Research Note

Future trends in life expectancies in the European Union

by Joop de Beer

Abstract:

In all member states of the European Union life expectancy has increased during the last decades. Since 1980 the average annual increase in life expectancy at birth in the EU25 countries has been slightly under 0.2 years. There is general agreement among demographers that life expectancy will continue to rise. There is, however, no agreement how fast and to what level life expectancy will grow. Some experts expect that life expectancy will continue to rise by 2 years per decade and that this increase will continue for many years. Others claim that the increase will slow down as they expect that there is a limit to the growth in life expectancy. Another point of discussion is whether or not differences in life expectancy across European countries will become smaller.

This is not just an academic debate. The issue is very relevant for policy makers as alternative projections of future changes in life expectancy lead to quite different projections of the future number of elderly people which make quite a difference for assessing the future costs of ageing due to e.g. pensions and health care. Evidently not only the average increase in the European Union is relevant. At least as important is the question whether changes will be similar across the member states of the European Union.

Even though there has been a continuous rise of life expectancy at birth for several decades in most European countries, there have been variations in the pace of increase over time and across countries. In almost all EU member states the average annual increase in recent years has been lower than in the previous decades. This does not necessarily imply that we are approaching a limit to the growth in life expectancy. The slowing down of the pace of increase may be temporary. But at least one should be cautious in taking a linear increase in life expectancy for granted.

Another reason why a linear increase in life expectancy is not certain at all is that there are changes in the underlying causes of death and age pattern of mortality. One important factor explaining the increase in life expectancy during the last decades has been the strong decrease in mortality from cardiovascular diseases in late middle age. Consequently death has increasingly been delayed to advanced ages. Further substantial increases in life expectancy can be achieved only through a strong reduction in mortality at advanced ages. It is not self-evident that this would result in the same pace of change in life expectancy at birth as in the last decades. Mortality at advanced age often cannot simply be attributed to one single disease, but rather to frailty leading to comorbidity. Thus medical advance in the treatment of one disease may lead to only a limited gain in the duration of life as the patient may die from another disease. Moreover, whereas medical progress and improvement of living conditions have led and probably will continue to lead to an increase in life expectancy it is much more uncertain what the effect of life styles (smoking, diet, physical exercise, use of alcohol) will be. The decline in smoking in the 1970s and 1980s had a favourable impact on life expectancy. However, the current increase in the prevalence of obesity may well have adverse effects on future life expectancy. Thus even though medical advances may contribute to a further rise in life expectancy, unhealthy behaviour may have a restraining effect.

This Research Note has been produced for the European Commission by Joop de Beer (NIDI) on behalf of the Demography network of the European Observatory on the Social Situation and Demography. The views expressed are those of the author and do not necessarily represent those of the European Commission.

European Commission
Directorate-General "Employment, Social Affairs and Equal Opportunities"
Unit E1 - Social and Demographic Analysis

Manuscript completed in August 2006

European Commission

Future trends in life expectancies in the European Union[1]

1. Introduction

Debate about future trends in life expectancy in European countries…

In all member states of the European Union life expectancy[2] has increased during the last decades. Nevertheless there are still big differences in life expectancy among the EU25 countries. Life expectancy at birth of men ranges from 66 years in the Baltic countries to 78 years in Sweden, and life expectancy of women ranges from 76 years in Latvia to almost 84 years in Spain and France. Since 1980 the average annual increase in life expectancy at birth in the EU25 countries has been slightly under 0.2 years.

There is consensus among demographers that life expectancy will continue to grow. There is, however, no agreement among experts how long the increase will continue and what level of life expectancy can be reached. Some experts say that the almost linear increase in life expectancy is going to continue in the years to come and that life expectancy will increase by some two years per decade. Thus life expectancy at birth of women in several countries may reach the level of 100 years in the second half of this century. Others expect the increase to level off as they claim that there is a limit to the growth in life expectancy. Another point of discussion is whether differences in life expectancy between European countries will become smaller in the future or whether differences will be persistent or even increase.

…requires analysis of underlying changes

In order to assess the plausibility of assumptions on future changes in life expectancy it is necessary to examine past trends in mortality and to analyse determinants of these trends. Section 2 of this research note describes past trends in life expectancy in the EU member states. Particularly attention is given to analyses of differences across European countries, underlying changes in age patterns of mortality and differences between women and men. Section 3 examines determinants of the changes and differences in life expectancy. Attention is given to both effects of medical progress and changes in lifestyle. On the basis of these analyses section 4 discusses the question how likely a continuation of past trends in life expectancy is and whether one may expect differences between men and women as well as differences across European countries to decrease. Finally section 5 summarizes the main conclusions.

2. Trends in life expectancy

Life expectancy at birth has increased

Life expectancy has increased enormously in the 20th century. In the early 1900s life expectancy at birth was around 50 years in most European countries. Around the year 2000 life expectancy at birth for men was around 75 years and for women around 81 years. In the first half of the 20th century the increase in life expectancy was mainly caused by the decline in mortality from communicable diseases at young ages. During the last fifty years mortality has shifted towards older ages. Degenerative and man-made diseases have become the main causes of death. Mortality at older ages has declined, mainly due to decreasing mortality rates from cardiovascular diseases.

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[2] Life expectancy at birth is the most widely used indicator for comparing mortality levels over time and across countries. Life expectancy at birth in a given year can be interpreted as the average duration of life of a (hypothetical) population that would experience the age-specific mortality rates measured in that particular year during their lifetime. Usually separate life expectancies for men and women are calculated. Life expectancy at birth reflects the level of mortality rates across all ages. Alternatively one may calculate life expectancies at older ages which reflect the level of mortality rates at older ages only.

