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Dynamics of poverty and mortality

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Abstract

A first prerequisite for a sustainable welfare state is to take action to enhance population health and decrease mortality risks. Poverty has for several centuries been seen as a key social risk factor in these respects. Consequently, the fight against poverty has historically been at the forefront of public health and social policy. The relation between *relative* poverty rates and population health indicators is less self-evident, but the relation has been at the centre of one of the most debated topics within the field of public health research and social epidemiology during the last decades, namely the health impact of income inequality. The so called 'Wilkinson hypothesis' states that income inequality is a major threat to population health in modern societies. Although that hypothesis is formulated as the impact of income inequality, rather that poverty, it seems evident that it should, first and foremost, work through poverty and lack of resources. But can we evidence that cross-national variations in relative poverty rates are related to cross-national variations in survival possibilities within relatively rich countries? In this study we make a comparative analysis on the relation between poverty and mortality across 25 countries over time. We utilize data from the Luxembourg Income Study to construct age-related poverty rates across countries and time covering the period from around 1980 to 2005 merged with data on age- and gender-specific mortality data from the Human Mortality Database. We present results from pooled cross-sectional time series analysis of poverty and mortality are studied.

Introduction

Fighting poverty has always been at the centre of welfare state activities. There are several important reasons for such a focus but a key issue is no doubt that poverty is associated with increasing risks for ill-health and possibly also death. That at least extreme poverty and health go together seems instinctively obvious and historically one finds numerous classical examples of investigators highlighting the interrelation between scarce economic resources and health. Friedrich Engels' *The condition of the Working Class in England* (1845) and Seebohm Rowntree's investigation in York *Poverty: A study of town life* (1901) are perhaps the two most classical examples. In the latter, Rowntree did not only show the high mortality risks among the poorest areas of the working class but also that York at that time had what is nowadays called a 'social gradient' (Marmot 2005). For example, the infant mortality rate in the area with "highest class labour" was close to double to that in the "servant-keeping class". Interesting enough, it was also higher than in the nation that according to UN has the highest infant mortality in the world today, Sierra Leone.

The finding of the social gradient is also of interest when going from these historical studies to present discussions about poverty, inequality and population health since it indicates that not only the poorest sections were hit but that relative poverty also was of importance. That countries with high absolute poverty rates today (e.g. World Bank indicators of 1 or 2 $ a day) also tend to be countries with low life expectancy and high mortality risks is well-known. But what is the relation between relative poverty rates and mortality risks among the richer countries of the world?

Assuming that most poor people in rich countries have enough resources to survive, a relation between variations in relative poverty rates and variations in mortality rates may seem less self-evident. Still, it is actually one foundation for the so-called Wilkinson hypothesis. It basically states that it is not the economic level as such that matters among rich countries but rather how the pie of total economic resources is distributed (Wilkinson & Pickett 2009). Now this hypothesis is articulated in relation to the whole social structure, thus stating that it is income inequality as such that kills and not only poverty. However, most evidence, both on the macro-level of countries and on the micro-levels of individuals, suggests a curvilinear association between income and health which implies that health gains can be made by transferring money from richer to poorer. If this is so it also means that not only should income inequality be associated with population health indicators but this should be even more evident when it comes to variations in relative poverty rates. But can we evidence that

cross-national variation in relative poverty rates is related to cross-national variations in survival possibilities within relatively rich countries?

In this study we make a comparative analysis on the relation between poverty and mortality across 25 countries over time. We utilize data from the Luxembourg Income Study (www.lisdatacenter.org/) to construct age-related poverty rates across countries and time covering the period from around 1980 to 2005 merged with data on age- and gender-specific mortality data from the Human Mortality Database (www.mortality.org). We present results from pooled cross-sectional time series analysis (Change and fixed effects models will be analysed in later version of the paper).

In the next section we will shortly go through some of the arguments and empirical evidence of relevance to our study. Thereafter we will present our data, methods and analytical design. We then present our results and the paper ends by a concluding discussion about our findings.

