The economic benefits of reducing health inequalities in 11 European countries

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Abstract

In recent years there has been growing interest in studying the socio-economic inequalities in health and the economic benefits of reducing these inequalities. In this paper we use longitudinal data from SHARE survey to estimate the age and sex specific mortality rates by socioeconomic status (SES) for 11 European countries with the aim of studying the benefits of reducing mortality in the most disadvantaged classes.

We start with the accurate description of existing inequalities by estimating the influence of the household total net worth (used as a proxy of SES) on mortality between waves using Cox survival regression models. In a second step, we construct life tables for each combination of country, sex and SES, and we estimated the number of actual deaths in the population. Then, some "inequality reduction" scenarios are depicted by reducing the SES gradient for each country and providing an estimate of the hypothetical saved life-years. The saved life years are then valued in monetary terms to obtain estimates of the expected economic benefits resulting from reducing health inequalities.

Our results suggest that the economic benefits to be had if only the health inequalities scenarios could be realised are very sizeable. Even the least ambitious scenario would provide a monetised benefits to countries ranging from €0.643 (0.3% of GDP) billions in Denmark to €60.026 billions in Italy (4.3% of GDP).

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1. Introduction

In recent years there has been growing interest in studying the socio-economic inequalities in health in many European countries (Mackenbach et al., 2007). Reducing these health inequalities has become an important policy objective. It is widely accepted that socioeconomic inequalities in health are an unfair feature of Western societies, as health is good that all citizens – regardless of their socioeconomic status – should equally get access to. However, on the top of the "social justice" argument, an "economic" one can be added to justify the reduction of health inequalities.

There are some studies estimating the economic benefits of reducing health inequalities (or the cost of not doing so). Mackenbach et al. (2007) pursued two different approaches in measuring economic costs of health inequalities in one year, 2004: for the EU-25 as a whole the estimates of inequalities-related losses to health as a 'capital good' (leading to less labour productivity) seem to be modest in relative terms (1.4% of GDP) but large in absolute terms (€141 billion). They also valued health as a 'consumption good', which involves the application of the value of a statistical life (VSL) concept. From this more comprehensive perspective the economic impact of socioeconomic inequalities in health may well be large: in the order of about €1,000 billion, or 9.5% of GDP.[1]

Dow and Schoeni (2008) apply the VSL approach to the US. They also find a large potential benefit of improving the health of disadvantaged Americans: raising the health of all Americans to that of college educated Americans would result in annual gains of just over 1 trillion dollars worth of increased health as of 2006.

The same approach has been used by the Marmot Review (2010) for the UK and it has been estimated that if everyone in England had the same death rates as the most advantaged, a total of between 1.3 and 2.5 million extra years of life would be enjoyed by those dying prematurely each year as a result of health inequalities. The economic benefits would total between about £98-118 billions.

In this paper we seek to provide similar estimates for other European countries, derived from survey data. In particular, we will use data from SHARE (Survey of Health, Ageing and Retirement in Europe) surveys. SHARE provides us with longitudinal information on people aged over-50. We therefore estimate the age and sex specific mortality rates by socioeconomic status for all the available country and estimate the benefits of reducing mortality in the most disadvantaged classes.

[1] Mackenbach et al. (2007) also separately estimate the impacts on costs of social security and health care systems and health care. Inequalities-related losses to health account for 15% of the costs of social security systems, and for 20% of the costs of health care systems in the European Union as a whole.

2. DATA AND METHODS

2.1 Data

Data from the Survey of Health, Ageing and Retirement in Europe (SHARE) are used. The survey is a panel database providing information on health and socio-economic status of non-institutionalized adults aged 50 or over[2] representing the various European regions (Börsch-Supan et al., 2005). In this way comparable information across countries are available. In particular, in the 2004 SHARE baseline study representative samples were obtained for ten countries which are the focus of our paper[3]: Denmark and Sweden (representing Scandinavian countries), Austria, Belgium, France, Germany, Netherlands (representing the Central Europe), Greece, Italy, and Spain (for the Mediterranean area). The second wave of data collection was conducted in 2006-2007 and the third one in 2008-2009.

We used information on the socio-economic status (SES) of individuals in the first wave and we considered whether the same individuals are alive in the following waves. For dead individuals the date of death is available so that we can consider the socio-economic status as a determinant of individuals' survival.

SHARE allows us to use different indicators of socioeconomic status.

Following the definition used by other researches (see Avendano et al., 2009), the first indicator that we consider is the household total net worth. Following Avendano et al. (2009) this is "the sum of all financial (net stock value, mutual funds, bonds, and savings) and housing wealth (value of primary residence net of mortgage, other real estate value, own business share, and owned cars) minus liabilities". Missing items were imputed using the methodology of multiple imputation (see SHARE Release Guide 2.5.0 waves 1& 2, Mannheim Research Institute for the Economics of Aging, 2011). The differences in the number of household members are accounted for by dividing wealth by the square root of household size (Buhmann et al., 1998; Huisman et al 2003; Avendano et al., 2009). In the following analyses, we collapsed wealth into country-specific quintiles.

The second indicator of socio-economic status is education. In the survey it is measured using the ISCED (International Standard Classification of Education) coding; then we grouped the different levels into three categories: low corresponding to the ISCED-codes from 0 to 2 (lower secondary

[2] The focus only on population aged 50 or over is not a limitation since most of mortality is concentrated on ages over 50. In fact, a limitation may be the fact that only non-institutionalized individuals are considered and clearly the most healthy: as a consequence the mortality may be underestimated.