Even though there has been a considerable rise in life expectancy over a long period of time, there were periods with less favourable developments as well. For example, in many European countries there were unfavourable developments in life expectancy of men in the 1960s. This can be related to the changes in lifestyle after the Second World War, particularly smoking and unhealthy diet. This led to a strong increase in cancer, ischemic heart diseases and cerebrovascular diseases at relatively young ages, which had a negative effect on life expectancy. Since the 1970s life expectancy has increased, particularly due to a decline in mortality from cardiovascular diseases. In Central European countries developments in life expectancy in the 1990s were not very positive after the break up of communist regimes. Both unhealthy behaviour and the decay of the medical system contributed to this development.

Differences in life expectancy across European countries

European countries in which life expectancy around 1960 was high, generally experienced smaller increases in life expectancy than countries with lower life expectancy. In 1960 life expectancy was higher in Northern Western European countries than in Southern European countries. In the latter countries the rise of life expectancy has been higher since. However this does not imply that there has been a convergence, as the increase in life expectancy of women in Spain, France and Italy have continued to increase even after the gap was closed. Consequently at present in these countries life expectancy of women is higher than in all other European countries.

Spain and France have taken the lead

The ranking of the EU25 member states has changed considerably since 1980 (see table 1). Whereas in 1980 the Netherlands had the highest life expectancy for women, since then the Netherlands has dropped to the 12th place in the ranking. Denmark has fallen from 7th to 18th place. Spain and France have taken the lead position for women. In the ranking for men Sweden has kept its first place. The Netherlands have dropped from the 2nd to the 5th place, while Denmark fell from the 6th to the 15th place. There were favourable developments in Italy, jumping from 7th to 3rd place. Central European countries have stayed at the bottom of the table, both for men and women.

1. Life expectancy at birth in EU25 countries

	Men					Women				
	Ranking in 1980			**Ranking in 2004**			**Ranking in 1980**			**Ranking in 2004**	
1	Sweden	72.8	1	Sweden	78.3	1	Netherlands	79.3	1	Spain	83.8
2	Netherlands	72.7	2	Spain	77.2	2	Sweden	78.8	2	France	83.8
3	Spain	72.5	3	Italy	*77.0*	3	Spain	78.6	3	Italy	*82.7*
4	Cyprus	72.3	4	Malta	76.9	4	France	78.4	4	Sweden	82.6
5	Greece	72.2	5	Netherlands	76.9	5	Finland	77.6	5	Finland	82.2
6	Denmark	71.2	6	France	76.7	6	Italy	77.4	6	Luxembourg	82.2
7	Italy	70.6	7	Cyprus	76.6	7	Denmark	77.3	7	Germany	82.1
8	France	70.2	8	Greece	76.6	8	Cyprus	77.0	8	Austria	82.1
9	United Kingdom	70.2	9	Germany	76.5	9	Belgium	76.8	9	Belgium	*81.9*
10	Ireland	70.1	10	United Kingdom	*76.5*	10	Greece	76.8	10	Cyprus	81.7
11	Belgium	70.0	11	Austria	76.4	11	United Kingdom	76.2	11	Portugal	81.4
12	Germany	69.6	12	Ireland	76.4	12	Germany	76.1	12	Netherlands	81.4
13	Finland	69.2	13	Belgium	*76.2*	13	Austria	76.0	13	Greece	81.4
14	Luxembourg	69.1	14	Luxembourg	76.0	14	Luxembourg	75.9	14	Ireland	81.2
15	Austria	69.0	15	Denmark	75.4	15	Ireland	75.6	15	United Kingdom	*80.9*
16	Malta	68.5	16	Finland	75.3	16	Lithuania	75.4	16	Malta	*80.9*
17	Portugal	67.7	17	Portugal	74.9	17	Poland	75.4	17	Slovenia	80.7
18	Slovenia	67.4	18	Slovenia	73.5	18	Portugal	75.2	18	Denmark	80.1
19	Poland	66.9	19	Czech Republic	72.6	19	Slovenia	75.2	19	Czech Republic	79.2
20	Czech Republic	66.8	20	Poland	70.6	20	Slovakia	74.3	20	Poland	79.2
21	Slovakia	66.8	21	Slovakia	70.3	21	Latvia	74.2	21	Slovakia	78.0
22	Lithuania	65.5	22	Hungary	68.7	22	Estonia	74.1	22	Lithuania	77.7
23	Hungary	65.5	23	Estonia	*66.6*	23	Czech Republic	73.9	23	Estonia	*77.5*
24	Estonia	64.1	24	Lithuania	66.3	24	Hungary	72.7	24	Hungary	77.2
25	Latvia	63.6	25	Latvia	65.9	25	Malta	72.7	25	Latvia	76.2

Note. Italic numbers are estimated

Convergence or divergence?

The gap in life expectancy between the EU25 countries with the highest and lowest levels has increased since 1980. For men this gap has increased from 9 years in 1980 to 12 years in 2004. For women there was a smaller increase, from 7 to 8 years. This may suggest that there has been a diverging rather than a converging trend in life expectancy among European countries. However, this

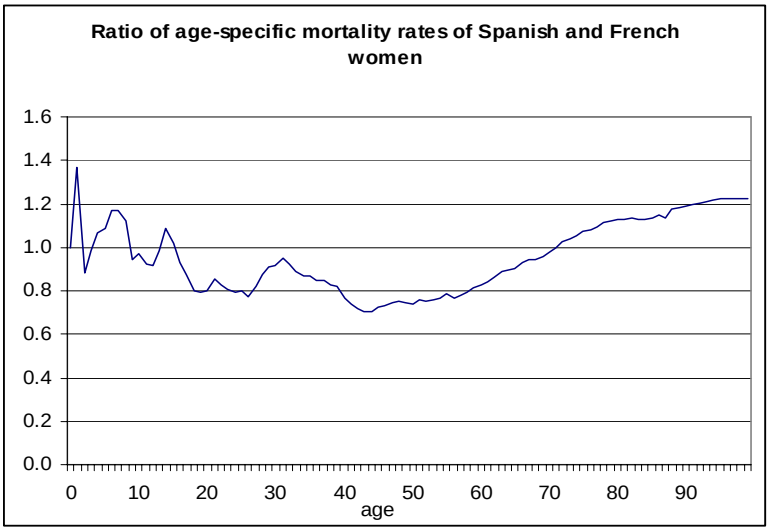
has been no general tendency. The increasing gap was mainly caused by the difference between the EU15 countries on the one hand and the new member states on the other. Whereas in Central European countries life expectancy at birth in 1980 was lower than in the EU15 countries, the pace of increase since has been smaller as well.

