For Debate

Income distribution and life expectancy

R G Wilkinson

In Britain, as in other developed countries, variations in morbidity and mortality have been associated with a wide variety of measures of socioeconomic status including car ownership, housing tenure, occupational class, overcrowding, education, and unemployment.[1-5] Associations with income have also been reported.[6-8] The cross sectional relation between income and health seems to be strictly non-linear. Figure 1 shows this relation in the 7000 people studied in the example, the health and lifestyles survey.[6] For three different measures of morbidity standards of health improved rapidly as income increased from the lowest towards the middle of the range. No further gains in health accompanied increases in income beyond that point. (Such a strongly non-linear relation may sometimes have been missed by researchers using linear methods.)

In a test of the causal significance of the relation between income and mortality during 1971-81 changes in occupational mortality were significantly related to changes in the proportion of people in each occupation earning less than about 60% of average earnings and also to changes in the proportion unemployed.[7] Changes in the proportions of people in higher earnings categories seemed to have less impact on mortality. If there are sharply diminishing health returns to increases in income, income redistribution might improve the health of the less well off while having little effect on the health of the better off. The end result would be to improve the average standard of health of the population.

Cross sectional evidence suggesting that there is a significant tendency for mortality to be lower in countries with a more egalitarian distribution of income does exist.[7-10] That this relation has been identified in different groups of countries, at different times, and with different measures of income distribution, suggests that it is robust. Correlation coefficients above 0·8 have been reported,[7 8] suggesting that the underlying relation may be important and should be pursued further. Nevertheless, if such an association exists it is surprising that mortality in developed countries has been found not to be closely related to measures of average income such as gross national product per head.[9-11]

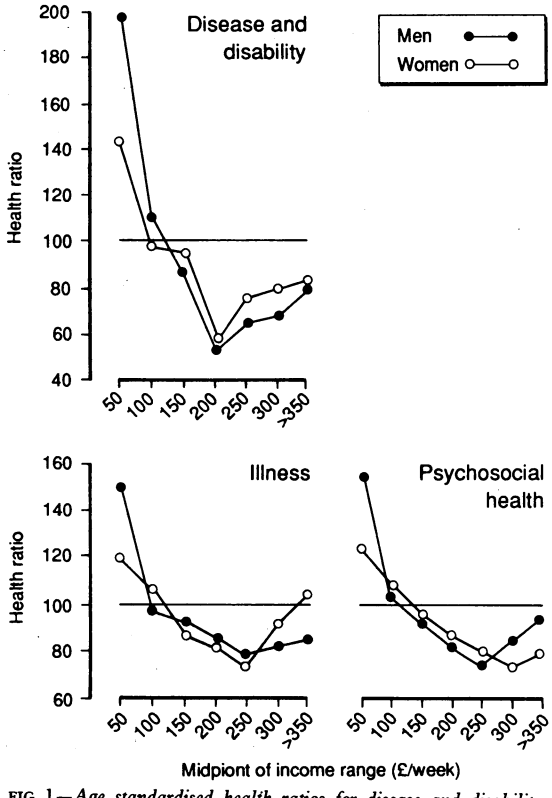

FIG 1—*Age standardised health ratios for disease and disability, illness, and psychosocial health in relation to weekly income (£) in 1981 of men and women aged 40-59*[6]

Analysis of data

I collected data to investigate the cross sectional relation between income distribution and mortality and its possible interactions with gross national product per head and to assess whether changes in income distribution over time are related to changes in mortality in developed countries. Throughout the following analyses mortality is measured by combined male and female life expectancy at birth. Data are from the *World Tables*,[11] supplemented by figures for Italy and Portugal from the *World Health Statistics Annuals*[13] and for the United Kingdom from the Government Actuary's Department (personal communication).

