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(Accepted 17 September 2001)

Education, income inequality, and mortality: a multiple regression analysis

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ELPS

The full version of this article appears on bmj.com

Abstract

Objective To test whether the relation between income inequality and mortality found in US states is because of different levels of formal education.
Design Cross sectional, multiple regression analysis.
Setting All US states and the District of Columbia (n = 51).
Data sources US census statistics and vital statistics for the years 1989 and 1990.
Main outcome measure Multiple regression analysis with age adjusted mortality from all causes as the dependent variable and 3 independent variables—the Gini coefficient, per capita income, and percentage of people aged ≥18 years without a high school diploma.
Results The income inequality effect disappeared when percentage of people without a high school diploma was added to the regression models. The fit of the regression significantly improved when education was added to the model.
Conclusions Lack of high school education accounts for the income inequality effect and is a powerful predictor of mortality variation among US states.

Introduction

Several recent studies have reported a positive relation between income inequality and mortality.[1–3] The relation remains intact when different measures of income inequality are used, but how should this be interpreted?

Three competing interpretations have been advanced. Wilkinson believes that income inequality produces psychosocial stresses for individuals placed at lower ranks of the socioeconomic hierarchy.[4–6] Continuous stress due to deprivation of status will lead to deteriorating health and higher mortality over time. The fact that median or per capita household income cannot account for the relation has been taken as evidence that "relative income," or income inequality, is more important than absolute income for human health and longevity.

The correlation between income inequality and mortality may be artefactual in part, as there is a negative, curvilinear relation between income and the probability of dying for individuals.[7] It seems, however, that the individual relation between income and mortality cannot fully account for the aggregate relationship.[8]

The "neo-material" interpretation asserts that income inequality reflects individual and community forms of absolute deprivation. Poorer individuals disproportionately experience health taxing events and lack of resources throughout their lives.[9] They live in deprived communities characterised by "underinvestment" in the social and physical infrastructure. Both forms of deprivation produce cumulative wear and tear. The experience depletes health, resulting in higher mortality for those in lower socioeconomic strata. The aggregate effect is that societies with increasing income inequality will experience higher mortality than they would otherwise. Such material conditions may be sufficient in explaining the relation between income inequality and mortality.[9]

The neo-material interpretation gives only a broad indication of which material circumstances are important. An analysis of US states, however, suggests some potential answers[2]: income inequality is significantly correlated with certain risk factors (homicide rates and unemployment rates), social resources (food stamps and lack of health insurance), and measures of human capital (educational attainment). The substantial correlations with some measures of human capital imply that income inequality may not have a direct effect on mortality. Instead, income inequality may reflect the effects of other socioeconomic variables that are also related to mortality. Among those variables, the contribution of formal education deserves most attention since it typically precedes, and predicts, work and income.[10] It is also related to mortality.[11–14]

Therefore, the association between income inequality and mortality found in aggregate studies may be partially the result of variation in educational attainment. I tested this hypothesis using data for the US states, which have shown substantial associations between measures of income inequality measures and age adjusted mortality.

Data and methods

The study is based on a cross sectional analysis of US census statistics and vital statistics for the years 1989 and

Editorial by Mackenbach

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BMJ 2002;324:23–5

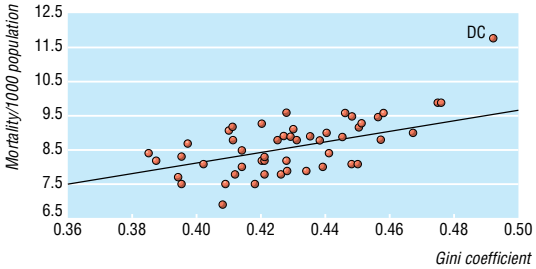

Fig 1 Age adjusted death rates by Gini coefficient for the 50 US states and the District of Columbia (DC), 1989-90 ($y=1.831+15.705\times x$; $R^2=0.24$; weighted regression). (Data sources US Public Health Service[15] and US Census Bureau[16])

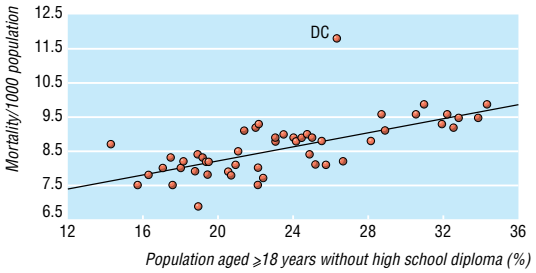

Fig 2 Age adjusted death rates by educational attainment for the 50 US states and the District of Columbia (DC), 1989-90 ($y=6.16+0.103\times x$; $R^2=0.51$; weighted regression). (Data sources US Public Health Service[15] and US Census Bureau[20])

1990 for all US states. Age adjusted mortality from all causes was the main dependent variable of the analysis.[15]

The Gini coefficient for households was the main independent variable of interest.[16] This measures the difference between the areas under the curve of a graph of actual distribution of cumulative income and one indicating equality of income distribution. A value of 0 indicates that each household obtains the same amount of income, while a value of 1 indicates that only one household earns all income.[17 18]

To control for varying income levels among states, I included the 1989 per capita income of all people in the regression model.[19] I measured educational attainment by the percentage of people aged ≥18 years without a high school diploma in 1990.[20] I analysed age adjusted mortality by multiple regression.[21]

Results

There was a positive linear relation between income inequality and age adjusted mortality, with the District of Columbia being an apparent outlier (fig 1). A 0.1 unit increase in the Gini coefficient was associated with an increase of 1.6 deaths per 1000 population.