Among the EU15 countries the difference in life expectancy has declined, at least between Sweden and Portugal, the countries with the highest and lowest life expectancy of men respectively. This suggests convergence, but looking at the countries in between, the picture is less clear. Whereas differences between several countries have declined (e.g. Sweden and Italy), differences between other countries have increased (e.g. Sweden and the Netherlands).

For women the six EU15 countries with the lowest life expectancy in 1980 have experienced the strongest increase since. This has led to some convergence, but the difference between the countries with the highest and lowest life expectancies in 2004 was hardly smaller than that in 1980. This was mainly due to the unfavourable development in Denmark that has dropped to the bottom of the ranking of EU15 countries in 2004. Furthermore, the Netherlands has fallen from the 1st place to a place below average. Thus there has been no over-all convergence.

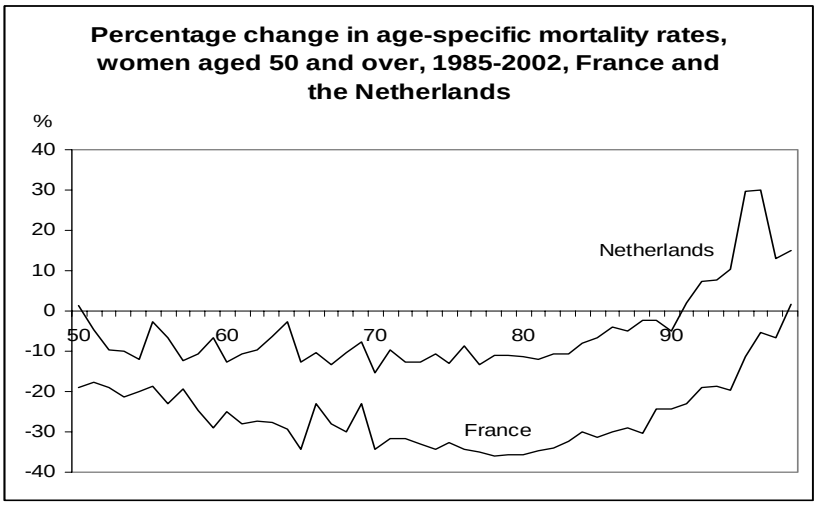
Differences in underlying age pattern

Even if life expectancies at birth in two countries are similar this does not imply that there are no differences in mortality patterns. For example, even though life expectancies at birth of women in France and Spain are equal, age-specific mortality rates in both countries differ. In Spain mortality rates below age 70 are lower than in France, whereas mortality rates above that age are higher than in France. As a consequence, the level of the survival curve of Spanish women until age 80 is higher than that in France, but lower at older ages. The median age at dying as measured by the survival curve is in France higher than in Spain. Thus even if countries have reached the same level of life expectancy at birth this does not necessarily imply complete convergence of mortality patterns.



Mortality at advanced ages has decreased

Since 1950 there has been a decrease in mortality among those aged 80 and over, with a convergence in the mortality level between countries over time (Janssen et al., 2004). Around 2000 the differences in mortality rates at ages 80 or over were considerably smaller than around 1950, due to the fact that on average the decline in mortality was relatively high in countries in which mortality rates around 1950 were relatively high. However, there was large heterogeneity in the pace of decline. Whereas there was a continuous decline of mortality rates at advanced ages in France, since the 1980s there was stagnation (i.e. small mortality declines or even increases) in Denmark and the Netherlands.



The pace of increase in life expectancy seems to slow down

During the last three decades the average annual increase in life expectancy at birth in EU countries has been 0.2 years. However, in recent years the average annual increase has been lower than in previous years. Table 2 shows that in almost all EU member states the annual average increase in life expectancy in 2000-2004 has been lower than in the 1990s for both men and women. Thus the pace of increase in life expectancy seems to be slowing down.

2. Average annual increase in life expectancy at birth							
	men				women		
	1980-1990	1990-2000	2000-2004		1980-1990	1990-2000	2000-2004
Austria	0.32	0.29	0.13		0.28	0.23	0.10
Belgium	0.27	0.19	0.08		0.26	0.14	0.07
Cyprus	0.18	0.16	0.10		0.16	0.21	0.07
Czech Republic	0.08	0.41	0.10		0.15	0.30	0.02
Denmark	0.08	0.25	0.05		0.04	0.16	0.00
Estonia	0.06	0.09	-0.17		0.08	0.15	0.00
Finland	0.17	0.33	0.10		0.13	0.21	0.13
France	0.26	0.25	0.05		0.25	0.18	0.05
Germany	0.24	0.30	0.15		0.23	0.26	0.07
Greece	0.24	0.09	-0.02		0.27	0.11	0.03
Hungary	-0.04	0.23	0.17		0.10	0.22	0.13
Ireland	0.20	0.18	0.20		0.20	0.15	0.15
Italy	0.30	0.30	0.03		0.27	0.24	0.07
Latvia	0.07	0.07	-0.05		0.04	0.15	-0.05
Lithuania	0.09	0.04	-0.20		0.08	0.12	0.02
Luxembourg	0.32	0.25	0.10		0.26	0.26	-0.10
Malta	0.52	0.26	-0.05		0.54	0.23	0.13
Netherlands	0.11	0.17	0.07		0.16	-0.04	0.05
Poland	-0.02	0.30	0.13		0.09	0.16	0.10
Portugal	0.27	0.28	0.07		0.22	0.26	0.07
Slovakia	-0.02	0.26	0.10		0.11	0.20	0.07
Slovenia	0.21	0.28	0.00		0.22	0.23	0.15
Spain	0.08	0.24	-0.03		0.17	0.22	0.10
Sweden	0.20	0.26	0.05		0.16	0.16	0.02
United Kingdom	0.27	0.26	0.05		0.23	0.17	0.05

