Later life somatic health in Europe: is country level variation amenable to change?

George B. Ploubidis[1] & Emily Grundy[1]

[1]Centre for Population Studies, Department of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, University of London

49/50 Bedford Square, London, WC1B 3DP UK

Abstract

National differences in health indices may be valuable in providing insights into macro level influences, including structural and policy influences, on health in later life. Our aim was to investigate the possibility for country level variation in later-life health in Europe, using a between country invariant population health metric as well as to test five explanatory theories of county level variation. We employed data from 13 European countries included in the second SHARE measurement wave (N = 32,421) and a latent health index derived by the combination of self reported and observe measured health indicators. We used gender, age, living arrangements and years of education as individual level predictors and as country level predictors we employed a categorical indicator of obesity, the GINI coefficient, GDP per capita, social trust and a binary regime typology. Twenty-one percent of the overall variation in later life health in Europe appears to be due to country level differences. The Scandinavian countries along with Germany, the Netherlands and Switzerland appear to have the best health, whereas Spain, Italy and Poland received the lowest health score. This country level variation is largely associated with differences in the level of egalitarianism of each country as measured by the GINI coefficient, with less inequality being associated with better somatic health. Furthermore differences in health related lifestyle as approximated by the prevalence of obesity in each country also have a substantive influence on later life somatic health, with healthier lifestyle (lower prevalence of obesity) being associated with good health. Our results indicate the presence of systematic macro level health variation in Europe and that policies to reduce income inequality and population interventions to promote healthier lifestyles in order to decrease the prevalence of obesity will have a substantive effect in improving population health, increase disability free life expectancy and therefore have the potential to offset the effects of ageing in Europe.

Introduction

The 20th century witnessed significant improvements in health in most countries including substantial increases in survival to older ages and large reductions in late age mortality. Considering the inevitable demographic ageing of European populations national differences in health indices may be valuable in providing insights into macro level determinants of health, including structural and policy influences on health in later life. [1] Further study might show which macro level factors are most influential and could identify those that could be modified through intervention. A recent study suggested that older people in continental Europe have superior health when compared to the USA and the UK [2] raising the question of whether policies in particular countries or other country specific characteristics which are amenable to change play a part in this. Country level health differences in Europe have been widely reported and the presence of country level variation is consistent despite the various health outcomes that have been used. [3] [4] [5] [6] Several explanations for this variation have been suggested, for example, it has been proposed that characteristics of the welfare states, such as social benefits and generally high social expenditure are related to better population health. [7] Another explanation concerns economic growth and development which are viewed as important predictors of population health. In accordance with this hypothesis GDP per capita has been consistently linked with population health [8] , with wealthier countries generally having better population health. Furthermore, income inequality which is prevalent, to varying degrees, in all European countries is thought to influence country level variation, with several studies reporting an association between the GINI coefficient and population health. [9] Consistent with the lifestyle explanation of health inequalities, differences in health related lifestyle have been found across Europe [10], and these may be contributing to health differences between countries. Finally, from a psychosocial perspective, social capital and its dimensions such as social trust and social participation have been suggested as important predictors of country level variation in health. [11]

A critical component of such comparative studies are valid, reliable, and comparable measures of health. Previous studies have often relied on self reported health indicators, [12] which are known to suffer from the influence of response bias, such as social desirability [13]. Evidence shows that, for example, there may be differences in the way which individuals of high and low socioeconomic position assess their health [14] as well as differences between national populations. [15] All cause mortality has also been employed in country level comparisons [16] but we believe that for European countries which are all past the epidemiologic transition [17] mortality is not a reliable indicator of population health and thus it may be misleading when used as a population health metric in country level comparisons. For example, an individual diagnosed with a chronic illness will be considered healthy by any mortality outcome, when in reality is not and continuous to contribute to the burden of disease. Furthermore, a common feature of previous country level comparisons is that they suffer from a major methodological limitation since with few exceptions [18] the issue of between country measurement invariance has not being addressed. Measurement invariance is a set of hypotheses stating that measurement model parameters function without bias across groups –countries in this case - or occasions [19].To engage in a meaningful country level comparison, the measurement invariance of the health indicators under study needs to be considered due to the possible influence of country specific biases on measurement. Considering that most country level comparisons in Europe have focused on the general population, the aim of the present study is to investigate the importance of country level variation in later-life health, as well as to empirically compare five explanatory hypotheses for this variation.