Earlier research: why and how could relative poverty influence mortality

As already mentioned, the idea that income inequality could influence population health was something noted already by the typical curvilinear association of the so called Rodgers curve. Partly based on empirical data, Rodgers (1979) presented a model of how smaller income disparities and relative poverty at societal level are linked to better public health through differential impact on individual health status among both low- and high-income earners. He argues that the health returns by income are diminishing at higher income levels, implying that this relation is curvilinear (Rodgers, 1979; Kawachi, 2000). In the Rodgers example (Figure 1) health of the low-income person x1 is much poorer than that of the high-income person x2 at t_1. Redistributing income from x2 to x1 at t_2 will result in an unchanged average income ($\bar{x}$), while average health ($\bar{y}$) improves. This is simply the result of the health gain among the poor ($\Delta yx1$) being larger than the health loss among the rich ($\Delta yx2$) as a consequence of this income redistribution. Rodgers also presented results from cross-national, cross-sectional analysis supporting the specification that countries with lower inequality had higher life expectancy.

Although Rodgers, and later Wilkinson, articulated how the whole income distribution could make a difference, it is evident following from the hypothesis that what should

particularly make a difference is how the relatively poor fare and how large a fraction of the population is at risk of poverty.

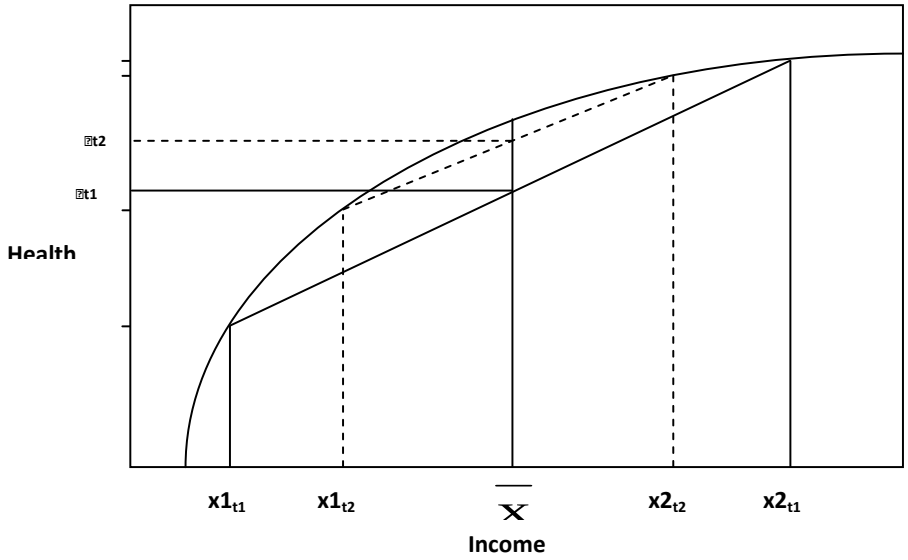

Figure 1. Theoretical connection between individual and aggregate level relationships between income and health (From the NEWS-report (Lundberg et al 2008a), adapted from Rodgers 1979).

The topic of income inequality and health has become a little research industry within social epidemiology, with some influence from economics and sociology, and numerous studies have been published especially on the relation between income inequality across American states and various health outcomes. A major review (Wilkinson & Pickett, 2006, and Wilkinson & Pickett 2009) was by and large in favour of the hypothesis, whereas another one (Lynch et al. 2004) was sceptical. A meta-analysis of multi-level studies linking income inequality to mortality and self-rated health gave support to the idea (Kondo et al. 2009).

Contrary to the many studies on income inequality, few studies have directly investigated the role of relative poverty.