[3] Further data were collected in Israel in 2005-2006 and from the second wave (in 2006-2007) also Poland and the Czech Republic joined SHARE. These three countries are not used in this paper.

school or lower), medium corresponding to the ISCED-code 3 (upper secondary school), and high including ISCED-codes from 4 to 6 (postsecondary).

2.2 Methods

Our analysis of health inequalities and potential scenarios of their reductions consisted of four steps. First, we start with the accurate description of existing inequalities. In particular, we estimate the influence of SES on mortality by mean of Cox survival regression models. Net of age and sex, they estimate the effects of SES on the risk of death considering the first wave as a starting time.
In a second step, from the results of the regression models we construct life tables for each combination of country, sex and SES status. Predicted values of mortality rates have been obtained by the estimated models and from these predicted values we constructed the life tables. From the life tables we take five-years age-specific mortality rates by SES and referring to the population by gender, SES and countries (obtained from weighted survey samples), we estimated the number of real deaths in the population.
Then, considering separately men and women, some "inequality reduction" scenarios will be depicted by reducing the SES gradient for each country and providing an estimate of the saved life-years (clearly, all scenarios are hypothetical).
Finally, in the next step if this work, for each country and for each scenario, an estimate of the monetary expected benefits resulting from inequality reduction will be provided, based on available estimates and/or assumptions of the value of a statistical life in each country.
In each step, the two measures of SES (the household total net worth and education) will be used alternatively so that we will have two sets of results of "health inequality reduction-scenarios" for each sex and for each country.

3. EMPIRICAL ANALYSIS

3.1 Inequalities based on wealth as a SES proxy

Table 1 describes the existing inequalities for men and women of the different countries considering as a synthetic measure of mortality the life expectancy at the age of 50. These life expectancies have been calculated basing on country-specific Cox regression models in which the covariates used are sex, age, and wealth (as a continuous variable). It should be noted that these life expectancies are constantly higher than those reported by official statistics. For example, France life expectancy at 50 reported by the national institute of statistics (INSEE) is 29.09 for men and 34.96 for women, while life expectancies at 50 reported in table 2 are all higher than these values. This discrepancy is certainly due to the fact that individuals in institutions (included hospitals) are not included in the SHARE sample. Moreover, it is likely that individuals living at home but with severe health conditions have not participated in the survey. Therefore, we should expect that individuals of the SHARE sample have a better health – and, consequently a higher life expectancy – than the whole population. We should keep this in mind when commenting the results of our computations.

Table 1. ***Estimated life expectancy at 50 by wealth quintiles, sex and countries.***

	MEN				
	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
AUSTRIA	34.262	34.328	34.562	35.018	36.095
BELGIUM	35.449	35.644	35.801	36.104	37.564
DENMARK	32.900	32.972	33.045	33.196	34.318
FRANCE	32.988	33.198	33.370	33.718	35.913
GERMANY	33.916	33.912	33.882	33.814	33.562
GREECE	36.977	37.614	38.209	39.047	42.646
ITALY	27.568	28.182	28.940	30.014	36.478
NETHERLANDS	32.024	32.360	33.312	34.446	40.175
SPAIN	30.182	30.235	30.301	30.328	30.885
SWEDEN	33.152	33.585	34.047	34.584	37.827
	WOMEN				
	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
AUSTRIA	37.318	37.404	37.639	38.027	39.067
BELGIUM	41.880	42.100	42.178	42.318	43.428
DENMARK	35.867	36.000	36.116	36.314	37.271
FRANCE	38.122	38.293	38.524	38.784	40.643
GERMANY	38.729	38.681	38.629	38.519	38.299
GREECE	39.121	39.791	40.315	41.066	44.219
ITALY	32.825	33.500	34.173	35.250	41.018
NETHERLANDS	36.711	37.025	37.917	38.950	43.884
SPAIN	34.302	34.332	34.365	34.386	34.924
SWEDEN	37.919	38.267	38.667	39.257	42.101

The estimated life expectancies at 50 by wealth quintiles reveal a varying level of inequality in each country. In Greece, for example the life expectancy of men aged over 50 belonging to the 1st wealth quintile (i.e. the poorest group) is about 6 years below that of men belonging to the 5th wealth quintile (i.e. the richest). In Netherlands and Italy the difference between the poorest group and the richest group life expectancies is even larger (8 and 9 years, respectively) whereas in other countries (e.g. Belgium) the difference across the wealth quintiles is smaller. Germany is a special case where we find basically no difference between people belonging to different wealth groups: the poorest turn out to have higher life expectancy than the richer, but these differences are not statistically significant.

3.2 Health inequalities reduction scenarios based on wealth as a SES proxy

We use age-specific mortality rates referring to 5-year age groups (50-54, 55-59, …85+) by wealth quintiles obtained from Cox regression models and we multiply these mortality rates by the population at risk by wealth quintiles. In this way, we obtain an estimated number of deaths, by age groups and wealth quintiles for each country.

Subsequently, we simulate the number of life-years that would be gained if people of lower SES experienced the lower mortality rates of those of higher SES.

In particular, we considered four different scenarios:

1. mortality rates of the 1st wealth quintile group decrease to those of the 2nd;
2. mortality rates of the 1st and 2nd wealth quintile group decrease to those of the 3rd;
3. the social gradient about the level of the 3rd quintile, but only 50% of the way to becoming a horizontal line. In practice, this is achieved by halving the coefficients of the Cox regression models. Moreover, the general level of survival has been increased so that the life expectancy of the richest group remains unaltered and life expectancies of all the other groups increase.
4. Mortality rates of all quintile groups decrease to those of the 5th.

