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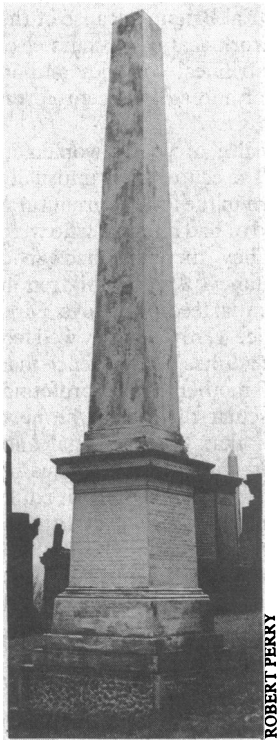
Socioeconomic differentials in mortality: evidence from Glasgow graveyards

George Davey Smith, Douglas Carroll, Sandra Rankin, David Rowan



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BMJ 1992;305:1554-7

Introduction

In 1842 the average age of death for "gentlemen and persons engaged in the professions and their families" was 45 years, for "tradesmen and their families" it was 26 years, whereas for "mechanics, servants and labourers and their families" it was only 16 years.[1] In 1904, the report of the interdepartmental committee on physical deterioration noted the paucity of data available on social status and mortality, commenting in particular on the failure of the registrar general's routine statistical returns in this regard.[2] Responding in part to this demand, T H C Stevenson, one time superintendent of statistics at the General Register Office, analysed mortality for the years 1910-2 according to eight occupationally based social class groups.[3] He noted that this was unsatisfactory, since it was too dependent on classifications according to industry, with "all grades of worker, master and man, skilled and unskilled" grouped together in some cases. In 1921 "a determined attempt was made to purge the occupational classification of its industrial taint,"[3] and it is from the reports of social class differentials in mortality around the 1921 census[4] that the continuing series of decennial supplements on occupational mortality are generally dated.[5]

Since 1921 these reports have revealed a more or less consistent pattern of risk in all cause mortality increasing from the professional groups in social class I to the unskilled labourers in social class V.[4,6-10] More recent studies focusing on non-occupational measures of material wellbeing, such as housing tenure and car ownership, have generally been able to differentiate mortality risk better than analysis by social class alone.[11] Indices such as these are not recorded on death certificates, so mortality rates cannot be computed by comparing death registrations (numerator) to census figures for the population at risk (denominator). Showing large differentials in mortality according to asset based measures of available income has therefore depended on following up large cohorts[12,13]—but such data cannot be obtained for earlier periods.

One way the issue can be explored is through commemorative obelisks of a uniform design (figure) found in burial grounds in Glasgow. The height of these obelisks varies greatly, yet their shape remains standard. As the height would influence the cost of the obelisk, it is reasonable to assume that more wealthy decedents would be commemorated by taller obelisks. We set out to determine whether better socioeconomic status, indexed by taller obelisks, was associated with greater longevity during the period 1801-1920.

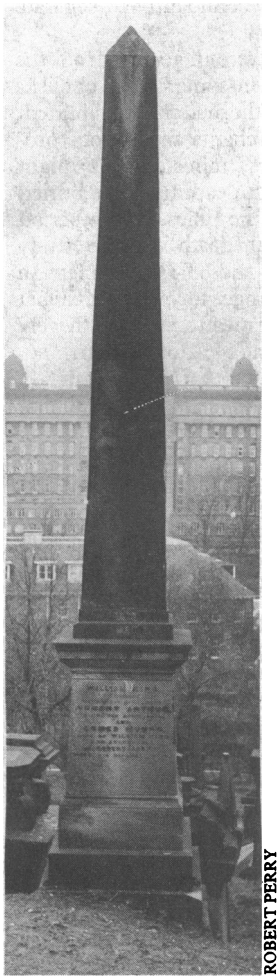
Method

A standard form of obelisk is a common marker of graves in the graveyards of Glasgow. All such obelisks were inspected in eight graveyards in Glasgow: the Cathedral, Eastern, Southern, and Western Necropolises, and Sighthill, Vennel, Rutherglen, and Craigton graveyards. From the obelisk, details were taken of the year of death and age at death of the first generation of the family commemorated by the obelisk. In general the obelisk would have been erected in memory of the first deceased of these; their year of death was taken to be the year of construction of the obelisk. Some obelisks commemorated only a male or female family elder; from these only one set of data were recorded. Only people dying before 1921 were included in this study as the registrar general started reporting death rates by five social class groups for the period around the 1921 census. If one of a couple commemorated on an obelisk died before 1921 and one after, only data for the former were used.

