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Welfare State Regimes and Social Determinants of Health in Europe

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Abstract

The aim of the paper is to identify social determinants of poor health when considering differences across countries and types of welfare states. In order to do so, we first perform a cluster analysis to classify countries into groups of welfare state models. The innovation of the paper is clustering method using the information about the actual redistributional effects and country health care expenditures instead of concentrating on country institutional arrangements. Thereafter, a logistic regression model is used to investigate the social determinants of poor health status in Europe, taking into account demographic and socioeconomic factors, indicators of relative poverty and finally environmental factors. Following the recent literature, we also apply an alternative estimation strategy and employ a multilevel logistic regression of individuals nested within countries with random intercept on the country level. The results show that, apart from age, inequality at the individual level is mostly determined by the education level, income and employment status as well as indicators of relative poverty. Environmental factors as well as other demographic characteristics such as migration or the marital status seem to matter less. Moreover, welfare state models play an important role in determining health inequalities across countries, even after controlling for a large number of socioeconomic characteristics at the individual level.

Keywords: health, welfare regimes, health care expenditures, poverty, cluster analysis, multilevel analysis

JEL classification: H51, I18

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TABLES AND FIGURES

1. Introduction

Keeping in mind the steadily rising total health care expenditures, it is crucial for policy-makers to identify the factors associated with poor health. According to the World Health Organisation (WHO 2008), social determinants of health such as conditions in which people are born, grow, live, work and age, are responsible for a major part of health inequalities between and within countries. These are shaped by the distribution of money, power and resources (Marmot and Wilkinson 1999). The WHO distinguishes further between socioeconomic, physical and individual determinants of health. Socioeconomic factors include education, income and employment status. Physical conditions cover environmental aspects like water or air quality, safety status, working conditions and housing. Individual or personal attributes refer to genetics and behavioural habits. Some other characteristics that are contributing to health inequalities are access to health services and their quality, social support networks, nutrition and stress aspects (Marmot and Wilkinson 1999). The role of the welfare state in protecting and promoting a common minimum of well-being transforms into a mediatory role concerning health status determinants. From this point of view the welfare state regime is assumed to be connected with the health outcome of individuals in a country by the virtue of conditioning some primary health determinants such as socioeconomic factors, health services or employment regulations. The welfare state regime typology is usually based on macroeconomic indicators describing welfare state institutions rather than using the information about actual individual redistributional effects.

The aim of the paper is to identify social determinants of poor health when considering differences across countries and types of welfare states. Building on previous efforts we start by grouping countries into welfare state models using cluster analysis. This is done by using the information about the actual redistributional effects and country health care expenditures. Afterwards, a logistic regression model is used to investigate the determinants of poor health status in Europe, taking into account demographic and socioeconomic factors, indicators of relative poverty and finally environmental factors. Furthermore, we use the information from the cluster analysis and analyse to what extent the health status depends on welfare state regimes or country characteristics. Following the recent literature, we also apply an alternative estimation strategy and employ a multilevel logistic regression of individuals nested within countries with random intercept on the country level. Advantages and disadvantages of the two approaches are discussed in the methodology section.

The remainder of the paper is set out as follows: Section 2 gives a brief overview of the literature in this field; Section 3 provides information on the dataset and describes the empirical methodology; Section 4 provides a descriptive analysis; Section 5 presents the results; and Section 6 concludes.

2. Welfare state regimes and health

2.1. SOCIAL DETERMINANTS OF HEALTH

The association between socioeconomic status and health has been intensively studied (Kunst *et al*. 2005, Mackenbach *et al*. 2008, 2008, Marmot and Wilkinson 1999). Among the most important socioeconomic determinants identified are *income* (Marmot 2002; Van Doorslaer and Koolman 2004), *education level* (Cavelaars *et al.* 1998a, Schütte *et al*. 2013, 2013, Silventoinen and Lahelma 2002), *occupational class* (Cavelaars *et al. 1998b*) and *employment status* (Artazcoz *et al*. 2004; Stronks *et al*. 1997). The studies control for demographic characteristics such as age, sex and marital status. Furthermore, a significantly poorer health status of immigrants has been observed (Borrell *et al*. 2008; Nielsen and Krasnik 2010, Rechel *et al*. 2013, 2013). In line with the above findings poverty, relative deprivation and social exclusion are strongly associated with poor health (Marmot and Wilkinson 1999). (Bobak *et al*. 2000) analyses material deprivation based on availability of food, clothing and heating and perceived control as additional drivers of health inequalities.

Also *unmet need for healthcare* was subject to research, mostly in the United States (Pagán and Pauly 2006; Strunk and Cunningham 2002) whereas in Europe due to universal health coverage such research efforts were less extensive. Socioeconomic status is correlated with the way how the health care is utilised and unmet care needs are experienced mostly by people with low socioeconomic status (Allin *et al*. 2010; De Looper, M. and G. Lafortune 2009). Unmet need for medical treatment can be attributed to organisational arrangements (waiting lists, insurance coverage), individual obstacles (employment obligations, child care), financial barriers, lack of available professionals or other specific reasons.

The potential role of environmental risks is outlined by Evans and Kantrowitz (2002). They highlight characteristics of physical environment such as air and water quality, neighbourhood conditions, housing conditions and educational facilities that are determining health disparities. Some literature addresses particularly housing conditions in this respect (Dunn *et al*. 2004; Evans and Kantrowitz 2002; Krieger and Higgins 2002; Thomson *et al*. 2001).

2.2. WELFARE STATE REGIMES AND HEALTH

The literature on welfare state regime typology is dominated by the seminal work of Esping-Andersen (1990) 'The three worlds of welfare capitalism'. Based on principles reflecting the role of market, state and family in the provision of welfare, three types of welfare states are defined: liberal, conservative and social-democratic. Since then many critical remarks (Arts and Gelissen 2002), alternative classifications (Bambra 2004, 2007; Bonoli 1997; Castles and Mitchell 1993) and further regimes (especially the 'Southern model' (Ferrera 1996)) were added.

One of possible alternatives is the analysis of the actual distributional outcomes of welfare policies instead of concentrating on institutional macroeconomic characteristics. (Kammer *et al*. 2012) use this concept to examine if the traditional welfare state typology persists when the outcomes of welfare policies are analysed using micro data. In this paper, a similar approach is used to group countries into clusters. Additionally public health expenditures were included, since they supplementary influence the redistribution by transfer policies.

At the overall country level, the average level of self-perceived health is lower in Central and Eastern Europe (Bobak *et al*. 2000; Carlson 1998) and substantially higher in Social Democratic countries (Chung and Muntaner 2007). Whereas individual differences in health are largely determined by socioeconomic, demographic, environmental and personal factors, disparities in health status between countries can be attributed to different country specifics. (Navarro *et al*. 2006) examine the complex interactions between political traditions, policies, and public health outcomes. They have found that policies aimed at reducing social inequalities have positive effect on health. (Chung and Muntaner 2007) conduct multilevel analysis of health indicators clustered in welfare state regime types. Their results have shown that twenty per cent of the differences in the infant mortality rates among countries could be explained by the type of welfare state. The welfare state perspective is brought to the analysis of health by Bambra and Eikemo as well, also using multilevel modelling to demonstrate the degree to which welfare state regimes explain the variation in self-assessed health (Bambra and Eikemo 2008; Eikemo *et al*. 2008a; Eikemo *et al*. 2008b). In line with above findings the welfare state regime accounts for approximately half of the variation in the health status at the national level (Bambra and Eikemo 2008).

3. Data and methods

For the subsequent analysis EU-Silc data from the 2010 wave, released on August 2013, was used. EU-Silc contains information about income and living conditions at the individual and household level as well as information on the self-perceived health status of the individuals. Furthermore, detailed income and tax components for assessing outcomes of redistributional policies are available. The final sample covers household members aged above 16 in twenty European countries.