These four scenarios are increasingly ambitious order: the first one provides the mildest reduction of health inequality while the fourth one completely remove any form of inequality. The idea of the third scenario is to half the wealth gradient but none of the wealth groups is expected to undergo a rise in mortality rates. Here we assume that survival of the poorest groups will increase more than that of the richest ones.

All scenarios certainly provide a reduction of the number of expected deaths (with the exception of Germany, which has a slightly negative gradient).

By comparing the number of deaths simulated in the different scenarios to the number of deaths in the initial situation (Table 2), we can derive the number of deaths saved in each scenario.

These estimates are reported in Table 3.

Table 2. ***Estimated number of deaths by wealth quintiles, sex and countries.***

	MEN				
	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile

AUSTRIA	16,261	16,437	12,301	14,739	12,918
BELGIUM	21,398	17,385	17,120	14,429	13,616
DENMARK	12,856	12,257	12,813	10,701	8,723
FRANCE	130,159	127,469	134,432	117,378	102,715
GERMANY	182,185	139,273	150,793	147,924	158,200
GREECE	20,768	19,146	17,313	14,660	5,793
ITALY	285,810	199,164	155,749	199,584	116,501
NETHERLANDS	52,850	31,837	18,656	19,555	12,959
SPAIN	128,295	124,049	137,044	114,136	99,434
SWEDEN	25,859	26,174	22,035	20,715	11,372
			WOMEN		
	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
AUSTRIA	36,145	17,215	16,942	16,902	12,392
BELGIUM	27,232	18,827	11,562	16,972	12,776
DENMARK	24,020	17,952	13,363	9,747	9,975
FRANCE	258,362	140,854	122,433	98,716	99,135
GERMANY	513,320	195,390	102,066	104,860	91,040
GREECE	31,790	20,766	15,046	13,084	4,621
ITALY	401,997	200,558	166,886	177,893	99,478
NETHERLANDS	76,392	45,502	14,822	25,062	7,479
SPAIN	156,241	116,257	127,894	128,352	146,950
SWEDEN	51,833	26,916	18,428	17,660	7,171

Table 3. ***Estimated number of individual whose lives would be saved under alternative scenarios by sex and countries*.**

	MEN			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	77	597	3,758	7,277
BELGIUM	337	797	5,675	10,843
DENMARK	83	233	2,708	5,047
FRANCE	2,299	6,620	56,252	107,506
GERMANY	-85	-1,041	-9,828	-21,745
GREECE	1,113	3,271	15,175	26,371
ITALY	13,760	43,094	247,936	423,693
NETHERLANDS	1,451	8,308	38,938	63,808
SPAIN	529	1,593	13,447	24,839
SWEDEN	927	2,915	16,169	28,998
	WOMEN			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	294	1,141	4,988	9,772
BELGIUM	503	791	4,660	8,275
DENMARK	236	566	2,783	5,554
FRANCE	2,333	9,710	53,524	104,395
GERMANY	-1,218	-4,535	-16,221,	-32,136
GREECE	1,737	3,992	16,108	27,590
ITALY	18,183	47,217	245,483	412,787
NETHERLANDS	1,887	9,997	40,902	67,345
SPAIN	290	992	12,220	23,816
SWEDEN	1,369	3,551	16,202	28,971

* a negative number indicates that the number of deaths under that scenario is higher than that observed in real data.

Generally speaking, among these four scenarios, the fourth one provides - not surprisingly - the highest reduction of deaths and the first the lowest one. In the fourth scenario all the quintile groups share the same morality level (i.e. the same life expectancy). Table C in appendix shows the gain in terms of life expectancies at 50 provided by these four scenarios.

We then have to take into account the fact that those individuals whose lives would be saved in 2004 would be expected to live many more years beyond 2004, on average. To do so, we consider the life expectancies by 5-years age groups for each of the SES classes. The total number of life years saved with improved mortality is equal to the number of lives saved in 2004 multiplied by remaining life expectancy, for each age group and SES class. In this way we assume that the health benefits are instantaneous. The latter sounds as a bit unrealistic assumption but since life expectancies are estimated in a cross-sectional perspective and not in a longitudinal one (we would need to observe the total extinction of our sample in order to have a longitudinal estimate of life expectancies) we are forced to make it. In this way, true life expectancies are under-estimated, so that our estimates of the economic benefits of reducing health inequalities are conservative.

The increase in deaths observed in Table 3 is reflected in results of Table 4. We find that, even when considering the mildest scenario (i.e. the first one) a considerable number of life years are saved in Italy and France, while for Netherlands and Greece we find a slightly smaller increase (around 10,000 life years) and less for other countries. Scenario 4 produces the most substantial number of life-years saved, especially for Italy (more than 5,000,000 life years saved for men).