If data were incomplete—on some obelisks the date of death, but not age at death, was recorded—a record of the burial was consulted.[14] Even so, complete data could not be obtained for 60 people. The inscriptions were illegible on 95 obelisks, usually because of weathering, although some could not be read because they had collapsed with the inscription facing downwards and could not be turned over.

The height of each obelisk was measured with a set of chimney sweep rods, each 90 cm long, with gradations added. Height was measured from the base of the plinth to the crest of the pyramidal top piece, to the nearest 5 cm. The principal material in the obelisk—granite, marble, or sandstone—was recorded. Four obelisks made of different materials (three iron, one concrete) were not included in the study. Granite was, and is, the most expensive of these materials and sandstone the least expensive (R Taylor, personal communication).[15] The price differential between the materials depends on the exact source of the material and has varied over time, so no precise quantification of costs can be made. Therefore the three materials have been simply treated as giving an ordering of the cost for each obelisk at any given height.

The relations between continuous variables were



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examined by correlation and linear regression analyses. Differences in means were examined through analysis of variance and difference in medians by the Mann-Whitney U test.

Results

Data were obtained from 843 obelisks, 264 from the Cathedral Necropolis, 191 from Sighthill graveyard, and 388 from the six other graveyards combined. The earliest obelisk was constructed in 1805, and the median year of construction was 1883. Table I presents the number and proportion of obelisks built during 20 year periods from 1801 to 1920.

Height of the obelisks ranged from 1·75 m to 11·40 m, with a mean (SD) of 3·91 (1·11) m. Granite was the principal material for 514 (61%) of the obelisks, marble for 171 (20%), and sandstone for 158 (19%). The median year of construction of the sandstone obelisks was 1873, earlier than the median of 1884 for the granite ones, which in turn is earlier than 1890 for the marble ones (all differences $p<0·01$ by Mann-Whitney U test). The mean heights of the three types of obelisk (3·89 m for granite, 3·91 m for marble, and 3·98 m for sandstone) are similar ($p=0·7$ by analysis of variance).

The 843 obelisks yielded data for 725 men and 624 women dying before 1921. The median year of death of these 1349 people was 1889. The mean ages at death are presented according to year of death and sex in table II (range 20-98). Men had a higher mean age of death than women during all but the most recent time period. After 1860 there is a steady increase in mean age at death. If deaths occurring during the main child-bearing years are excluded, a female advantage emerges earlier and is more pronounced (table III).

Correlations between height of obelisk, age at death, and year of death are presented in table IV. As shown in table II, age at death increased over the time period. The average height of the obelisks decreased with year of death, but increased with age at death. Table V presents age at death according to tertile of the height of the obelisks, together with the coefficient from simple linear regression of age at death against height of obelisk. The regression analyses show that every metre in height of obelisk translates into 1·42 years later age at death (95% confidence interval 0·53 to 2·31) for men and 2·19 (0·93 to 3·45) for women.

The average height of obelisks fell over time, whereas mean age at death increased. Correlations between height of obelisk and age at death are presented for different time periods in table VI. These are generally higher than the overall correlations. Multiple regression was performed, with age at death as the dependent variable and height of obelisk and year of death as the independent variables. These analyses reveal that, adjusted for year of death, each metre in height of obelisk translates into 1·93 (1·06 to 2·80) years later age at death for men and an equivalent value of 2·92 (1·76 to 4·08) years for women.

The mean ages at death according to the material of the obelisk are presented in table VII. The trend is in the expected direction—that is, higher mean age at death correlates with the more expensive materials—but the effect is weak and not significant at conventional levels for either men (analysis of variance $p=0·1$; as trend in regression analysis $p=0·06$) or women (analysis of variance $p=0·7$; as trend in regression analysis $p=0·4$).