In the following subsections, we first implement a cluster analysis for assigning countries into welfare state models. Second, the social determinants of health are analysed using binary logistic regression with country level respectively welfare regime level fixed effects. The results are then compared with the estimates from multilevel logistic regression model, which is accounting for the hierarchical structure of the data on the one side but implying some difficulties discussed below on the other side. All computations were performed using R version 3.1.3.

3.1. CLUSTER ANALYSIS

By redistribution income and providing public health care, welfare state regimes are important factors influencing the health of its citizens. Based upon these two functions of the welfare state, redistribution of income and provision of health care, we will cluster states into groups of similar welfare regimes. As it is difficult to measure the quality of the public health system, we will simply use the total public health care expenditures as an indicator measuring the countries´ intention to provide good health care. The expenditures for 2010 are calculated in USD per capita and made comparable across countries using purchasing power parities. The indicator includes expenses for personal health care, prevention, administration and investment in medical facilities (OECD 2014). In order to quantify distributional policies outcomes, we follow (Kammer *et al*. 2012) and calculate pre-government (market) and post-government (disposable) household incomes, which are equivalised[1] to account for different household sizes. Post-government income is computed using the following formula:

post-government (disposable) income = pre-government (market) income – taxes – social insurance contributions + benefits + pensions

Pre-government or market income includes wages and salaries, income from self-employment and capital income. The variable ‘taxes’ includes only taxes attributable to households (income and wealth taxes without corporate or indirect taxes). Social insurance contributions consist of employee and employer social insurance contributions as these vary across countries.

1 Household income was divided by the number of equalised adult household members by applying the following rule: the first adult counts with a factor of 1.0; due to economies of scale in the household, the second adults as well as each subsequent person older than 14 counts as 0.5; children under 14 counts as 0.3.

Finally, we end up with the following clustering criteria:

› Total public health care expenditures in PPP USD per capita

› Inequality in pre-government and post-government equivalent household income expressed as Gini coefficients

› Difference between these two Gini coefficients as measurement of overall redistribution effects

› Shares of taxes and social insurance contributions in market income

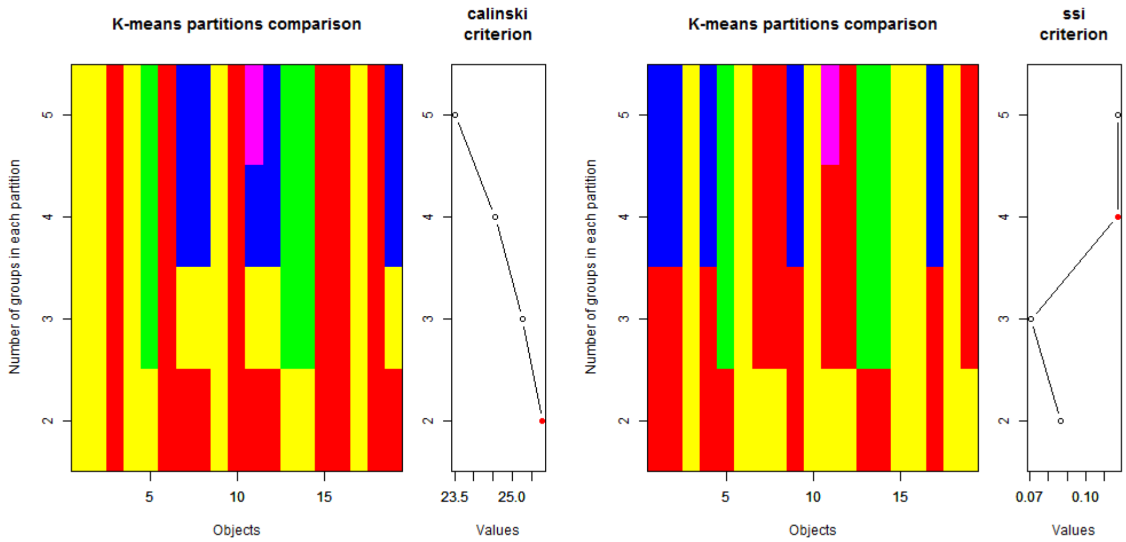
› Shares of benefits in disposable income

If not already in this range, the variables for the cluster analysis were rescaled to range from zero to one. The advantage of this approach is that factual distributional effect in the country is considered instead of concentrating exclusively on institutional arrangements.

The first question when dealing with cluster analysis is whether one should follow a hierarchical or a non-hierarchical approach. The hierarchical approach starts from the bottom up and first combines countries which are most similar depending on the method and variables chosen. We have chosen the Ward´s method, which minimises the total within-cluster variance. In each merger-step, the pair of clusters with minimum between-cluster distance is merged. The hierarchical clustering algorithm continues to combine countries and clusters until finally all countries are finally merged in one cluster. With the output of the cluster tree, one can then decide upon the number of clusters that make sense for the data. The disadvantage of this approach is that when looking at higher levels of aggregation, the overall within-cluster variance could possibly be reduced if one country would move to another cluster. But once a country belongs to a cluster in this bottom up approach, it does not change clusters anymore. The non-hierarchical clustering works differently in this respect, as it is an iterative process. The usual method used is the k-means algorithm. The problem with this method is, however, that one needs to know the number of desired clusters beforehand. Furthermore, the algorithm is not deterministic, possibly leading to different groupings when performing the cluster analysis multiple times.

In the subsequent analysis, both methods are used and differences investigated. Starting with non-hierarchical clustering, one first of all needs to know the number of clusters that are suitable for the data. In order to find that out, the Calinski-Harabasz criterion as well as the simple structure index SSI is used (Calinski and Harabasz 1974; Dolnicar *et al*. 2000). As can be seen from Figure 1, the Calinski-Harabasz criterion opts for two large clusters, as the criterion looks for clusters of similar size. The criterion might thus be less suitable in our case as the size of the clusters is very different (with e.g. fives clusters, Ireland would be separate). As we are interested in further differentiation, we thus rely on the SSI. The SSI evaluates the outcome for a given number of clusters depending on 3 elements:
(1) the maximum difference of each variable between the clusters, (2) the sizes of the most contrasting clusters and (3) the deviation of a variable in the cluster centres compared to its overall mean.

Figure 1 / Results for the simple structure index and the Calinski-Harabasz criterion



If we set the maximum number of desired clusters to five, the SSI index advises us to use four clusters as can be seen from Figure 1. This information of the preferred cluster number is then provided to the non-hierarchical cluster method k-mean and the result is shown in Figure 2.