The role of welfare state programmes in population health has recently been highlighted. Not least within the NEWS-project (Lundberg et al 2008a), initiated in collaboration with the WHO Commission on Social Determinants of Health, a number of studies were produced linking specific designs, generosity and coverage of social policy programmes on the one hand, to overall and age-specific mortality, and on the other, to morbidity (Lundberg et al. 2008b; Esser & Palme 2010; Ferrarini & Norström 2010; Kangas 2010; Norström & Palme 2010). These studies focused on the cash side of the welfare state and gave support to the idea that cash programmes of the welfare state have been of importance to public health during the second half of the 20th century. These studies did not investigate the role of welfare services, nor did they study any specific mechanisms behind the found associations. However, the ability of these programmes in poverty alleviation was often referred to, which in turn then, the argument was, could be seen as a key factor for cross-national variations in mortality rates. Of course, the programmes of the welfare state are likely to also influence other more proximal health-related factors that could influence mortality risks. In this study we will explore the relative poverty argument directly by making use of the best sources for comparative studies on poverty and mortality over a 25-year period. As the small-N problem occurs in most cross-national studies, we partly overcome this problem by making use of multiple waves of data for each country included.

Data and methods

Our two main data sources are the Luxembourg Income Study (LIS) and the Human Mortality Database. LIS is a cross-national harmonised database that includes multiple waves of microdata for a number of countries. It has a focus on income inequality, poverty but also includes a lot of information on for example family situation and employment status. The first wave started around 1980 having five-year intervals so that wave six of the data is around 2005 (for a thorough presentation of the database see Atkinson, Rainwater & Smeeding, 1995). LIS is commonly regarded as the best source for cross-national comparisons of poverty and income inequality. At the time of writing the database includes data from 36 countries.

The Human Mortality Database (HMD), maintained by the University of California, Berkeley and the Max Planck Institute of Demographic Research, provides detailed open access mortality and

population data for a number of countries for years reaching from the 1800's to approximately 2009/2010 (www.mortality.org). Currently, the database includes information for 37 countries, which are partly the same and partly different than those in the LIS database.

In our study, we include all countries from LIS that have at least two waves of data from the same original survey source, and for these countries, all LIS waves for which also mortality data were available in the HMD for corresponding years. Furthermore, we decided to exclude Taiwan because of its peculiar nature compared to other mostly Western type of countries that were included. These principles lead to a country sample of 25 countries with 2 to 6 waves, a total of 116 data points. Countries that are included are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Luxembourg, Netherlands, Norway, Poland, Russia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom and the United States. Countries and waves included are listed in Table 1.

Variables

Poverty rates: Our exposure of interest is then relative poverty rates, or at-risk-of-poverty rates as they are now called in EU-language, for 25 countries from around 1980 to around 2005 (waves 1–6 of the Luxembourg Income Study). We use a standard income poverty head-count measurement in which those individuals living in households with equivalent disposable income lower than 60 percent of median income are regarded as poor. Accordingly we measure income after taking into account welfare state transfers and taxes. In order to be able to compare households of different sizes we make use of a standard one-parametric equivalence scale which simultaneously tries to handle economies of scale and the fact that costs increase so each household's disposable income is divided by the square root of the number of persons in the household. Poverty rates in each country and each wave were calculated separately for two age bands: children (0-17-year-olds) and working-age adults (25-64-year olds).

Mortality rates: Data on deaths and populations at risk were collected for 1-year age bands for each country from the HMD for all LIS wave years and for three following years of each wave. Rates were calculated separately for each of the two age bands. Standardized rates were calculated to adjust for the different age structures of the countries. In these calculations, we used the direct method and the so called European standard population (http://www.euphix.org/object_document/o5338n27620.html). The standardized rates thus represent what the crude rates would have been if the populations of the countries had the same

age distribution as the European standard population. To allow for some exposure time on mortality after the cross-sectional poverty measurement, we calculated lagged mortality rates. Lagged standardized mortality rates were calculated as the average of the SMR of the LIS year and that of three following years. Poverty and mortality rates for each of the countries are shown for each country for the last wave year in Table 1.

Control variables:

LIS wave number was used in all analyses to allow for time-related changes in poverty and mortality rates. The wave number also is an indicator variable pertaining to the more or less automatic change process that takes place in all countries. *GDP per capita* data were derived from Penn's world tables (http:pwt.econ.upenn.edu/php_site/pwt_index.php) that contain information on the GDP per capita levels for all the countries included in our analyses. The GDP levels are adjusted to changes in cost of living across time and space. Data on social expenditure are from OECD data bases.

