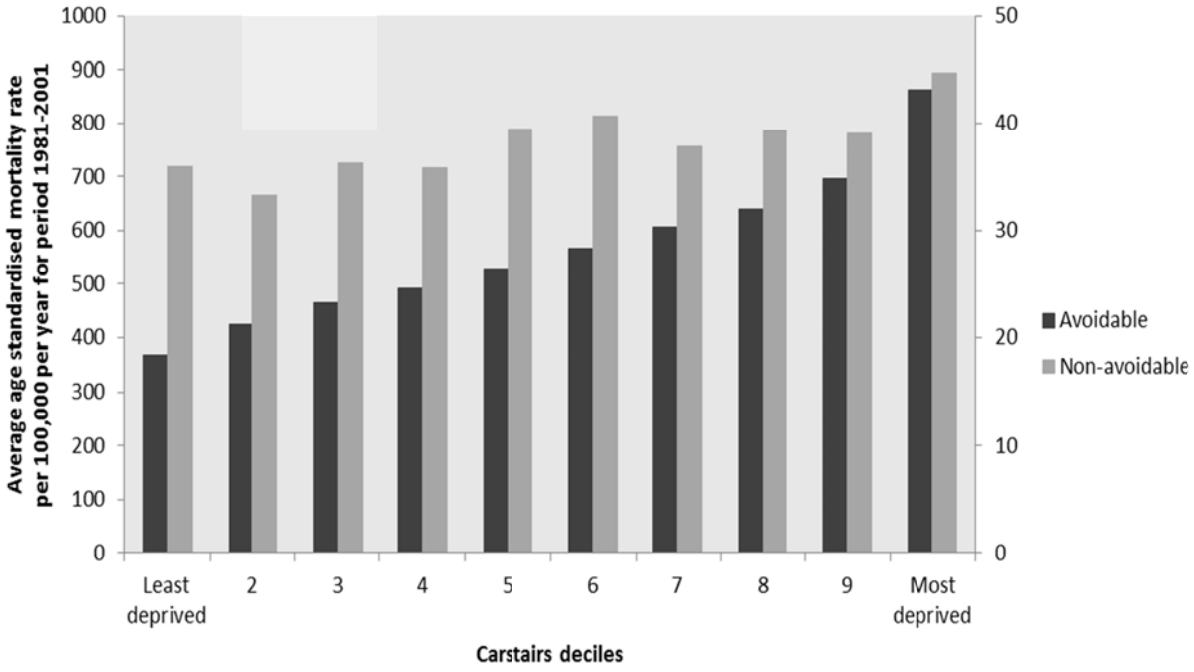
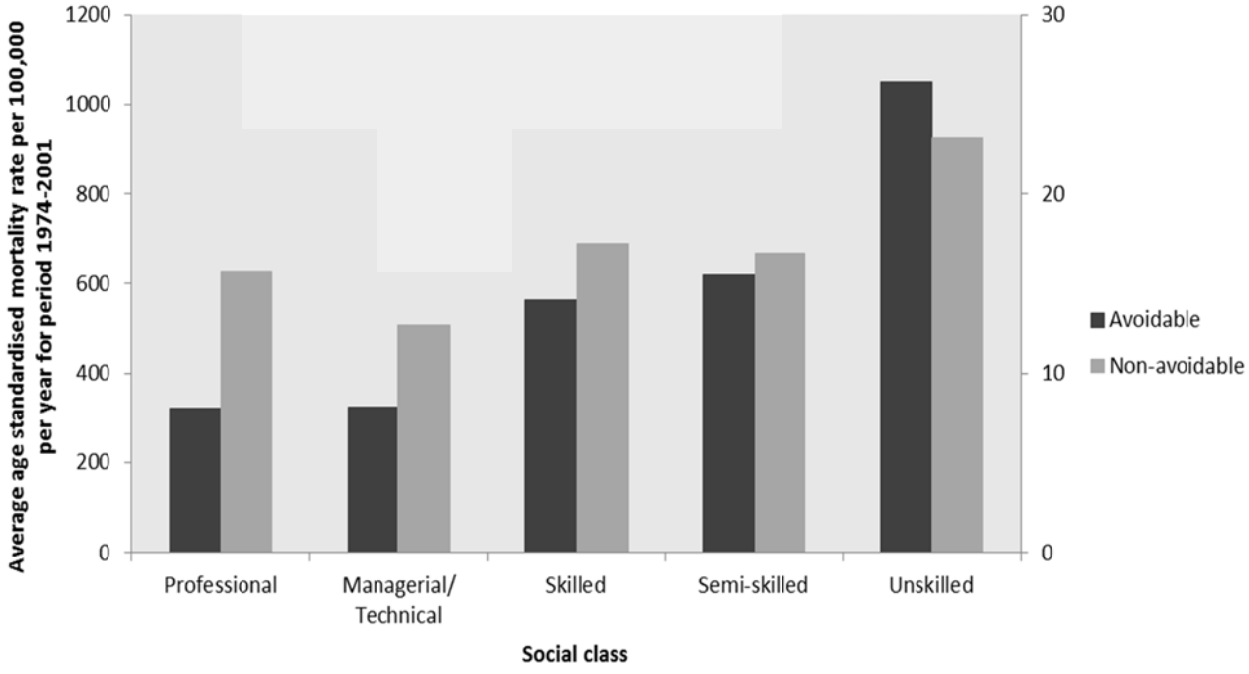


