National infant mortality rates in relation to gross national product and distribution of income

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We examined the relation between infant mortality rates, gross national product, and income distribution. Our findings support the hypothesis that average measures of population health are influenced by the distribution of income within societies.
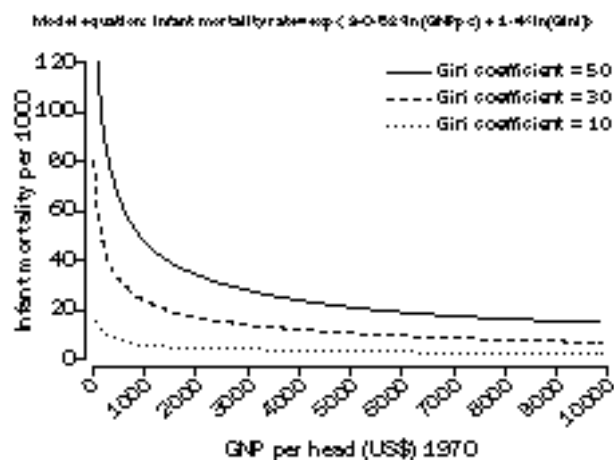
There is evidence that health status is influenced by absolute and relative income at national, community, and individual scales.[1] Several studies have suggested that national infant mortality rates are related to income distribution within countries, after control for confounding factors including national income.[2] In these studies, national income was generally estimated from gross national product (GNP) per head, and income distribution has been assessed by various means, including Gini coefficients and the proportion of national income received by the lowest quintile groups. Studies supporting the relative income theory have been criticised on various grounds, but particularly in relation to the quality of the income distribution data used.[2] We have re-assessed the relation between national income, income distribution, and infant mortality, and used high-quality income distribution data from 23 poor countries (GNP per head <US$1000) and 15 richer countries (GNP per head >$1000).

All data were derived from World Bank databases.[3] The major limitation on the number of countries that could be included in the study was the availability of data on Gini coefficients. These data were not available for the same year as the infant mortality data for all countries; in this case values for the nearest available year were used. Gini coefficients were included where they had been classified as acceptable in a World Bank database (classification was based on surveys of national income distribution—in most cases gross household income unadjusted for household size).[4] We were able to assemble complete data for 38 countries in 1970 and 26 countries in 1990. Because information was available from few countries in the later time period, we also assembled data from 94 countries in which the Gini coefficient was calculated by a different method. In this case, the Gini coefficients were calculated on the basis of income or consumption data.[3] We used data from 1970 to fit the model equation and then validated the model with the two sets of data for 1990.

On the basis of model fit, the relation between infant mortality rates, GNP per head, and income distribution was non-linear (figure). Although a linear model fitted the data well ($r^2=0.55$) the best fitting model related the natural logarithm of infant mortality rate to the natural logarithm of GNP per head and the natural logarithm of the Gini coefficient (figure, $r^2=0.83$). In both models, infant mortality was negatively associated with GNP per head, and positively associated with income inequality; these relations were all highly significant ($p<0.001$). When we used 1990 data on the GNP per head and the Gini coefficient to validate the model, predictions for infant mortality rates in 1990 were in close agreement with the true values ($r=0.89$ with the Gini coefficient data for 26 countries; and $r=0.91$ with the Gini coefficient data for 94 countries).

Our findings suggest that in poor countries (GNP per head <US$1000) a substantial reduction in infant mortality rate may be possible by decreasing income inequality or increasing GNP per head. In rich countries, reduction of income inequality is likely to be more effective in lowering infant mortality rates than further increases in GNP per head would be.

1 Wilkinson RG. Unhealthy societies: the afflictions of inequality. London: Routledge, 1996.
2 Judge K, Mulligan JA, Benzeval M. Income inequality and population health. *Soc Sci Med* 1998; **46:** 567–79.
3 World Bank. World Development Indicators 1999. http://www.worldbank.org/data/wdi/home.html
4 Deininger K, Squire LA. A new data set measuring income inequality. *World Bank Economic Review* 1996; **10:** 565–91. http://www.worldbank.org/html/prdmg/grthweb/dddeisqu.html

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Model equation: Infant mortality rate=exp(9-0.52·ln(GNPp·c) + 1.4·ln(Gini))

Infant mortality rate in relation to absolute and relative income in 38 countries in 1970