GROSS NATIONAL PRODUCT PER HEAD

The relation between average income and life expectancy was assessed using figures of gross national product per head (based on purchasing power parities) for 23 countries in the Organisation for Economic Cooperation and Development.[14] The Pearson correlation coefficient for the cross sectional relation between life expectancy and gross national product per head in 1986-7 was 0·38 ($p<0·05$). The correlation between the increases in gross national product per head and in life expectancy over the 16 years 1970-1 to 1986-7 was almost non-existent at 0·07. These data seem to confirm that there is, at best, only a weak relation between gross national product per head and life expectancy in developed countries.[9-11]

INCOME DISTRIBUTION

Unfortunately, internationally comparable data on

Trafford Centre for Medical Research, University of Sussex, Brighton BN1 9RY
R G Wilkinson, MMEDSCI, *senior research fellow*

BMJ 1992;**304**:165-8

the distribution of income within each country are scarce. The data used here were originally put together for reasons unrelated to health, and in each case all the countries given in the sources were included in the analyses. The measures of income distribution were also limited by the sources.

For a few countries the data bank of the Luxembourg Income Study provides income distribution data of "an unparalleled degree of comparability between countries."[15] The study gives data on the share of total income going to successive tenths in the income distribution in nine countries: Australia 1981, Canada 1981, the Netherlands 1983, Norway 1979, Sweden 1981, Switzerland 1982, West Germany 1981, United Kingdom 1979, and the United States 1979.[15] Income was family net cash income, defined as gross original income plus public and private transfers and minus direct (income and payroll) taxes. The table shows the Pearson correlation coefficients for the relation between life expectancy in 1981 and the share of total income going to successive tenths of the population, starting with the poorest and ending with the richest, in each of these nine countries. The coefficients in the first column show the relation between life expectancy and the proportion of total income going to each tenth of the population taken separately. The second column is a cumulative version of the first column: it shows the correlation between life expectancy and the proportion of income going to the combined population below each successive decile of income distribution. Here the strength of the correlation peaks at the seventh decile —that is, with the proportion of income going to the least well off 70% of the population. Figure 2 shows the relation between average life expectancy and the proportion of income received by the least well off 70% of the population in different countries.

Pearson correlation coefficients for relation between life expectancy (male and female at birth) and income distribution in nine countries in the Organisation for Economic Cooperation and Development[15]

Income distribution	Each interdecile group separately	Everyone below each decile	
			Controlling for gross national product/head
Decile 1	0·13	0·13	0·28
Decile 2	0·63*	0·45	0·57
Decile 3	0·76**	0·57*	0·66*
Decile 4	0·92***	0·65**	0·73*
Decile 5	0·64*	0·75**	0·83**
Decile 6	0·28	0·84***	0·91***
Decile 7	0·18	0·86***	0·90***
Decile 8	0·17	0·80**	0·81**
Decile 9	0·11	0·68*	0·68*
Decile 10	−0·68*		

*p<0·05, **p<0·01, ***p<0·001.

The third column of the table shows partial correlation coefficients which repeat the cumulative analysis in the second column while controlling for gross national product per head (a measure of the average income in each country). Regressing life expectancy on gross national product per head and the proportion of income going to everyone below the seventh decile in each country produced an equation with a correlation coefficient of 0·90 and an adjusted R^2 suggesting that three quarters of the variation in life expectancy is accounted for by these two variables alone. However, gross national product per head does not make a significant independent contribution to the equation. The change in R^2 produced by bringing gross national product per head into the equation suggests that it contributes less than 10% to the proportion of the variance explained. This existence of a strong cross sectional relation between life expectancy and income distribution stands in marked contrast to the weak relation with gross national product per head.