Method

Sample

The Survey of Health Ageing and Retirement in Europe (SHARE) is a multidisciplinary cross-national survey including data on the health, socio-economic status and social and family networks of individuals aged 50 or over. Here we employ data from 13 European countries included in the SHARE second wave (we excluded Ireland from the analysis, since sampling weights were not available at the time of the analysis). The countries included are drawn from Northern (Denmark and Sweden), Western (Austria, France, Germany Belgium, and the Netherlands), Mediterranean (Spain, Italy and Greece) and Eastern (Poland and the Czech republic) regions of Europe. Full details of the SHARE sampling methodology have been reported elsewhere [20]. Our analytic sample comprised 32,421 respondents and included participants with partially missing data.

INSERT TABLE 1 ABOUT HERE

Measures

We employed a latent variable modelling approach that allowed us to combine information from self reported and observer measured health indicators under the assumption that they are manifestations of latent (not directly observed) "true" health status, as reflected in their shared (common) variance. [21] Population health is thus viewed as a variable whose true values cannot be directly observed [22]. Two observer measured (grip strength and a measure of respiratory function) and six self reported health indicators (self-assessed general health, presence of long standing illness, the presence of one or more functional limitations, the presence of one or more problems with activities of daily living, the presence of one or more symptoms and the presence of one or more mobility problems), were combined with the latent health dimension representing in this case somatic/physical health, since mental health indicators were not included in the model. All indicators were recoded so high values on the latent dimension represent good somatic health. In the second stage of the analysis we estimated a multilevel model in an attempt to account for country level variation in somatic health, we used gender, age, living arrangements, net household income and years of education as individual level predictors (see Table 1 for descriptive statistics of all health and individual level predictors). As country level predictors (see Table 2) we employed a categorical indicator of obesity (BMI>29.99) aggregated by country as a proxy measure of healthy lifestyle, the GINI coefficient as a measure of income inequality and logged GDP per capita (adjusted for purchasing power standards) as a measure of economic development. Information on the 2007 values of GDP per capita was derived from Eurostat, whereas the GINI values (after taxes and transfers) for mid 2000's were taken from OECD tables. We employed a binary indicator of whether a country is a social democracy, with Sweden, Denmark and the Netherlands classified as social democracies, a classification in accordance with previously published regime typologies [23]. Finally an aggregated by country indicator of social trust was employed as a measure of social capital ("would you say that most people can be trusted"?). Responses on the social trust item ranged from 0 to 10, with high scores indicating that people can be trusted. We decided to employ aggregate social trust as an indicator of country level social capital, since it can be argued other indicators such as the availability of social contacts, social network resources and interactions are endogenous to health.

