EDUCATION, INCOME, MATERIAL DEPRIVATION AND MORTALITY IN HUNGARY BETWEEN 2001 AND 2008

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ABSTRACT: *In Hungary, as in other Central Eastern European countries, large inequalities in mortality by level of education have been observed based mostly on cross-sectional data. This paper explores prospective mortality data from Hungary to evaluate the role of education, income and material deprivation using negative binomial regression.*

Education, income and material deprivation are all found to be important determinants of mortality. However, in the multivariate regression only low income and deep material deprivation remained important independent predictors of mortality for both men and women. Contrary to expectations, education had no independent effect on mortality once subjective income and material deprivation was taken into account. Medium-level deprivation increased mortality risk only among men, and medium to low income only among women.

Keywords: mortality, Hungary, education, material deprivation, income, follow-up study, poverty

1 INTRODUCTION

Differences in mortality by education have already been proven to be larger in Central Eastern European and Baltic countries than in Western, Northern and Southern European countries (Mackenbach et al. 2008). The very fact that national incomes are lower and poverty is more prevalent in Central Eastern European and Baltic countries suggests that inequalities in mortality, including those that have already been detected along the educational axis of social inequalities, cannot be understood without exploring the role of poverty.

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Examining the role of poverty in shaping inequalities in health and mortality in different settings and from the perspective of different research traditions is challenging. In the social sciences in Europe the focus shifted in earlier decades from exploring absolute poverty to exploring relative poverty. While this shift can be partially justified from the perspective of the wealthiest countries of Europe, it also represented a hiatus in understanding major social processes in less wealthy European countries. In recent years, however, and parallel with the emergence of Europe-wide social surveys and the claims of EU social agencies, another significant shift has taken place in understanding poverty, at least within the context of the European Union.

It is now widely accepted that poverty cannot be measured (and consequently compared) in absolute terms across countries. Alternative approaches using country-specific relative income thresholds, such as 60 per cent of the country-specific median income, have also proven to be less fruitful for a number of reasons (Bradshaw and Mayhew, 2011). One of the proposed solutions is to introduce measurements based on the operationalization of the (wider) concept of deprivation. In practice, the European tradition of measuring deprivation is largely built on Peter Towsend's deprivation index (Towsend, 1954), but nowadays the index covers ownership of numerous household items, the possibility of carrying out several activities and aspects related to quality of housing, all judged to be necessary for conducting life without being socially excluded. From a theoretical point of view, the deprivation approach is useful for measuring persistent and deep poverty (Bradshaw and Mayhew, 2011), though we also know that deprivation is more complex than simply being the outcome of persistent poverty (Whelan et al. 2004). From a technical point of view, use an index of deprivation is particularly promising for measuring the actual extent of deep poverty in less wealthy European countries. In these countries several factors modify pure income effects and their influence is more intensive than in wealthier countries, such as persistent low income resulting from long-term unemployment or long-term receipt of low wages.

Systematic examination of the nature of deprivation in the social sciences resulted in notable discoveries during the last decade. For instance, the clustering of specific aspects of deprivation was recognised in European countries (Whelan et al. 2001); by and large this clustering proved not to be country specific. The authors found five distinct dimensions of material deprivation, which they labelled as "basic", "secondary", "housing facilities", "housing deterioration" and the "environment". The first dimension included very basic elements of everyday life, such as nutrition, adequate heating of the house, arrears as well as the possibility of having holidays and cooking for family and friends. The "secondary" dimension of deprivation was measured by ownership of different household items, while the third and fourth dimensions covered quality of apartments and the fifth measured quality of housing environment. Some

years later another study showed that while health has the strongest relationship with basic deprivation, it is also strongly related to the level of secondary deprivation; its relationship with the other dimensions of deprivation, though not negligible, is considerably weaker (Whelan and Maitre, 2012).