The gender gap in life expectancy became smaller

In all European countries life expectancy at birth of women is higher than that of men. However, the magnitude of the gender gap widely differs among countries. It ranges from 4 years in Malta to over 10 years in the Baltic countries (see table 3). Moreover, the gender gap has changed over time. In the 1960s the gender gap increased due to the unfavourable development of mortality of men. As women had a more healthy life style, life expectancy of women increased during that period. Around 1980 the gender difference started to decline in North Western European countries and since the mid 1990s the gender gap has reduced in France and in Southern European countries as well.

The decrease in the gender gap is caused both by a slowing down in the increase in life expectancy of women and a stronger increase in life expectancy of men. One explanation of the slowing down in life expectancy of women is that they more or less follow the less healthy life style patterns of men. Another explanation is that women are approaching the limit to further improvements in mortality risks as they already have attained low mortality levels. One explanation of the acceleration for men is the strong decrease in the prevalence of smoking since the 1960s.

3. Difference between life expectancy at birth of women and men

	1960	1990	2004
Malta	4.0	4.4	3.9
Sweden	3.7	5.6	4.3
United Kingdom	5.8	5.6	4.4
Netherlands	3.8	7.1	4.5
Denmark	4.0	5.7	4.7
Greece	5.1	4.9	4.8
Ireland	3.8	5.5	4.8
Cyprus	4.1	4.5	5.1
Italy	5.1	6.5	5.6
Germany	4.8	6.4	5.6
Belgium	5.8	6.7	5.7
Austria	6.5	6.6	5.7
Luxembourg	5.7	6.2	6.3
Portugal	5.6	7.0	6.5
Spain	4.8	7.0	6.6
Czech Republic	5.5	7.8	6.6
Finland	7.0	8.0	6.9
France	6.7	8.1	7.1
Slovenia	5.9	7.9	7.2
Slovakia	4.3	8.8	7.7
Hungary	4.2	8.6	8.4
Poland	5.7	9.6	8.6
Latvia	7.2	10.3	10.3
Estonia	7.3	10.2	10.8
Lithuania	6.5	9.8	11.4

Longer life is not necessarily healthier life

Differences in life expectancy across countries give some indication on differences in health status. However, there is no perfect correlation between both, as not all years are spent in good health. Similarly, an increase in life expectancy over time does not necessarily imply that all years gained are spent in good health. For that reason, healthy life expectancies can be calculated. They estimate the number of life years that are spent in good health[3].

As most unhealthy years are spent at older ages it is useful to look at life expectancy at age 60 rather than at birth. The highest life expectancy at age 60 is observed among French women who at that age may expect to live another 25.7 years, of which they will spend 19.1 years in good health (see table 4). The ranking of EU member countries by healthy life expectancy differs from that of total life expectancy at age 60. For example, the life expectancy of Swedish women aged 60 is one year lower than that of Spanish women, but their healthy life expectancy is slightly higher. This indicates that differences in life expectancy cannot fully be explained by differences in health status.

[3] The WHO publishes the Health Adjusted Life Expectancy (HALE) which is based on the prevalence of disability at each age. It can be interpreted as the expected number of years in full health based on current mortality and disability rates.

The difference in healthy life expectancy at 60 between women and men is about 1 to 2 years smaller than that in total life expectancy. Thus part of the gender gap is caused by years spent in bad health. Nevertheless more than half of the difference in life expectancy is spent in good health. Thus women have both more healthy and unhealthy life years than men.

4. Life expectancy and healthy life expectancy at age 60, 2001

	Men					Women				
	Ranking of life expectancy at 60			Ranking of healthy life expectancy at 60			Ranking of life expectancy at 60			Ranking of healthy life expectancy at 60	
1	Sweden	20.9	1	Sweden	16.5	1	France	25.7	1	France	19.1
2	Italy	20.7	2	France	16.1	2	Spain	25.2	2	Sweden	18.5
3	France	20.6	3	Austria	15.7	3	Italy	25.0	3	Austria	18.5
4	Spain	20.6	4	Greece	15.7	4	Sweden	24.3	4	Luxembourg	18.3
5	Greece	20.3	5	Italy	15.5	5	Austria	24.1	5	Spain	18.2
6	Austria	20.1	6	Denmark	15.5	6	Belgium	24.0	6	Italy	18.2
7	Germany	19.8	7	Spain	15.2	7	Finland	23.9	7	Finland	18.1
8	Luxembou	19.7	8	Finland	15.2	8	Germany	23.9	8	Belgium	17.8
9	United Kin	19.7	9	Luxembourg	15.1	9	Luxembourg	23.7	9	Germany	17.7
10	Belgium	19.6	10	Netherlands	15.0	10	Netherlands	23.5	10	Netherlands	17.3
11	Cyprus	19.5	11	Germany	15.0	11	Portugal	23.2	11	Greece	17.1
12	Malta	19.5	12	United Kingdom	15.0	12	Greece	23.2	12	United Kingdom	16.9
13	Finland	19.4	13	Belgium	14.8	13	United Kingdom	23.1	13	Denmark	16.7
14	Netherland	19.4	14	Malta	14.3	14	Slovenia	23.0	14	Slovenia	16.6
15	Portugal	19.3	15	Ireland	13.9	15	Malta	22.8	15	Malta	16.5
16	Denmark	19.0	16	Portugal	13.4	16	Cyprus	22.6	16	Portugal	16.2
17	Ireland	18.9	17	Slovenia	13.3	17	Ireland	22.5	17	Ireland	16.1
18	Slovenia	17.9	18	Cyprus	13.2	18	Denmark	22.4	18	Czech Republic	16.0
19	Czech Rep	17.3	19	Czech Republic	12.8	19	Poland	21.7	19	Estonia	15.0
20	Poland	17.0	20	Poland	11.9	20	Lithuania	21.7	20	Lithuania	14.8
21	Lithuania	16.3	21	Slovakia	11.5	21	Czech Republic	21.4	21	Poland	14.6
22	Slovakia	16.0	22	Estonia	11.1	22	Estonia	21.2	22	Slovakia	14.6
23	Hungary	15.9	23	Lithuania	11.0	23	Slovakia	20.9	23	Cyprus	14.5
24	Estonia	15.3	24	Hungary	10.4	24	Latvia	20.7	24	Latvia	14.4
25	Latvia	15.1	25	Latvia	10.0	25	Hungary	20.6	25	Hungary	14.4

