Inequalities in healthy life years in the 25 countries of the European Union in 2005: a cross-national meta-regression analysis

Carol Jagger, Clare Gillies, Francesco Moscone, Emmanuelle Cambois, Herman Van Oyen, Wilma Nusselder, Jean-Marie Robine, and the EHLEIS team

Lancet 2008; 372: 2124–31

Published Online November 17, 2008
DOI:10.1016/S0140-6736(08)61594-9

See Editorial page 2088

See Comment page 2090

See Department of Error page 2114

Department of Health Sciences (Prof C Jagger PhD, C Gillies PhD) **and Department of Economics** (F Moscone PhD), **University of Leicester, Leicester, UK; French Institute for Demographic Studies, INED, Paris, France** (E Cambois PhD); **Scientific Institute of Public Health, Brussels, Belgium** (Prof H Van Oyen PhD); **Erasmus Medical Center, University Medical Center Rotterdam, Rotterdam, Netherlands** (W Nusselder PhD); **and French Institute of Health and Medical Research, INSERM, Montpellier, France** (J-M Robine DED)

Correspondence to: Prof Carol Jagger, Department of Health Sciences, University of Leicester, 22–28 Princess Road West, Leicester LE1 6TP, UK
cxj@le.ac.uk

Summary

Background Although life expectancy in the European Union (EU) is increasing, whether most of these extra years are spent in good health is unclear. This information would be crucial to both contain health-care costs and increase labour-force participation for older people. We investigated inequalities in life expectancies and healthy life years (HLYs) at 50 years of age for the 25 countries in the EU in 2005 and the potential for increasing the proportion of older people in the labour force.

Methods We calculated life expectancies and HLYs at 50 years of age by sex and country by the Sullivan method, which was applied to Eurostat life tables and age-specific prevalence of activity limitation from the 2005 statistics of living and income conditions survey. We investigated differences between countries through meta-regression techniques, with structural and sustainable indicators for every country.

Findings In 2005, an average 50-year-old man in the 25 EU countries could expect to live until 67·3 years free of activity limitation, and a woman to 68·1 years. HLYs at 50 years for both men and women varied more between countries than did life expectancy (HLY range for men: from 9·1 years in Estonia to 23·6 years in Denmark; for women: from 10·4 years in Estonia to 24·1 years in Denmark). Gross domestic product and expenditure on elderly care were both positively associated with HLYs at 50 years in men and women ($p<0·039$ for both indicators and sexes); however, in men alone, long-term unemployment was negatively associated ($p=0·023$) and life-long learning positively associated ($p=0·021$) with HLYs at 50 years of age.

Interpretation Substantial inequalities in HLYs at 50 years exist within EU countries. Our findings suggest that, without major improvements in population health, the target of increasing participation of older people into the labour force will be difficult to meet in all 25 EU countries.

Funding EU Public Health Programme.

Introduction

Life expectancy at birth and at 65 years of age in countries of the European Union (EU) has risen greatly, suggesting not only that greater numbers of individuals are reaching old age but also that elderly people are themselves living longer. However, populations are not ageing uniformly in all European countries; notably, the gap in life expectancy between eastern and western European countries, which began to converge in the second half of the 20th century, has been widening over the past decades.[1] Different trends have also been recorded within western Europe. Mortality in old age has decreased consistently in France, England, and Wales between the 1950s and 1990s, whereas declines have remained constant in Denmark and the Netherlands.[2]

Increasing life expectancy does not in itself mean a healthier population. Health expectancies were developed to bring a quality-of-life dimension to life expectancy,[3] and to establish whether the yearly increases in life expectancy are accompanied by decreases in unhealthy life years (known as the compression of morbidity hypothesis),[4] increases in unhealthy life years (expansion of morbidity),[5] or intermediate scenarios such as dynamic equilibrium in which the increases in years spent unhealthy are offset by a decrease in the mean level of severity of the prevalent disability.[6] An ageing population in poor health has important implications for future medical and care requirements and pension provision, whereas an ageing population in good health has mainly long-term consequences for pension provision.

One of the targets added to the Lisbon Strategy by the European Council in 2001, is that the employment rate for older workers (aged 55–64 years) should reach 50% by 2010. Recent pension reforms in several European countries have extended working lives and begun to offset the rising trends in early retirement. The main arguments supporting extensions of working life seem to be the evidence of gains in life expectancy and an assumption of decreasing disability in old age. However, as with life expectancy, trends of disability in old age are far from uniform across European countries, with clear evidence of decrease in only four (Denmark, Finland, Italy and Netherlands) of the eight European countries studied by the Organisation for Economic Co-operation and Development (OECD).[7] In 2004, the European Commission added a measure of health expectancy to

	Definition	Quality grade
Gross domestic product (GDP)	GDP per head in purchasing power standards (expressed in relation to the average for the 25 European Union countries in 2005, which is set to equal 100)	A
Expenditure on elderly care	The share of social protection expenditure devoted to care of the elderly (covering care allowance, accommodation, and assistance in undertaking daily tasks) as a percentage of GDP	Not available
Poverty risk for >65 years	People aged 65 years and older with an equivalised disposable income below the risk-of-poverty threshold, which is set at 60% of the national median equivalised disposable income after social transfers, as a percentage of all people aged 65 years and older	C
Inequality of income distribution	The ratio of total income received by the 20% of the population with the highest income (top quintile) to that received by the 20% of the population with the lowest income (lowest quintile)	C
Employment rate of older workers	Employed people aged 55–64 years as a percentage of the total population of the same age group	A
Long-term unemployment rate	Long-term unemployed (12 months and more) as a percentage of the total active population	A
Mean exit age from the labour force	Mean exit age from the labour force weighted by the probability of withdrawal from the labour market	Not available
Life-long learning	Percentage of the adult population aged 25–64 years participating in education and training over the 4 weeks before the survey	Not available
Low education attainment	Percentage of the population aged 25–64 years having completed most lower secondary education (international standard classification of education level of 2 or less)	Not available

A=data obtained from reliable sources applying high standards of methodology and accuracy, with a common method for the EU and comparable over time. C=data might have to be interpreted with care since there could be incomparability across countries (including the absence of data) and breaks in series that hamper comparison over time.