Deprivation measures, alongside income, also appeared in the studies searching for powerful determinants of health but typically only as a characteristic of the neighbourhood. Spatial comparison of the determinants of ill health became a well-established field of research first in the United Kingdom (Townsend et al. 1985; Phillimore et al. 1994; Romeri et al. 2006), and later on in other countries (for instance Beneach et al. 2003; Fukuda et al. 2007). Recognition that income alone is not able to capture all the aspects of disadvantageous living conditions affecting health and that other factors are also important at the individual (household) level is not new but has only recently become more popular in social epidemiology (Alley et al. 2009). Different aspects of material deprivation have been given particular attention in individual countries, such as access to health services and food in the United States (Rowntree 2000; Alley et al. 2009). Different aspects of housing (Elleway and Macintyre, 1998) and material living conditions (Pikhart et al. 2003; Laaksonen et al. 2004; Groffen et al. 2008) were included in studies on inequalities in health status in a heuristic way. The items included differed by study. Whatever the component of deprivation studied, deprived people were more often found to be in ill health. On the one hand, this relationship was found to reflect systematic disadvantages which were often found in parallel with living in deprivation, such as low education or low income, and on the other hand it affected health independently of these factors. The growing evidence base led to the practice of studying many facets of material deprivation simultaneously (Grundy and Holt, 2001; Sacker et al. 2001) and setting up a clear distinction between individual- and area-level deprivation (Torsheim et al. 2004). In addition to a call for a more systematic use of social stratification indicators (Galobardes et al. 2007), increasing efforts were put into finding methodologically sound ways to use the different indicators. Exploration of the role of material deprivation in health inequalities is therefore highly justified, but fitting the practices of social sciences and social epidemiology together is far from over. Improving this fit is one of the objectives of our study.

In the wider Baltic-CEE region the major role of income and material deprivation in mortality can be partly confirmed by the most recent findings regarding mortality in the Czech Republic, Russia, Poland and Lithuania (Vandenheede et al. 2013). However, this study was based on samples of urban dwelling populations. Regarding the wider geographical and political environment of Hungary, mortality appears to depend on several aspects of material conditions in Russia (Perlman and Bobak, 2008b). For Hungary, only one large-scale mortality research project (with a follow-up design) has been com-

pleted so far, but the results of this survey have been mainly evaluated from the point of view of mental health; mortality outcomes have only been analysed with regard to regional differences (Skrabski et al. 2003; Kopp et al. 2005; Kopp et al. 2006).

Variations of the sociological concept of deprivation (e.g. a characteristic of individuals in households) have already been used to explore health inequalities in countries of the CEE region, but usually not in their own right. In an analysis Pikhart et al. (2003) studied health inequalities in Poland and Hungary using different aspects of deprivation. In order to study the effect of "relative" and "absolute" deprivation, they used separate categories of "deprivation", "ownership of basic items", "fulfilling socially oriented needs" and "ownership of luxury items". Irrespective of the original goal of this investigation, one of its important outcomes was that the dimensions of deprivation mentioned above were all strongly correlated with self-rated health, and this was largely independent of the effect of the actual monetary position of the household. An earlier study of small samples from seven countries in the Central Eastern, Eastern and Baltic regions focused on the role of the psychological concept of perceived control in forming health inequalities. It also measured material deprivation in a simple way (affordability of food, clothing and heating), and found that material deprivation is a strong factor determining chances of ill health, mediated at least partly by psychological characteristics, such as perceived control over life (Bobak et al. 2000).

Studies on relation between mortality and sociologically based concept of deprivation and other aspects of social stratifications for general populations in the region of Central and Eastern Europe are still missing. Taking into account the hiatus in this respect, our investigation aims to fill this gap by exploring the exact role of income and deprivation in shaping inequalities in mortality.

2 DATA AND METHODS

2.1 Sample and variables

In order to explore the effects of education, income and material deprivation on health our study uses data from the "Turning Points of the Life Course" panel survey, launched by the Demographic Research Institute at the Hungarian Central Statistical Office in 2001. The original sample was representative of the non-institutionalised Hungarian population aged 16–85 by age, gender, education and place of residence. The sampling design over-represented social groups that are known to produce low response rates (Kapitány, 2003). The original sample size was 16,035. Respondents were interviewed again in 2004 and in 2008. The time of death was also registered for those who died during the follow-up period. During the period 1138 participants died. The exact time

of death is known for 856 cases, while for 282 the exact time of death could not be determined; we only know that it occurred between the first and the second wave of data collection. For these 282 cases an approximated time is used: exactly in between the first and the second wave of the survey.