The main analyses were repeated separately for the two largest graveyards, which supplied 54% of obelisks in this study. As shown in table VIII, the pattern of

TABLE I—*Period of construction of obelisks*

	No (%) built
1801-1820	7 (1)
1821-1840	20 (2)
1841-1860	94 (11)
1861-1880	267 (32)
1881-1900	282 (33)
1901-1920	173 (21)

TABLE II—*Age at death (years)*

	Males		Females	
	No	Mean age	No	Mean age
1801-1860	89	59·7	57	53·4
1861-1880	194	57·5	147	52·6
1881-1900	252	65·4	234	63·6
1901-1920	190	67·5	186	70·2

TABLE III—*Mean age at death of men and women aged over 45 years*

	Males		Females	
	No	Mean age	No	Mean age
1801-1860	71	65·1	37	62·5
1861-1880	153	63·0	90	64·0
1881-1900	234	67·4	201	68·5
1901-1920	184	68·5	171	73·2

TABLE IV—*Correlations between height of obelisk, age at death, and year of death (men above diagonal, women below diagonal)*

	Age at death	Year of death	Height of obelisk
Age at death		0·25**	0·12**
Year of death	0·40**		−0·15**
Height of obelisk	0·14**	−0·11*	

*p<0·01. **p<0·005.

TABLE V—*Age of death according to height of obelisks*

	Mean height (m)	Age at death	
		Men	Women
Lowest third	2·99	61·6	58·3
Middle third	3·77	62·8	63·1
Highest third	5·10	64·8	65·1
Regression coefficient per metre height		1·42*	2·19*

*p<0·005.

TABLE VI—*Mean age at death related to height of obelisks*

	Males	Females
1801-1860	0·34**	0·15
1861-1880	0·15*	0·23**
1881-1900	0·16*	0·12
1901-1920	0·07	0·28**

*p<0·05. **p<0·005.

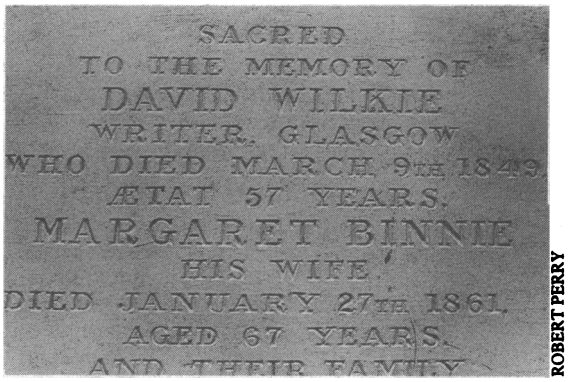
TABLE VII—*Mean age at death according to material of obelisk*

	Males	Females
Granite	63·7	62·6
Marble	63·5	61·3
Sandstone	60·9	61·3

TABLE VIII—*Analyses for the two major burial grounds*

	Cathedral Necropolis		Sighthill graveyard	
	Male	Female	Male	Female
Age at death correlated with height	0·21**	0·14*	0·11	0·16*
Regression coefficient	1·93**	1·75*	1·41	3·12*
Regression coefficient (including year of death as a covariate)	2·45**	2·09*	1·87*	4·60**

*p<0·05. **p<0·005.



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Inscriptions on obelisks sometimes gave occupations—most often "merchant," but other professions were mentioned as well

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Obelisks were part of the Egyptian imagery so popular in Victorian graveyards

results which emerged from these analyses was much the same as in the whole sample.