Table 1: **Definition and quality grade of structural and sustainable indicators**

the set of structural indicators, under the name of healthy life years (HLYs). HLYs is the first and only EU structural indicator for health, and includes information about disability. In its 2005 annual report to the Spring European Council,[8] the Commission emphasised that increasing HLYs is crucial to achieve an increase in the employment rate of older workers.

Health expectancies—predominantly disability-free life expectancies—are available for more than 50 countries worldwide including many European countries, but cross-national comparisons have been difficult because of little consistency of health measures and calculation methods.[9] Both of these factors have been resolved with the HLYs indicator. Harmonisation at the point of data collection, by use of a single survey—the statistics of income and living conditions (SILC)—across the 25 EU countries, has particularly aided comparability of the underlying measure of disability. We therefore aimed to use HLYs at 50 years of age to investigate the potential for healthy ageing across the 25 EU countries in 2005, to establish the potential for increasing the proportion of older people in the labour force, and to explore macro-level factors that might explain any diversity in HLYs at 50 years between countries.

Methods

Data collection

The usual method of calculation of disability-free life expectancies is by the Sullivan method[10] and requires the age-specific prevalence of disability from a survey and a standard life table. We obtained the disability data for HLYs from SILC 2005 survey. The SILC survey contains the minimum European health module, which was devised by the Euro-REVES group[11] and includes the global activity limitation index as a measure of disability. This index aims to capture long-term limitation (>6 months) in usual activities, which are caused by ill-health, with three severity levels: none, limited but not severely, and severely limited health (apart from Denmark where there were only two response categories: limited or not).[12] For HLYs we defined disability to be any limitation. We obtained death counts and population estimates for the life tables for every country from the Eurostat database,[13] apart from France and Italy where death counts were not available from the database at the time of calculation and thus were directly obtained from the respective national statistical offices.

We selected relevant macro-level factors, and structural and sustainable indicators, for every country to cover broad areas of wealth and expenditure (gross domestic product [GDP], poverty risk for people aged >65 years, inequality of income distribution, and expenditure on elderly care), labour-force participation (employment rate of older workers, long-term unemployment rate, and mean age of exit from labour force), and level of education (life-long learning and low education attainment), which we obtained from the Europa Eurostat website. Table 1 provides a definition for all the indicators and shows their quality grade. Most indicators chosen included all adult age groups. Those for the older population (expenditure on elderly care and poverty risk for people aged >65 years) were chosen as an indicator of the country's provision for older people specifically. Most data related to 2005 and were collected or estimated to ensure maximum harmonisation across all countries. The exception was expenditure on elderly care, for which the most recent data available were from 2004.

For the **Europa Eurostat website** see http://epp.eurostat.ec.europa.eu/

Statistical analysis

Estimates of HLYs for the 25 EU countries in 2005 were computed with an algorithm developed by Eurostat in

For more on the **European Health Expectancy Monitoring Unit** see http://www.ehemu.eu/

collaboration with the European Health Expectancy Monitoring Unit (EHEMU) and on the basis of the Sullivan method.[10,13] The Sullivan method uses the observed age-specific disability prevalence from a cross-sectional survey to subdivide the number of person-years lived into years with and without disability. To take into account the population living in institutions who were excluded from general population surveys such as SILC, we have assumed that the prevalence of health states outside and within institutions does not differ. All HLY calculations were done online through the EHEMU information system and are available on the EHEMU website.

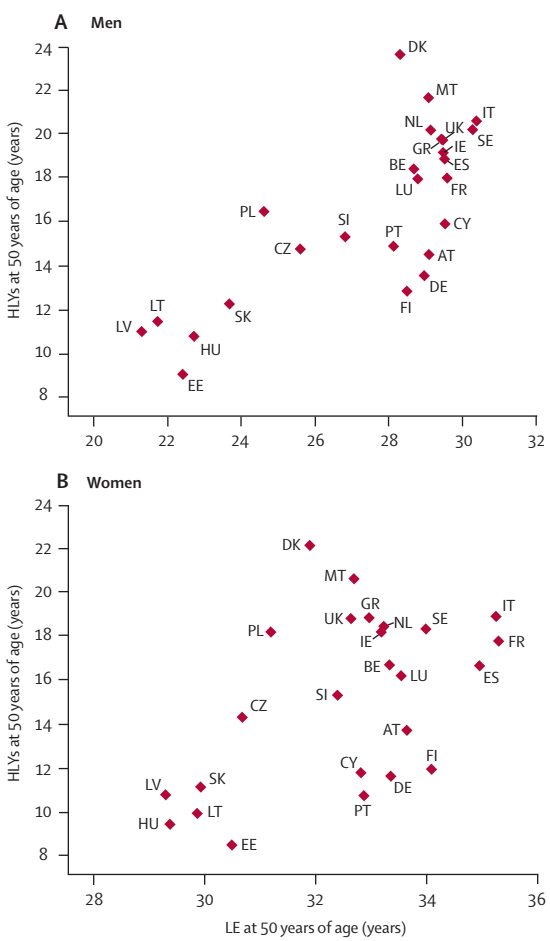
To investigate the relations between HLYs at 50 years of age and country-specific structural indicators, we fitted meta-regression[14] models, entering every structural indicator univariately and fitting separate models for men and women. We fitted the models for all the 25 EU countries together and then separately for the former 15 EU countries and the ten newly joining countries. Although we did not undertake formal tests for outliers or influential data points, we visually assessed scatter plots of all relations to ascertain whether any trends were the result of just one or two data points.