Education can be a powerful indicator of health, but only for those who have presumably already finished their educational career; consequently, the sample in our analysis was limited to those who were at least 30 years old when the survey started. Therefore our sample was reduced to 11,546 individuals.

Information on education, income and deprivation was collected in all of the waves, but only the information provided in the first wave is used here. Education was measured by completed level: elementary school (or lower), vocational training (lower secondary), maturation (higher secondary) and tertiary education (college or university). In the analysis the first two categories are merged into "lower secondary or less" category.

Exact data on income was available for 88.9 per cent of the respondents, while information on "subjective" income was available for 99.4 per cent. The latter was measured by the question "Are you able to make ends meet?". Evaluation was made on a five-point scale: "have to go without", "financial problems from month to month", "can just make ends meet by budgeting carefully", "live acceptably" or "live without problems". The correlation coefficient between the subjective evaluation and the actual income adjusted for household composition (in quartiles) was 0.44 ($p<0.001$).

Only a subset was available for the items measuring social exclusion in the most comprehensive way, termed secondary deprivation by Whelan et al. (2001). This measurement is based on ownership of different household items (such as microwave oven, washing machine, video recorder, car, computer and telephone). The usage of this set of dichotomous items can be justified because it was used in a very similar way in European Household Panel Surveys in the second half of the 1990s, not long before the first wave of our data collection (2001). There is no established method of constructing an index from the variables that characterise material deprivation. Some use standardised scores of variables to construct the index, while others use un-standardised scores. For this study we standardised our variables, i.e. the ownership of less commonly owned items were given a higher index weight. The standardised scores were summarised and deprivation categories were constructed by dividing the study population into three roughly equal groups. The Cronbach alpha for the constructed index was 0.706.

In order to analyse individual data we stratify our dataset according to age (>44, 45–54, 55–64, 65+), education (lower secondary or lower, upper secondary, tertiary education) and by the two other variables – deprivation and subjective income. Deprivation categories were described in the previous paragraph.

Table 1
Descriptive statistics

	Number of observations						Number of person months					
	Men		Women		Men	Women	Men		Women		Men	Women
	Survivors	Deceased	Survivors	Deceased	Total	Total	Survivors	Deceased	Survivors	Deceased	Total	Total
Education												
Tertiary	731	59	899	27	790	920	52,050	2,358	64,442	989	54,408	65,431
Upper secondary	1,105	94	1,865	67	1,199	1,992	75,151	3,819	137,593	2595	81,970	140,188
Lower secondary or less	2,633	406	3,178	300	3,039	3,578	189,350	15,209	242,601	12,059	204,559	254,654
Deprivation												
No deprivation	1,331	62	1,581	29	1,393	1,610	100,045	5,288	122,617	2,447	222,662	7735
Medium deprivation	1,559	166	1,958	87	1,725	2,045	163,040	11,179	137,939	9,946,	400,979	21,125
Serious deprivation	1,579	331	2,497	278	1,910	2,775	56,466	4,919	84,080	3,244	140,546	8,163
Subjective income												
Without major difficulties	1,412	133	1,668	65	1,545	1,733	100,045	5288	122,617	2,447	105,333	125064
With careful budgeting	2,247	294	3,197	243	2,541	3,440	163,040	11179	237,939	9,946	174,219	247885
With major difficulties	811	132	1,171	86	943	1,257	56,466	4919	84,080	3,244	61,385	87324
Age												
30–39	1,714	62	2,004	16	1,776	2,020	118,434	2349	145,632	622	264,066	2,971
40–49	1,262	131	1,657	57	1,372	1,714	9,1560	5053	112,425	2145	213,985	7,198
50–59	909	136	1,328	98	1,045	1,426	6,6590	5476	110,316	4,027	166,906	9,503
60+	584	230	1,047	223	814	1,270	42,967	8508	76,263	8,843	119,230	17,351
Total	4,506	565	6,078	396	5,071	6,474	319,551	21,386	441,636	15,637	340,937	460,273

Source: HDRI GGS, Turning Points of Life Course, 1st Wave.