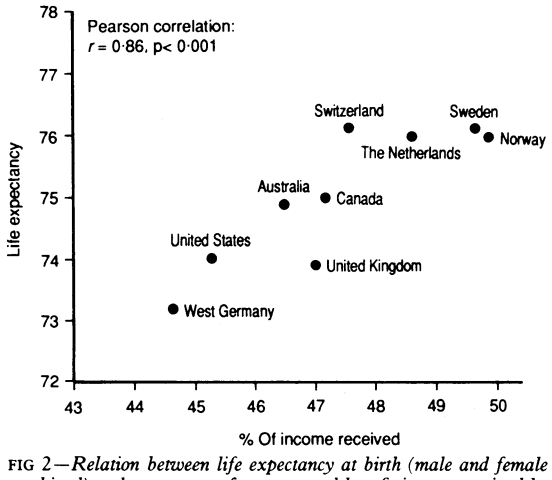

FIG 2—*Relation between life expectancy at birth (male and female combined) and percentage of post tax and benefit income received by least well off 70% of families, 1981*

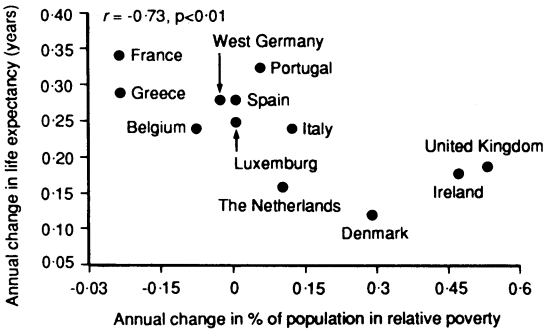

FIG 3—*Annual rate of change in life expectancy and in proportion of population in relative poverty in 12 European Community countries, 1975-85*

EFFECT OF CHANGES IN INCOME DISTRIBUTION

To provide a more demanding test of the relation with income distribution changes in income distribution between two dates were compared with changes in life expectancy in different countries. Only two small sets of data with internally consistent definitions of income and of the income receiving unit could be found from which figures of changes in income distribution could be derived. Results are also reported from a third source which falls short of these standards.

The first data set comes from a European Commission project to provide estimates of changes in the prevalence of relative poverty in 12 European Community countries between 1975 and 1985.[16] Relative poverty is defined as the proportion of the population living on less than 50% of the national average disposable income. As the initial estimates of poverty for some countries varied during 1973-7, resulting in estimates of change over different time spans, changes in both poverty and life expectancy were expressed as average annual rates of change. Figure 3 shows the relation between the annual rates of change in life expectancy and the proportion of the population in poverty. The correlation coefficient was −0·73 (p<0·01), showing that among these countries a fall in the prevalance of relative poverty was significantly related to a more rapid improvement in life expectancy.

The second data set contains the income distribution in some countries in the Organisation of Economic Cooperation and Development at varying dates.[17] Changes in the proportion of total disposable income received by the least well off 60% of households can be calculated over one period for five countries, and over two periods for a sixth, to provide seven observations of change in all. As the length of the periods varied from five to 11 years, all changes were again expressed as annual rates (fig 4). To ensure the independence of the observations, the two periods shown for Japan

were combined, and a correlation coefficient of 0·80 ($p<0·05$) across the six countries suggested once more that increases in the share of income going to the least well off were associated with faster increases in life expectancy.

The last set of data on changes in income distribution comes from the *World Development Reports*.[18] Changes in the proportion of income received by the least well off 60% can be calculated for 15 developed countries (Australia, Canada, Denmark, Finland, France, Italy, Japan, the Netherlands, Norway, West Germany, Spain, Sweden, Switzerland, United Kingdom, and the United States). This data set is larger than the last two partly because data are included that are often not strictly comparable. There are variations both in the definition of income and in the income receiving unit.[19] The correlation coefficient between the annual rate of change in life expectancy and in the proportion of income received by the least well off 60% of the population was 0·47 ($p<0·05$).