Table 4. ***Total number of life years saved under alternative scenarios by sex and countries.***

	MEN			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	735	7,099	52,073	103,023
BELGIUM	3,644	8,311	70,054	139,893
DENMARK	596	1,579	32,004	58,713
FRANCE	25,128	63,311	584,980	1,228,517
GERMANY	-265	-6,615	-65,677	-163,219
GREECE	12,758	31,477	194,294	218,316
ITALY	112,330	383,016	2,717,180	5,586,375
NETHERLANDS	10,714	71,068	454,724	866,059
SPAIN	3,254	17,185	144,231	238,188
SWEDEN	6,418	26,781	153,939	303,219
	WOMEN			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	2,659	9,770	66,158	136,376
BELGIUM	6,830	9,468	67,753	119,865
DENMARK	2,568	4,695	28,857	61,480
FRANCE	24,235	85,957	569,685	1,206,894
GERMANY	-15,927	-48,954	-165,892	-302,487
GREECE	20,518	42,532	218,844	309,400

ITALY	177,700	386,410	2,888,353	5,630,737
NETHERLANDS	15,629	71,511	453,351	869,336
SPAIN	2,438	9,332	120,394	245,335
SWEDEN	9,896	23,253	161,149	319,377

3.3 Inequalities based on education as SES proxy

A similar approach can be followed using education as the SES proxy.

Cox survival regression models are used with education, sex and age as covariates (Table E in Appendix reports the hazard ratios estimates for education) to estimate age-specific mortality rates and life expectancies (Table 5 reports the life expectancies at the age of 50).

Table 5. *Estimated life expectancy at 50 by educational levels, sex and countries.*

	MEN		
	Low	Medium	High
AUSTRIA	31.516	34.092	40.968
BELGIUM	35.186	36.026	37.935
DENMARK	33.045	32.345	35.085
FRANCE	30.666	37.074	43.390
GERMANY	33.056	33.462	34.843
GREECE	37.865	39.86	40.018
ITALY	29.082	34.553	28.062
NETHERLANDS	32.967	34.699	33.649
SPAIN	30.338	35.326	30.247
SWEDEN	33.996	31.717	37.562
	WOMEN		
	Low	Medium	High
AUSTRIA	35.928	38.262	43.889
BELGIUM	41.822	42.437	43.752
DENMARK	35.889	35.255	37.839
FRANCE	37.371	42.711	46.938
GERMANY	38.287	38.553	39.930
GREECE	39.809	41.659	41.902
ITALY	33.96	39.073	32.949
NETHERLANDS	37.344	38.952	38.018
SPAIN	34.379	39.319	34.277
SWEDEN	38.464	36.307	41.693

Also these tables, as the corresponding ones obtained considering wealth as a SES proxy, reveal a varying level of inequality in each country. We need, however, to be cautious in interpreting the results reported. These are particularly odd for Italy and Spain, where education seems to increase mortality rather than reduce it, in contradiction with most of the existing literature. It should be noted that the proportion of high educated individuals (the reference group) is very low in Italy and Spain, so the unusual effect of education might partly depend on this.

3.4 Health inequalities reduction scenarios based on education as a SES proxy

The number of deaths is obtained multiplying age-specific mortality rates for education groups by the population at risk (Table 6).

Table 6. *Estimated number of deaths by educational levels, sex and countries.*

	MEN		
	Low	Medium	High
AUSTRIA	17.595	31.680	17.645
BELGIUM	49.140	19.551	16.530
DENMARK	19.125	24.580	14.450
FRANCE	500.469	100.396	39.366
GERMANY	87.172	470.230	222.176
GREECE	62.987	10.118	5.267
ITALY	645.874	215.826	83.356
NETHERLANDS	82.972	29.430	28.248
SPAIN	532.421	19.071	41.025
SWEDEN	73.433	14.954	18.082
	WOMEN		
	Low	Medium	High
AUSTRIA	61.395	30.979	7.725
BELGIUM	58.250	17.229	12.577
DENMARK	42.932	22.540	8.836
FRANCE	307.999	342.798	15.844
GERMANY	580.875	335.300	97.517
GREECE	67.814	13.664	3.002
ITALY	1.018.123	38.511	23.138
NETHERLANDS	133.283	23.041	16.867
SPAIN	631.818	9.670	31.589
SWEDEN	99.361	12.174	11.184

Following in principle the approach used above, we can simulate the number of life-years that would be gained if people of lower educational groups experienced the lower mortality rates of those of higher educational levels. Four different scenarios are considered:

1. mortality rates of individual with low education decrease to those of individuals with a medium educational level.
2. all individuals have the mortality rates of the higher educated ones;
3. similarly to scenario 3, we pivot the social gradient about the level of the medium educational level, but only 50% of the way to becoming a horizontal line. In practice, this is achieved by halving the coefficients of the Cox regression models.

Table 7 reports the estimates of the number of deaths saved in each scenario, obtained comparing the number of deaths simulated in the different scenarios to the number of deaths in the initial situation (of Table 6). Table D in appendix shows the gain in terms of life expectancies at 50 provided by these three scenarios.

Table 7. ***Estimated number of individual whose lives would be saved under alternative scenarios by sex and countries*.**

	MEN		
	Scenario 1	Scenario 2	Scenario 3
AUSTRIA	3.843	27.143	-2,682
BELGIUM	3.727	14.359	207
DENMARK	-1.054	8.366	-1,225
FRANCE	214.328	391.556	7,900
GERMANY	3.316	78.715	-10,098
GREECE	10.856	11.734	-2
ITALY	273.752	-166.464	8,848
NETHERLANDS	13.397	2.353	1,076
SPAIN	191.650	-16.647	817
SWEDEN	-17.966	27.743	-2,130
	WOMEN		
	Scenario 1	Scenario 2	Scenario 3
AUSTRIA	9.320	39.883	2,139
BELGIUM	3.020	11.079	592
DENMARK	-1.922	9.661	-569
FRANCE	159.631	304.985	12,020
GERMANY	13.268	114.995	4,449
GREECE	10.079	11.742	193
ITALY	324.970	-114.828	10,165
NETHERLANDS	17.327	5.362	1,974
SPAIN	200.427	-11.729	4,960
SWEDEN	-18.720	26.655	-1,326

* a negative number indicates that the number of deaths under that scenario is higher than that observed in real data.