Methods

In the first part of the analysis, we used pooled cross-sectional time-series regression methods. These methods take advantage of the panel structure of the data while taking care of the correlations of data points between waves using panel-corrected standard errors (e.g. Hsiao 1990; Hicks 1994; Micklewright 1994). The analyses were conducted in the Stata statistical package.

There are a number of regression techniques available to deal with the special problems of analyzing pooled data –not that surprisingly, each of them has its weaknesses and results seem to be highly sensitive to the specific method applied (see. e.g. Hsiao 1990; Beck and Katz 1995; Kittel 1999; Huber and Stephens 2000). In this study, it is neither necessary nor possible to go deeper into these methodological problems. By using cross-sectional analyses and combining them with pooled regression data, we simply want to shed some light on the debate on the relationships between poverty, economic growth and mortality.

In principle, the results were robust for different method applied, although the standard errors varied. Models assuming and modeling autocorrelation tended to produce larger standard errors but satisfactorily enough, the levels of significance were robust. Pooled regressions were run by the STATA 10 (STATA 2005, 226-235) cross-sectional time-series package using Prais-Winsten regressions on correlated panels and corrected standard errors (PSCE). In order to further test robustness of our results we could have used change variables and fixed effects regressions, but then we would have

lost the effect of the level variables and our results would have been more dependent on the short-term changes (see Huber and Stephens 2000). In order to avoid this we chose the above described approach. It seems reasonable to assume that it is the level of poverty rather then fluctuating yearly changes that has an effect on mortaliy. (In the next phase of our analyses a fixed effect regression will be run and the result from different approached will be compared with each other and discussed more in details.)

Results

We proceed step-wise and first, as a base model, include only poverty rate as explanatory variable and then step-wise include additional variables as trend (=the LIS wave), GDP and social expenditure. We start with children and then proceed to the adult population for which analyses are produced for the total population and then separately for men and women to see if there are gender-specific differences.

The results for children are displayed in table 2. Results support our intuitive hypotheses. Child poverty rates are positively and significantly associated to child mortality rates. The only exceptions are the first and the last models. In the first model that contains the poverty rate as the only explanatory variable the association is negative but far from significant. In the last model the introduction of social spending hollows out the importance of poverty – which can be explained by the fact that child poverty rates are systematically lower in countries with high social spending levels. The welfare state matters for poverty and poverty matters for child mortality rates.

[table 2 about here]

The story for the adult populations, be it stratified for females or males, is very much the same as for children: poverty rates are positively associated to mortality and the association holds although control variables are step-wise added into the models as can be seen in tables 3a to 3c.

Discussion (to be continued)

Our preliminary results indicate that poverty remains of great importance to cross-national variations in mortality also in modern Europe. Moreover, our analysis of the influence of social expenditure suggests that the relation between poverty and mortality is possible to influence by social policy programmes.

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Table 1. Countries and years included in the analyses, with poverty and mortality rates in the last wave.