Figure 2 / Clustering according to the means algorithm

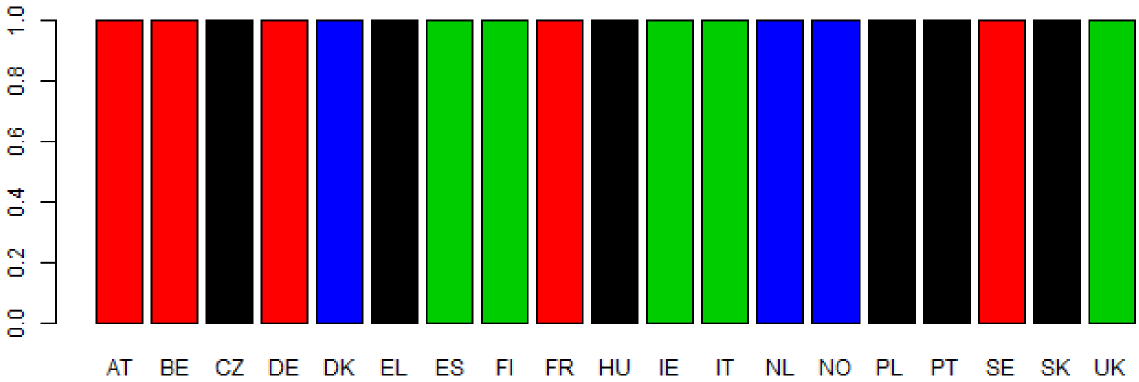
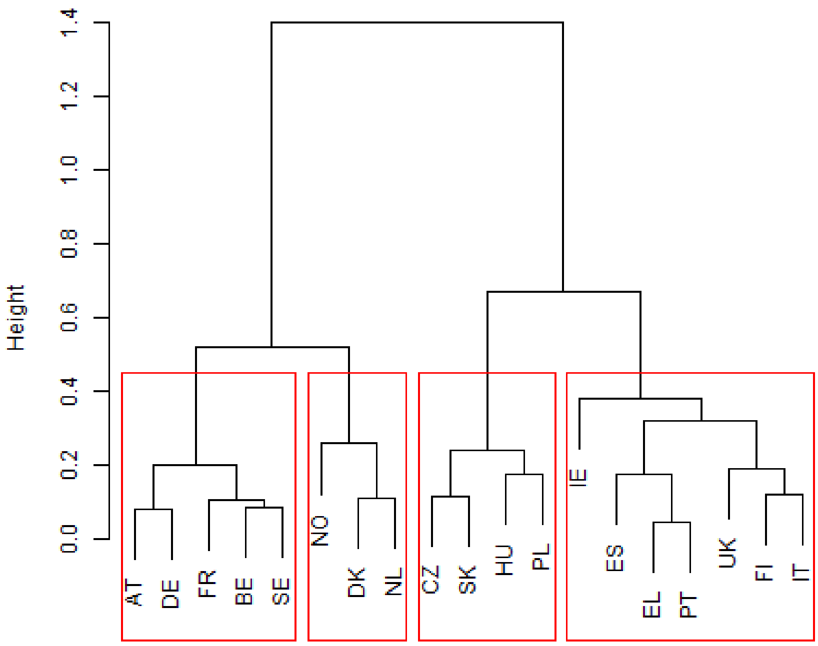


Figure 3 / Cluster dentogram using Ward´s criterion



In addition to the non-hierarchical cluster analysis we perform a hierarchical cluster analysis using Ward´s criterion. The result can be seen in Figure 3 and shows a picture similar to the one of the non-hierarchical cluster analysis. Only one country has switched to another cluster, namely Portugal. While Portugal was found in the cluster of Central and Eastern European (CEE) countries before, it is now in a group together with other Southern European countries. For political and thematically reasons we prefer the clusters obtained from the hierarchical cluster analysis, leaving us with one cluster of CEE countries.

Our final cluster grouping thus looks as follows

› Cluster 1: Denmark, Netherlands, Norway

› Cluster 2: Austria, Belgium, France, Germany, Sweden

› Cluster 3: Finland, Greece, Ireland, Italy, Portugal, Spain, United Kingdom

› Cluster 4: Czech Republic, Hungary, Poland, Slovakia

As can be seen from Figure 4 and Figure 5, cluster 1 is characterised by the lowest average Gini index and the highest health system expenses in PPP USD per capita. The highest average Gini can be found in cluster 3, containing foremost Anglo-Saxon and Southern European countries. Cluster 2 and 4 contain countries with somewhat similar and moderate Gini indices, but are very different in terms of public health expenses. While cluster 4, containing the CEE countries has by far the lowest public health system expenses, cluster 2, which contain mostly Central European countries of the manufacturing core, exhibits rather high public expenditures for health.

Figure 4 / Income Gini before and after government redistribution

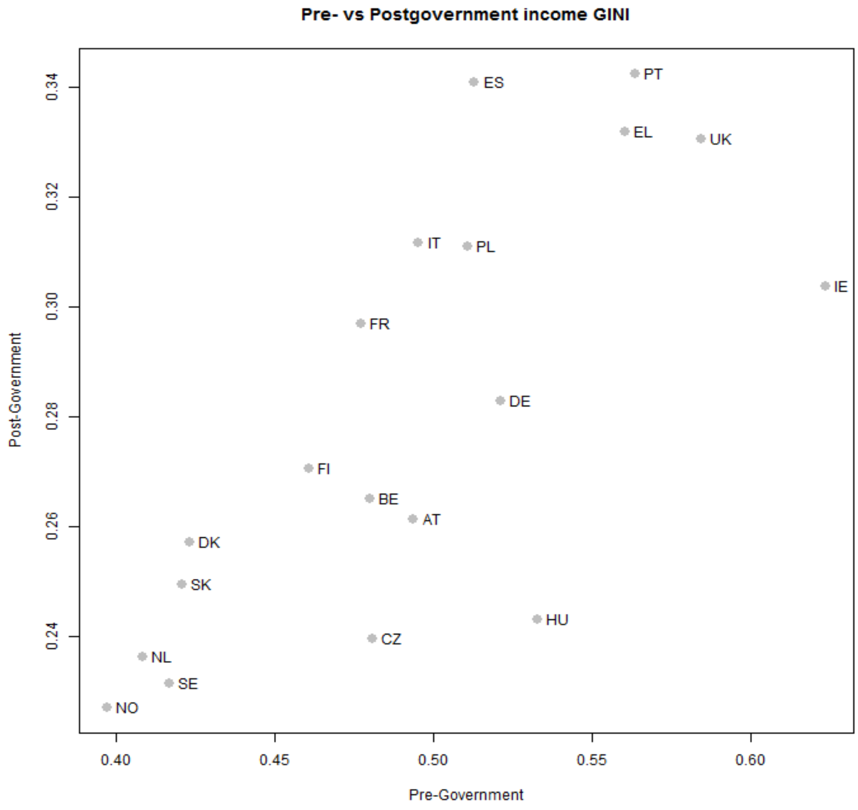
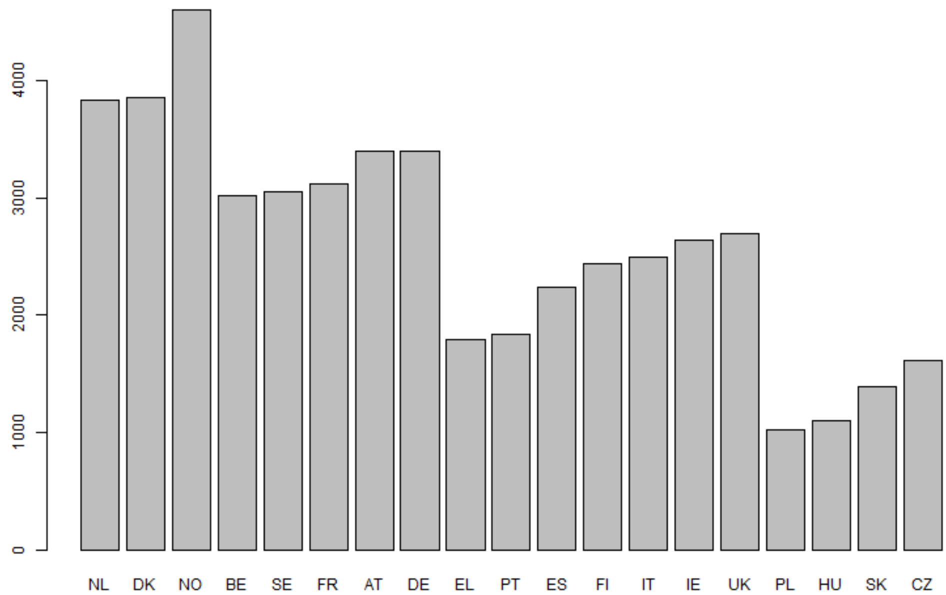