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Statistical modelling

The measurement model for health and the tests for invariance are based on a latent variable model appropriate for the combination of binary ordinal and continuous indicators. The part of the model where ordinal or binary indicators are linked with the continuous latent variables is a normal ogive item response model, similar to the graded responses model [24]. The latent variables represent continuous variables that underlie observed "coarsened" responses such as binary or ordinal responses. The associations between latent health and the health indicators are modelled with a 2 parameter probit regression. In this instance, factor loadings represent the strength of the association between the indicator and latent health, whereas the thresholds represent the level of latent health that needs to be reached for a particular response in a categorical or ordinal health indicator to be endorsed. The part of the model where continuous health indicators are linked with continuous latent factors is a traditional confirmatory factor analytic model with linear regressions between observed and latent variables. In this instance intercepts and factor loadings are estimated, and as in the binary/ordinal case they capture the association between the health indicators and latent health. Factorial invariance is achieved when measurement parameters (thresholds, factor loadings and their associated standard errors for binary or ordinal indicators, factor loadings, intercepts and standard errors for continuous indicators) function equivalently in each group of a multigroup confirmatory factor analytic model [25]. The between country invariant latent variable measurement model was estimated with the Weighted Least Squares, Mean and Variance adjusted (WLSMV) estimator which is appropriate for multiple group analysis and invariance tests. We re-estimated the measurement model fixing the model parameters (thresholds, loadings and intercepts) to the values obtained by the between country invariant model with the robust maximum likelihood estimator using missing data and auxiliary variables (missing data correlates) to reduce the uncertainty caused by the missing data as well as reduce or eliminate parameter estimate biases that are due to the missing data when the missing data is not missing at random. Factor scores that represent individual later life health were derived from this model and used in further analyses. Model fit was assessed with the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA) following the recommendations of Yu (2002) on their interpretation, as well as though difference tests between nested models. In the second stage of the analysis we estimated a random effects (random intercepts only, since the slope variation was negligible) model using the between countries equivalent (invariant) latent health outcome derived from the first stage of the analysis. We employed the robust maximum likelihood estimator (MLR) with Gauss – Hermite numerical integration. All models were estimated with the Mplus 5.21 software [26].

INSERT GRAPH 1 ABOUT HERE

Results

The strict measurement invariance model which implies that all parameters of the measurement model that was used to derive the somatic health population health metric are equal between countries was established, CFI =0.97, TLI = 0.96, RMSEA = 0.058. In Graph 1 we present the crude (not adjusted) latent health means for all countries within SHARE. Sweden, Denmark, Germany the Netherlands and Switzerland were the countries with the highest latent health score, whereas Spain, Poland and Italy are the countries with the lowest health score. A fixed effects one way analysis of variance revealed that the observed between- countries differences were significant, $F(12, 32061) = 576.08$, $p<0.001$. In Table 2 we present the standardised coefficients derived from the random effects (multilevel) model. The estimated intraclass correlation from a null random effects model (the random effects equivalent to the fixed effects ANOVA) was 0.21, indicating that country of residence accounts for 21% of the overall health variance. In Table 3 we present the standardised parameters and associated errors derived by the multilevel model. As expected women had worse health compared to men $\beta = -0.381$, $p<0.001$, age had a negative association with health, $\beta = -0.416$, $p<0.001$ and years of education were positively associated with health, $\beta = 0.129$, $p<0.001$, as was net household income $\beta = 0.086$, $p<0.001$ and living with a spouse or partner $\beta = 0.033$, $p<0.001$. On the country level, obesity had a negative association with health, $\beta = -0.355$, $p<0.05$ as did the GINI coefficient, $\beta = -0.517$, $p<0.001$. The regime typology was not associated with later life health, $\beta = 0.034$, $p>0.05$. Similarly, we did not observe a significant association between health and GDP per capita, $\beta = 0.226$, $p>0.05$ neither with health and social trust, $\beta = 0.017$, $p>0.05$.

INSERT TABLE 3 ABOUT HERE

Discussion

The majority of studies on international differences in health within Europe have focused on the general population and consistently report between countries differences. [7] [4] Considering the demographic ageing of European populations, the aim of the present study was to investigate the extent and pattern of country level variation in later life health, as well as to empirically compare five explanatory hypotheses for this variation. Our results indicate that despite the improvements in population health in Europe in the last four decades twenty-one percent of the overall variation in later life health is due to country level differences. The Scandinavian countries along with Germany, the Netherlands and Switzerland appear to have the most optimal health, whereas Spain, Italy and Poland received the lowest later-life health score.