Role of the funding source

The sponsor of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. CJ, CG, and JM had full access to the total dataset of the study (although all data are separately available publicly) and the authors jointly had final responsibility for the decision to submit for publication.

Results

In 2005, life expectancy at 50 years of age for men and women in all 25 EU countries was 28·6 years and 33·5 years, respectively, although the range between countries was 9·1 years for men (from 21·3 years in Latvia to 30·4 years in Italy) and 6·1 years for women (from 29·3 years in Latvia to 35·4 years in France) (figure 1). Inequalities in male life expectancy at 50 years



C

	Men		Women	
	LE	HLYs	LE	HLYs
Austria (AT)	29·08	14·53	33·70	15·66
Belgium (BE)	28·67	18·42	33·39	18·66
Cyprus (CY)	29·52	15·92	32·86	13·71
Czech Republic (CZ)	25·61	14·77	30·72	16·26
Denmark (DK)	28·30	23·64	31·94	24·12
Estonia (EE)	22·42	9·05	30·52	10·42
Finland (FI)	28·48	12·86	34·15	13·87
France (FR)	29·57	18·01	35·37	19·74
Germany (DE)	28·96	13·56	33·41	13·55
Greece (GR)	29·43	19·78	33·02	20·81
Hungary (HU)	22·72	10·78	29·40	11·39
Ireland (IE)	29·50	18·91	33·24	20·17
Italy (IT)	30·37	20·63	35·31	20·86
Latvia (LV)	21·31	11·02	29·32	12·74
Lithuania (LT)	21·74	11·49	29·90	11·86
Luxembourg (LU)	28·78	17·99	33·60	18·16
Malta (MT)	29·07	21·68	32·74	22·58
Netherlands (NL)	29·14	20·21	33·28	20·40
Poland (PL)	24·62	16·48	31·23	20·16
Portugal (PT)	28·12	14·90	32·92	12·67
Slovakia (SK)	23·68	12·28	29·96	13·07
Slovenia (SI)	26·81	15·34	32·44	17·25
Spain (ES)	29·48	19·16	35·02	18·62
Sweden (SE)	30·28	20·22	34·05	20·31
UK (UK)	29·46	19·74	32·69	20·78

Figure 1: **Life expectancy (LE) and healthy life years (HLYs) at 50 years of age for all EU countries**
HLYs=healthy life years. LE=life expectancy. (A) and (B) show scatter graphs for men and women, respectively. (C) Data for scatter graphs.

of age were greater in the ten newly joined countries of the EU (range 8·2 years) than for the older established 15 EU countries (range 2·3 years), but were similar in both for women (range 3·5 years and 3·6, respectively) (figure 1).

In all 25 EU countries, men aged 50 years could expect to live a further 17·3 years (SE 0·17)—ie, 60% of their remaining life free of activity limitation—whereas the number of HLYs at 50 years for women was 18·1 years (SE 0·18), 54% of remaining life. At 50 years of age, the spread in HLYs was greater than was that for life expectancy for both men and women: for men the range was 14·5 years, from 9·1 years (Estonia) to 23·6 years (Denmark); women's HLYs at 50 years had a range of 13·7 years, from 10·4 years (Estonia) to 24·1 years (Denmark) (figure 2). Figure 1 clearly shows the wide diversity in HLYs at 50 years: for men, eight countries had a life expectancy at 50 years within 1 year of the maximum, whereas their HLYs at 50 years of age varied by 4·7 years. At 50 years of age, life expectancies for men and women were significantly positively correlated ($\rho=0·91$, $p<0·0001$), as were HLYs ($\rho=0·95$, $p<0·0001$), suggesting that countries with high life expectancy and HLYs at 50 years for men tended to have high values for women.

The values of the macro-level factors that we used for the meta-regression analyses varied greatly by country, with the ten newly joining EU countries performing worse than the established 15 EU countries for all indicators (table 2). When we included all countries in the meta-regression model, GDP and expenditure on elderly care were significantly associated with HLYs at 50 years for both men and women (table 3). Additionally, for men only, long-term unemployment rate, life-long learning, and low education attainment were also significantly associated with HLYs at 50 years. When we redid the analyses for the 15 and ten EU countries separately (table 4), none of the structural or sustainable indicators was significantly associated with HLYs at 50 years in the established 15 countries, although some evidence supported an association between long-term unemployment rate and HLYs at 50 years in men ($p=0·056$). For the ten newer EU countries, expenditure on elderly care and low education attainment were significant in both men and women. The relation between HLYs at 50 years and expenditure on elderly care differed greatly between the 15 and ten EU countries. A 1% increase in expenditure on elderly care as a percentage of GDP represented a little more than a 1-year increase in