Figure 23. Age standardised mortality rate for avoidable causes of mortality by social class for men aged 20-64 years 1974-2001.



3.3 Do socioeconomic mortality gradients for specific causes of mortality increase with increasing preventability?

Socioeconomic gradients across Carstairs deciles were not evident for the least preventable category of mortality but were observed for all other preventability categories including the least preventable category across social class for men aged 20-64 years (Figures 24-26).

Figure 24. Socioeconomic gradients across Carstairs deciles in age standardised mortality by preventability of death for women in Scotland 1981-2001.

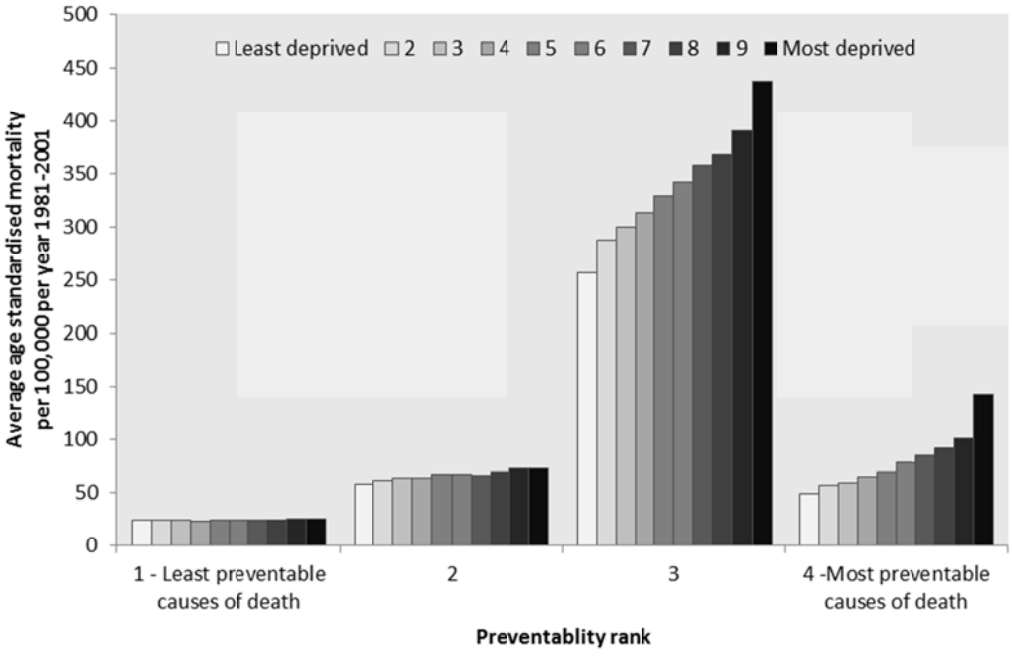


Figure 25. Socioeconomic gradients across Carstairs deciles in age standardised mortality by preventability of death for men in Scotland 1981-2001.

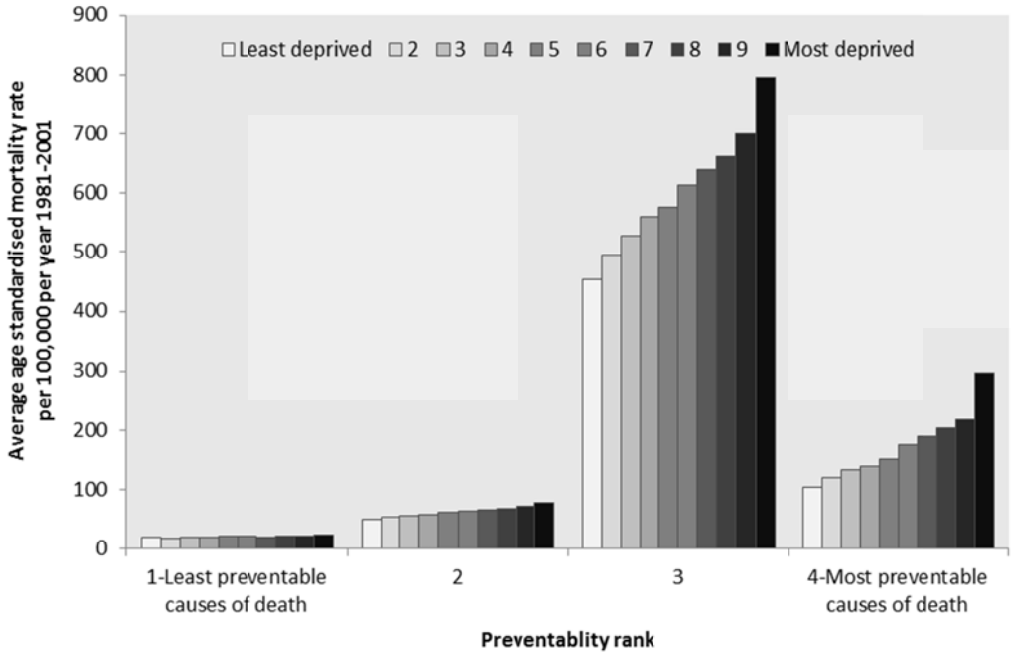
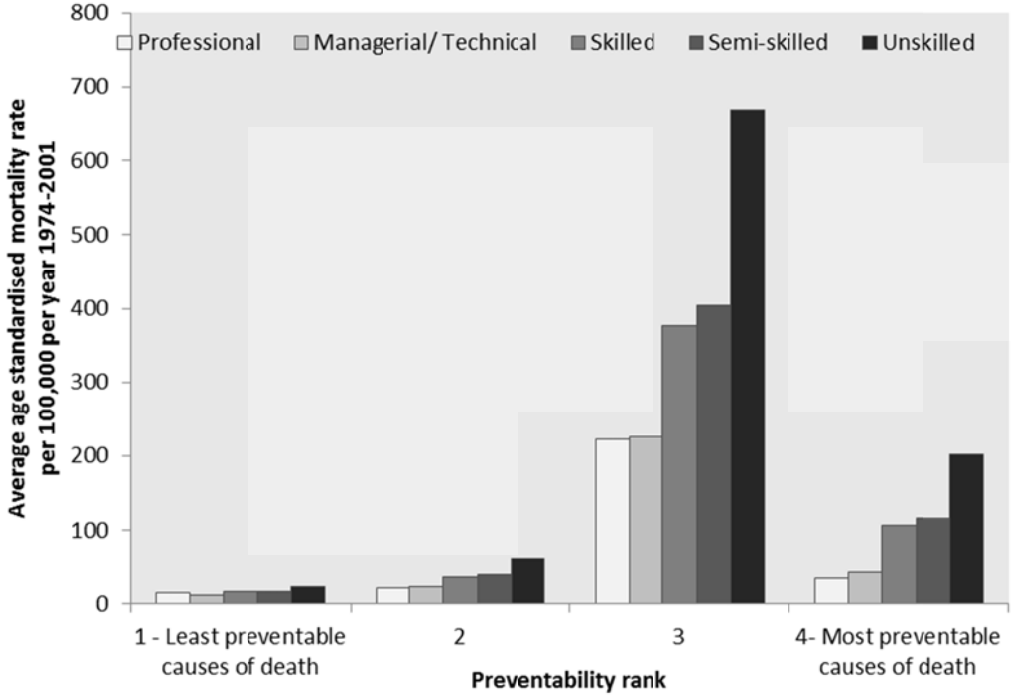