Once again, Scenario 2 looks as the most ambitious, as it provides the highest number of lives "saved" (with the exception of Italy and Spain, because the above mentioned strange effect of education on mortality in these countries, and of Netherlands). By contrast, Scenario 3 is the one providing the lowest increment of lives, with many countries provide an increase of deaths.

Table 8 reports the total number of life years saved with improved mortality under the different scenarios.

Table 8. ***Total number of life years saved under alternative scenarios by sex and countries.***

	MEN

	Scenario 1	Scenario 2	Scenario 3
AUSTRIA	50.668	495.547	-44,917
BELGIUM	45.599	190.835	566
DENMARK	-8.477	106.432	-15,543
FRANCE	2.535.021	6.173.183	-74,967
GERMANY	31.929	788.208	-108,374
GREECE	126.902	138.048	-5,963
ITALY	3.478.302	-1.385.444	80,358
NETHERLANDS	137.900	21.481	12,007
SPAIN	2.335.931	-211.213	6,512
SWEDEN	-122.770	289.350	-19,447
		WOMEN	
	Scenario 1	Scenario 2	Scenario 3
AUSTRIA	118.216	643.371	16,712
BELGIUM	40.983	156.885	4,840
DENMARK	-17.008	111.651	-9,797
FRANCE	2.410.432	5.118.601	27,157
GERMANY	97.423	1.194.207	-1,479
GREECE	138.049	165.496	-1,031
ITALY	4.031.140	-1.251.323	125,073
NETHERLANDS	177.261	51.940	17,875
SPAIN	2.558.004	-161.087	69,552
SWEDEN	-130.019	282.586	-23,733

5. Monetary valuation of the life years gained in the different scenarios

The final step ascribes a monetary value to the additional life-years gained. Assigning monetary values to life and health is a highly controversial topic in health (but much less in economics). Hence we start by motivating and explaining the basic approach adopted.

Much of the reservation about putting a monetary value on life and health stems from a misunderstanding of what such a value actually means. In fact, we cannot – and do not seek to – place a monetary value on our own or others' lives. Instead, we are valuing often comparatively small changes in the risk of mortality, a very different matter. A more appropriate term than value of life would thus be the value of mortality risk reduction. While under normal circumstances no one would trade his or her life for money, most people would weigh safety against cost in choosing safety equipment, safety against time in crossing a street, and on-the-job risks against different wages. In making these choices, people are implicitly putting a price on their risk of mortality.

While the value of a reduction in mortality risk is not directly observable, it can be inferred from the decisions people make when choosing between mortality risk and financial compensation. The most common procedure uses labour market data about the wage premium workers demand from a job with higher mortality risk, as it is well known that, given a choice, individuals demand higher wages to work in jobs associated with greater risks, such as coal mining or off-shore oil work. For example if an individual is willing to forego €200 to reduce the risk of mortality by 1/1000, this trade-off gives a value of life of €200,000 only in the sense that the risk reduction is achieved in a population of 1000: if mortality risk is reduced by 1/1000 per capita over a population of 1000, this is the same as saying that we expect – statistically – one life to be saved in this population. Put this way, we can also speak of the "value of a statistical life" (VSL).

Yet is it really possible to elicit an actual price to be placed on life or health? It would be foolish to pretend that this is easy. Nevertheless, there is now a wealth of studies that have measured how people value the risks of mortality or even morbidity. Many of these studies infer willingness to pay for small changes in mortality risk from observed choices in labour markets and in markets for safety-related products (e.g., seat belts, smoke detectors). Other studies use what is termed contingent valuation methodology, where people are asked directly what they would be willing to pay for a change in risk, using surveys. The considerable experience that has accumulated with both market-based and survey approaches has led to significant improvements in the methods used but there is still a sizeable variation in the estimates obtained from different studies, as well as large confidence intervals around the point estimates obtained from any single willingness-to-pay study.

While this is a challenge that calls for cautious use of such estimates (as well as for the use of appropriate sensitivity analyses), it is certainly not a reason for abandoning the pursuit of more accurate measures of this meaningful concept. Further improvement in both measurement methods and data sources will make it possible to narrow the degree of uncertainty around estimates. Indeed, the act of undertaking such measurements has value in itself as it forces decision makers to be explicit about what are often implicit and unexamined choices concealed within policy decisions.

There is a host of estimates of the VSL in the literature. A most recent meta-analysis of the VSL in OECD countries represents a particularly useful resource for our present exercise (OECD 2012). The carefully conducted study proposes a range for the average adult VSL for OECD countries of USD (2005-USD) 1.5 million – 4.5 million, with a base value of USD 3 million. For our purposes we convert the dollar figures into Euros and use 2010 as our reference year, starting from the VSL that the OECD study proposes for every country that is also included in the SHARE data. We then adjust for inflation and differences in purchasing power, using the online tool developed by Shemilt et al (2010) and available here http://eppi.ioe.ac.uk/costconversion/default.aspx. We do so for every SHARE country and in the end average country values across the SHARE sample.