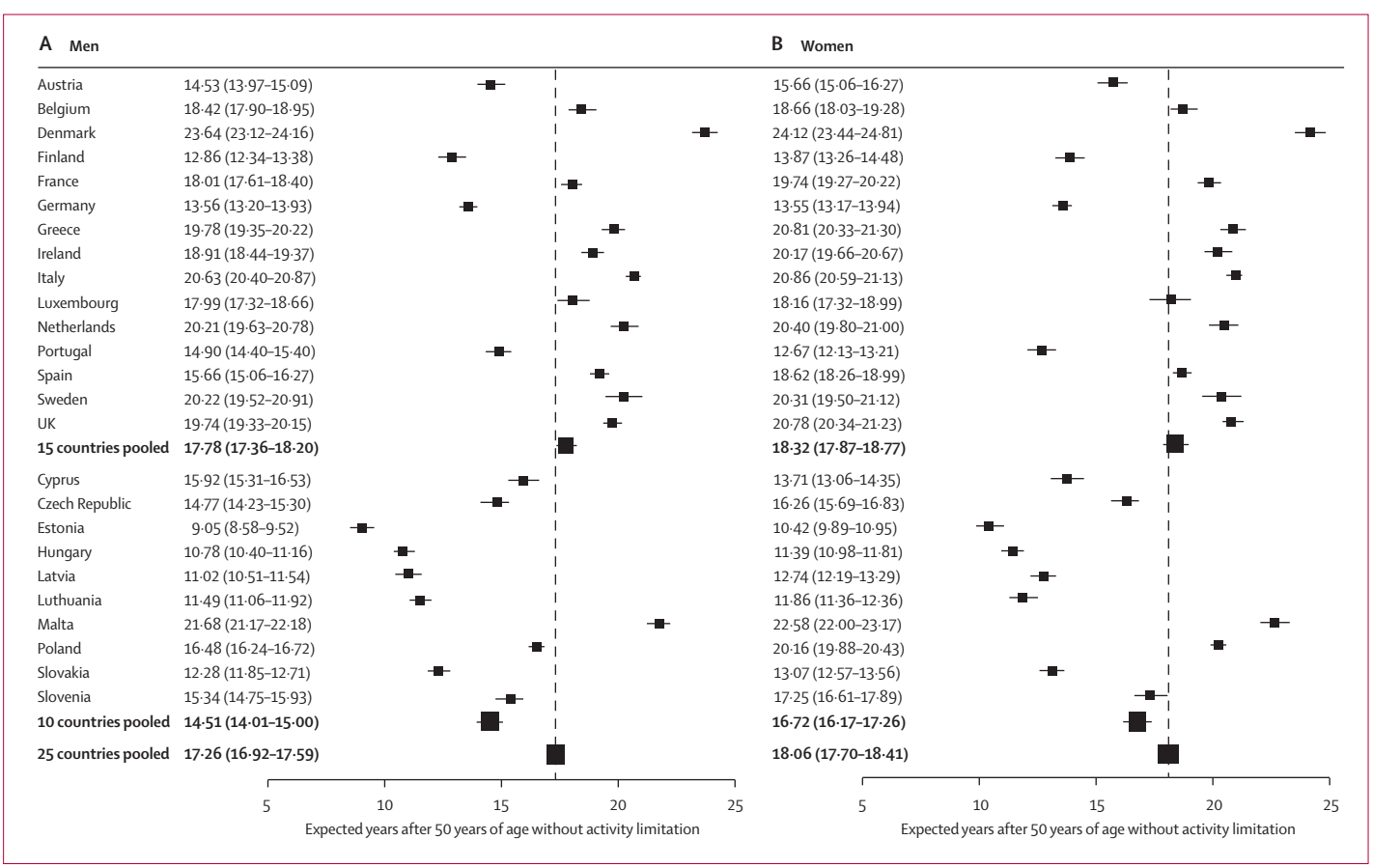


Figure 2: **Healthy life years by sex at 50 years of age for all 25 EU countries**
Data are mean (95% CI). The dotted line indicates the overall pooled average.