Figure 5 / Health system expenses in PPP USD per capita



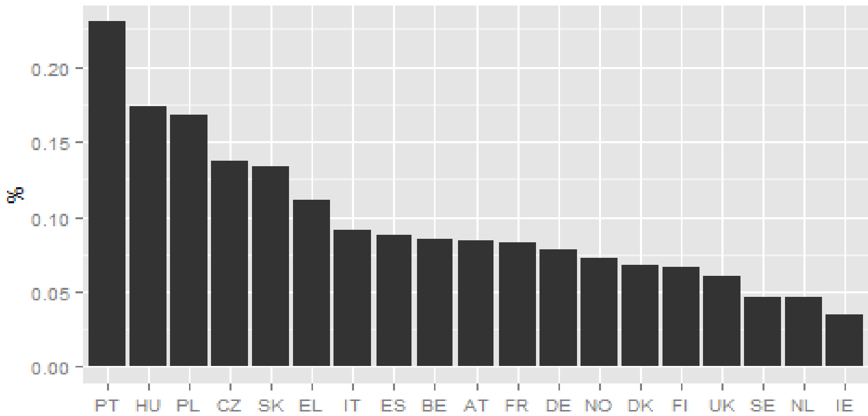
3.2. REGRESSION ANALYSIS

While the welfare system is responsible for a lot of the variation in the health status at the cross-country level, most of the variation happens at the individual level. To identify the most important social determinants of health, a large number of individual characteristics are investigated using a binary logistic regression model. The baseline model uses country fixed effects to control for cross-country heterogeneity. In a second step, fixed effects for the four types of welfare models are included instead of the country dummies to investigate the effect of different welfare regimes on the health status. The latter model is then extended in a final step and random country effects are added to control for the variation within welfare model clusters.

3.2.1. Binary logistic regression

The dependent variable in our analysis is the self-perceived health status which originally comprises five categories (very good, good, fair, bad and very bad). In our analysis, the variable was dichotomised creating a variable poor health status, PH, taking on value 1 when respondents answered the question about their general health status with ‘bad’ or ‘very bad’ and value 0 otherwise. The percentage of respondents reporting poor health status by country is shown in Figure 6. It is highest in Portugal followed by Eastern and the remaining Southern European countries. The lowest share of people reporting poor health status was observed in Ireland, Netherlands and Sweden followed by United Kingdom.

Figure 6 / Percentage of respondents reporting poor health status by country



Following the literature we consider the following groups of explanatory variables: *education level, income, employment status, relative poverty indicators, material deprivation and environmental characteristics*. The logistic regression model aiming at identifying determinants of poor health status in Europe can be written as

$$P(PH = 1) = F(\,\beta_1 AGE + \beta_2 FE + \beta_3 MAR + \beta_4 SEP + \beta_5 MIG + \beta_6 EDU + \beta_7 INCQ + \\ + \beta_8 UNEMP + \beta_9 INACT + \beta_{10} ENDS + \beta_{11} LOAN + \beta_{12} EXP + \beta_{13} HOL + \\ + \beta_{14} FOOD + \beta_{15} UNMET + \beta_{16} HOME + \beta_{17} COLD + \beta_{18} DARK + \beta_{19} NOISE + \\ + \beta_{20} POL + \beta_{21} CRIME + \tau_c + \varepsilon)$$

Table 1 offers an overview of the explanatory variables used in the model. We controlled for demographic characteristics such as age (*AGE*), sex (*FE*), marital status (*MAR*, *SEP*) and migration status (*MIG*). With respect to the marital status we differentiate between singles, which are our reference group, married persons (*MAR*) and those being divorced, separated or widowed (*SEP*). The variable covering the migration status (*MIG*) takes on the value one, if the country of birth is not equal to the country of residence and zero otherwise. *AGE* is divided into eight categories (below 20, 20-29, 30-39, 40-49, 50-59, 60-60, 70-79 and above 80). Depending on the highest *education level* (*EDU*) attained, persons are divided into six categories according to the International Standard Classification of Education (ISCED).

Furthermore, various relative poverty indicators were introduced. These include difficulties to make ends meet (*ENDS*), difficulties to repay loans (*LOANS*) or to face unexpected expenses (*EXP*) and enforced lack of consumption goods and activities. Latter relative deprivation measures cover the availability of food, which is defined as the capacity to afford a meal with meat or a vegetarian equivalent every other day (*FOOD*), and holidays (*HOL*), denoting the capacity to afford holidays once a year. *Unmet need for medical treatment* (*UNMET*) is also included in this category. Despite the fact that the reasons for unmet need for medical treatment are of various nature (could not afford to, waiting lists, time reasons, distance, fear etc.) the highest proportion of population with unmet healthcare need is represented in first income quartile.

Environmental characteristics being considered as social determinants of health are home problems (*HOME*), the ability to keep home not adequately warm (*COLD*), a lack of light in the dwelling (*DARK*), and crime (*CRIME*), noise (*NOISE*) and pollution (*POL*) in the area.

Employment status was divided into three categories: employed (reference group), unemployed (*UNEMP*) and inactive (*INACT*). These variables pose several problems with regard to possible sources of endogeneity, as it is unclear whether inactive or unemployed workers were in poor health condition first and thus dropped out of employment or vice versa. For this reason further employment characteristics such as part time work or fixed-term contracts were excluded from the analysis. Income (*INCQ*) was measured by equivalised annual disposable income. Individuals were assigned to income quartiles, with boundaries calculated for every single country, with respect to different standards of living.

Furthermore, we included information about countries or country groups, τ_c, in order to control for heterogeneity at the country (group) level. The variable τ_c hereby stands for either country dummies or welfare regimes in the model.

Table 1 / Descriptive statistics for the variables to be analysed

Variables	Name	Description	Per cent
Poor health	PH	Self-assessed poor general health (bad or very bad)	10.4%
Demographic factors			
Age	AGE	16-19, 20-29, 30-39, 30-39, 40-49, 50-59, 60-69, 70-79, Above 80	
Female	FE	Gender, 1 = women, 0 = men	52.1%
Married	MAR	Married	28.8%
Separated	SEP	Divorced, separated or widowed	56.5%
Migration status	MIG	Home country doesn't equal the country of birth	5.3%
Socioeconomic status			
Education	EDU	0 pre-primary education	1.0%
		1 primary education	12.5%
		2 lower secondary education	19.8%
		3 (upper) secondary education	41.3%
		4 post-secondary non tertiary education	2.9%
		5 tertiary education	22.5%
Income	$INCQ$	Income quartiles by country	25.0%
Unemployed	$UNEMP$	Unemployed and actively looking for a job	6.0%
Inactive	$INACT$	Persons neither employed nor unemployed (Students, pupils, retiree, permanently disabled, domestic care responsibilities, otherwise inactive person)	44.3%
Relative poverty indicators			
Making ends meet	$ENDS$	Difficulties to make ends meet	52.7%
Repaying loans	$LOAN$	Difficulties to repay loans	8.9%
Unexpected expenses	EXP	Difficulties to face unexpected expenses	33.1%
Holidays	HOL	Capacity to afford holidays once a year (no)	34.6%
Food	$FOOD$	Capacity to afford a meal with meat or vegetarian equivalent every second day (no)	8.0%
Unmet need for healthcare	$UNMET$	Unmet need for medical treatment	6.1%
Environmental factors			
Home problems	$HOME$	Leaking roof, damp walls/floors/foundation or rot in window frames or floor	14.7%
Not warm	$COLD$	Not able to keep home adequately warm	7.6%
Dark dwelling	$DARK$	Too dark, not enough light	5.8%
Noise	$NOISE$	Noise from neighbours or from street	17.2%
Pollution	POL	Pollution, grime or other environmental problems	12.5%
Crime	$CRIME$	Crime, violence or vandalism in the area	11.7%
Welfare state model			
Model 1		DK, NL, NO	12.3%
Model 2		AT, BE, DE, FR, SE	23.7%
Model 3		UK, IE, EL, ES, PT, FI, IT	40.5%
Model 4		CZ, HU, PL, SK	23.4%

3.2.2. Multilevel logistic regression

Multilevel modelling is increasingly used in social sciences to account for the hierarchical structure of the data, where individuals are nested within groups and dependent variable can be explained by predictors on both the individual and the group level. It represents a special case of a mixed effects approach with both fixed and random effects allowed (Finch *et al*. 2014, 2014, Gelman and Hill 2006; Snijders 2011; West *et al*. 2014). In the following, we describe the multilevel logistic regression model[2] used in the subsequent analysis with a random intercept on the country level and individuals (Level 1) nested within countries (Level 2).