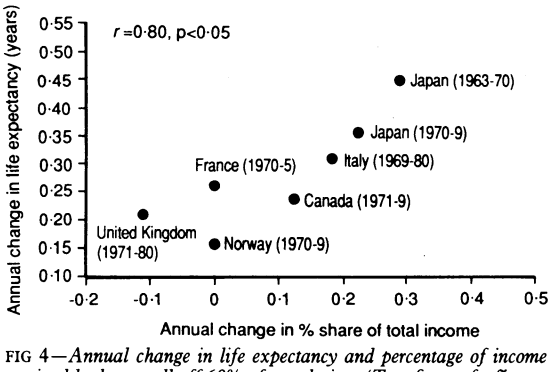

FIG 4—*Annual change in life expectancy and percentage of income received by least well off 60% of population. (Two figures for Japan were combined when calculating correlation coefficient)*

Discussion

The relation between income distribution and life expectancy is sufficiently strong to produce significant associations in analyses of cross sectional data and of data covering changes over time, despite the small number of countries for which compatible data are available. Because several countries appear in more than one data set, the four analyses reported here cannot be regarded as strictly independent. Nevertheless, data on income distribution from 19 developed countries has been included and the data on changes over time are independent of the cross sectional data given for nine countries. Other countries have been included in previous analyses.[8-10] Overall, there is clear evidence of a strong relation between a society's income distribution and the average life expectancy of its population.

How should this relation be interpreted? Four possibilities may be suggested. The first two concern potential intervening variables. The strength of the relation (correlation coefficients as high as 0·8 and 0·9) reduces the likelihood that it could be a byproduct of a closer underlying relation. Countries with a more egalitarian income distribution are likely to have better public services which benefit health, but medical services are unlikely to have a decisive influence on national mortality. Even the small proportion of deaths from conditions regarded as wholly amenable to medical treatment seem less influenced by differences in medical provision than they are by differences in socioeconomic factors.[20] Deaths from many other important causes are only marginally affected by medical care. In addition, it has been shown statistically that neither public nor private expenditure on medical care can account for the relation.[10] Although the effects of other areas of public expenditure still await examination, it is hard to imagine any which could give rise to spurious correlations as strong as these.

The second possibility is that ethnic minority communities may have poor health and widen the income distribution as a result of discrimination in employment. The evidence suggests that ethnic minorities, at least in Britain, have very little effect on national standards of health.[21] In addition, such a hypothesis cannot explain the relation between changes in income distribution and life expectancy during years when international migration (especially of the unskilled) was tightly controlled. Lastly, the scale of the effect of income distribution on health is too large to be accounted for by minorities.

The third possibility is reverse causality. If sickness is sometimes a cause of poverty, a higher proportion of sick people would widen the income distribution. Processes of this kind have been found to make only a small contribution to the differences in mortality between social classes.[22-24] Class differentials in mortality are measured among economically active people of working age, among whom such effects might be expected to be at their strongest. As the current analyses have used life expectancy at birth for the total population, the impact of reverse causality will be reduced still further: children, pensioners, and those who are not economically active are unlikely to suffer any loss of income when ill.

If reverse causality were the main explanation of the association reported here, it would imply that changes in income distribution were mainly determined by autonomous changes in health. That would mean denying the contribution of economic factors like unemployment, taxes, benefits, profits, and wage bargaining to income distribution. Lastly, there is direct evidence from other sources that mortality is responsive to changes in income.[7 8]

The fourth possibility is that mortality is affected by income distribution. This interpretation is consistent with the curvilinear relation between income and mortality found in Britain (fig 1) and the suggestion that health is more responsive to changes in income among the least well off.[7 8] The contrasting experiences of Britain and Japan illustrate the possible effects of income distribution on health. In 1970 income distribution and life expectancy were similar in the two countries and fairly typical of other countries in the Organisation for Economic Cooperation and Development.[8] Since then they have diverged: Japan now has the highest life expectancy in the world. Marmot and Davey Smith found no obvious explanation (in changing diet, health services, or other aspects of life) for the rapid improvement in Japanese life expectancy.[25] They did, however, observe that Japan now has the most egalitarian income distribution of any country on record. In Britain, on the other hand, income distribution has widened since the mid-1980s and mortality among men and women aged 15-44 years has increased.[26] That these divergent trends in mortality are related to what has happened to socioeconomic differentials is confirmed by the tendency for mortality to fall most rapidly among the upper classes in Britain and the lower classes in Japan.[25]