	Gross domestic product (per head)	Expenditure on elderly care (%)	Poverty risk for people ≥65 years (%)	Inequality of income distribution	Employment rate of older workers (%)		Long-term unemployment rate (%)		Mean exit age from labour force (years)		Life-long learning (%)		Low education attainment (%)
					Women	Men	Women	Men	Women	Men	Women	Men	
Austria	128·9	1·03%	14%	3·8	22·9%	41·3%	1·4%	1·2%	59·4	60·3	13·5%	12·3%	19·4%
Belgium	121·3	0·05%	21%	4·0	22·1%	41·7%	5·0%	3·8%	59·6	61·6	8·5%	8·2%	33·9%
Denmark	126·8	1·78%	18%	3·5	53·5%	65·6%	1·2%	1·1%	60·7	61·2	31·2%	23·6%	19·0%
Finland	115·3	0·71%	18%	3·6	52·7%	52·8%	1·9%	2·4%	61·7	61·8	26·1%	19·0%	21·2%
France	112·1	0·32%	16%	4·0	36·0%	41·6%	4·3%	3·3%	59·2	58·7	7·2%	7·0%	33·6%
Germany	115·3	0·34%	14%	3·8	37·5%	53·5%	5·3%	5·9%	61·4	61·8	7·4%	8·0%	16·9%
Greece	96·3	0·09%	28%	5·8	25·8%	58·8%	8·9%	2·6%	61·0	62·5	1·8%	1·9%	40·0%
Ireland	143·9	0·23%	33%	5·0	37·3%	65·7%	0·8%	1·9%	64·6	63·6	8·6%	6·2%	34·8%
Italy	105·3	0·12%	23%	5·6	20·8%	42·7%	5·2%	2·9%	58·8	60·7	6·2%	5·4%	49·6%
Luxembourg	264·6	..	7%	3·8	24·9%	38·3%	1·2%	1·2%	..	..	8·5%	8·5%	34·1%
Netherlands	131·3	0·87%	5%	4·0	35·2%	56·9%	1·9%	1·9%	61·4	61·6	16·1%	15·6%	28·2%
Portugal	75·5	0·25%	28%	6·9	43·7%	58·1%	4·2%	3·2%	63·8	62·4	4·2%	4·0%	73·5%
Spain	103·1	0·32%	29%	5·4	27·4%	59·7%	3·4%	1·4%	62·8	62·0	11·4%	9·7%	51·5%
Sweden	123·9	2·57%	11%	3·3	66·7%	72%	1·0%	1·4%	62·7	64·4	38·5%	28·5%	16·4%
UK	119·4	0·99%	26%	5·8	48·1%	66%	0·7%	1·3%	61·9	63·4	32·0%	23·0%	28·3%
EU15*	125·5 (41·8)	0·69% (0·73)	19% (8)	4·6 (1·1)	37·0% (13·7)	54·3% (10·9)	3·1% (2·4)	2·4 % (1·3)	61·4 (1·7)	61·9 (1·4)	14·7% (11·5)	12·1% (8·0)	33·4% (15·6)
Cyprus	92·7	0·01%	51%	4·3	31·5%	70·8%	1·7%	0·8%	..	..	6·3%	5·4%	33·4%
Czech Republic	76·7	0·34%	5%	3·7	30·9%	59·3%	5·3%	3·4%	59·1	62·3	5·9%	5·2%	10·1%
Estonia	63·0	0·09%	20%	5·9	53·7%	59·3%	4·2%	4·2%	..	..	7·3%	4·3%	10·9%
Hungary	64·3	0·38%	6%	4·0	26·7%	40·6%	3·2%	3·3%	58·7	61·2	4·6%	3·2%	23·6%
Latvia	50	0·14%	21%	6·7	45·3%	55·2%	3·7%	4·4%	..	..	10·6%	5·0%	15·5%
Lithuania	53·2	0·13%	17%	6·9	41·7%	59·1%	4·5%	4·2%	..	..	7·7%	4·2%	12·4%
Malta	77·5	0·56%	16%	4·1	12·4%	50·8%	3·2%	3·4%	..	..	4·5%	6·1%	74·7%
Poland	51·3	0·32%	7%	6·6	19·7%	35·9%	11·4%	9·3%	57·4	62·0	5·4%	4·3%	15·2%
Slovakia	60·6	0·22%	7%	3·9	15·6%	47·8%	12·3%	11·2%	57·6	61·1	5·0%	4·3%	12·1%
Slovenia	87	0·20%	20%	3·4	18·5%	43·1%	3·3%	2·9%	..	..	17·2%	13·6%	19·7%
EU10*	67·6 (15·1)	0·24% (0·16)	17% (14)	5·0 (1·4)	30·0% (13·7)	52·1% (10·6)	5·3% (3·6)	4·7% (3·1)	58·2 (0·8)	61·7 (0·6)	7·5% (3·9)	5·6% (2·9)	22·8% (19·6)
EU25*	102·4 (44·1)	0·50% (0·60)	18% (10)	4·7 (1·2)	34·0% (13·9)	53·5% (10·6)	4·0% (3·0)	3·3% (2·5)	60·7 (2·1)	61·8 (1·3)	11·8% (9·8)	9·5% (7·2)	29·1% (17·7)

EU15=15 established EU countries. EU10=ten newly joined EU countries. EU25=all 25 EU countries in 2005. *Data are mean (SD). Data were taken from the Eurostat website and not all indicators were collected or reported for every country.

Table 2: **Structural and sustainable indicators by country**

	Men		Women	
	Coefficient (SE)	p value	Coefficient (SE)	p value
Gross domestic product	0·04 (0·016)	0·013	0·04 (0·017)	0·039
Expenditure on elderly care	2·87 (1·262)	0·023	2·81 (1·295)	0·030
Poverty risk for people aged ≥65 years	0·05 (0·076)	0·486	−0·002 (0·078)	0·974
Inequality of income distribution	−0·70 (0·648)	0·277	−0·67 (0·660)	0·307
Employment rate of older workers	0·07 (0·075)	0·374	−0·04 (0·058)	0·543
Long-term unemployment rate	−0·68 (0·298)	0·023	−0·17 (0·267)	0·522
Mean exit age from labour force	0·53 (0·669)	0·430	0·20 (0·439)	0·643
Life-long learning	0·23 (0·101)	0·021	0·13 (0·079)	0·088
Low education attainment	0·10 (0·040)	0·010	0·07 (0·044)	0·105

For all models, the indicators were entered singly.

Table 3: **Results of meta-regression analyses assessing association between healthy life years at 50 years of age and the structural and sustainable indicators for all 25 EU countries**

HLYs at 50 years in both men and women in the 15 established EU countries, but a more than 13-year increase in the ten newly joined countries (table 4). In the ten newly joined EU countries, HLYs at 50 years were also significantly associated with mean exit age from the labour force in men ($p=0·033$) and employment rate of older women ($p=0·004$). Generally, all associations were in the direction that we expected, apart from low education attainment, for which countries with the lowest levels of poor education tended to have the lowest HLYs (table 2 and figure 1).