The five possible response categories for subjective income were merged into three categories ("serious difficulties in making ends meet", "able to make ends meet with some difficulties", and "live acceptably or without any problems") (see *Table 1*).

We ran all regressions separately for men and women.

Table 2
Crude mortality rates with confidence intervals, 1/1000

	Men			Women			Total		
	Rate	Lower CI	Higher CI	Rate	Lower CI	Higher CI	Rate	Lower CI	Higher CI
Age									
30–39	34.91	26.77	44.75	7.92	4.53	12.86	20.55	16.24	25.64
40–49	95.48	79.83	113.30	33.26	25.19	43.09	60.92	52.52	70.28
50–59	130.14	109.19	153.95	68.72	55.79	83.75	94.70	82.95	107.64
60+	282.56	247.22	321.53	175.59	153.30	200.21	217.37	197.81	238.34
Education									
Tertiary	74.68	56.85	96.34	29.35	19.34	42.70	50.29	40.23	62.11
Upper secondary	78.40	63.35	95.94	33.63	26.07	42.71	50.45	42.96	58.88
Lower secondary or less	133.60	120.92	147.25	83.85	74.63	93.89	106.69	98.97	114.86
Deprivation									
No deprivation	44.51	34.12	57.06	18.01	12.06	25.87	30.30	24.40	37.21
Medium deprivation	96.23	82.15	112.04	42.54	34.08	52.48	67.11	59.09	75.91
Serious deprivation	173.30	155.13	193.01	100.18	88.75	112.68	129.99	119.87	140.74
Subjective income									
Without major difficulties	86.08	72.08	102.02	37.51	28.95	47.81	60.40	52.28	69.43
With careful budgeting	115.70	102.85	129.71	70.64	62.04	80.10	89.78	82.35	97.71
With major difficulties	139.98	117.12	166.00	68.42	54.72	84.49	99.09	86.37	113.15
Total	111.42	102.42	121.00	61.17	55.29	67.50	83.24	78.06	88.67

2.2 Count regression for the follow-up study

First, we applied Poisson regression in our analysis. Poisson regression analysis allows modelling of dependent variables that are count data (e.g. positive inte-

gers). Poisson regression is often applied to study the occurrence of a small number of events as a function of a set of explanatory variables, and is therefore commonly used in demographic and mortality studies.

Poisson regression, as for any other generalised linear model, is characterised by a random component, a linear predictor and a link function. In Poisson regression the random component is the number of events (in our case the number of deaths) d_i in the i-th group (strata) of n_i person-months of observation. The linear predictor is $log[n_i] + \alpha + x_i\beta$, the expected number of deaths in the i-th group $E[d_i \mid x_i]$ is related to the linear predictor through a logarithmic link function (Dupont, 2002). Thus, the simple univariate Poisson regression can be written as follows:

$$\log\left[E[d_i \mid x_i]\right] = log[n_i] + \alpha + x_i\beta \cdot$$

Multiple Poisson regression is a simple extension of univariate Poisson regression. The notation is similar to the previous one. The dependent variable is the number of deaths observed in a given number of person months in the prespecified strata. We regressed this dependent variable on different independent variables, taking into account the logarithm of the exposition time for every observation as an offset variable. This corresponds to the variable with a coefficient of zero. The formula of multiple Poisson regression is the following:

$$\log\left[E\left[d_j \mid x_j\right]\right] = log\left[n_j\right] + \alpha_j + \beta_1 x_{j1} + \beta_2 x_{j2} + ... + \beta_q x_{jq},$$

where α_j are unknown nuisance parameters, $\beta_1 \ldots \beta_q$ are unknown regression coefficients, $log\left[n_j\right]$ is the logarithm of person-months in the j-th strata. If we subtract $log\left[n_{jk}\right]$ from both sides of the equation we get:

$$\log\left[E\left[d_j \mid x_j\right]/n_j\right] = \alpha_j + \beta_1 x_{j1} + \beta_2 x_{j2} + ... + \beta_q x_{jq} \cdot$$