3. Determinants of trends in mortality

In order to assess the likelihood of assumptions on future changes in life expectancy it is important to examine the determinants of changes in mortality. Three groups of determinants can be distinguished: economic conditions, life style and medical progress. In assessing the effects of these factors it is important to note that these factors are not independent of each other. For example, life style and use of medical care differ strongly by socio-economic status.

Positive relationship between wealth and life expectancy

Socio-economic developments are a key factor in explaining changes in mortality over time. In analysing mortality trends in seven European countries during the second half of the 20th century, Janssen (2005) found that there is a positive relationship between the level of GDP and life expectancy. In addition to explaining changes in life expectancy over time and differences across countries, socio-economic factors explain differences in mortality within countries as well. Many studies have shown that differences in life expectancy between groups with low and high socio-economic status are very large. During the last decades in many developed countries the differences even seem to have increased (Mackenbach, et al., 2003). The differences are smaller for women than for men.

Life style causes large differences in life expectancy

Differences in life style are to an important extent responsible for geographic and socio-economic differences in life expectancy. Smoking, diet and physical activity are the most important aspects of life style affecting life expectancy. The healthy Mediterranean diet may be one explanation of the relatively high life expectancy in Spain and Italy.

Life style is strongly related with socio-economic status and thus one of the main explanations of the strong differences in mortality by socio-economic status. Life style is also the main explanation for changes in the difference in mortality between women and men. As differences in healthy behaviour between men and women have become smaller, the differences in life expectancy between men and women have reduced, and the remaining sex differential can increasingly be attributed to biological sex differences.

Smoking is known for its strong negative effect on survival (e.g. Peto et al., 2000). The increase in the proportion of smokers among men in the 1950s and the subsequent decrease since the 1960s is one important factor in explaining the unfavourable development of life expectancy of men in the 1960s and the favourable development since the 1970s. The decrease in difference in smoking between men and women since the 1960s may be one explanation of the decrease in the gender gap in life expectancy between men and women. Several studies suggest that the effect of overweight on life expectancy may be as unfavorable as that of smoking. For example, Peeters et al. (2003) estimate that life expectancy at age 40 of obese people is 7 years lower than that of people with normal weight. The role of alcohol is less straightforward than that of smoking, as alcohol has both positive and negative effects on health. Excessive alcohol use has a negative impact on mortality, whereas moderate use has a positive impact on cardiovascular diseases (Doll et al., 1994).

Medical advances have delayed mortality

Medical improvement has led to a strong increase in the probability of survival of people with serious health problems. More effective medicines and improved surgery have reduced the probability of dying by cardiovascular diseases and several types of cancer. As a consequence mortality from cardiovascular diseases have not only declined, but also have led to an increase in the age at which people die from cardiovascular diseases.

Determinants may have long-lasting effects

In identifying determinants of trends in mortality it is important to distinguish between period and cohort effects (e.g. Caselli et al., 1987). Period effects refer to current conditions that have an immediate effect on mortality, whereas cohort effects reflect long-lasting effects of determinants earlier in the life course. Barker (1995) argued that there is a relationship between conditions in uterus and in the first life year on the prevalence of heart disease at middle and old age. This suggests that the improvement of the conditions of pregnant women during the 20th century is one explanation of the decrease of mortality from heart diseases at middle age. Janssen and Kunst (2005) found that living conditions in childhood and smoking in adulthood are important factors in explaining changes in mortality among the elderly across cohorts. Improvements in living conditions in early life have a favourable effect on mortality from infectious diseases, cerebrovascular diseases and stomach cancer at older ages, whereas a decrease in the exposure to smoking has a favourable effect on mortality from lung cancer and COPD. Due to differences in the development of smoking among adults, cohort effects differ between countries. Moreover, Janssen (2005) found that there was a negative correlation between GDP at earlier age and the level of mortality at older age of the same cohorts. Socio-economic circumstances during adulthood and middle age seem important in determining old-age mortality.

4. What are the likely future trends?

On the basis of the analysis of past trends and cross-country differences in life expectancy in section 2 and a concise overview of the main determinants of changes and differences in section 3, this section assesses which future trends are likely.

Optimistic or pessimistic?

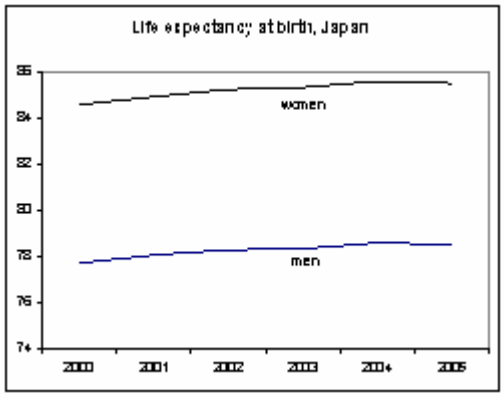
Among mortality experts there is much debate about the question whether we are approaching a limit to the growth in life expectancy. Some experts claim that due to biological and practical constraints to reductions in mortality the limit to life expectancy is approached and as a consequence in the future life expectancy will rise more slowly than it used to in the past (e.g. Olshansky et al., 2001). In contrast, other researchers argue that life expectancy will continue to increase because life expectancy has been increasing continuously for over one century and a half and will continue to do so as there will be biomedical progress. They note that past mortality projections, assuming that life expectancy is approaching a limit, have repeatedly been proven too pessimistic (e.g. Manton et al., 1991; Oeppen and Vaupel, 2002).