To begin with, the variance component model (also referred as intercept only model) was implemented in order to analyse the variance of health between individuals and countries. The equation is given by:

$$\text{Level 1: } y_{ij} = \beta_{0j} + \varepsilon_{ij}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + U_{0j}$$

where *ij* refers to *i*th individual in the *j*th cluster, γ_{00} is the fixed part or general intercept across countries, U_{0j} is the random coefficient or group specific effect varying across countries (group specific deviation from fixed effect with zero mean and variance τ^2) and ε_{ij} is the individual level residual (with zero mean and variance σ^2). Variance of the latter two can be interpreted as the population variance across countries τ^2, whereas the residual variance σ^2 represents the variance between individuals. The first justification for using multilevel models is usually based on the value of intraclass correlation, which is measuring the variation in the outcome variable that occurs between groups relative to total variation. The values of intraclass correlation imply that the share of total variation in the outcome associated with cluster assignment and τ^2 can be interpreted as the impact of the cluster on the dependent variable (Finch et al. 2014). Using the latent variable approach, the binary outcome variable is assumed to follow the standard logistic distribution with the (residual) variance $\pi^2/3$ (Snijders 2011). The variance of random coefficients U_{0j} amounts to 0.2772 (0.2768 using Penalised Quasi Likelihood technique). The proportion of the variance across countries in the total variance equals 8.43% which supports the introduction of multilevel model (see Table 2).

Table 2 / Variance component model – proportion of variation of poor health between individuals and countries

Level		Individual	Country
Variance	Gauss-Hermite Quadrature	3.2899	0.2772
	Quasi Penalised Likelihood	3.2899	0.2768
% of total variance		91.58%	8.42%

2 As expression for the likelihood of generalised mixed effects models cannot be evaluated exactly, Gauss-Hermite approximation was employed. This is more accurate than Penalised Quasi Likelihood (PQL) technique also used for estimating multilevel models and unlike it, it makes it possible to calculate the relative model comparison measures based on log-likelihood function.

The multilevel logistic regression model used in the subsequent analysis includes the same explanatory variables as in the binary logistic regression model. In the last stage, welfare state dummies as predictors at the group level are added. The final multilevel model with random intercept on the group level may be written as follows:

$$\text{Level 1: } y_{ij} = \beta_{0j} + \beta_1 X_{1ij} + \ldots + \beta_{n+1} X_{n+1ij} + \varepsilon_{ij}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \gamma_{01} Z_j + U_{0j}$$

where X_{ij} denotes explanatory variables on the individual level, Z_j represents the group level predictor (here welfare state model), γ_{01} is the fixed effect of group level variable and β_1 to β_{n+1} are the coefficients of individual level predictors.

To fully exploit the advantages of multilevel models, random slopes for explanatory variables and cross-level interactions can be considered. Problems with multilevel modelling may arise due to a non-random selection of groups and a small number of observations at the country level (N<25). The small number of countries makes it therefore impossible to consider random effects for all explanatory variables or cross-level interactions. Although we tried a number of additional cross-level interactions, a selection of specific effects is always disputable and thus we focus purely on the random country effects in the results section. For the above problems related to multilevel models in comparative country analysis, Möhring (2012) suggests the use of a fixed effects approach. Following this suggestion, our baseline estimation is a binary logistic regression with fixed effects, which is then compared to the generalised linear mixed-effects model.

4. Descriptive analysis

The following section provides some descriptive statistics on the health status of individuals conditional on a number of dependent variables. Proportions of individuals in categories of self-perceived health by age, education and income quartiles using equivalised annual disposable income are provided by Table 3 to Table 5. As expected, the percentage of individuals assessing their health as ‘bad’ or ‘very bad’ increases with higher age categories, lower education levels and higher income quartiles. The highest proportion can be found for respondents aged above 80, those without primary education and those within first income quartile. While this is nothing new, the magnitude of the differences is quite striking. While across all age groups, only 4.0% of the people with tertiary education report to be in bad or very bad health, this share makes up for 36.0% of the people without primary education and is still double as high with 8.3% for people with upper secondary education. And these differences are only partially explained by income differences resulting from differences in education levels. Here, the differences are much smaller with 14.7% and 14.1% of the people in the lower two quartiles reporting to be in bad health conditions compared to 11.1% and 6.4% in the higher quartiles.

Table 3 / Health status by age category

	Age category							
health	16-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
very good	55.1%	45.9%	33.3%	22.9%	13.7%	9.5%	5.6%	3.5%
good	39.3%	46.2%	52.8%	54.4%	47.6%	39.5%	28.2%	19.5%
fair	4.5%	6.4%	11.1%	17.5%	27.8%	36.2%	42.1%	40.6%
bad	0.9%	1.3%	2.3%	4.2%	9.1%	12.1%	18.8%	26.4%
very bad	0.2%	0.3%	0.5%	0.9%	1.9%	2.7%	5.3%	10.1%
Obs	13,283	40,029	46,170	54,211	53,535	47,049	33,468	16,935

Table 4 / Health status by education level

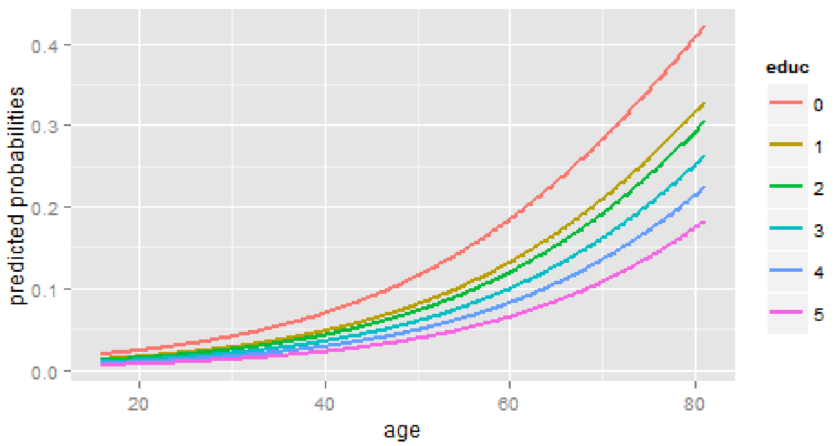
	Education level					
health	Pre-primary	Primary	Lower secondary	Upper secondary	Post-secondary	Tertiary education
very good	5.1%	8.0%	21.7%	23.1%	29.5%	30.6%
good	20.7%	32.2%	43.3%	46.6%	47.9%	50.4%
fair	38.2%	37.5%	23.8%	22.1%	17.2%	15.1%
bad	26.1%	17.4%	8.7%	6.8%	4.5%	3.3%
very bad	9.9%	4.9%	2.4%	1.5%	0.9%	0.7%
Obs	3,404	41,137	56,836	122,592	8,821	64,974

Table 5 / Health status by income (quartile boundaries calculated for each country)

	Income			
health	1. Quartile	2. Quartile	3. Quartile	4. Quartile
very good	14.8%	20.0%	25.0%	32.7%
good	35.6%	44.0%	49.4%	50.1%
fair	30.6%	25.6%	19.5%	13.7%
bad	14.9%	8.3%	4.9%	2.9%
very bad	4.1%	2.2%	1.2%	0.6%
Obs	106,638	106,633	106,636	106,631