With a number of simplifying assumptions[4], it is possible to convert the VSL value into a Value of a Statistical Life *Year* (VoSLY) using the standard compound interest formulae $VoSLY = VoSL*d/[1-(1+d)^{-L}]$ with L as the remaining years up to life expectancy, and d as the discount rate. Assuming the Value of a Statistical Life is for an 'average' person, aged, say, 40 years, and a remaining life expectancy of 40 years (=L), and also assuming the recommended discount rate of 3.5% (=d), the VoSLY for the OECD would be about £163,895 (as of 2005 USD).[5] To express future amounts in present value terms (Dow and Schoeni, 2008), a discount rate of 3.5% is used.

[4] In addition to the critical assumption that each year of life over the life cycle has the same value, this approach assumes that the VSL can be expressed as the present discounted value of these annual amounts. In practice, a number of factors are likely to lead to differences in how one values survival at different ages, e.g. changes in wealth levels, family responsibilities, health status, and other aspects of one's life cycle. For a critical discussion see e.g. Hammitt, 2007 J.K. Hammitt, Valuing changes in mortality risk: lives saved vs. life years saved, Review of Environmental Economics and Policy 1 (2007), pp. 228–240.

[5] We also allow for a range of VoSLY estimates in our sensitivity analysis, assuming +/-50% of the mean value, the same range suggested by the OECD report (OECD 2012).

Table 9 reports the monetary gains (in Euros) obtained in each scenario of health inequality reduction when socio-economic status is measured through wealth. Table 10 shows similar figures for the education based scenarios. Tables C and D in Appendix reports the economic gain due to inequality reduction in terms of percentage of GDP.

Table 9. *Economic benefits (in billion Euros) due to life years saved by three health inequality reduction scenarios (wealth as socio-economic measure). A range of +/- 50% is reported between parentheses.*

	MEN			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	0.154 (0.077, 0.231)	1.529 (0.760, 2.293)	11.448 (5.720, 17.172)	23.240 (11.621, 34.861)
BELGIUM	0.792 (0.396, 1.187)	1.705 (0.850, 2.557)	15.154 (7.580, 22.732)	30.373 (15.186, 45.559)
DENMARK	0.117 (0.059, 0.176)	0.320 (0.160, 0.480)	6.854 (3.430, 10.281)	12.659 (6.329, 18.989)
FRANCE	5.583 (2.791, 8.374)	13.135 (6.570, 19.702)	122.818 (61.409, 184.228)	269.111 (134.555, 403.666)
GERMANY	-0.057 (-0.085, -0.028)	-1.268 (-1.902, -0.634)	-12.874 (-19.311, -6.437)	-32.600 (-16.300, -48.901)
GREECE	2.786 (1.393, 4.178)	7.849 (3.924, 11.773)	42.286 (21.143, 63.430)	44.409 (22.204, 66.613)
ITALY	22.897 (11.449, 34.346)	77.479 (38.740, 116.219)	574.784 (287.392, 862.177)	1237.635 (618.818, 1856.423)
NETHERLANDS	2.116 (1.058, 3.175)	14.550 (7.273, 21.819)	100.127 (50.064, 150.191)	197.608 (98.804, 296.416)
SPAIN	0.630 (0.315, 0.945)	3.696 (1.848, 5.544)	30.823 (15.412, 46.235)	50.709 (25.354, 76.063)
SWEDEN	1.257 (0.628, 1.885)	5.834 (2.917, 8.751)	31.901 (15.951, 47.852)	64.135 (32.068, 96.203)
	WOMEN			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	0.527 (0.450, 0.604)	2.318 (1.550, 3.082)	13.067 (7.340, 18.791)	30.847 (19.227,42.467)
BELGIUM	1.515 (1.120, 1.910)	2.309 (1.460, 3.161)	13.150 (5.570, 20.727)	27.625 (12.438, 42.811)
DENMARK	0.526 (0.470, 0.584)	1.134 (0.970, 1.294)	5.397 (1.970, 8.823)	13.153 (6.824, 19.483)
FRANCE	5.443 (2.650, 8.234)	22.065 (15.498, 28.633)	105.818 (44.409, 167.227)	258.364 (123.809, 392.919)
GERMANY	-3.813 (-3.841, -3.784)	-11.498 (-12.132, -10.864)	-27.186 (-33.623, -20.749)	-60.864 (-44.564, -77.165)
GREECE	4.500 (3.107, 5.893)	10.281 (6.357, 14.206)	41.730 (20.586, 62.873)	65.641 (43.437, 87.845)
ITALY	37.129 (25.680, 48.577)	93.949 (55.209, 132.688)	558.901 (271.509, 846.293)	1262.923 (644.106, 1881.741)
NETHERLANDS	3.177 (2.119, 4.235)	17.288 (10.015, 24.560)	79.804 (29.740, 129.868)	193.513 (94.709, 292.316)

SPAIN	0.490 (0.175, 0.805)	2.161 (0.313, 4.009)	22.138 (6.726, 37.550)	49.851 (24.497, 75.206)
SWEDEN	1.962 (1.333, 2.590)	6.293 (3.376, 9.210)	28.431 (12.481, 44.382)	68.117 (36.049, 100.185)

Obviously we find the highest monetary gain in the scenario predicting the highest gain in terms of life years (i.e. the fourth one) and lowest in the first scenario, which provides the lowest expectations in terms of life years gained. In addition, keeping fixed the scenario, the countries with the highest inequality are also those who get more benefits from reducing it. Italy, for instance, will gain between €11.449 and 34.346 billions, if the first scenario (i.e. that predicting the mildest health inequality reduction) comes true just for the male population.