Oeppen and Vaupel (2002) conclude from a time series of record life expectancies (i.e. for each year they take the life expectancy at birth of the country with the highest level in that year) that life

expectancy has increased by about 2.5 years per decade and that there are no signs of a levelling off of this trend.

Record life expectancy has been that of Japanese women for two decades now. At present life expectancy at birth of women in Japan equals 85.5 years. In 1980 this was 78.8 years, so life expectancy of women has risen by 0.25 years on average. Table 4 shows that the pace of increase in life expectancy of Japanese women has slowed down in recent years. In 2005 there even was a slight decline. Thus the question is whether the historic strong increase during the last decades in Japan will continue in the future. This does not necessarily imply that we are approaching a limit to the growth in life expectancy. The slowing down of the pace of increase may be temporary. But at least one should be cautious in taking a linear increase in life expectancy for granted.

Bongaarts (2006) notes that life expectancy at birth has risen more slowly in recent decades than before. Before 1950 life expectancy improved mainly by a strong decline in mortality at young ages, whereas during the last decades a decline in mortality at advanced ages has been the main source of increases in life expectancy. This had led to a slowing down in the rise of life expectancy. Bongaarts estimates that the increase in life expectancy at birth due to reductions in mortality at advanced ages equals 1.5 years per decade. Thus, even though he expects the increase in life expectancy to continue for several decades, he expects that the rate of increase will be smaller than the optimistic scenario of Oeppen and Vaupel.



4. Average annual increase in life expectancy at birth, Japan		
	Men	Women
1970-1980	0.40	0.41
1980-1990	0.26	0.31
1990-2000	0.18	0.27
2000-2005	0.16	0.18

Eurostat assumes a slowing down of the increase in life expectancy…

In the latest Eurostat population projections for the 25 Member States, published under the acronym EUROPOP2004[4] (Lanzieri, 2006), it is assumed that the average annual increase of life expectancy at birth in the first half of the 21st century will equal around 0.15 years for men and 0.10 years for women. This is lower than the average increase during the last four decades. Since 1960 the average annual increase in life expectancy at birth in the EU15 countries has been 0.2 years, whereas for those countries an average annual increase of 0.12 until 2050 is assumed. Thus a slowing down of the increase is assumed. This is consistent with the finding that in recent years the pace of increase in life expectancy, particularly for women, seems to have slowed down.

[4] EUROPOP2004 = EUROstat Population Projections 2004-based

… and a converging trend between new member states and EU15 countries

Eurostat assumes that the future increase in life expectancy at birth in the new member states, where current life expectancy is low, will be higher than in the EU15 countries (Lanzieri, 2006). As a result, differences between countries with the lowest and highest life expectancies will become smaller (see table 5). Hence a converging trend is assumed.

However, no convergence in the trend of all EU member states is assumed. For example, whereas current life expectancy at birth of women in France and Italy is more than two years higher than in the Netherlands, it is assumed that life expectancy in the former two countries will increase by 3 years more than in the Netherlands until 2050. Thus the difference will become considerably larger than it is today.

In assessing the consequences of ageing on public expenditure, the European Commission notices that these cross-country differences in assumptions on future life expectancy would have a significant impact on projections of pension and health care expenditure (European Commission, 2006). For that reason, the European Commission uses an alternative scenario in which the range of variation in life expectancy in 2005 is half that of the Eurostat baseline scenario. However, it is not stated which scenario is considered to be most likely.

5. Eurostat projections of life expectancy at birth

	males				females		
	2004*	2050	increase		2004*	2050	increase
Sweden	78.1	83.3	5.2	Spain	83.4	87.9	4.5
Italy	77.3	83.6	6.3	France	83.4	89.1	5.7
Spain	76.6	81.4	4.8	Italy	83.2	88.8	5.6
Greece	76.4	80.3	3.9	Sweden	82.4	86.5	4.1
United Kingdom	76.4	82.9	6.5	Austria	82.1	87.7	5.6
Cyprus	76.3	81.9	5.6	Finland	81.9	86.5	4.6
Malta	76.3	81.8	5.5	Germany	81.7	86.9	5.2
France	76.2	82.7	6.5	Belgium	81.6	88.3	6.7
Netherlands	76.2	80.2	4.0	Greece	81.4	85.1	3.7
Austria	76.2	83.6	7.4	Luxembourg	81.4	86.7	5.3
Germany	76.1	82.0	5.9	Portugal	81.0	86.6	5.6
Belgium	75.5	82.3	6.8	Netherlands	80.9	83.6	2.7
Ireland	75.5	82.4	6.9	United Kingdom	80.9	86.6	5.7
Finland	75.3	81.9	6.6	Cyprus	80.8	85.1	4.3
Denmark	75.2	80.9	5.7	Ireland	80.7	87.0	6.3
Luxembourg	75.0	81.6	6.6	Malta	80.7	85.0	4.3
Portugal	74.2	80.4	6.2	Slovenia	80.2	85.2	5.0
Slovenia	72.6	79.8	7.2	Denmark	79.6	83.7	4.1
Czech Republic	72.4	79.7	7.3	Czech Republic	78.8	84.1	5.3
Poland	70.5	79.1	8.6	Poland	78.5	84.4	5.9
Slovakia	69.7	77.7	8.0	Slovakia	77.8	83.4	5.6
Hungary	68.5	78.1	9.6	Lithuania	77.6	83.7	6.1
Lithuania	66.5	75.5	9.0	Estonia	76.9	83.1	6.2
Estonia	65.5	74.9	9.4	Hungary	76.8	83.4	6.6
Latvia	64.9	74.3	9.4	Latvia	76.2	82.5	6.3

**The values for 2004 are forecasts. The observed values can be found in table 1.*

Past projections were too pessimistic

Past mortality projections have repeatedly been proven too pessimistic (Oeppen and Vaupel, 2002). For example, the sharp reduction in cardiovascular disease mortality since 1970 as a result of advances in medical care and behavioural change, was not foreseen. However, the fact that past projections were too pessimistic in itself does not necessarily imply that recent projections will be too pessimistic as well.