We found that income inequality is the strongest predictor of country level variation, followed by the prevalence of obesity. The finding that country level variation in health is largely associated with differences in the level of egalitarianism of each country as measured by the GINI coefficient, with less inequality being associated with better health is in accordance with previous findings. [9, 27] Our results therefore highlight the importance of within country structural changes in income distribution which are likely to reduce country level differences and therefore succeed in improving population health. GDP per capita was not strongly associated with later-life health, although the direction was on the expected direction. This finding is in line with previous reports on the association between GDP and health, which on a global level is not linear suggesting a diminishing marginal effect. [28] The implication of this is that within the relatively homogeneous with respect to GDP per capita Europe, countries enjoy a similar level of economic development which provides an adequate basis for organization of living conditions, thus rendering the relatively small differences in GDP per capita within Europe non influential on population health. Furthermore, due to the similar living conditions, the experience of having low income is relatively similar in all European countries. It appears that in Europe the relatively similar level of economic development as reflected in the observed homogeneity in GDP implies that the more unequal distribution of income within a country leads to a larger proportion of older individuals with incomes less that the minimum required for healthy living [29-30], which in turn produces a decrease in the country's average health.

We found that the prevalence of obesity was a strong predictor of country level variation in later life health, with as expected lower prevalence of obesity being associated with good health. This finding is in accordance with differences in health related lifestyle in Europe that have been previously reported. [10] Lifestyle effects are well-established at the individual level, smoking, excessive alcohol use, and obesity being strongly associated with morbidity and mortality. [31] However, external constraints dominate choices, making this not only an individual choice, but also a country level one, since different policies on the availability of high-quality foods may have an impact on the prevalence of obesity. [32] It appears therefore that improving the health related lifestyle – and therefore decreasing the prevalence of obesity – will reduce country level variation and improve population later life health in Europe, largely by postponing the onset of obesity related chronic diseases and disability.

We did not observe an association between social trust and country level variation in later life health, a finding in agreement with previous studies. [33] [4] Although it has been suggested elsewhere that income inequality leads to more violence, less social cohesion and lower levels of social trust, thus having a negative effect on population health [9], it appears that at least for the older population in Europe the mechanism through which income inequality influences health is not related to social capital, but perhaps is expressed by constraining the proportion of individuals with adequate income for healthy living [29-30]. Considering that differences in social capital have been reported in Europe [34] [35], an explanation for the lack of association between social trust and health may be due to the relatively high level of social trust and social cohesion that European countries enjoy, rendering the differences in social capital irrelevant to population health, or perhaps that other than social trust dimensions of social capital may be more influential to health.

In agreement with previous studies, the direct effect of the regime typology on health was negligible. Since the social democracies in our sample were the countries with the most optimal health, and the unadjusted regression parameter which captures the association between type of regime and health was significant, we concluded that Social Democratic countries exhibit better population health status, but this effect is largely due to more equal distribution of income and lower prevalence of obesity. This was confirmed by an additional model where the GINI coefficient and the prevalence of obesity were modelled as mediators of the association between regime type and health. Both indirect effects were significant, suggesting that in social democratic regimes policies such as strong employment and wage protection, coupled with high unemployment benefits, adequate and early take-up of social retirement, lead to more equal income distribution and thus to better health. [36]

Strengths of this study include the use of a population health metric derived by the combination of observer measured and self reported health indicators, as well as the establishment of its between country measurement equivalence. The properties of the derived population health metric imply that random as well as systematic measurement error, such as between country differences in responding to self reported health indicators as well as differences in the instrumentation related to the observer measured indicators were statistically controlled. As in any study, there are some limitations that should be considered while interpreting our results. Our analysis was carried out using partially incomplete data. Missing data mostly occurred in the observer measured health indicators. We estimated several models for sensitivity purposes excluding the observer measured health indicators from the analysis thus increasing the proportion of complete cases in the analysis sample, as well as models with complete data (results available from corresponding author). The results of these models were similar with the one we present here, suggesting that the inclusion of missing data in our analysis did not bias our results. Another limitation which is present in all country level analyses in Europe is the relatively small number of level 2 units (countries) in the multilevel model. Several analytic strategies have been adopted to tackle this issue. In order to further validate our results we re-estimated the multilevel model using Bayesian estimation (with diffuse/non informative priors employing the MCMC algorithm based on the Gibbs sampler as implemented in Mplus 6) which is not dependent on sample size. We also estimated a random effects model but with the country level predictors included on the fixed part of the model as well as a full fixed effects only model. The results of all these alternative analytic strategies were similar to the ones presented here, indicating that the relatively small number of level two units did not bias our results. Furthermore, despite the fact that 71% of country level variation was accounted by the predictors in our model, there was still unexplained variance, even though indicators for all existing explanatory theories of between countries health differences were included in our model. This could be partly due to measurement error in the existing indicators or the exclusion of important indicators of the existing theories, such as other than social trust dimensions of social capital, or is perhaps an indication that further explanatory theories are needed to fully capture country level variation in later life health. Despite this, in this study we present evidence of systematic macro level variation in later life health in Europe that is amenable to change. Our results indicate that policies to reduce income inequality and population interventions to promote healthier lifestyles in order to decrease the prevalence of obesity will have a substantive effect in improving population health, increase disability free life expectancy and therefore have the potential to offset the effects of ageing in Europe.