Figure 26. Socioeconomic gradients across social class in age standardised mortality by preventability of death for men aged 20-64 years in Scotland 1974-2001.



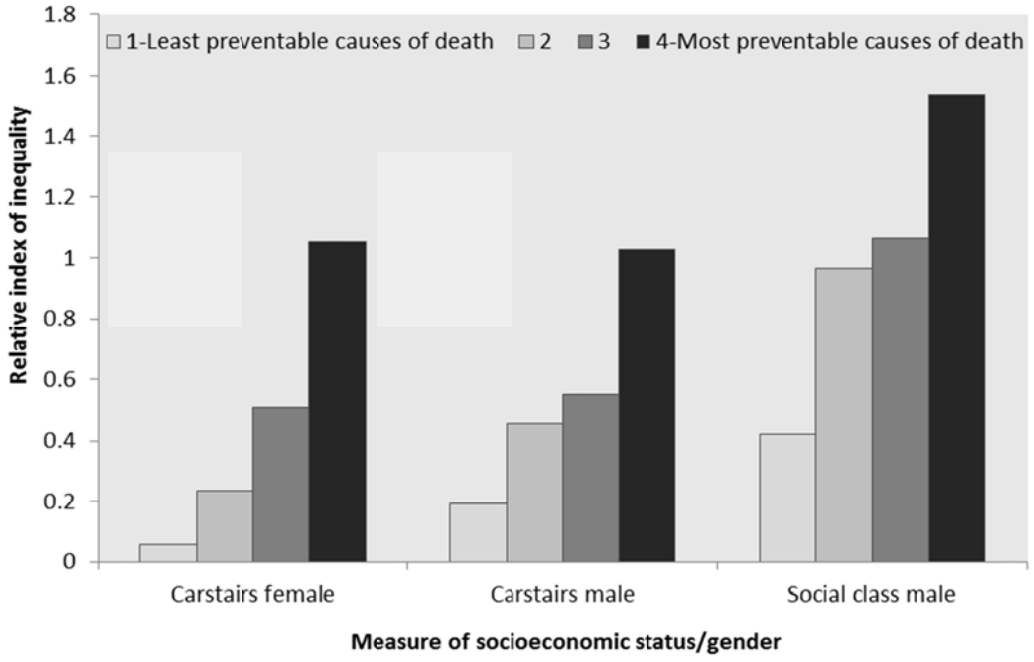
As a result of the inclusion of a larger number of, and more frequent, specific causes of death, the second most preventable causes of death category had a higher absolute mortality gradient (SII) than the most preventable category. When the mean frequency of death for each preventability category was considered socioeconomic gradients in mortality (RII) were directly proportional to preventability of death for both sexes across Carstairs deciles and social class for working aged men (Table 2 and Figure 27).