Most gains from medical progress will likely be obtained from the further reduction of mortality from cardiovascular diseases and cancers, as they are the most important causes of death. However, unfavourable developments may occur as well. The stagnation in old-age mortality in Denmark and the Netherlands shows that mortality at older ages may be susceptible to unfavourable developments. The obesity epidemic among young adults may have a negative impact on future mortality (Olshanksy et al., 2005). Re-emergence of infectious diseases may be another unfavourable development (Olshansky et al., 1998).

How much can be gained by medical advances?

On the basis of Dutch data Garssen (2005) calculates that halving of mortality rates from cancer would result in an increase in life expectancy at birth of men by less than two years. Halving mortality from cardiovascular diseases would lead to similar gains. Thus even very strong improvements of prevention and cure of cancer and cardiovascular diseases would lead to limited gains in life expectancy. Moreover, it should be noted that these estimated gains cannot simply be added up: a decrease in mortality by one cause may lead to an increase in the risk of dying from another cause. A considerable further increase in life expectancy can only be achieved if mortality rates from various diseases at the oldest ages can be reduced, but it is very uncertain to what extent medical progress can lead to a substantial reduction in the mortality of these diseases.

Positive effects of genetic therapies?

Positive correlations between life expectancies of parents and children (Garssen and Deerenberg, 2006) and between siblings (Perls et al, 2002) suggest that genes may have a considerable impact on life expectancy. Vaupel et al. (1998) estimate that genes determine about one quarter of differences in duration of life. Thus possible advances in genetic therapies could have a significant effect on life expectancy in the future. One problem, however, is that no single gene can be identified that is responsible for a longer duration of life. Duration of life depends on complex interactions of genes and environment.

Impact of life style

A more healthy lifestyle could lead to a considerable rise in life expectancy. Particularly young people and persons with a low socioeconomic status tend to have unhealthy life styles. If these groups would adopt more healthy behaviour, this could lead to a considerable rise of life expectancy. For example, those who stop smoking at age 30 may expect to live 10 years longer (Doll et al., 2004). If people would not smoke, eat less saturated fat, eat more fish, moderately drink alcohol and have more physical exercise, this would reduce risk of cardiovascular disease considerably.

The question is, of course, how likely it is that there will be a substantial rise in the percentage of people with healthy life styles. Even though the prevalence of smoking declined sharply in the 1970s and 1980s, there has been no strong further decrease in recent years. Moreover, the proportion of people with overweight and obesity has been increasing. The percentage among men is higher than among women, but women show an increasing trend as well. The prevalence of obesity among young adults is lower than among people in middle age, but has been rising. This will have a negative impact on the future health status, as obesity at young ages is a risk factor for obesity at older ages (Gunnell et al., 1998). This will have an unfavourable impact on the prevalence of diabetes, cardiovascular diseases and cancer, and in the long run on mortality. On the basis of Dutch data Garssen (2005) estimates that if the increasing trend in the prevalence of overweight and obesity will continue until 2050, this would have a downward effect on life expectancy at birth by one to two years.

As noted above, life style is strongly correlated with socio-economic status. Thus changes in the distribution of the population by socio-economic status may have a considerable impact on life expectancy. People moving from the lowest socio-economic status level to the next experience a large improvement in life expectancy (Backlund et al., 1996).

Reduction of mortality at young or middle age?

Infant mortality rates have declined to such low levels in most European countries, that no substantial further reduction is likely. Moreover, as the level is already low, a reduction will only have a small impact on life expectancy at birth. Garssen (2005) estimates that a complete elimination of infant mortality in the Netherlands would result in a rise in life expectancy at birth of only 0.3 to 0.4 years. A complete elimination of all mortality between ages 15 and 30 years would have a similar effect. Reduction of mortality rates at middle age has a larger, but still limited impact. Garssen (2005) estimates that halving of the mortality rates between ages 40 and 70 would result in an increase in life expectancy at birth by only two years.

These calculations imply that strong increases in life expectancy at birth can only be realised by a sharp reduction in mortality rates of people aged 70 or over. However, it is very uncertain how much further mortality rates at advanced ages can be reduced. There is no agreement among experts about this question.

Linear increase in life expectancy?

In discussing the question whether changes in life expectancy will continue or may slow down it is important to note that the relationship between age-specific mortality rates and life expectancy is non-linear. Halving mortality rates at all ages does not lead to a doubling of life expectancy, but to a much smaller increase. Garssen (2005) calculates that halving all age-specific mortality rates would lead to an increase in life expectancy of women in the Netherlands by 9 percent, and that doubling of life expectancy would require a reduction of mortality rates by 96 percent.

As noted above, Oeppen and Vaupel (2002) show that best practice life expectancies have increased linearly during one century and a half. This increase corresponds with an annual decline of mortality rates by 2 percent. Olshansky and Carnes (1994) argue that an annual decrease of mortality rates by 2 percent during all future years for all ages is implausible. This would lead to very low mortality rates which they regard as unrealistic. For example, it would imply that in 2080 mortality rates of those aged 70 to 90 would equal the current mortality level of people in their forties.

