Short report

What is the lag time between income inequality and health status?

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Income inequality has been associated with poorer self rated health in the United States.[1] Possible mechanisms linking income distribution to health include: variations in a person's access to life opportunities and material resources (for example, health care, education); social cohesion, whereby mutual support and cooperation secure better health outcomes; and possible direct psychosocial processes related to relative perceptions of position on the socioeconomic hierarchy.[2] It seems implausible that these mechanisms of action are instantaneous—there should be a lag time during which income inequality affects these intermediary factors, which in turn affect health. In this study, we provide a test of the potential time lags between income inequality and self rated health.

Methods

We used data for 213 695 people aged 15 years and older sampled by the 1995 and 1997 Current Population Survey (CPS) in the United States.[3] Two reasons dictated using just 1995 and 1997 data. Firstly, the CPS has only collected self rated health data since 1995. Secondly, each CPS respondent stays in the CPS sample for two consecutive years—additionally including 1996 and 1998 data would only lead to double counting the same people. The individual level covariates were sex, age, race, and equivalised household income. Equivalisation of household income aims to adjust for the number of people in each household, and was achieved by dividing the total household income by the square root of the number of people in that household. Self rated health was dichotomised as fair/poor versus good/very good/excellent.

State level income inequality and median household income were calculated for the 50 US states for five different time periods using CPS data: 1979–81, 1983–85, 1987–89, 1991–93, and 1995–97. We used the Gini coefficient as the measure of income inequality. The Gini ranges theoretically from zero (absolute equality) to 1.0 (absolute inequality in the distribution of income).[4]

Weighted multi-level logistic regressions were conducted in SAS using Proc Glimmix, with a random error term at both the individual and state level. All variables were modelled as categorical variables: state level Gini and median household income as four level variables, using cut points of the mean and the mean (±1 SD); age in 10 year age groups; race as black, other, and white; and equivalised household income as a nine level variable. We also fitted models with the Gini as a continuous variable, and report the odds ratios (superimposed on fig 1) for a 0.05 increase in the Gini—0.05 was equivalent to a 2 to 2.5 SD increase in the Gini. Finally, we constructed a test for heterogeneity of the association of income inequality with health across time periods using the general form of the Wald χ^2 statistic[5] using output from the regression models with the continuous Gini.

Results

To discern the time period of relevant exposure, the rank order of states by income inequality across the time period 1979 to 1997 must first vary. The correlation coefficient of the 1995–97 Gini across states with the Gini for previous periods was 0.76, 0.59, 0.63, and 0.46 for 1991–93, 1987–89, 1983–85 and 1979–81, respectively. Thus, the correlation was weaker with increasing distance in time suggesting it was feasible to investigate lag times.

Figure 1 shows the odds ratios of fair/poor health for people living in medium-low, medium-high, and high income inequality states, compared with people living in low income inequality states, for the five time periods. For a time period of relevant exposure, we would expect a steeper slope up from left to right for each cluster of bars in figure 1, and a greater odds ratio for each 0.05 unit change in the continuous Gini (superimposed on fig 1). Using these criteria for 15–44 year olds the interpretation of the figure is uncertain. For persons aged 45 years and older, the weakest association was for income inequality measured contemporaneously with individual self rated health in 1995–97, the strongest association was for 1979–81, and the association for income inequality measured from 1983–85 through 1991–93 was intermediary. The Wald χ^2 statistic for heterogeneity of the association between time periods for 45+ year olds was 1.00 (df=4, p=0.91).

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Accepted for publication
19 December 1999