Table 10. *Economic benefits (in billion Euros) due to life years saved by three health inequality reduction scenarios (education as socio-economic measure). A range of +/- 50% is reported between parentheses.*

	MEN			WOMEN		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
AUSTRIA	10.905 (5.453, 16.358)	119.209 (59.604, 178.813)	-10.564 (-15.846, -5.282)	25.580 (20.128, 31.033)	148.758 (89.154, 208.362)	1.106 (-4.176, 6.388)
BELGIUM	9.987 (4.993, 14.980)	42.847 (21.423, 64.270)	0.088 (0.044, 0.131)	8.291 (3.298, 13.285)	35.157 (13.734, 56.581)	0.782 (0.738, 0.825)
DENMARK	-1.675 (-2.513, -0.838)	22.981 (11.491, 34.472)	-3.326 (-4.990, -1.663)	-3.443 (-4.281, -2.605)	24.064 (12.573, 35.554)	-2.300 (-3.963, -0.637)
FRANCE	542.272 (271.136, 813.408)	1437.188 (718.594, 2155.782)	-23.832 (-35.749, -11.916)	531.339 (260.203, 802.475)	1202.958 (484.364, 1921.552)	-8.870 (-20.787, 3.406)
GERMANY	6.817 (3.409, 10.226)	165.067 (82.533, 247.600)	-24.034 (-36.052, -12.017)	19.488 (16.079, 22.897)	243.493 (160.960, 326.026)	-2.786 (9.231, -14.804)
GREECE	27.574 (13.787, 41.361)	29.844 (14.922, 44.766)	-1.562 (-2.343, -0.781)	30.191 (16.404, 43.978)	36.382 (21.460, 51.303)	-0.470 (-1.250, 0.311)
ITALY	741.379 (370.689, 1112.068)	-292.059 (-438.088, -146.029)	15.962 (7.981, 23.944)	876.232 (505.543, 1246.921)	-270.372 (-416.402, -124.343)	27.249 (19.268, 35.230)
NETHERLANDS	29.572 (14.786, 44.358)	4.359 (2.179, 6.538)	2.625 (1.312, 3.937)	37.477 (22.691, 52.263)	10.667 (8.487, 12.846)	3.533 (2.220, 4.845)
SPAIN	504.409 (252.205, 756.614)	-181.790 (-272.685, -90.895)	1.328 (0.664, 1.992)	553.552 (301.347, 805.756)	-36.715 (-127.610, 54.180)	15.635 (14.971, 16.299)
SWEDEN	-25.250 (-37.875, -12.625)	61.167 (30.584, 91.751)	-3.992 (-1.996, -5.988)	-24.612 (-37.237, -11.987)	61.162 (30.578, 91.746)	-5.778 (-7.774, -3.783)

As expected, when we use education as a measure of socio-economic status, the most ambitious scenario (i.e. the second one) is that providing the highest gain (about 1400 billions for France) whereas the third scenario gives the lowest gain – and in some cases we see a loss of euros.

6. Discussion

With few exceptions our estimates in the different scenarios imply an enormous economic benefit associated with improving mortality in the lower socio-economic groups. Of course, it is beyond the scope of this paper to determine the "correct" scenario out of the many we presented, but we can say that even the mildest one (i.e the first one) would provide a monetised benefits to countries ranging from €0.643 billions in Denmark to €60.026 billions in Italy. The education based estimates provide more heterogeneous results, i.e. we see for the same scenario (i.e. the second one) a gain of about 1400 billions of euros in France (i.e. 85% of GDP) and a loss of about 300 billions of euros in Italy (i.e. 21.5% of GDP). Undeniable there are some caveats about the assumptions underlying the inequality reduction hypothesized in our scenario. Two assumptions might look particularly strong: first we assume that health benefits are instantaneous, second the economic benefits we estimated for one saved life years are net of health opportunity costs (or, even more implausibly, health opportunity costs are assumed to be zero). Furthermore, our scenarios all ignore any effects on economic growth and social security expenditure. However, if the latter assumption probably makes the economic benefits of reducing health inequalities overestimated, the first one – which we are forced to make as life expectancy estimates are traditional and backward-looking demographic estimates of life expectancy based on past mortality rates – substantially under-estimate the life expectancy of the population currently alive. In addition, certainly the SHARE samples are averagely healthier than the whole national populations: institutionalised people have not been surveyed and more generally we may expect that healthier individuals are more likely to collaborate with the survey. This caveat is confirmed if we compare life expectancies at 50 estimated in SHARE data with national estimates, which are lower. Therefore, we might assume that the SES gradient on mortality is underestimated, and so are the estimated benefits of reducing health inequalities. Given all these caveats we certainly cannot claim that the numbers we provide are a correct estimate of the true benefits we would observe if one the scenarios we depicted will come true. However, there are good reasons to believe that even though the assumptions we are making might look overly strong, the overall effect of these assumption is not an over-estimation of the economic benefits of reducing health inequalities, an under-estimation looks more likely.

In closing we can only claim that the expected economic benefits of reducing mortality inequalities according to (arguably) not very ambitious scenarios appear large. Therefore, even though reducing health inequalities should be high on the political agenda per se, the likely gains that here are suggested, might be an additional argument to consider it.