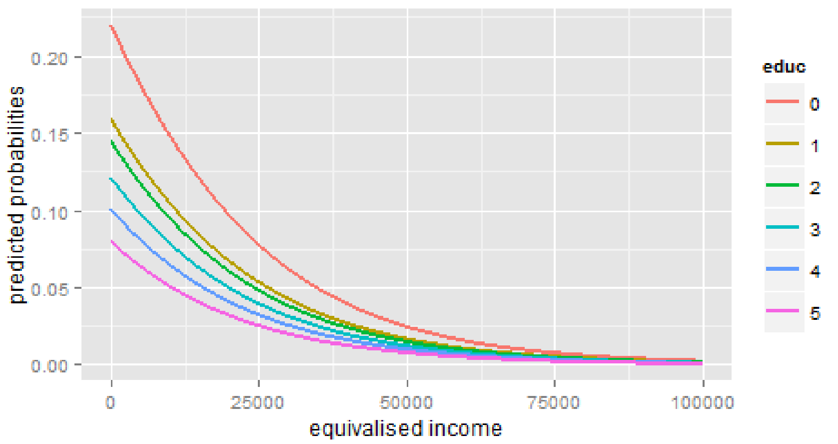
Thus, education seems to be a crucial determinant of the health status. Higher education level is associated with the relative lower probability of reporting poor health. Figure 7 shows the predicted probabilities of poor health status by education category for age levels when controlling for age and equivalised annual disposable income (keeping the income at mean for the prediction). The lowest level of education (no primary education) is associated with the highest probability of having poor health and the distance to next higher level is large. For the other ISCED levels, this difference is less pronounced. Of course, these differences are to some extent influenced by country characteristics, as wealthier countries with better health systems are usually characterised by higher levels of education. Figure 8 shows the differences in predicted probabilities of poor health between education categories for the levels of equivalised annual disposable income (after government redistribution) keeping the age at mean. While we used income levels in this descriptive analysis, we will focus on income quantiles in logistic regression as we then also control for country income level differences. The quartile boundaries are then calculated for each country.

Figure 7 / Predicted probabilities of poor health by education category age



Note: For description of education level categories see Table 1

Figure 8 / Predicted probabilities of poor health by education category equivalised income



Note: For description of education level categories see Table 1

Evidence for the differences between *welfare state models* can be obtained from Figure 9 and Figure 10, which are drawing the predicted probabilities of poor health explained by equivalised annual disposable income and age (keeping the age/income at their means, respectively) for the welfare state models separately. The fourth welfare state model containing Eastern European countries shows the highest probabilities of poor health compared to other models. The lowest probabilities of poor health were calculated in the first model including Denmark, Netherlands and Norway.

Figure 9 / Predicted probabilities of poor health by welfare state model age

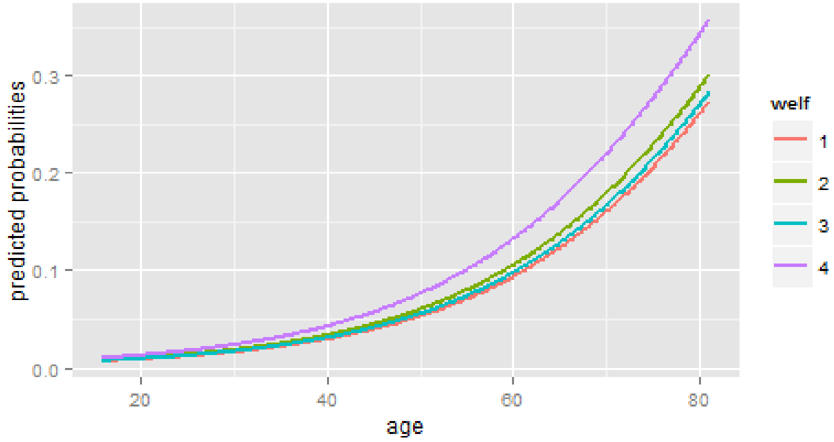
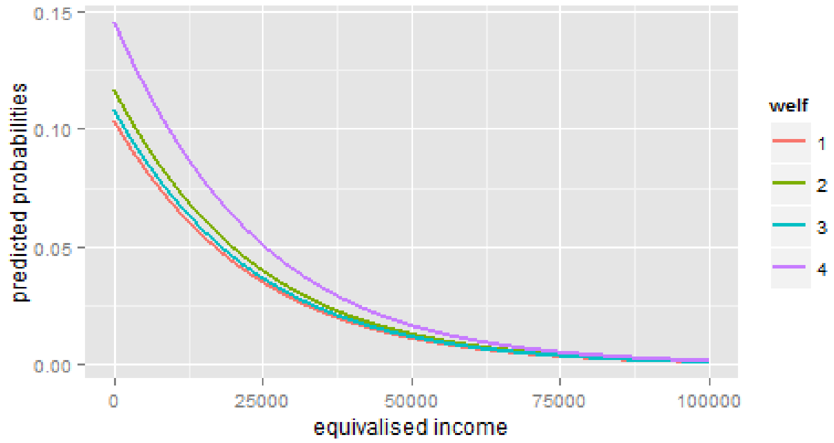


Figure 10 / Predicted probabilities of poor health by welfare state model equivalised income



5. Results

The results from the binary logistic regression can be taken from the Table 6. Coefficients were used to calculate odds ratios of poor health in order to enable straightforward interpretation. The odds ratios can be read as a factor by which the probability of poor health status is higher than for the reference group. The binary logistic model estimation is basically done in five stages. In the first stage *(1)* demographic variables and education levels, covering the pre-conditions of individuals, are included. In the second stage *(2)* relative poverty indicators and unmet need for healthcare are added. Third *(3)*, we test the significance of environmental factors. Income quartiles and employment status, as the most problematic predictors in terms of endogeneity, are included in the fourth stage *(4)*. In the last step (5) we replace country dummies with welfare state models dummies to investigate differences in the health status across welfare stage regimes[3].

In estimation *(1),* we have examined whether education level is related to self-perceived health, adjusting for age, sex, marital status and migration status. As expected, age is found to be the major determinant of health. When disregarding income effects, one can see that already people in their thirties are around 4 times more likely to be in a poor health condition than those aged 16 to 19. This increases for people in their forties and fifties to a factor of around 8 and 18, respectively and further thereon. The effects of education are highly significant and imply that higher education levels are related to lower odds of poor health. The chance of an individual with tertiary education to report poor health is assumed to be about half as high as the one of an individual without primary education. Women are found to have a slightly higher chance of exhibiting a poor health status than men, but this effect is explained by the employment status. Once the employment status is controlled for, women are actually found to be in a better average health condition than men with similar characteristics. Being married reduces the chances of being in a bad health condition by around 20%. Compared to singles, individuals being separated, widowed or divorced actually also exhibit slightly a better health status, once relative poverty indicators are taken into account. The migration status covariate is only slightly significant in the first model and becomes insignificant once relative poverty indicators are controlled for.

Relative poverty indicators and unmet need for medical treatment are added in estimation *(2).* The results reveal a positive linkage between relative poverty and untreated medical conditions on the one side and the poor health on the other. For the relative poverty indicators, the capacity to afford holidays once a year away from home appears to have the highest relation with poor health followed by ability to make ends meet. Somehow lower but very significant linkages are estimated for the capacity to afford meals with meat or a vegetarian equivalent at least once a week, the ability to face unexpected expenses or the ability to repay loans, respectively. In this group of indicators, the strongest effect on health is observed for individuals with an untreated medical condition who are more than double as likely to be in poor health.