The logarithm of the response variable is linked to a linear function of the explanatory variables. More simply the formula is:

$$\log[Y] = \alpha_j + \beta_1 x_{j1} + \beta_2 x_{j2} + ... + \beta_q x_{jq},$$

which is equivalent to:

$$Y = exp^{\alpha_j} \cdot exp^{\beta_1 x_{j1}} \cdot exp^{\beta_2 x_{j2}} \cdot \mathrm{K} \;\; exp^{\beta_q x_{jq}},$$

The most important assumption of Poisson regression is that at each level of the covariates the number of cases has equal variance to the mean (μ), formally: $Var(Y) = \mu$. This assumption is rarely met with real data. In many cases the variance is greater than the mean, indicating that the Poisson model is overdispersed and it is not the appropriate analytical approach. The estimates of the coefficients can still be consistent but the standard errors may be biased down-

wards, i.e. they will be too small. The first attempt to analyse our dataset with Poisson regression ended this way.

One remedy to analyse the over-dispersed count outcome variables is application of the negative binomial regression. This type of count regression addresses the failure of Poisson regression by adding a parameter that reflects the unobserved heterogeneity among observations. The negative binomial regression adds an error term, ε, that is assumed to be uncorrelated with the vectors of the independent variables x's (Long and Freese, 2006):

$$\begin{aligned} \mu_j &= exp\left(\alpha_j + \beta_1 x_{j1} + \beta_2 x_{j2} + ... + \beta_q x_{jq} + \varepsilon_j\right) \\ &= exp\left(\alpha_j + \beta_1 x_{j1} + \beta_2 x_{j2} + ... + \beta_q x_{jq}\right) exp\left(\varepsilon_j\right) \\ &= exp\left(\alpha_j + \beta_1 x_{j1} + \beta_2 x_{j2} + ... + \beta_q x_{jq}\right) \delta_j \end{aligned}$$

where $xp\left(\varepsilon_j\right) = \delta_j$. To identify the model we assume that:

$$E\left(\delta\right) = 1$$

With this assumption, it can be shown that:

$$E\left(\mu\right) = \mu E\left(\delta\right) = \mu$$

Because δ is unknown we are not able to compute $Pr(Y \mid x)$. We assume that δ is drawn from a gamma distribution (Cameron and Trivedi, 1998). That is why we compute $Pr(Y \mid x)$ as a weighted combination of $Pr\left(Y|x,\delta\right)$ for all values of δ, where the weights are determined by $\Pr(\delta)$. The negative binomial regression appears well suited to our dataset.

We used the conventional interpretation of the regression coefficient, taking the natural logarithm of the incidence rate ratio, which explains the rate in incidence rate ratio (IRR) comparing all categories to the (lowest) baseline category. As mentioned, IRR has a multiplicative effect on the response variable. Data were analysed with Stata 12 software.

3 RESULTS

Men with maximum lower secondary education had 80 per cent higher mortality compared to those with tertiary education (*Table 3*). The mortality of men who completed upper secondary education, on the other hand, was only slightly and non-significantly higher than that of the best educated. Based on education, two-thirds of male respondents experienced highly elevated mortality risk (*Table 1, 2*).

Mortality rates were 160 per cent higher for the 38 per cent of men who reported the highest level of material deprivation. Medium-level deprivation also had a significant effect on mortality, elevating the IRR by 60 per cent, compared with those who experienced no or only minor material deprivation.