Table 2. Absolute and relative inequalities in mortality by preventability of causes of death for men and women by Carstairs 1981-2001 and men aged 20-64 years across social class 1974-2001 in Scotland

	Carstairs female		Carstairs male		Social class male	
	SII	RII	SII	RII	SII	RII
Least preventable causes of death	1	0.1	4	0.2	7	0.4
Preventability group 2	16	0.2	28	0.5	35	1.0
Preventability group 3	171	0.5	331	0.5	404	1.1
Most preventable causes of death	84	1.1	178	1.0	155	1.5

SII = slope index of inequality
RII = relative index of inequality

Figure 27. Relative socioeconomic gradients in mortality by preventability of causes of death for women and men across Carstairs deciles1981-2001 and men aged 20-64 years across social class 1974-2001 in Scotland.



4. Discussion

Our analyses demonstrate that socioeconomic inequality meets Phelan and Link's criteria for a fundamental cause of health inequalities in Scotland. It is associated with multiple causes of death, mediated by a range of proximal risks and , despite success in reducing inequalities in certain specific causes of death, its relationship with all-cause mortality is maintained over time as a result of strengthening association with existing threats and the emergence of new cause-specific gradients. In addition, socioeconomic gradients in mortality appear to increase with increasing preventability, supporting the hypothesis that inequalities exist where there is the ability to use a variety of resources to protect oneself from harm.

Reductions in socioeconomic inequalities across Carstairs deciles were seen for rheumatic heart disease (men and women), TB, hypertension and diabetes (women only). Success in reducing rheumatic heart disease mortality and TB is likely to be related to improved control of infectious disease, in the form of vaccine and antibiotic development and improved living conditions in the generations achieving middle-age during the time period of this study. Similarly, a focus on treating specific risks in the context of universally provided health care is likely to explain progress in reducing inequalities in mortality related to hypertension and diabetes. Over the same time period new socioeconomic gradients emerged for other causes of death (e.g. HIV and colorectal cancer) mediated by a range of mechanisms including tobacco (perinatal complications), alcohol (e.g. some acute abdomen conditions and cardiomyopathy), industrial exposures (bladder cancer), ultraviolet light (melanoma) and health care itself (health care related (i.e. iatrogenic) mortality).

Taking into account absolute and relative measures, the greatest inequalities for the period 1997-2001 were observed for ischaemic heart disease, lung cancer and COPD mortality for women and ischaemic heart disease, lung cancer and alcohol related disease mortality for men. In the case of ischaemic heart disease, mobilisation of resource to protect oneself from harm can be thought of in terms of having more time and money for enjoyable physical activity, good quality diet and employment conditions and social circumstances which offer protection from chronic stress. Similarly, with tobacco and alcohol-related disease, knowledge of harms, financial security, good quality employment, affirming environments and prevalent social norms can all be drawn upon to prevent initiation of drug use and/or rehabilitation from addiction (21). Conversely, where we do not know how to prevent or treat a disease, as in the case of brain or ovarian cancer, resource cannot be consciously mobilised to protect oneself harm and we consequently see no, or less of a, socioeconomic gradient in mortality. Of note, cardiomyopathy, one of the causes of death not currently included in the ONS definition of avoidable mortality, did show an emerging socioeconomic gradient for working age men across social classes. One explanation for this may be that an increasing proportion of cardiomyopathy deaths are now related to preventable risk factors such as alcohol and it is therefore likely to have been misclassified in the Scottish context (22,23).