3 LR $Chi^2 = 1278.1^{***}$ compared to model without welfare regimes fixed effects.

Table 6 / Regression results – odds ratios of poor health (95% CI)

	Dependent variable: Poor health status						
	logistic					*generalised linear mixed-effects*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age 20-29	2.008*** (1.813, 1.203)	1.796*** (1.598, 1.994)	1.761*** (1.563, 1.960)	3.537*** (3.284, 3.789)	3.856*** (3.603, 4.109)	3.853*** (3.600, 4.106)	3.856*** (3.603, 4.109)
Age 30-39	4.590*** (4.403, 4.777)	4.122*** (3.932, 4.312)	4.018*** (3.828, 4.208)	13.052*** (12.808, 13.297)	14.691*** (14.445, 14.936)	15.454*** (15.208, 15.699)	15.466*** (15.221, 15.712)
Age 40-49	8.442*** (8.258, 8.626)	8.025*** (7.838, 8.212)	7.820*** (7.633, 8.007)	27.107*** (26.866, 27.349)	31.318*** (31.076, 31.560)	32.933*** (32.690, 33.175)	32.968*** (32.725, 33.211)
Age 50-59	18.511*** (18.328, 18.693)	18.786*** (18.600, 18.971)	18.442*** (18.256, 18.628)	52.735*** (52.496, 52.974)	57.382*** (57.142, 57.621)	60.458*** (60.218, 60.698)	60.498*** (60.258, 60.738)
Age 60-69	23.961*** (23.778, 24.143)	28.690*** (28.504, 28.876)	28.354*** (28.168, 28.540)	39.639*** (39.400, 39.877)	42.313*** (42.074, 42.551)	44.013*** (43.774, 44.252)	44.036*** (43.797, 44.275)
Age 70-79	37.020*** (36.837, 37.203)	47.981*** (47.794, 48.167)	47.798*** (47.611, 47.984)	56.120*** (55.882, 56.359)	60.088*** (59.849, 60.327)	63.905*** (63.665, 64.145)	63.937*** (63.697, 64.177)
Age 80+	55.620*** (55.436, 55.805)	81.025*** (80.837, 81.214)	81.545*** (81.357, 81.734)	90.922*** (90.681, 91.162)	97.776*** (97.535, 98.017)	107.150*** (106.908, 107.392)	107.196*** (106.954, 107.438)
Educ: Primary	0.641*** (0.563, 0.719)	0.798*** (0.715, 0.880)	0.804*** (0.721, 0.886)	0.841*** (0.751, 0.932)	0.822*** (0.732, 0.913)	0.731*** (0.637, 0.826)	0.731*** (0.637, 0.825)
Educ: Low.Sec.	0.505*** (0.425, 0.585)	0.772*** (0.688, 0.856)	0.791*** (0.706, 0.876)	0.820*** (0.727, 0.914)	0.727*** (0.633, 0.821)	0.638*** (0.539, 0.738)	0.638*** (0.538, 0.737)
Educ: Secondary	0.407*** (0.328, 0.485)	0.663*** (0.580, 0.746)	0.690*** (0.606, 0.773)	0.714*** (0.621, 0.807)	0.555*** (0.461, 0.649)	0.496*** (0.397, 0.594)	0.495*** (0.396, 0.593)
Educ: Postsec	0.291*** (0.170, 0.412)	0.526*** (0.399, 0.653)	0.542*** (0.415, 0.669)	0.626*** (0.481, 0.771)	0.491*** (0.345, 0.637)	0.464*** (0.314, 0.613)	0.463*** (0.313, 0.612)
Educ: Tertiary	0.185*** (0.100, 0.271)	0.438*** (0.347, 0.530)	0.450*** (0.358, 0.541)	0.575*** (0.471, 0.679)	0.459*** (0.354, 0.565)	0.406*** (0.296, 0.516)	0.405*** (0.296, 0.515)
Married	0.752*** (0.708, 0.796)	0.803*** (0.757, 0.848)	0.827*** (0.781, 0.873)	0.820*** (0.767, 0.872)	0.796*** (0.743, 0.850)	0.774*** (0.720, 0.828)	0.774*** (0.720, 0.828)
Separated	1.081*** (1.032, 1.130)	0.916*** (0.865, 0.968)	0.935** (0.884, 0.987)	0.941** (0.884, 0.999)	0.893*** (0.835, 0.952)	0.873*** (0.815, 0.932)	0.873*** (0.814, 0.932)
Female	1.062*** (1.036, 1.089)	1.046*** (1.018, 1.073)	1.047*** (1.019, 1.075)	0.875*** (0.842, 0.908)	0.865*** (0.832, 0.898)	0.868*** (0.835, 0.901)	0.868*** (0.835, 0.901)
Immigrant	1.051* (0.996, 1.106)	1.031 (0.974, 1.088)	1.007 (0.949, 1.064)	0.987 (0.918, 1.056)	1.020 (0.949, 1.091)	1.046 (0.975, 1.118)	1.047 (0.975, 1.118)
Unmet		2.394*** (2.352, 2.436)	2.278*** (2.236, 2.320)	2.215*** (2.167, 2.263)	2.174*** (2.126, 2.222)	2.270*** (2.221, 2.319)	2.269*** (2.221, 2.318)
Unable make ends meet		1.601*** (1.565, 1.638)	1.563*** (1.527, 1.600)	1.438*** (1.394, 1.482)	1.452*** (1.408, 1.497)	1.467*** (1.421, 1.514)	1.467*** (1.421, 1.514)
Loan burden		1.106*** (1.060, 1.152)	1.071*** (1.025, 1.117)	1.155*** (1.101, 1.209)	1.165*** (1.110, 1.220)	1.194*** (1.139, 1.249)	1.194*** (1.138, 1.249)
Cover unexp. expenses		1.356*** (1.323, 1.389)	1.317*** (1.284, 1.351)	1.186*** (1.149, 1.224)	1.155*** (1.117, 1.193)	1.258*** (1.219, 1.297)	1.257*** (1.218, 1.296)
Holidays		1.888*** (1.853, 1.923)	1.851*** (1.816, 1.886)	1.710*** (1.669, 1.751)	1.715*** (1.673, 1.756)	1.646*** (1.604, 1.687)	1.646*** (1.604, 1.688)
Food		1.598*** (1.559, 1.637)	1.493*** (1.453, 1.534)	1.333*** (1.290, 1.376)	1.224*** (1.180, 1.268)	1.236*** (1.191, 1.281)	1.236*** (1.191, 1.280)