Table 3
Social differences in mortality based on negative binomial regression, men aged 30–85 in 2001

	Incident Rate Ratios and 95% confidence intervals						
	Model 1	Model 2	Model 3	Model 4	Model5	Model 6	Model 7
Education							
Tertiary	1.00			1.00	1.00		1.00
Upper secondary	1.23 (0.84–1.80)			1.09 (0.77–1.53)	1.19 (0.84–1.69)		1.09 (0.78–1.51)
Lower secondary or less	**1.81** (1.29–2.55)			**1.38** (1.02–1.88)	**1.64** (1.20–2.23)		1.31 (0.97–1.77)
Deprivation							
No deprivation		1.00		1.00		1.00	1.00
Medium deprivation		**1.59** (1.17–2.16)		**1.47** (1.07–2.01)		**1.53** (1.14–2.07)	**1.44** (1.06–1.96)
Serious deprivation		**2.64** (1.96–3.53)		**2.29** (1.67–3.13)		**2.31** (1.72–3.09)	**2.06** (1.51–2.81)
Subjective income							
Able to make the end meet…							
without difficulties			1.00		1.00	1.00	1.00
only with careful budgeting			1.24 (0.94–1.63)		1.16 (0.91–1.48)	1.08 (0.87–1.33)	1.03 (0.83–1.28)
only with major difficulties			**2.09** (1.52–2.87)		**1.87** (1.40–2.50)	**1.61** (1.24–2.09)	**1.54** (1.18–2.00)
-Log likelihood	205.4786	194.3837	202.8506	191.1420	197.037	187.0347	184.6945

Notes: M1: age + education; M2: age + deprivation; M3: age + subjective income; M4: age + education + deprivation M5: age + education+ subjective income; M6: age + deprivation + subjective income; M7: age + education + deprivation + subjective income.
Significant results are marked with bold letters.

When only subjective income was taken into account the narrow 20 per cent of men who reported that they had financial problems from month to month had more than 100 per cent excess mortality compared to those who reported having none or only minor difficulties in this respect. That half of male respondents can make ends meet with minor difficulties faced a mortality risk stating that they not significantly different from the mortality of respondents with satisfactory income.

In multivariate analysis (*Table 3*), however, the effect of education diminished and eventually disappeared when the effects of the other two variables were taken into account. Entering material deprivation or subjective income into the model reduced the educational IRR values somewhat, and entering both reduced it below the significance level. The effect of education was slightly reduced when income was also included (model 5). The decrease in effect was higher when deprivation was included in the model (model 4). Entering both subjective income and material deprivation into the model reduced the IRR values below the level of significance (model 7).

Regarding material deprivation, both a medium and high level of deprivation was associated with an elevated mortality risk among men. The deprivation effect was highly independent of the effects of the other variables examined: IRRs were only slightly reduced both in cases of medium and high level material deprivation, and when subjective income or/and education was/were entered into the model.

Perceived low income was associated with high mortality risk only in its extreme form. The high IRR of those men who experienced day-to-day difficulties diminished significantly when deprivation was also entered into the model (model 6) but still 60 per cent higher compared to those who did not experience difficulties in making the ends meet. When education was also entered into the model (model 7) mortality remained more than 50 per cent higher.

Men with major financial difficulties had a much higher risk of dying than those with a satisfactory level of income. Medium-level financial difficulties, however, did not result in elevated mortality.

As for women, educational differences in mortality seem comparable to what we saw among men (*Table 4*). Women having only lower secondary or less education (55 percent of our female respondents) had 61 per cent higher mortality than women with tertiary education. Those with upper secondary education did not have a higher chance of dying than women with tertiary education.

Table 4
Social differences in mortality based on negative binomial regression, women aged 30–85 in 2001

	Incident Rate Ratios and 95% confidence intervals						
	Model 1	Model 2	Model 3	Model 4	Model5	Model 6	Model 7
Education							
Tertiary	1.00			1.00	1.00		1.00
Upper secondary	1.06 (0.66–1.69)			0.99 (0.62–1.57)	1.00 (0.63–1.57)		0.98 (0.61–1.50)
Lower secondary or less	**1.61** (1.05–2.46)			1.32 (0.86–2.02)	1.39 (0.92–2.09)		1.20 (0.79–1.83)
Deprivation							
No deprivation		1.00		1.00		1.00	1.00
Medium deprivation		1.44 (0.93–2.22)		1.36 (0.87–2.10		1.31 (0.85–2.01)	1.27 (0.82–1.96)
Serious deprivation		**2.18** (1.44–3.30)		**1.92** (1.24–2.97)		**1.80** (1.19–2.73)	**1.65** (1.07–2.54)
Subjective income							
Able to make the end meet…							
without difficulties			1.00		1.00	1.00	1.00
only with careful budgeting			**1.58** (1.16–2.13)		**1.48** (1.11–1.97)	**1.44** (1.08–1.90)	**1.39** (1.04–1.84)
only with day to day difficulties			**2.21** (1.54–3.14)		**1.97** (1.37–2.82)	**1.80** (1.29–2.53)	**1.75** (1.24–2.45)
-Log likelihood	156.05053	152.19808	151.70095	149.95613	148.42864	146.15434	144.70607