Discussion

Our results show that an average 50-year-old man in 2005 in the 25 EU countries could expect to live until 67·6 years free of activity limitation and a woman to 69·1 years.

	EU15				EU10			
	Men		Women		Men		Women	
	Coefficient (SE)	p value	Coefficient (SE)	p value	Coefficient (SE)	p value	Coefficient (SE)	p value
Gross domestic product	0·01 (0·020)	0·784	0·01 (0·022)	0·651	0·12 (0·076)	0·106	0·07 (0·091)	0·434
Expenditure on elderly care	1·34 (1·17)	0· 252	1·41 (1·28)	0·270	13·22 (6·579)	0·044	16·61 (6·482)	0·010
Poverty risk for people aged ≥65 years	0·03 (0·098)	0·797	0·02 (0·107)	0·887	0·03 (0·096)	0·739	–0·046 (0·103)	0·660
Inequality of income distribution	0·12 (0·75)	0·878	–0·25 (0·817)	0·764	–0·95 (0·876)	0·280	–0·63 (0·989)	0·521
Employment rate of older workers	0·10 (0·071)	0·168	0·01 (0·066)	0·871	–0·07 (0·123)	0·753	–0·21 (0·071)	0·004
Long-term unemployment rate	–1·07 (0·557)	0·056	–0·15 (0·379)	0·685	–0·13 (0·419)	0·759	0·18 (0·390)	0·638
Mean exit age from labour force	0·30 (0·614)	0·620	–0·36 (0·545)	0·504	3·63 (1·698)	0·033	–1·79 (3·048)	0·557
Life-long learning	0·10 (0·099)	0·323	0·08 (0·074)	0·262	0·42 (0·423)	0·323	–0·03 (0·364)	0·945
Low education attainment	–0·00 (0·052)	0·988	–0·04 (0·057)	0·492	0·15 (0·043)	0·001	0·13 (0·057)	0·026

For all models, the indicators were entered univariately. EU15=15 established EU countries. EU10=ten newly joined EU countries.

Table 4: **Results of meta-regression analyses assessing association between healthy life years at 50 years of age and the structural and sustainable indicators for EU country groups**

HLYs at 50 years of age showed a greater variability between countries than did life expectancy, and generally the more recently joined ten EU countries could expect fewer HLYs than could the more established 15 EU countries, although we did note some overlap. For ten countries, the age at which men can expect to live without activity limitation is less than 65 years, which is the official retirement age in most of the EU. After these ages, the average individual will be limited in their activities of daily living, reducing their capacity to work. That there are several countries—especially within the ten newly joined EU countries—with low HLYs at 50 years and in which men already retire early, suggests that ill-health could be a predominant factor in retirement. Efforts will be needed to increase health (and HLYs) in these countries if the target of increasing participation of older people into the labour force is to be met, but the same finding could arise in the more established 15 EU countries if official retirement ages are increased.

Within countries, there is increasing evidence of reduced healthy life expectancy in less privileged social groups.[15–21] The large differences in health that we recorded between countries are partly a manifestation of social, economic, and environmental factors, which are shown through the country-level associations detected between HLYs at 50 years and a range of structural indicators. We noted a strong relation between GDP and HLYs at 50 years, adding to previous published work on the link between GDP and health.[22–24] Per-head GDP is likely to affect health by easing access to many of the goods (eg, drugs, better lifestyles) and services (eg, health-care and social-care services) that contribute to improving health and longevity. However, evidence from several sources now suggests that, in addition to raising wealth, attention should be given to how wealth is distributed and used. Indeed, higher poverty conditions—either in absolute terms (eg, poverty rate) or relative terms (eg, inequality of income distribution)—are possibly associated with reduced life expectancy.[25] Much work has been done to investigate the effect of per-head GDP on health expenditure in the OECD countries.[26,27] Differences in per-head GDP could explain a greater proportion of health spending (eg, on elderly people) and on improved lifestyles (reduced levels of smoking, increased physical activity, improved nutrition), which in turn should lead to improved population health, explaining our findings of a positive relation between HLYs at 50 years and expenditure on elderly care. However, this finding should be viewed with caution, since the cross-national comparability of elderly care spending, as judged by the quality grade, is not at an optimum.

We noted evidence of a negative relation between HLYs at 50 years and male unemployment, in terms of long-term unemployment rate in the 25 EU countries in 2005 and mean exit age from the labour force in the ten newly joined EU countries. Unemployment is linked to poor health, and has been associated with increased mortality rates, especially from heart disease and suicide.[28] Although the connection between unemployment and health is not simple, and can partly be explained by the healthy worker effect, sufficient evidence suggests that employment is beneficial to health, and that this benefit is lost without paid work.[28]

Education is an important factor to explain extended life expectancy in the population.[29,30] Within every age group, people with more years of education make fewer demands on health care than do people with less years, although the magnitude of inequalities within countries in mortality and health by education are larger in some countries than in others, notably some of the ten newly joined EU countries.[31] However, more has to be done to understand the relation between education and health, especially in view of the difficulties in valuing inputs and outputs, for which no (monetary) metric exists to measure health outcomes, as well as possible reverse

causality.[32,33] We recorded a positive relation between HLYs at 50 years and life-long learning not only overall in men, but also, unexpectedly, between HLYs at 50 years and low education attainment. The first relation could be an indicator of the greater training opportunities available to men through work. The second relation only seems to apply to the ten newly joined EU countries that contain many former communist countries, in which most of the population were fairly highly educated. These findings suggest that the pathway between education and health is not straightforward.