The strengths of this study include: the comprehensive counts of deaths; the use of predetermined classification systems for socioeconomic status, cause of death and preventability/avoidable mortality; the number of causes for which trends are described; the use of both an individual and area based measure of socioeconomic status and the relatively long duration of time considered. Furthermore the clarity and consistency of findings for the comparison of mortality rate inequalities for avoidable and unavoidable

causes of death and across preventability categories by sex and measure of socioeconomic status support their reliability and validity.

There are also limitations of this work. For some causes of death, small numbers reduce the precision of estimates of inequalities. The definition of avoidable mortality and the preventability ratings are somewhat subjective having been determined by expert consensus with their validity further limited by the boundaries of current knowledge. The inclusion of such a small number of non-avoidable causes of mortality risks selection bias. The use of 1991 Carstairs index scores for all years introduce the possibility of exposure misclassification. Social class based on occupation is a relatively broad and blunt measure of individual socioeconomic status and may not accurately reflect contemporary resource access. In addition, long-term unemployed are excluded under National Statistics Socioeconomic Status Classification (NS-SEC) whilst often still recorded according to last occupation on death certificates. The change to NS-SEC in the 2001 Census therefore potentially increases an existing numerator-denominator mismatch caused by, amongst other things, an inflation of social status which often occurs on death certificates. This results in an overestimation of numerators and consequently mortality rates for some social classes. It is difficult to know which social classes are affected as this will depend on the previous employment of the long-term unemployed but it may mean a quantitative (although unlikely qualitative given the area-deprivation results) overestimate of inequalities gradients for the social class analysis. Finally, data over a longer time period are required to better capture the substitution of new for old causes of mortality associated with socioeconomic status and the emergence of socioeconomic gradients, as causes once unavoidable become avoidable (e.g. where new curative treatment becomes possible).

Further work is required to extend the described inequalities trends for specific causes of mortality when the 2011 census denominator data are available. Phelan and Link's preventability ratings (11) include a number of causes of mortality not assessed in this study. These could also be incorporated in future studies describing trends over a longer time period (e.g. gallbladder and extrahepatic bile duct cancer and multiple sclerosis as additional examples of non-avoidable causes of mortality). Possible additional analyses also include comparing indices of inequalities for purely preventable and purely amenable subcategories of avoidable mortality to consider potential modification of the observed association by proportionate universal healthcare and categorising preventable causes of mortality according to whether universal prevention has or has not been instituted.

It would appear that the association between socioeconomic status and all-cause mortality persists through the substitution of new for old risks once thought to explain it (e.g. health –related behaviours substituting malnutrition/lack of water sanitation). That avoidable mortality should display a socioeconomic gradient whilst non-avoidable mortality does not, suggests that socioeconomic gradients in mortality result from either a difference in knowledge on how to avoid harm or a difference in the ability to act on that knowledge. Recent work exploring the relationship between knowledge, motivation and outcomes in a Scottish population sample indicates the latter is more likely (24). This is further supported by recent work which has shown that trends in health inequalities mirror trends in socioeconomic inequalities (2,3). Taken together these observations signal that: socioeconomic inequality is a fundamental cause of health inequalities; focusing on controlling proximal mediators such as tobacco will ultimately fail to eradicate socioeconomic inequalities in health; and that elimination of health inequalities will require that underlying resource inequalities be addressed.

To reduce health inequalities, public health policy should focus on redistributing a broad range of resources, including power, towards those who are currently resource poor. Education, employment, wealth and income have been suggested as priority areas for redistributive actions (25). In addition, given the suggested increased ability of those of higher socioeconomic status to act to avoid harm, public health interventions should rely less on individual agency and more on universal contextual change (e.g. ban on smoking in public places and relative poverty reduction) (1,25,26).

5. Conclusion

Socioeconomic inequalities in mortality are large and increasing in Scotland. These inequalities represent unjust differences in the amount of life lived between the most and least deprived members of society. They are not inevitable. Eradicating this injustice requires us to tackle its root cause. Tackling underlying inequalities in income, wealth and power is likely to be the only way this can be sustainably achieved.

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