Notes: M1: age + education; M2: age + deprivation; M3: age + subjective income; M4: age + education + deprivation> M5: age + education+ subjective income; M6: age + deprivation + subjective income; M7: age + education + deprivation + subjective income.
Significant results are marked with bold letters.

Just as among men, only a very high level of deprivation influenced female mortality, raising the IRR by 65 per cent. On the other hand, when the effect of income was examined alone, we found a more pronounced effect on female than on male mortality. Among women not only a very low but also a medium level of income led to an elevated risk of mortality: those 53 per cent of women who managed everyday life with difficulties had a 48 per cent higher mortality, and those 20 per cent of women who faced day-to-day difficulties had a 121 per cent higher mortality compared to those who reported no such difficulties. When the role of education was additionally taken into account (model 5) then the decrease of mortality among those with minor and major financial difficulties was modest. The inclusion of deprivation into our model decreased the

over-mortality of both groups of women with moderate and major financial difficulties only slightly. When education and deprivation were simultaneously considered (model 7), women with moderate financial difficulties still had 39 per cent higher mortality than women without financial difficulties. Women with major financial difficulties on the other hand had 75 per cent higher mortality compared to those experiencing no financial difficulties.

Unlike for men, the effect of deep deprivation did not disappear among women when the effect of low income was also taken into account (model 6), but most mortality differences remained. Education had an even more restrained role in the relationship between deep material deprivation and mortality: after its inclusion into the model (model 4) the mortality rate was still 92 per cent higher among the most deprived women than their non-deprived counterparts. Medium-level education, on the other hand, did not involve significantly higher mortality among women.

4 DISCUSSION

In an earlier analysis (Kovács, 2006) we examined inequalities in health by different aspects of social stratification, similar to those used in the present paper for analysing the determinants of mortality. Using the same sample, we found that inequalities by education, deprivation and income all had effects of a similar magnitude on the chances of having poor health. These effects were partially independent and partially overlapping: by and large, two-thirds of the educational effect among the least educated did not disappear after adjusting for income and deprivation, and half of the effect did not disappear among those with medium-level education. Similarly, a large share of deprivation and income effects were found to be independent of the effect of the other variables. Both in uni- and multivariate analyses the effects of education, material deprivation and income were of similar magnitude, but overall income was the most important predictor of ill health for men, while education and income were equally important and leading determinants for women.

Collating past and recent results, the striking difference between determinants of poor health and mortality is that education no longer has an effect on mortality once the effects of subjective income and material deprivation are taken into account. These findings may indicate, at least in societies, like Hungary the commonly reported and analysed educational differences in mortality can actually be fully attributed to the short- or long-term poverty experienced by the less educated. Several aspects usually thought to determine educational inequalities in mortality, such as social disparities in general and health-related knowledge, or the problem solving/managing skills of the highly educated, do not seem to be relevant under certain conditions.

The relative importance of the determinants of ill health and mortality also seems to differ. While in the case of ill health material deprivation is an important factor on its own right – though relatively less important than income or education for both men and women –, in the case of mortality its weight seems supreme. This finding is not surprising considering the nature of mortality and material deprivation. Both mortality and income assimilate cumulative experiences: the first refers to experiencing ill health, in most cases for a longer period, and the second mostly refers to experiencing poverty for longer periods of the life course. This relationship, however, is not likely to be strong in many societies, except in cases where low education consistently involves not only relative but also absolute poverty for a longer period of time.

