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Commentary: The Preston Curve 30 years on: still sparking fires

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Samuel H Preston's classic paper,[1] 'The Changing Relation between Mortality and Level of Economic Development', published in 1975, remains a cornerstone of both global public health policy and academic discussion of public health. Preston's paper illuminates two central 'stylized facts'. The first is a strong, positive relationship between national income levels and life expectancy in poorer countries, though the relationship is non-linear as life expectancy levels in richer countries are less sensitive to variations in average income. The second is that the relationship is changing, with life expectancy increasing over time at all income levels.

Preston examined the relationship between life expectancy and income in three different decades: the 1900s, 1930s and 1960s. In each decade the association between the two measures held true; more recent research shows that the income–life expectancy relationship still applies and continues to move upwards (although the AIDS epidemic in Sub-Saharan Africa has reduced life expectancy at the low end of the income scale in recent years). Although the basic facts set out by Preston are generally accepted, there is still a great deal of dispute about the mechanisms that lie behind the relationships and the policy implications we can draw from them.

Preston proposes a number of possible mechanisms through which income may affect health, including improvements in nutrition, access to clean water and sanitation, and medical treatment. There is still debate about the relative importance of these different factors. Fogel[2] emphasizes the historical effect of rising incomes on nutrition while Preston[3] and Deaton[4] put more weight on public health measures such as clean water and sanitation,[5] and medical care in modern populations.[6] The relative importance of these mechanisms clearly varies in different times and places, and the interaction between them makes a precise accounting difficult. Although there is a strong case for the direct effect of income on health due to nutrition and health interventions becoming more affordable, it may be that income is also acting as a proxy for a wider measure of socioeconomic status and development and that the causal effect is due to other mechanisms, for example, education.[7]

The link between income and health holds for individuals as well as countries. Although the same direct mechanisms may operate, another possible explanation for the link at the individual level is that it is relative, and not absolute, income that matters. A low position in the social hierarchy may induce psychosocial stress that is linked to increased behaviours that put people at risk of ill health and to physiological reactions in the immune system that directly lead to worse health.[8–10] The relative income hypothesis suggests that inequality has a direct negative effect on health but the evidence for such a direct effect is contested.[11–13]

The curvature of the relationship between income and health suggests that a policy of redistributing income from the rich to the poor will improve average health outcomes since the gains in health of those with low incomes will outweigh the losses of those with high incomes.[14] However, this policy prescription depends on the relationship being causal rather than income merely acting as a proxy for some broader notion of socio-economic status, and needs to be balanced against the negative incentive effects of redistributive taxation.[15]

The upward slope of the Preston curve gave birth to the idea that increased wealth leads causally to increased health. Pritchett and Summers[16] argue that focusing on economic growth in developing countries will lead directly to reductions in infant mortality rates and improvements in life expectancy, as they see improved health as a by-product of higher income levels. The problem with this argument is that, as shown by Preston's paper, most of the health gains we have experienced have been due to improvements in health at each level of income, which is likely to be due to technological progress, i.e. using resources more effectively. Bloom and Canning[17] found that before 1870 health in rich and poor countries was very similar, but after 1870 health improved in rich countries whereas improvements in poor countries only began after 1930. This is consistent with the view that technological advances are employed first in rich countries before eventually diffusing to poorer societies. Relatively little work has been done that focuses directly on the contribution of technological progress to population health, though Jamison *et al.*[18] identify technological progress in health and study its determinants, and Cutler *et al.*[19] conclude that scientific and technical advance is 'the ultimate determinant of health'. A further argument against focusing on income growth as a method of alleviating health burdens is that although income levels and population health are closely linked, the connection between periods of economic growth and periods of improvement in population health is very weak, suggesting that if the relationship is causal it has long and variable lags.[20] Although rising incomes mean that society has greater resources, these resources are not always applied to health.

Preston's diagram has been taken by many to imply a causal link from wealth to health. In the years since the paper was

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written, however, the possibility that the link could also run in the reverse direction, from improved health to higher incomes, has been investigated. Healthier workers are more productive, and longer lifespans create incentives to invest in schooling and save for retirement.[21] In addition, of course, healthier children are likely to attend school more regularly,[22] more easily absorb knowledge while in school, and increase their cognitive ability.[23] The health-to-wealth idea has important policy implications because it suggests that health is a cause as well as a consequence of income growth, and can be a powerful instrument of economic development and poverty reduction.[24] Micro-level studies such as those reported by Strauss and Thomas[25] and Schultz[26] support this thesis, although work to estimate the size of the effect of health on wealth at the aggregate level is still ongoing.[27,28]

The impacts of Preston's study have not been limited to discussion of the links between income and health. It has also supported the notion of broadening the very definition of development. Steady improvements in health, independent of income level, mean that income per capita is an imperfect proxy for human wellbeing. Becker *et al*.[29] compute a growth rate of welfare that incorporates both health and income improvements and found that life expectancy improvements contributed significantly to gains in global welfare between 1960 and 2000. Even with the advent of AIDS, which has cut life expectancy in parts of Africa, these gains have been particularly large in much of the developing world, and were helping to reduce inequality in welfare between poor and rich countries.

In sum, many discussions and insights that are at the heart of economic and human development would not have arisen, or would have arisen much later, without Samuel Preston's paper. Indeed, this paper demonstrates well the aptness of Oliver Wendell Holmes' famous line: 'One's mind once stretched by a new idea, never regains its original dimensions.'

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