Country	LIS years included	Child poverty rate[1] in the last wave year (%)	Adult poverty rate in the last wave year (%)	Child mortality rate (SMR[2]) in the last wave year, girls	Child mortality rate (SMR) in the last wave year, boys	Adult mortality rate (SMR) in the last wave year, women	Adult mortality rate (SMR) in the last wave year, men
Australia	1981, 1985, 1989, 1995, 2001, 2003	22.1	16.9	0.42	0.54	1.77	3.05
Austria	1987, 1994, 2000, 2004	15.4	12.0	0.41	0.49	1.93	4.01
Belgium	1985, 1988, 1995, 2000	12.7	11.3	0.44	0.56	2.34	4.51
Canada	1981, 1987, 1991, 1994, 2000, 2004	25.3	18.5	0.44	0.54	2.03	3.36
Czech Republic	1992, 1996, 2004	17.9	11.2	0.35	0.47	2.53	6.06
Denmark	1987, 1992, 1995, 2000, 2004	10.5	8.3	0.36	0.51	2.65	4.37
Finland	1987, 1991, 1995, 2000, 2004	10.0	9.1	0.29	0.44	2.05	4.78
France	1979, 1984, 1989, 1994, 2000	15.9	12.4	0.39	0.54	2.03	4.83
Germany	1990, 1994, 2000, 2004	17.7	12.8	0.35	0.44	2.02	4.06
Hungary	1991, 1994, 1999, 2005	15.2	12.5	0.50	0.68	3.82	9.92
Ireland	1987, 1995, 2000, 2004	25.1	19.0	0.40	0.51	2.16	3.60
Israel	1986, 1992, 1997, 2001, 2005	34.5	25.2	0.39	0.48	1.79	3.22
Italy	1986, 1991, 1995, 2000, 2004	29.6	19.8	0.33	0.41	1.58	3.10
Luxembourg	1985, 1991, 1994, 2000, 2004	19.5	13.7	0.32	0.40	1.96	4.20
Netherlands	1987, 1991, 1994, 1999, 2004	15.5	11.1	0.36	0.48	2.24	3.30
Norway	1979, 1986, 1991, 1995, 2000, 2004	10.0	8.6	0.33	0.38	1.95	3.18
Poland	1986, 1992, 1995, 1999, 2004	25.0	18.5	0.55	0.71	2.84	7.84
Russia	1992, 1995, 2000	28.8	25.8	1.32	1.92	5.61	18.16
Slovak Republic	1992, 1996	16.0	11.0	0.80	1.03	3.22	8.70
Slovenia	1997, 1999, 2004	10.2	9.8	0.37	0.44	2.41	5.53
Spain	1980, 1990, 1995, 2000, 2004	25.2	17.8	0.36	0.49	1.55	3.93
Sweden	1981, 1987, 1992, 1995, 2000, 2005	10.9	8.4	0.25	0.32	1.84	2.85
Switzerland	1982, 1992, 2000, 2004	17.2	11.8	0.38	0.48	1.61	3.03
United Kingdom	1979, 1986, 1991, 1995, 1999, 2004	24.2	16.6	0.41	0.52	2.23	3.63
United States	1979, 1986, 1991, 1994, 2000, 2004	29.1	20.8	0.57	0.75	2.86	4.83

Notes: 1. Relative poverty rate calculated as living in households with equivalent disposable income lower than 60 percent of median income.
2. SMR= standardized mortality rate per 1000, calculated with the direct method useing the so called European standard population.

Table 2. Results from pooled cross-section analyses, children.

	coefficient	P	coefficient	P	Coefficient	P	Coefficient	P
Constant	1.459	.000	2.090	.000	2.217	.000	3.082	.000
Poverty	-.001	.934	.020	.000	.020	.000	.006	.319
Wave		-.266	.000	-.160	.004	-.106	.003	
GDP				-.000	.035	-.000	.000	
Social spending							-.043	.000
R sqr	.502		.803		.825		.857	

Table 3a. Results from pooled cross-section analyses, females.

	coefficient	P	coefficient	P	Coefficient	P	Coefficient	P
Constant	2.352	.000	2.852	.000	3.172	.000	3.919	.000
Poverty	.020	.138	.039	.002	.028	.001	.016	.487
Wave		-.191	.000	.005	.926	.063	.149	
GDP				-.000	.000	-.000	.000	
Social spending							-.039	.000
R sqr	.719		.819		.870		.884	

Table 3b. Results from pooled cross-section analyses, males.

	coefficient	P	coefficient	P	Coefficient	P	Coefficient	P
Constant	4.688	.000	6.005	.000	7.241	.000	9.931	.000
Poverty	.077	.185	.117	.086	.082	.099	.047	.651
Wave		-.470	.000	.314	.125	.524	.001	
GDP				-.000	.035	-.000	.000	
Social spending							-.141	.002
R sqr	.542		.665		.755		.816	

Table 3c. Results from pooled cross-section analyses, females and males.

	coefficient	P	coefficient	P	Coefficient	P	Coefficient	P
Constant	3.546	.000	4.414	.000	5.116	.000	6.728	.000
Poverty	.043	.162	.071	.064	.053	.063	.030	.619
Wave		-.319	.000	.145	.235	.267	.005	
GDP				-.000	.035	-.000	.000	
Social spending							-.082	.003
R sqr	.613		.706		.803		.849	

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