SIZE OF THE EFFECT

If Britain was to adopt an income distribution more like the most egalitarian European countries the slope of the regression equation suggests that about two years might be added to the population's life expectancy. As people in social class V account for less than 6% of the economically active population, reducing their death rates to the average would add only a few months to the life expectancy of the whole population. To account for the whole two year increase in life expectancy requires the assumption that the least well

off half of the population overcome a mortality disadvantage almost as great as that of social class V. The fact that such a large group of the population at such high risk has not yet been identified[1] implies that the benefits may be more widespread.

It is not only the scale of the health benefits which suggest that income distribution may improve the health of the majority of the population. The pattern of correlations in the table and the shape of the curve relating income to mortality in figure 1 carry the same implication. The table suggests that the health of the least well off 60-70% of the population may benefit from income redistribution. Although the correlations with the lowest tenth were not significant, the fact that changes in life expectancy and the proportion of the population in poverty were significantly related (fig 3) suggests that the income data used in the table are least accurate among the poor.

As income distribution is skewed, so that a little over 60% of the population live on less than the average, we may be seeing a demarcation between the potential beneficiaries of a more egalitarian income redistribution living on less than the average income and the 35% or so above the average income. In this context, the negative association between income and health among the most well off is interesting. That it has previously been found in women's mortality[7] suggests that it should not be ignored.

RELATIVE OR ABSOLUTE INCOME?

Gross national product per head ceases to be an important determinant of national mortality only among developed countries.[27] In 1984 few countries achieved an average life expectancy at birth of 70 years or more until gross national product per head approached a threshold of almost $5000 a year. Beyond that level it seems that there is little systematic relation between gross national product per head and life expectancy. Thus despite the long term tendency for life expectancy and the standard of living to increase, among the developed countries the two are no longer closely connected.

This suggests that the association between health and income distribution is a result of factors to do with relative rather than absolute income. Increasingly social scientists have emphasised the importance of relative poverty and of the way it excludes people, socially and materially, from the normal life of society.[28] Many national and international statistical agencies now measure poverty in relative terms.[17 29] But the sense of relative deprivation, of being at a disadvantage in relation to those better off, probably extends far beyond the conventional boundaries of poverty. A shift in emphasis from absolute to relative standards indicates a fall in the importance of the direct physical effects of material circumstances relative to psychosocial influences. The social consequences of people's differing circumstances in terms of stress, self esteem, and social relations may now be one of the most important influences on health. There is little evidence to guide further speculation on the mechanisms that may lie behind this relation, though the strength of the relation suggests that a wide variety of factors may be acting. Indeed, if confirmed, the importance of relative poverty to public health may lie in the possibility it provides of influencing unknown as well as known risk factors.

These results should caution against using the lack of a close relation between national mortality and gross national product per head to infer that health inequalities within societies cannot be a reflection of income differentials.[30] Indeed, if health differences within the developed countries are principally a function of income inequality itself, this would explain why social class differences in health have not narrowed despite growing affluence and the fall of absolute poverty.

I thank the Economic and Social Research Council (grant No. R000232685) for financial support.