Discussion

We used the average age at death as the indicator of mortality risk, as it was in the 1840s and is currently,[16] because denominator data are not available. This index is sensitive to the age structure of the population. Even with internal comparisons and with analyses in which year of death is controlled, as in the present study, different age distributions for adults in different socioeconomic groups could be due to factors other than differential survival. When mortality differences between regions of Scotland at this time[17] are considered both in terms of average age at death and death rates in given age categories, similar differentials are seen despite large differences in age distribution. When numerator and denominator data are not available the average age at death can be a useful index, although it must be interpreted carefully.[16]

With this caveat in mind, we can consider reasons for height of obelisk being associated with age at death for people buried in the main graveyards of Glasgow. It is likely that one of two processes is involved—either higher socioeconomic status, as indexed by height of obelisk, is associated with greater longevity, or living longer leads to greater accumulation of assets, which are in part exchanged for a larger memorial after death. If the latter were the case, it would be expected that the height of obelisks would be more strongly related to men's than women's age at death, since for the middle class groups who were commemorated in this manner, few women would have been independent wage earners.[18] If anything, however, the association between obelisk height and age at death was greater for women than men.

It is a commonplace that Victorian society was obsessed with class. A historian of the period describes the "multiple gradations or ranks in a pyramidal order" but sees a crucial distinction between the respectable and the non-respectable.[18] Burial arrangements could clearly reflect respectability and social aspirations as well as economic position. In this respect height of obelisks is no different from registrar general's social class, which is based on the notion of the general standing of an occupation within the community rather than on economic rewards of particular jobs or a theoretical understanding of the class structure. The present data do not allow us confidently to separate social display from ability to pay.

The subjects of this study were in general from the privileged strata of society. On some of the obelisks occupations were recorded for the men commemorated, who were predominantly merchants and various professionals—engineers, doctors, ministers. As might be expected, the average age at death for those buried in these grounds was old for the times. In the period 1881-1900 the mean ages at death for the study population were 65·4 for men and 63·3 for women. In 1890,[17] the midpoint of this range, for people dying at 20 years or over in Glasgow the mean ages at death were calculated to be 50·1 for men and 52·4 for women.

Although in 1815 Milne stated that "There can . . . be no doubt but that the mortality is greater among the higher than the middle class of society,"[19] the scattered evidence available suggests that in the nineteenth century there was apparently a graded relation, such that lower occupational standing was associated with higher mortality risk.[20,21] An exception is sometimes made for members of the peerage, who some observers thought had lower life expectancy than the general population.[19] If this were the case, then it seems to be a specific property of the aristocracy, rather than showing that the relation between socioeconomic status and mortality does not exist outside of the truly poor.

This study suggests that socioeconomic differentials in mortality existed for the relatively well off during an earlier era. Absolute poverty, as discussed by Chadwick[1] and Booth,[22] presumably played no part in generating the differentials reported here. Although a continuous gradation of mortality risk accompanying the fine stratification of British society is seen currently,[23,24] for earlier periods more attention is generally paid to notions of absolute impoverishment. In Glasgow, James Burn Russell, who served as the city's first full time medical officer of health from 1872 to 1898, wrote numerous reports for the *Glasgow Medical Journal* and the *Sanitary Journal for Scotland* with titles such as "Local vices of buildings as affecting the death rate" and "Public health and pauperism."[25] Showing that mortality differentials persisted into privileged groups presents the same challenge for the interpretation of the factors underlying health inequalities then as it does now.[26]

A few other studies have examined the relation between non-occupational indicators of material wellbeing and mortality risk during an earlier age for which routine data are not available. Records of dowry investments made at birth for daughters of relatively affluent families in Florence from 1425 to 1442 have been related to ages at death for the girls concerned.[27] A gradient of decreasing mortality risk was seen from those accompanied by a dowry of less than 49 florins to those with dowries greater than 100 florins. In Providence, Rhode Island, mortality for taxpayers and non-taxpayers in 1865 could be calculated. Less than a quarter of the population were tax payers, who constituted the affluent section of Providence society. In most age groups, death rates for non-taxpayers were two to three times higher than for taxpayers.[28]

Studies such as these help document the existence of socioeconomic differentials in mortality risk. The existence of such differentials among privileged groups suggests that notions of absolute poverty do not, on their own, provide an adequate explanatory framework. Further, the existence of the usual mortality gradient at a time when the familiar triad of sin—sloth, smoking, and fatty food—may well have been a characteristic more of the rich than of the poor emphasises the parochial nature of explanations in terms of health related behaviours, as does the exist-

ence now of such differentials in societies with very different social structures to those of Britain today. When Chapin documented mortality differentials in Providence in 1924 he hoped that such a demonstration would be preparation for "what should be of great value, namely a study of the habits of life and environment which make for the longevity of the well-to-do."[28] This still pertains.