Material deprivation and income are strong predictors of mortality for both men and women, but their impacts are different. Experience of marked levels of deprivation or having very low income increases mortality equally. In turn, medium-low income has an effect only for female and medium-low material deprivation only for male mortality. Alternative arguments might offer explanations for this discrepancy.

Men's vulnerability to medium-level material deprivation can be understood by taking into account gender-specific experiences of social exclusion and its measurement. The material element of social exclusion used in this study – ownership of items – makes it easier to manage everyday life and maintain work relationships and friendships. Lacking the mentioned items might involve social exclusion as a result of loosened social connections more often in the case of men than women. Women often have additional opportunities to maintain social relations, unrelated to the ownership of items, for instance through caring for children or grandchildren. However, this reasoning cannot be proved, considering the relatively new and unexplored nature of the social exclusion measures examined in this study. Finally, the more commonly assumed reason for men's worse health – that they have less healthy lifestyles and a resultant lack of control of their financial situation – can also be considered.

Medium-level poverty was found to be a determinant of mortality for women but not men. The substantially higher mortality among men offers one possible interpretation. The higher average life expectancy of women compared to men implies that our female sample is older and less 'health selected' and consequently has more health problems than men of the same age. Management of ill health might depend on income, which could lead to elevated mortality risk for women with medium-low (subjective) income. Alternatively, or even in addition, one may consider the nature of gender roles and its implication on mortality. In traditional households the tasks of budgeting and managing everyday expenses are usually assigned to women. Indeed, in the same survey the majority of respondents indicated that everyday household expenses were predominantly dealt with by women. This prescribed role could be harmful to

women's health in two ways. First, the financial stress could translate into psychological stress on a daily basis; second, women might prioritise expenditures on other household members and play down their own needs, including those connected to their health.

The possibility that the actual determinants of ill health and mortality are different, however, cannot be ruled out. This concept was already proposed in a study analysing mortality and self-rated health in Russia (Perlman and Bobak, 2008a). In that study similar educational differences were found for having poor self-rated health and morality but income predicted poor health more strongly than mortality. Other factors which affected mortality but not self-rated health in the study on Russia, such as alcohol consumption and smoking, were not measured in our survey. Nevertheless, it is possible they could explain some of our findings regarding the less important role of income relative to deprivation among men.

Other possible explanations emerge if we take the time frame of our data collection into account. Inequalities in health were assessed in 2001 and mortality was assessed for a seven-year period afterwards (2001–2008). Changes regarding the relative importance of the determinants of ill health and mortality have already been reported for Northern Europe (Ronegund and Zahl, 2005).

Earlier studies from Central Eastern Europe based on samples representing selected fractions of the populations (for instance urban-based or the employed) raised the possibility that subjectively evaluated income is an overwhelmingly important determinant of ill health in this region of Europe. Our investigation, based on an unbiased national sample of the whole of a non-institutionalised adult population except for the oldest people, reinforces the point that poverty is among the leading causes of mortality inequalities in Hungary and presumably in other countries of the region too. Inequalities by education, which were reported in only one large-scale prospective study from another country of the CE and Baltic region, namely Lithuania (Shkolnikov et al. 2007), were as large as in Hungary, but probably also mainly driven by material conditions.

Our study, however, has several limitations. Though self-reported income has to be connected with actual income, using self-reported income we could not precisely measure the possible effects of income on mortality. It is possible that our deprivation measure captures more from the effect of 'real income' than subjective income. Employing different income measures leads to conflicting results regarding its effect on mortality, as was shown in previous research on Finland (Martikainen et al. 2009).

The most comprehensive review of dimensions of social deprivation by Whelan and Maitre (2012) has already shown that the dimension of deprivation that they labelled as "basic" has the strongest relationship with health. In this study we employed an index characterising the deprivation dimension that they labelled as "secondary". Overall, from among the five existing dimensions of

deprivation only one could be employed in this study. Consequently, the relationship between material deprivation and mortality remains largely uncharted, even if the findings of this study are presumably applicable to other countries of the Central Eastern European region.

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