1 Goldblatt P. Mortality and alternative social classifications. In: Goldblatt P, ed. *Longitudinal study 1971-1981*. London: HMSO, 1990:163-92. (OPLS series LS; No 6.)
2 Townsend P, Phillimore P, Beattie A. *Health and deprivation: inequality and the north*. London: Croom Helm, 1988.
3 Beale N, Nethercott S. The nature of unemployment morbidity 2. Description. *J R Coll Gen Pract* 1988;**38**:200-2.
4 Moser K, Goldblatt P, Fox J. Unemployment and mortality. In: Goldblatt P, ed. *Longitudinal study 1971-1981*. London: HMSO, 1990:81-97. (OPCS series LS No 6.)
5 Fox J, ed. *Health inequalities in European countries*. Aldershot: Gower, 1989.
6 Blaxter M. *Health and lifestyles*. London: Tavistock, 1990.
7 Wilkinson RG. Income distribution and mortality: a "natural" experiment. *Sociology of Health and Illness* 1990;**12**:391-412.
8 Wilkinson RG. Income and mortality. In: Wilkinson RG, ed. *Class and health: research and longitudinal data*. London: Tavistock, 1986:88-114.
9 Rodgers GB. Income and inequality as determinants of mortality: an international cross-section analysis. *Population Studies* 1979;**33**:343-51.
10 Le Grand J. Inequalities in health: some international comparisons. *European Economic Review* 1987;**31**:182-91.
11 Preston S. *Mortality patterns in national populations*. London: Academic Press, 1976.
12 World Bank. *World Tables*. Baltimore: Johns Hopkins University Press, 1990.
13 World Health Organisation. *World health statistics annual*. Geneva: WHO, 1979-90.
14 Organisation for Economic Cooperation and Development. *National accounts: main aggregates. Vol. 1. 1960-89*. Paris: OECD, 1991.
15 Bishop JA, Formby JP, Smith WJ. *International comparisons of income inequality*. Luxembourg: Luxembourg Income Study, 1989. (Working paper 26.)
16 O'Higgins M, Jenkins SP. Poverty in the EC. In: Teekens R, van Praag BMS, eds. *Analysing poverty in the European Community*. Luxembourg: EUROSTAT, 1990.
17 Organisation for Economic Cooperation and Development. Living conditions in OECD countries: a compedium of social indicators. Paris: OECD, 1986.
18 World Bank, *World development report 1979-90*. Oxford: Oxford University Press, 1990.
19 World Bank. *World development report 1990*. Oxford: Oxford University Press, 1990.
20 Mackenbach JP, Bouvier-Colle MH, Jougla E. Avoidable mortality and health services: a review of aggregate studies. *J Epidemiol Community Health* 1990;**44**:106-11.
21 Balarajan R, Bulusu L. Mortality among immigrants in England and Wales 1979-83. In: Britton M, ed. *Mortality and geography*. London: HMSO, 1990:103-21. (OPCS series DS: No 9.)
22 Power C, Manor O, Fox AJ, Fogelman K. Health in childhood and social inequalities in health in young adults. *Journal of the Royal Statistical Society* 1990;**153**:17-28.
23 Fox J, Goldblatt P, Jones D. Social class mortality differentials: artifact, selection or life circumstances? In: *Longitudinal study 1971-1981*. London: HMSO, 1990:99-108. (OPCS series LS: No 6.)
24 Wilkinson RG. Socio-economic differences in mortality: interpreting the data on the size and trends. In: Wilkinson RG, ed. *Class and health: research and longitudinal data*. London: Tavistock, 1986:1-20.
25 Marmot MG, Davey Smith G. Why are the Japanese living longer? *BMJ* 1989;**299**:1547-51.
26 Department of Health. *On the state of the public health for the year 1989*. London: HMSO, 1990.
27 Marsh C. *Exploring data*. Cambridge: Polity Press, 1988.
28 Townsend P. *Poverty in the United Kingdom*. Harmondsworth: Penguin, 1979.
29 Department of Social Security. *Households below average income: a statistical analysis 1981-87*. London: Government Statistical Service, 1990.
30 Baker D, Illsley R. Trends in inequality in health in Europe. *Int J Health Sciences* 1990;**1-2**:89-111.

(Accepted 25 September 1991)

Correction

Medical manpower

Several editorial errors occurred in table I of this article by Stephen Brearley (14 December, p 1534). The heading to the third column should read "No of inhabitants per doctor"; the figure given for the medical workforce in Germany is that for the medical workforce in the former West Germany; and the medical workforce in Austria is 21 572, not 211 572.