Restrictions of this research lie mainly with the contemporaneous nature of the outcome and explanatory variables with the potential for ecological fallacy. This restriction will be overcome when trend data are available, since time lagged macro-level indicators can be examined alongside present data for HLYs, thus allowing for more realistic temporal relations. Other limitations are the still imperfect harmonisation of the health measure, the exclusion of the institutional population, the grouping of countries into 15 established and ten newly joined EU countries, and the general issues with meta-regression. That Denmark had the highest HLYs at 50 years for both men and women should be interpreted in view of the difference in response categories, since moderate levels of disability could be under-reported. However, exclusion of Denmark from analyses does not change our results and conclusions. Although optimum translation of the health measure—the global activity limitation index—was not attained, this index seems to satisfactorily indicate other objective and subjective health measures in a similar way within a subset of European countries (unpublished data). Most cross-national comparisons of healthy life expectancies are affected by the exclusion of people in institutional care from the general surveys providing the health measure, and the SILC survey is no exception. Institutional rates vary across the EU, with variations in definitions of what constitutes a care home further complicating the issue. Although the prevalence of disability is generally higher in institutional care than in households, the assumption of a similar prevalence in institutions and in households leads to a slight overestimate of HLYs. Assessment of these assumptions for estimates of disability-free life expectancy in France and the UK suggests that the effect is small, at less than half a year of disability-free life expectancy at 65 years of age, which is unlikely to affect our conclusions.[34,35]

Our grouping of countries into 15 established and ten newly joined EU countries is a simplification of the sociopolitical reality, and indeed we noted a substantial overlap in HLYs at 50 years across the groups. However, our finding that a 1% increase in spending on elderly care would result in a 1-year increase in HLY at 50 years in the 15 established EU countries compared with a 13-year increase in the ten newly joined EU countries draws attention to the dissimilarities. Moreover, problems exist when country-level data are used, primarily because although relations might be detected at the country level, these relations might not hold for individuals.[36] Within the debate about extension of working, this study cannot provide definitive conclusions about the link between healthy life and working life. Both men and women within the EU retire well before the official retirement age, and few move to part-time work in the period before retirement.[37] Although several factors have been shown to explain premature retirement,[38] debate remains about the extent to which people who could continue to work, being healthy and in employment, wish to extend their working life, even to improve pensions.

Meta-regression analyses have low power to detect associations.[39] We kept analyses simple since data were insufficient to support any complex multivariate models because the sample size was between 10 and 25 data-points. However, results still need to be interpreted with consideration of the sample size, since small studies are more prone to instability of estimates and might not have enough power to identify significant relations. Moreover, since this study was primarily an exploratory analyses to investigate which structural indicators might be associated with HLYs, many comparisons were made, increasing the possibility of a false positive relationship being recorded. Further, data are required, ideally for individuals, to confirm the significant associations that we report here, although our findings do give an insight into which indicators could potentially be important in explanation of the diversity in HLYs between countries.

In conclusion, we noted a large variation in the remaining years spent free of activity limitations in men and women at 50 years of age between the 25 EU countries in 2005, amounting to a difference of around 14 years of healthy life. Generally, citizens of the established European community (15 EU countries) have both longer and healthier lives than do most of those of the ten new EU countries. Although our findings are limited by only 1 year of data, in future years we will be able to compare whether countries are experiencing compression or expansion of morbidity similarly. A major target for Europe is that the employment rate for older workers (defined as 55–64 years of age) should reach 50% by 2010. However, the low HLYs at 50 years for some countries, especially those of the ten newly joined EU countries, coupled with already early retirement ages, suggest that this target will not be achieved in some countries unless substantial health improvements are made. The present work shows that monitoring HLYs can be used to assess whether such targets are realistic.

Contributors

CJ and JMR initiated the study. CJ, JMR, and CG undertook the analysis and drafted the report. FM, EC, HVO, and WN commented on drafts. All authors have seen and approved the final version.

Conflict of interest statement
We declare that we have no conflict of interest.

Acknowledgments
Members of the European Health and Life Expectancy Information System (EHLEIS) team are listed at http://www.ehemu.eu/index.php?option=aboutehemu#team. We thank Eurostat for their support.