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Table 1. Descriptive statistics of individual level variables

Gender	***f***	***%***	**Living arrangements**	***f***	***%***
Male	14661	45.2	Living with spouse/partner	24175	74.6
Female	17760	54.8	Living alone	8241	25.3
Total	32421	100	Missing	5	0.01
			Total	32421	100
	N	*Mean*	*Std. Deviation*		
Age	32421	65.4556	10.044		
Years of Education	32213	9.93	4.548		

Limitations with activities -gali	*f*	*%*	**Chronic illness**	*f*	*%*
Not limited	18178	56.1	Less than 2 diseases	17916	55.3
Limited	14140	43.6	2+ chronic diseases	14373	44.3
Missing	103	0.3	Missing	132	0.4
Total	32421	100	Total	32421	100
Symptoms	*f*	*%*	**Mobility**	*f*	*%*
Less than 2 symptoms	18324	56.5	No problems	16637	51.3
2+ symptoms	13986	43.1	1+ mobility problems	15671	48.3
Missing	111	0.3	Missing	113	0.3
Total	32421	100	Total	32421	100
Self rated health	*f*	*%*	**ADL limitations**	*f*	*%*
Excellent	2778	8.6	No adl limitations	28904	89.2
Very good	5912	18.2	1+ adl limitations	3399	10.5
Good	12038	37.1	Missing	118	0.4
Fair	8086	24.9	Total	32421	100
Poor	3494	10.8	**IADL limitations**	*f*	*%*
Missing	113	0.3	No limitations	26833	82.8
Total	32421	100	1+ iadl limitations	5470	16.9
			Missing	118	0.4
			Total	32421	100
	N	Mean	Std. Deviation		
Grip strength	29626	34.61	12.001		
Peak flow	28829	336.0797	160.13296		

Table 2. Distribution of country level variables

	Obesity	Social trust	GINI	GDP per capita
Austria	24%	5.62	0.27	123.00
Germany	18%	5.38	0.30	115.80
Sweden	16%	6.55	0.23	122.80
Netherlands	15%	6.32	0.27	132.20
Spain	25%	5.60	0.32	105.00
Italy	19%	4.71	0.35	103.50
France	16%	4.57	0.28	108.50
Denmark	15%	7.34	0.23	121.20
Greece	21%	4.70	0.32	92.80
Switzerland	13%	6.49	0.28	140.80
Belgium	19%	5.25	0.27	115.70
Czechia	25%	5.76	0.27	80.10
Poland	26%	5.14	0.37	54.40

Table 3. Standardised multilevel model parameters and associated errors in parenthesis

Individual level		*Country level*	
	Health		**Health**
Gender (Women)	-0.381 (0.006)*	**Obesity**	-0.355 (0.111)*
Age	-0.416 (0.008)*	**Social trust**	0.017 (0.272)
Years of Education	0.129 (0.011)*	**Regime**	0.034 (0.226)
Income	0.086 (0.010)*	**GINI**	-0.517 (0.146)*
Living Arrangements (with spouse/partner)	0.033 (0.010)*	**GDP per capita**	0.226 (0.259)

*p<0.001

Graph 1: Crude/unadjusted country level means