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Appendix

Table A. *Years gained in terms of life expectancies at 50 due to four health inequality reduction scenarios (wealth as socio-economic measure).*

	MEN			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	0.0132	0.1068	0.6252	1.242
BELGIUM	0.039	0.1018	0.7178	1.4516
DENMARK	0.0144	0.0436	0.5424	1.0318
FRANCE	0.042	0.1108	1.025	2.0756
GERMANY	-0.0008	-0.0128	-0.1194	-0.2606
GREECE	0.1274	0.3654	1.9656	3.7474
ITALY	0.1228	0.426	3.128	6.2416
NETHERLANDS	0.0672	0.448	2.977	5.7116
SPAIN	0.0106	0.037	0.2692	0.4988
SWEDEN	0.0866	0.2714	1.6128	3.188
	WOMEN			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	0.0172	0.1112	0.5808	1.176
BELGIUM	0.044	0.0752	0.5516	1.0472
DENMARK	0.0266	0.073	0.4516	0.9574
FRANCE	0.0342	0.1266	0.8906	1.7698
GERMANY	-0.0096	-0.0304	-0.1382	-0.2724
GREECE	0.134	0.3436	1.7966	3.3166
ITALY	0.135	0.4042	2.969	5.6648
NETHERLANDS	0.0628	0.4196	2.6814	4.9866
SPAIN	0.006	0.0192	0.24	0.4622
SWEDEN	0.0696	0.2296	1.4684	2.8588

Table B. *Years gained in terms of life expectancies at 50 due to four health inequality reduction scenarios (education as socio-economic measure).*

	MEN		
	Scenario 1	Scenario 2	Scenario 3
AUSTRIA	5.443	0.859	-0.708
BELGIUM	1.553	0.280	-0.219
DENMARK	1.593	-0.233	-0.303
FRANCE	6.347	2.136	-1.374
GERMANY	1.056	0.135	-0.085
GREECE	0.770	0.665	-0.273
ITALY	-2.504	1.824	0.227
NETHERLANDS	-0.123	0.577	0.014
SPAIN	-1.823	1.763	0.035
SWEDEN	3.137	-0.760	-0.533
	WOMEN		
	Scenario 1	Scenario 2	Scenario 3
AUSTRIA	4.529	0.778	-0.527
BELGIUM	1.082	0.205	-0.158
DENMARK	1.511	-0.211	-0.295
FRANCE	4.598	1.780	-0.909
GERMANY	1.007	0.089	-0.132
GREECE	0.779	0.617	-0.250
ITALY	-2.378	1.704	0.248
NETHERLANDS	-0.087	0.536	0.001
SPAIN	-1.715	1.647	0.079
SWEDEN	2.872	-0.719	-0.479

Table C. *Economic benefits (in % of 2004 GDP) due to life years saved by three health inequality reduction scenarios (wealth as socio-economic measure). A range of +/- 50% is reported between parentheses.*

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AUSTRIA	0.290	1.639	10.445	23.044
BELGIUM	0.792	1.378	9.717	19.911
DENMARK	0.326	0.738	6.217	13.098
FRANCE	0.666	2.126	13.810	31.861
GERMANY	-0.176	-0.581	-1.824	-4.257
GREECE	3.933	9.786	45.349	59.401

ITALY	4.295	12.265	81.109	178.902
NETHERLANDS	1.078	6.482	36.632	79.628
SPAIN	0.133	0.696	6.295	11.953
SWEDEN	1.119	4.215	20.971	45.970

Table D. *Economic benefits (in % of 2004 GDP) due to life years saved by three health inequality reduction scenarios (education as socio-economic measure). A range of +/- 50% is reported between parentheses.*

	Scenario 1	Scenario 2	Scenario 3
AUSTRIA	15.545	114.170	-4.030
BELGIUM	6.275	26.779	0.299
DENMARK	-2.597	23.872	-2.855
FRANCE	64.848	159.470	-1.975
GERMANY	1.198	18.607	-1.221
GREECE	31.180	35.747	-1.097
ITALY	115.731	-40.239	3.092
NETHERLANDS	13.650	3.059	1.254
SPAIN	125.754	-25.972	2.016
SWEDEN	-17.332	42.521	-3.396

Table E. ***Estimated hazard ratios for educational levels of Cox regression models net of age and sex for the different countries (95% confidence intervals in parentheses).***

	Low	Medium	High
AUSTRIA	2.873 (1.236, 6.680)	2.208 (0.959, 5.082)	1.000 (ref)
BELGIUM	1.378 (0.834, 2.277)	1.252 (0.697, 2.250)	1.000 (ref)
DENMARK	1.256 (0.699, 2.259)	1.354 (0.787, 2.329)	1.000 (ref)
FRANCE	5.138 (2.037, 12.964)	2.450 (0.889, 6.753)	1.000 (ref)
GERMANY	1.260 (0.705, 2.252)	1.208 (0.736, 1.982)	1.000 (ref)
GREECE	1.361 (0.671, 2.763)	1.024 (0.438, 2.393)	1.000 (ref)
ITALY	0.897 (0.426, 1.889)	0.494 (0.174, 1.406)	1.000 (ref)
NETHERLANDS	1.092 (0.668, 1.786)	0.874 (0.468, 1.635)	1.00 (ref)
SPAIN	0.992 (0.488, 2.015)	0.556 (0.154, 2.004)	1.00 (ref)
SWEDEN	1.611 (0.959, 2.708)	2.194 (1.147, 4.200)	1.00 (ref)