Home problems			1.249***	1.238***	1.262***	1.283***	1.283***
			(1.214, 1.284)	(1.199, 1.278)	(1.222, 1.302)	(1.242, 1.323)	(1.243, 1.324)
Not warm			1.169***	1.131***	1.228***	1.162***	1.163***
			(1.127, 1.211)	(1.086, 1.177)	(1.182, 1.274)	(1.115, 1.209)	(1.116, 1.210)
Too dark			1.156***	1.152***	1.155***	1.176***	1.176***
			(1.105, 1.206)	(1.095, 1.209)	(1.098, 1.213)	(1.118, 1.233)	(1.118, 1.234)
Noise			1.127***	1.164***	1.180***	1.160***	1.160***
			(1.090, 1.164)	(1.121, 1.207)	(1.137, 1.223)	(1.116, 1.203)	(1.116, 1.203)
Pollution			1.126***	1.137***	1.131***	1.101***	1.101***
			(1.085, 1.167)	(1.089, 1.184)	(1.083, 1.179)	(1.053, 1.150)	(1.053, 1.150)
Crime			1.140***	1.154***	1.169***	1.191***	1.191***
			(1.099, 1.181)	(1.106, 1.201)	(1.121, 1.217)	(1.143, 1.240)	(1.143, 1.240)
Income 2^{nd}				0.668***	0.906***	1.023	1.026
quartile				(0.633, 0.702)	(0.860, 0.952)	(0.976, 1.071)	(0.978, 1.073)
Income 3^{rd}				0.625***	0.880**	0.993	0.997
quartile				(0.528, 0.722)	(0.774, 0.986)	(0.885, 1.102)	(0.888, 1.106)
Income 4^{th}				0.541***	0.775***	0.898	0.901
quartile				(0.407, 0.676)	(0.634, 0.915)	(0.753, 1.042)	(0.757, 1.045)
Unemployed				1.947***	2.112***	2.142***	2.143***
				(1.872, 2.022)	(2.037, 2.188)	(2.066, 2.218)	(2.067, 2.219)
Inactive				5.215***	5.392***	5.704***	5.706***
				(5.162, 5.268)	(5.338, 5.445)	(5.650, 5.758)	(5.652, 5.760)
AT	0.895**	0.940	0.933	1.004			
BE	0.879***	0.951	0.948	1.058			
CZ	0.992	1.003	1.004	1.029			
DE	1.102**	1.099**	1.105**	1.136***			
DK	0.937	0.940	0.940	0.992			
EL	0.857***	0.905**	0.903**	0.929			
ES	1.117***	1.122***	1.127***	1.158***			
FI	1.043	1.065	1.060	1.100**			
FR	1.066	1.096**	1.095**	1.108**			
HU	1.033	1.040	1.040	1.069			
IE	0.938	1.078	1.077	1.132**			
IT	0.920**	1.004	1.002	1.029			
NL	1.089**	1.069	1.065	1.095*			
NO	0.839***	0.917*	0.909*	0.940			
PL	1.051	1.051	1.054	1.083*			
PT	1.028	1.076	1.077	1.035			
SE	0.929*	0.960	0.960	0.989			
SK	0.956	1.088*	1.086*	1.146**			
UK							
Welfare 1					0.651***		0.660
					(0.554, 0.749)		(0.063, 1.257)
Welfare 2					0.709***		0.578**
					(0.649, 0.770)		(0.057, 1.099)
Welfare 3					0.515***		0.440***
					(0.465, 0.564)		(-0.046, 0.926)
Constant	0.019***	0.004***	0.004***	0.001***	0.001***	0.001***	0.001***
	(-0.182, 0.220)	(-0.204, 0.213)	(-0.205, 0.213)	(-0.266, 0.268)	(-0.257, 0.260)	(-0.344, 0.346)	(-0.464, 0.467)
Observations	297,748	295,810	295,346	183,715	183,715	183,715	183,715
Log Likelihood	-82,248.420	-75,967.080	-75,522.900	-54,798.820	-54,453.820	-53,906.630	-53,902.240
Akaike I. Crit.	164,566.800	152,016.200	151,139.800	109,701.600	108,981.600	107,883.300	107,880.500
Bayesian I. Crit.						108,237.500	108,265.100

Note : *p<0.1; **p<0.05; ***p<0.01

All environmental characteristics were also positively associated with odds of poor health, although slightly less than relative poverty indicators as can be seen from estimation (3). Home problems such as leaking roof, damp walls/floors/foundation or rot in window frames or floor have the strongest effect, increasing the chances of being in poor health by 25%. The other environmental variables, like the ability to keep the home warm or noise, pollution and crime in the living area are also significant health determinants with the negative effects ranging between 13 and 17% in estimation (3).

If not indicated otherwise before, the previous results also hold when controlling for income quartiles and employment status, as show in estimation *(4)*. The changes in odds ratios after including income and employment status were highest for the age covariates and education levels. As we already control for poverty indicators, the differences in health between income quartiles are less distinctive. Individuals with annual disposable income in the fourth quartile compared to first income quartile register the lowest odds to perceive their health as ‘bad’ or ‘very bad’. Unemployed have more than two times higher chance to report poor health than employed respondents. The largest health differences are observed between employed as reference category and those who are inactive where the latter exhibit a 5 times higher probability to be of poor health status.

As the country level dummies do not show significant differences for all countries, the welfare state regime dummies were included to test the inequalities across welfare state regimes in the final model *(5).* This earns statistically significant coefficients for the health inequalities between welfare state models. The fourth model (Welfare 4) including Eastern European countries has been chosen as the base. All remaining models are associated with lower odds of poor health than Eastern Europe. The lowest odds of poor health are indicated for the third welfare state model (Welfare 3) comprising of both Liberal and Southern European countries and Finland. The finding that liberal countries are doing rather well in these analyses is nothing new, but likely originates from the fact that indicators of relative poverty and income levels are already taken into account. We observe that in estimation *(4)*, most countries exhibit odds ratios above one, indicating that the relative health status is worse than in the reference country UK. When only controlling for demographic characteristics and education in equation (1), the picture however changes with more countries showing values below one, indicating that people in these countries are in a better relative health condition than those in the UK.

The size of the welfare state effect is however quite surprising, showing that individuals living in Eastern European countries (Welfare 4) still are around double as likely to be of poor health than individuals living in countries included in the third country group (Welfare 3). The other two welfare state models show slightly higher average probabilities of poor health status compared to the third regime. The first welfare model (Welfare 1) including Denmark, Netherlands and Norway ranks second, and the group of Continental Europe and Sweden (Welfare 2) ranks third.

The results of the multilevel analysis are reported in columns (6) and (7) in Table 6. Overall, they show very similar results. The main difference is that after introducing random intercepts at the country level, the coefficients of income quartiles are no more statistically significant and the estimates are slightly higher, which can point to possible omitted variable bias on the country level. The model comparison between fixed effects (5) and multilevel models (7) using likelihood-ratio test is not possible, as different additive terms are used in calculation of likelihood functions. Even though the value of AIC[4] implies better fit of multilevel models, in light of difficulties discussed above we chose the model (5) with welfare state fixed effects as our final model.

4 Based on approximated log-likelihood for mixed models.

6. Conclusion

In this paper we identify social determinants of poor health when considering differences across countries and types of welfare states. First, several important social determinants of health are identified. Apart from age, inequality at the individual level is mostly determined by the education level, income and employment status as well as indicators of relative poverty. Environmental factors as well as other demographic characteristics such as migration or the marital status seem to matter less. In the model with country fixed effects, people with tertiary education are 42% less likely to be of poor health than those without primary education, controlling for all other factors. This may imply that not only the means to treat medical conditions matter, but also the awareness and knowledge of possible health problems. An effect similar in size can be found for income levels where individuals in the lowest income quartile exhibit around double the chance of being of a poor health status than those in the highest income quartile. Strikingly, the results show that unemployed and inactive persons are even two and five times more likely to be of bad health than those in the lowest income quartile.

Furthermore, the relative poverty measures including relative deprivation are highly associated with poor health status. Among them the capacity to afford holiday once a year away from home appears to have the highest relation with poor health followed by ability to make ends meet. The relationship can also be caused by the psychosocial conditions induced by relative poverty and deprivation, which affect the health status of individuals. A slightly lower association is estimated for availability of food, the ability to face unexpected expenses or the ability to repay loans. Unmet need for medical treatment regardless the reason increases the probability of poor health by a factor of two. The relationship between poor health and bad environmental conditions such as dwelling problems (rot, damp, dark, not warm), noise, pollution and safety status (crime) is less strong but still highly significant.

Second, the welfare state models play an important role in determining health inequalities across countries. The clustering criteria is based on the information about income distribution and health care expenditures since it is assumed, that these are determining some primary social determinants of health. The fourth welfare state model including Eastern Europe (Welfare 4 – CZ, SK, HU, PL) seems to have the worst general health situation, whereas the third cluster covering Liberal and South European countries as well as Finland (Welfare 3 – UK, IE, EL, ES, PT, IT, FI) is associated with the lowest odds of reporting poor health. The first (Welfare 1 – DK, NL, NO) and the second model (Welfare 2 – AT, BE, DE, FR, SE) follow with still significantly lower chance to having poor health.

The major shortcoming of the used approach is given by the limitations of the data. The relevant controls concerning individual or personal attributes, referring to genetics or behavioural habits (smoking, sport activity), are absent. Besides that, the information on working conditions as potential social determinant of health is missing. Given data availability, this would be an interesting path for future research in a cross-country setting. Another interesting aspect that would require a panel or longitudinal data would be the inclusion of indicators for employment conditions at the country level.

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