Commentary: Income and health: why are curves so appealing?

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In this issue of the International Journal of Epidemiology Martikainen et al.\textsuperscript{1} report a linear relationship between household income and subsequent mortality. The linear trend accounts for ‘96% of the variation between income deciles’. Departures from linearity at the top and bottom of the income range are modest and variable—the most consistent being a flattening of the relationship at very high incomes. These results contrast markedly with the most directly comparable study of Backlund et al.\textsuperscript{2} which found pronounced curvilinearity, flattening at much lower income levels.

The first point to stress about this difference is that it is very unlikely to be due to statistical artefacts or methodological differences between the studies. Both studies have huge sample sizes with very high response rates. Whilst income data are frequently problematic, particularly at the top and bottom of the range, both results are consistent with other findings from their respective countries. In short, we can be confident that they reflect a real difference and one which may be informative about the underlying causal processes at work.

The importance of the finding can be illustrated in the context of the income inequality debate. This was sparked by Richard Wilkinson’s assertion that relative income is more important for health than absolute income in developed societies,\textsuperscript{3} and has given a new lease of life to research in the area. Although many of the resulting studies have used aggregate data, those based on individual-level data are inherently more informative.\textsuperscript{4,5} One reason is that studies employing only aggregate data are unable to distinguish between the various competing hypotheses. Gravelle has also argued that a relationship between income inequality and health at the aggregate level could simply be an ‘artefact’ of a curvilinear relationship between income and health at the individual level.\textsuperscript{6} With such a relationship the effects of income are greater at lower levels. Of two countries with the same average income, that with greater income inequality will have more people at both lower and higher incomes, but the ‘health loss’ at lower incomes will be greater than the ‘health gain’ at higher incomes. So the average health of the more unequal society will be lower. With a more linear relationship the losses and gains would tend to balance each other. Thus the shape of the relationship plays a critical role in the debate. Unfortunately, few studies have addressed it directly.

Whilst Wilkinson, himself, is agnostic about the shape of the relationship,\textsuperscript{5} others are less so. Wagstaff and van Doorslaer\textsuperscript{4} assert that, in addition to four studies explicitly cited, ‘the multitude of other studies ... suggest a concave relationship at the individual level between health and income’. In terms of


mortality, the study by Martikainen et al. directly contradicts this. For health more generally, we have suggested that there is no single relationship between health and income. In a study of 14 health measures,\(^7\) we found that the relationship to income varied according to the aspect of health considered as well as by age and sex. Now having clear evidence that the relationship of income with mortality varies between countries, we might speculate that associations with health also vary between countries.

If this is the case, we should be wary of relying too heavily on the evidence from a single country. A large proportion of the literature is based on data from the USA, but this may not be generalizable to other countries. Relative to other developed countries, the USA has high levels of income inequality whereas Finland has low levels. This leads the authors to suggest that the shape of the relationship may depend on the level of income inequality: higher income inequality corresponding to more curvilinear relationships and lower inequality to more linear relationships.

This line of reasoning, elaborated by Ellison,\(^8\) turns Gravelle’s formulation on its head. Instead of the association between income inequality and health (at the aggregate level) being an ‘artefact’ of a curvilinear relationship at the individual level, rather the curvilinear individual relationship is the result of income inequality within the society. The reason, put succinctly by Davey Smith,\(^9\) is that ‘Income inequality goes hand in hand with underinvestment in human resources’.

The absence of a steep curve at lower incomes in Finland is largely attributed by the authors to the protective effect of the Finnish welfare state which pre-empts ‘the emergence of a low paid underclass with particularly high mortality’. Implicit in this explanation is the notion of the curvilinear relationship as somehow the natural state which will tend to arise unless preventive measures are taken.

Why, we might ask, does the curvilinear relationship seem so appealing? There are several possible reasons. One is simply a carry over from the clear non-linearity that appears, for example between GDP and life expectancy, when a full range of countries is included. Wilkinson maintains that for ‘developed’ societies the curve has flattened so much that there is no longer any relationship. Others disagree. In an interesting variation on this theme, Ellison\(^8\) speculates that the effect of high income inequality is to reduce the poorest individuals’ income to the part of the relationship where the relationship becomes non-linear again.

Another possible reason lies in the intuitive appeal of the law of diminishing returns. Typically, this might be explained as follows: an increase of £1000 per month in household income will buy more ‘health benefit’ for a household where the current income is £1000 than for one where the current income is £4000. This seems self-evident. For some it suggests that an equal proportionate increase in income might confer the same health benefit and hence that log income would be a better predictor of health.\(^10\)

However, there may be a flaw in the reasoning. Currently wealthy households will, in general, have had the health benefits of a lifetime of affluence, including the material, social and cultural benefits that go with it, and vice versa for currently poor households. Altering current income could have little or no impact on the effects of the prior life course. Re-formulating an example of diminishing returns in terms of alternative life courses dilutes the intuitive appeal.

Ultimately, the shape of the relationship (or relationships) between income and health, is an empirical question. Martikainen et al. call for further research on this in a wider range of countries. I, for one, second that.

References