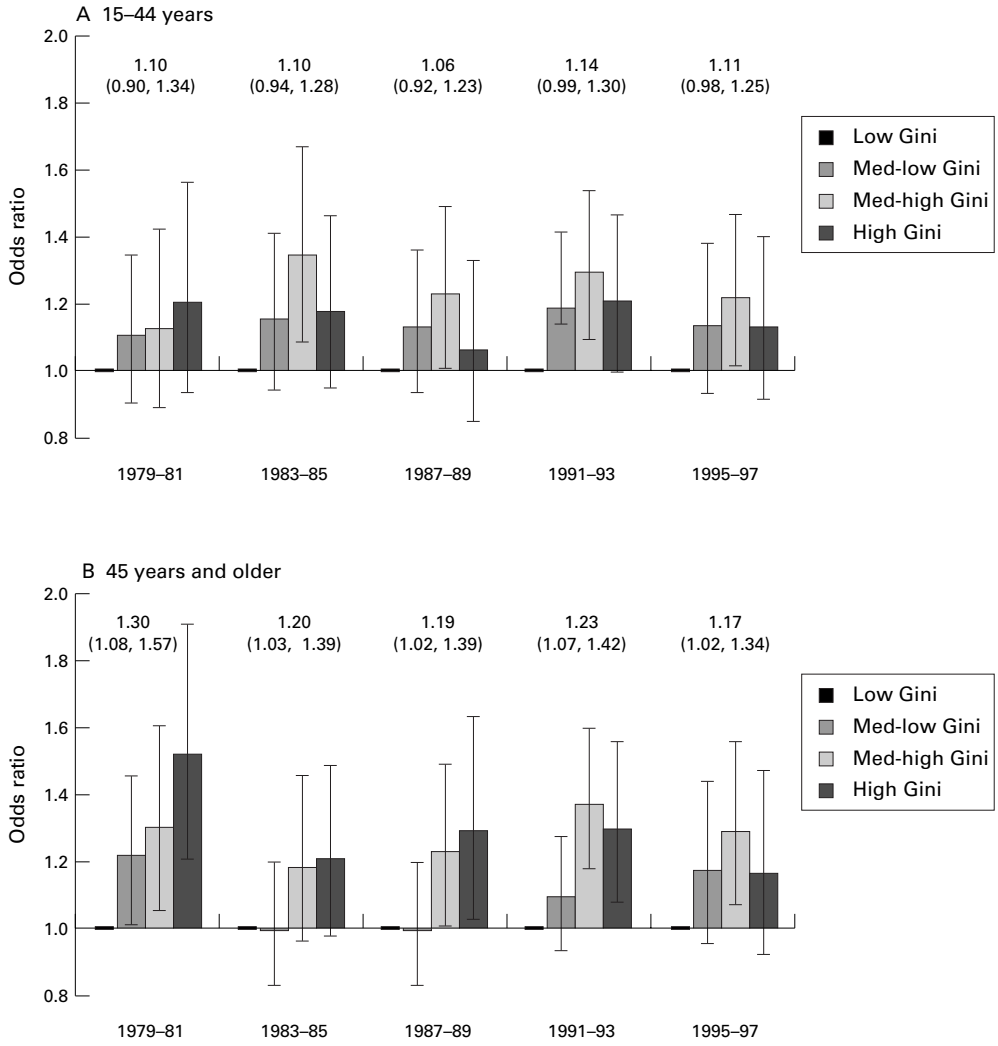

*Figure 1 Odds ratios by time period of fair/poor health for people living in medium-low, medium-high, and high income inequality states compared with low income inequality states. Superimposed numbers are the odds ratio (95% confidence intervals) for a 0.05 increase in the Gini modelled as a continuous variable. * Error bars are 95% confidence intervals.*

Conclusion

Although not conclusive, these data suggest that income inequality up to 15 years previously may be more strongly associated with self rated health than income inequality measured contemporaneously, for people aged 45 years and older at least.

Limitations with this study include movement of persons between states over the time period of interest (misclassification of exposure), and possibly insufficient variation in the association of health with income inequality (measured at different time periods) that would be required to identify any time lag. Regarding the latter, the test for heterogeneity we used failed to reject the hypothesis of homogeneity of the income inequality association across the five time intervals for people aged 45 years and older (p=0.91)—however, such tests have very low power to reject the null hypothesis in typical epidemiological settings.[5]

Further investigation of lag effects will be methodologically challenging. Data sets or natural experiments must be sought out where there is sufficient variation in the distribution of income inequality by unit of observation over time—the US states as units of observation may be too limited in this regard.

Dr Tony Blakely is a recipient of a New Zealand Health Research Council Training Fellowship. Dr Ichiro Kawachi and Dr Bruce Kennedy are recipients of Robert Wood Johnson Foundation investigator awards in health policy research.

Conflicts of interest: none.

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