References

1 Velkova A, Wolleswinkel-van den Bosch J, Mackenbach J. The East-West life expectancy gap: differences in mortality from conditions amenable to medical intervention. *Int J Epidemiol* 1997; **26:** 75–84.
2 Janssen F, Mackenbach JP, Kunst AE, NEDCOM. Trends in old-age mortality in seven European countries, 1950–1999. *J Clin Epidemiol* 2004; **57:** 203–16.
3 Sanders BS. Measuring community health levels. *Am J Public Health* 1964; **54:** 1063–70.
4 Fries JF. Aging, natural death, and the compression of the morbidity. *N Engl J Med* 1980; **303:** 130–35.
5 Gruenberg EM. The failures of success. *Milbank Mem Fund Q* 1977; **55:** 3–24.
6 Manton KG. Changing concepts of morbidity and mortality in the elderly population. *Milbank Mem Fund Q Health Soc* 1982; **60:** 183–244.
7 Lafortune G, Balestat G. Trends in severe disability among elderly people: assessing the evidence in 12 OECD countries and the future implications. Report number 26. Paris: Organisation for Economic Co-operation and Development, 2007.
8 Commission Communication to the Spring European Council. Working together for growth and jobs. A new start for the Lisbon Strategy. Brussels: Commission of the European Communities, 2005.
9 Robine JM, Romieu I, Michel JP. Trends in health expectancies. In: Robine JM, Jagger C, Mathers CD, Crimmins EM, Suzman RM, eds. Determining health expectancies. Chichester: John Wiley & Sons, 2003: 75–104.
10 Sullivan DF. A single index of mortality and morbidity. *Health Serv Ment Health Adm Health Rep* 1971; **86:** 347–54.
11 Robine JM, Jagger C, Euro-REVES Group. Creating a coherent set of indicators to monitor health across Europe: the Euro-REVES 2 project. *Eur J Public Health* 2003; **13** (suppl): 6–14.
12 Van Oyen H, Van der Heyden J, Perenboom R, Jagger C. Monitoring population disability: evaluation of a new Global Activity Limitation Indicator (GALI). *Soz Praventivmed* 2006; **51:** 153–61.
13 Jagger C. Health expectancy calculations by the Sullivan method: a practical guide. Nihon University Population Research Institute (NUPRI) Research Paper Series number 68. Nihon University: Tokyo, 1999.
14 Sutton AJ, Abrams KR. Bayesian methods in meta-analysis and evidence synthesis. *Stat Methods Med Res* 2001; **10:** 277–303.
15 Bajekal M. Healthy life expectancy by area deprivation: magnitude and trends in England, 1994–1999. *Health Stat* 2005; **25:** 18–27.
16 Cambois E, Robine JM, Hayward MD. Social inequalities in disability-free life expectancy in the French male population, 1980–1991. *Demography* 2001; **38:** 513–24.
17 Crimmins EM, Saito Y. Trends in healthy life expectancy in the United States, 1970–1990: gender, racial, and educational differences. *Soc Sci Med* 2001; **52:** 1629–41.
18 Guralnik JM, Ferrucci L. Assessing the building blocks of function: utilizing measures of functional limitation. *Am J Prev Med* 2003; **25** (suppl 2): 112–21.
19 Jagger C, Matthews R, Melzer D, Matthews F, Brayne C; MRC CFAS. Educational differences in the dynamics of disability incidence, recovery and mortality: findings from the MRC Cognitive Function and Ageing Study (MRC CFAS). *Int J Epidemiol* 2007; **36:** 358–65.
20 Matthews RJ, Jagger C, Hancock RM. Does socio-economic advantage lead to a longer, healthier old age? *Soc Sci Med* 2006; **62:** 2489–99.
21 Melzer D, McWilliams B, Brayne C, Johnson T, Bond J. Socioeconomic status and the expectation of disability in old age: estimates for England. *J Epidemiol Community Health* 2000; **54:** 286–92.
22 Cutler DM, Deaton DS, Lleras-Muney A. The determinants of mortality. *J Econ Perspect* 2006; **20:** 71–96.
23 Murthy N. Health status and income inequality: evidence from OECD countries. *Atl Econ J* 2006; **34:** 237–38.
24 Subramaniam SV, Belli P, Kawachi I. The macro-determinants of health. *Ann Rev Public Health* 2002; **23:** 287–302.
25 Wilkinson RG. Income distribution and life expectancy. *BMJ* 1992; **304:** 165–68.
26 Baltagi B, Moscone F. Health expenditure in the OECD: evidence from panel data. Leicester: University of Leicester (mimeo), 2008.
27 Newhouse JP. Medical care expenditure: a cross-national survey. *J Hum Res* 1977; **12:** 115–25.
28 Beland F, Birch S, Stoddart SG. Unemployment and health: contextual level influences on the production of health in populations. *Soc Sci Med* 2002: **55:** 2033–52.
29 Grabauskas V, Kalediene R. Tackling social inequality through the development of health policy in Lithuania. *Scand J Public Health* 2002; **30:** 12–19.
30 Williamson JB, Boehmer U. Female life expectancy, gender stratification, and level of economic development: a cross national study of less developed countries. *Soc Sci Med* 1997; **45:** 305–17.
31 Mackenback JP, Stirbu I, Roskam A-JR, et al. Socioeconomic inequalities in health in 22 European countries. *N Engl J Med* 2008; **358:** 2468–81.
32 Acemoglu D, Johnson S, Robinson J. Disease and development in historical perspective. *J Eur Econ Assoc* 2003: **1:** 397–405.
33 Hunt-McCool J, Bishop D. Health Economics and the economics of education: specialisation and division of labor. *Econ Educ Rev* 1998; **17:** 237–44.
34 Cambois E, Clavel A, Romieu I, Robine JM. Trends in Disability-free life expectancy at age 65 in France: consistent and diverging patterns according to the underlying disability measure. *Eur J Ageing* (in press).
35 Breakwell C, Bajekal M. Review of sources and methods to monitor healthy life expectancy. *Health Stat* 2005; **26:** 17–22.
36 Riley RD, Simmonds MC, Look MP. Evidence synthesis combining individual patient data and aggregate data: a systematic review identified current practice and possible methods. *J Clin Epidemiol* 2007; **60:** 431–39.
37 Romans F. The transition of women and men from work to retirement. Statistics in focus. Population and social conditions. Eurostat, 97/2007. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-07-097/EN/KS-SF-07-097-EN.PDF (accessed Oct 29, 2008).
38 Siegrist J, Wahrendorf M, Knesebeck Ovd, Jürges H, Börsch-Supan A. Quality of work, well-being and intended early retirement of older employees—baseline results from the SHARE study. *Eur J Public Health* 2007; **17:** 62–68.
39 Lambert PC, Sutton AJ, Jones DR. A comparison of summary patient-level covariates in meta-regression with individual patient data meta-analysis. *J Clin Epidemiol* 2002; **55:** 86–94.