A 20% increase in people aged ≥18 years without a high school diploma was associated with an increase of 2.1 deaths per 1000 population (fig 2).

Fig 3 presents the percentage of variation in age adjusted mortality explained by five regression specifications. All regression models were statistically significant at $P<0.001$. The two income measures accounted for 28% of the variation in age adjusted mortality. Lack of high school education by itself explained over half of the variation in the dependent variable. The regression coefficients for both income variables were non-significant when added to a model including the education measure: they accounted for no additional variation in the dependent variable when the education variable was controlled. The adjusted R^2 values slightly decreased with the addition of the income measures, since the adjustment corrects for redundancy.

Discussion

This study had two main findings. Income inequality, as measured by the Gini coefficient, had no unique effect on US age adjusted mortality when the level of formal education was controlled for. Educational attainment was a more powerful predictor of differences in mortality than income inequality in US states.

Limitations

Over a decade has passed since the 1990 US census was taken. Therefore, my findings may not be applicable today. When data on income inequality and vital statistics are released for individual states for the years 1999-2000 this concern can be examined.

The potential role of education has been overlooked in previous research on income inequality and mortality,[1 2] which focused more on the potentially contaminating effects of income and poverty. In my analysis I did not directly control for poverty, but the effect of poverty was not excluded. It was indirectly reflected in the per capita income and education measures.

Implications of results

Lack of high school education completely captured the income inequality effect and income level effect. This finding suggests that physical and social conditions associated with low levels of education may be sufficient for interpreting the relation between income inequality and mortality. My results therefore seem to support the idea that absolute deprivation rather than relative deprivation is important for influencing mortality. However, since aggregate data are not well suited for examining hypotheses at the individual level, my study cannot confirm or rule out the importance of psychosocial processes.[22]

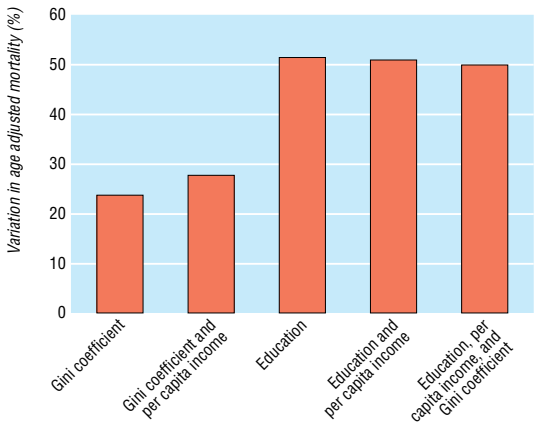

Fig 3 Percentage of variation in age adjusted mortality explained by education and income variables for the 50 US states and District of Columbia, 1989-90

What is already known on this topic

Aggregate studies have shown a positive relation between income inequality and mortality and three possible explanations have been suggested (relative deprivation, absolute deprivation, and aggregation artefact)

Income inequality may reflect the effects of other socioeconomic variables that are also related to mortality

What this study adds

The relation between income inequality and age adjusted mortality may be due to differences in high school educational attainment: education absorbs the income inequality effect and is a more powerful predictor of variation in mortality among US states

Lack of high school education seems to affect mortality by economic resource deprivation, risk of occupational injury, and learnt risk behaviour. It may also measure the lifetime, cumulative effect of adverse socioeconomic conditions

An expanded regression analysis (available on request) indicated that lack of high school education was related to lack of health insurance, belonging to economically depressed minority groups, working in jobs with high risk of injury, and smoking. This finding suggests that lack of material resources, occupational exposure to risk, and certain learnt risk behaviour might be reflected in the large education-mortality effect.

Less educated people may be concentrated in areas that are more risky to life and health. Some research has suggested that these communities may lack sufficient investment in health related infrastructure such as access to health care, proper police protection, and healthy housing.[23] These potential risk factors are only indirectly assessed by the variables used in my study.

Lack of high school education may also represent lifetime effects of socioeconomic deprivation. Socioeconomic conditions during childhood adversely affected adult mortality in a large, prospective study of adult Scottish men.[24] My study could not determine intergenerational effects of educational attainment. However, this path of research seems promising since considerable linkage between parents and offspring have been seen for educational attainment and for incomes in Britain[25] and in the United States.[26 27] Lack of high school education may also capture the lifetime effect of adverse social conditions increasing mortality. Income inequality is only one aspect of this broader experience.

I thank Drs Wilkinson, Davey Smith, and Altman for their valuable comments on an earlier version of this paper.

Funding: My study was supported by my sabbatical leave granted by the University of Arkansas at Little Rock.

Competing interests: None declared.

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(accepted 4 October 2001)

Endpiece

Advice from Osler

Learning from error is receiving renewed attention, but is a centuries' old tradition among health professionals. Here is some advice from Sir William Osler:

"Never ask a new patient a question without note-book and pencil in hand . . . Begin early to make a three-fold category—clear cases, doubtful cases and mistakes . . . It is only by getting your cases grouped in this way that you can make any real progress in your post-collegiate education; only in this way you gain wisdom with experience."

Submitted by Paul Gorman, assistant professor, Oregon Health and Science University, Portland, Oregon