The authors acknowledge the generous assistance of David Crawshaw, cemeteries and crematoria officer and registrar, Glasgow City Council, and the technical support of David Bell and Moira Willison of Glasgow Polytechnic.

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The transformation of maternal mortality

Irvine Loudon

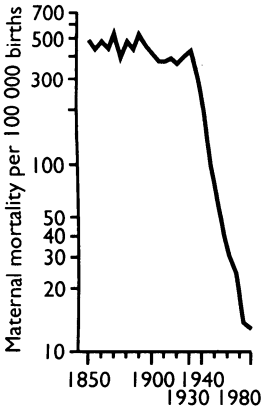

FIG 1—*Maternal mortality, quinquennial averages 1850-1980. Logarithmic scale*

There can be no doubt that the most remarkable feature of childbirth in this century is the profound decline in maternal deaths throughout the Western world. From 1900 to 1935 the average maternal mortality in England and Wales was around 400 per 100 000 births, with the lowest rate of 355 in 1910 and the highest, 441, in 1934. From 1935, however, there was a dramatic change. Maternal mortality began its steep and sustained decline until, by the 1980s, it had fallen to less than nine deaths per 100 000 births: roughly one fiftieth of the rate in 1934.[1]

Figure 1 shows these features: the plateau of maternal mortality followed by the steep and continuous fall. A broadly similar trend—a plateau and a steep decline—was seen in all Western countries. During the period from 1900 to 1935, however, there were striking differences in national levels of maternal mortality (table I, figure 2). The United States had the highest level of maternal mortality, the Netherlands and Scandinavia the lowest; England and Wales occupied an intermediate position. Only a small part of international differences could be attributed to statistical methodology. When these were eliminated, the rank order shown in table I remained intact.[2]

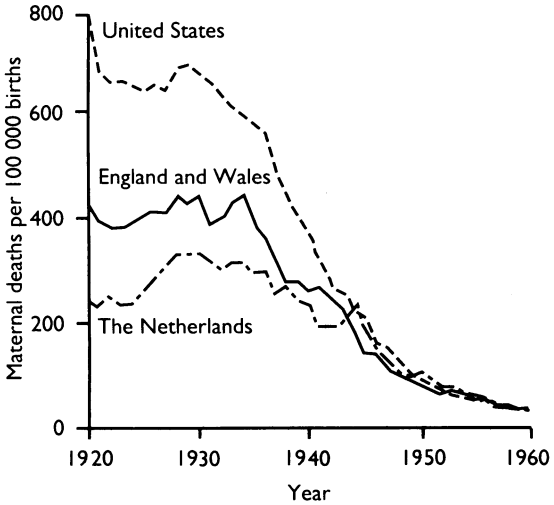

FIG 2—*Annual trends in maternal mortality expressed as maternal deaths per 100 000 births*

TABLE I—*Maternal mortality in certain countries in 1920.*[25]

Country	Maternal mortality from all causes (per 100 000 live births)
Denmark	235
The Netherlands	242
Sweden*	258
Norway†	297
Finland	360
England and Wales	433
Australia	501
Ireland	553
Belgium	609
Scotland	615
New Zealand	648
France	664
United States	689

*1918. †1919.

Why were there such wide differences between Western countries? Why was it so much safer in the 1920s to have a baby in the Netherlands than the United States? And why, as we will see, had these wide differences virtually disappeared by 1960? It might be thought that the answer lay in social and economic differences, on the assumption that rates of maternal mortality were primarily determined by factors such as poverty and malnutrition—but this was not the answer. Maternal mortality, unlike infant mortality, was remarkably insensitive to social and economic factors per se but remarkably sensitive to standards of obstetric care.[3,4] I believe that the answers to the questions asked above will be found in international comparisons of maternal policies and systems of maternal care. I have

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BMJ 1992;**305**:1557-60