Kannisto (2001) shows that the survival curve in a number of European countries becomes more rectangular. More people survive to advanced age, but then mortality occurs in a shorter span of time, i.e. there is a compression of deaths in a small age interval. This can be interpreted as an indication that the limit of life expectancy may be approached and that the increase in life expectancy will slow down.

However, Bongaarts (2006) notes that mortality rates at advanced ages have declined substantially during the last decades and he sees no reason why this decline would not continue for a few more decades. But, as mortality at younger ages has reached such low levels that they can make little or no contribution to further increases in life expectancy, Bongaarts expects that life expectancy will increase more slowly than according to the optimistic projections of Oeppen and Vaupel.

Convergence of men and women?

During the last decades the gender gap in life expectancy at birth has been decreasing. This narrowing of the gender gap was caused by both a slowing down of the increase in life expectancy of women and an acceleration for men. One explanation is that the differences in life styles between men and women were reduced. Since the gender gap still is larger than it used to be some 50 years ago, one may expect that a further reduction in the future is likely. If differences in life style between men and women will become smaller, the gender gap will decline to a difference that is due to irreducible biological gender differences (Gerland, 2005).

The latest Eurostat population scenarios assume a slightly higher increase in life expectancy of men than that of women, thus resulting in a slight narrowing of the gap. However, the scenarios assume strong differences across countries. For example, in Central European countries the gender gap is assumed to decrease by 2 to 3 years, whereas in several Western European countries a decrease by less than 0.5 year is assumed.

Convergence or divergence across countries?

Janssen et al. (2004) found considerable differences in the pace of mortality decline among the elderly in seven European countries in the second half of the 20th century, with stagnation since the 1980s in Denmark and the Netherlands and a strong decline in England and France. Even though smoking had an important effect on old-age mortality trends, it cannot fully explain the mortality differences.

One possible explanation of convergence is the so-called selection hypothesis. Mortality selection implies that when mortality decreases at young ages, an increasing proportion of the elderly population may be expected to be less healthy compared to survivors of earlier generations. Consequently the elderly population may experience higher mortality risks. For example, mortality declines in cardiovascular diseases, may lead to increased prevalence of chronic heart diseases at older ages (Bonneux et al., 1994). However, Janssen et al. (2005) found a positive correlation between mortality in late middle-age mortality and trends in old-age mortality, which is in contrast with the selection hypothesis. One explanation of the positive correlation is that conditions influencing mortality risk at middle age also have influence at old age. Janssen et al. (2005) suggest that risk factors for circulatory diseases, like physical activity, diet, smoking, and utilisation of medical care during adult age are determinants of mortality at both adult and old age among the same cohorts.

Another reason for expecting convergence is that declines in mortality will slow down in countries with low mortality levels as they are approaching a limit to life expectancy. However, cross-country comparisons show that whereas there has been a stagnation in mortality in countries such as the Netherlands and Denmark that used to have low mortality rates in the early 1980s, there was a continuous decrease in other countries that also had low mortality levels.

Does longer life go together with better health?

How changes in life expectancy will affect future trends in morbidity is being debated. Some experts argue that the number of years with morbidity will decrease or at least increase less strongly than life expectancy, i.e. that there will be a compression of morbidity. Fries (1980) assumed that the onset of chronic illness and disability can be postponed to older ages. Moreover, he assumed that there is a naturally fixed life span of 85 years. As a consequence he assumed that disability can be postponed to very near the end of life. Other researchers claim that there will be an expansion of morbidity, i.e. a longer period of chronic illness and disability associated with an increase in life expectancy (Olshansky et al., 1991). They claim that gains in life expectancy will predominantly be achieved by extending the life of those with disease and disability and that living longer will expose more people to non-fatal disabling diseases of old age such as dementia, Parkinson's disease, arthritis and loss of vision and hearing. An intermediate point of view is taken by Manton (1982) who claims that although the number of years lived with disability increases, the number of years lived with severe disability decreases. On the basis of a review of empirical studies in various developed countries Mathers and Robine (1997) confirm the hypothesis proposed by Manton. They conclude that there is no evidence of expansion of severe disability.

Role of policies

Policies aimed at lengthening life expectancy may focus on prevention, cure and care. Various policy options may be considered. Prevention, for instance, could focus on reducing deaths due to accidents, on reducing deaths due to unhealthy life styles and on improving screening. Improving cure could be achieved by improving pharmaceutical and surgical treatments but also by expanding health care provision. In order to lengthen healthy life expectancy policies might be aimed at reducing the impact of chronic diseases and disability on well-being and functional capacity.

Improvements in diet could have a potentially large impact on life expectancy. Improving the quality of food products, limiting the demand of unhealthy food, and stimulating the consumption of healthy diets may be considered. In addition policies may be aimed to stimulate more physical activity. As remarked above, there is a strong relationship between healthy life style and socio-economic status. Potential benefits are particularly large for people moving from the lowest socio-economic status to the next one. If people with a high socio-economic status improve their lifestyle the gain in life expectancy will be much smaller. Therefore policies may be aimed at improving living conditions of people with low socio-economic status and stimulating healthy behaviour among them.

5. Conclusions

Will there be a linear trend in life expectancy?

There is consensus among demographers that life expectancy is likely to continue to increase for some time. There is, however, no agreement on the pace of increase and on the level of life expectancy that will be reached around 2050 and later. Some experts expect a continuous linear increase in life expectancy at birth. One main argument supporting this assumption is that the maximum life expectancy has been increasing linearly for more than one century and a half. In recent years however has the increase in maximum life expectancy (viz. that of Japanese women) slowed down. Moreover, in almost all EU Member States the annual average increase in recent years has been lower than in the preceding two decades. This does not necessarily imply that we are approaching a limit to the growth in life expectancy. The slowing down of the pace of increase may be temporary. But at least one should be cautious in taking a linear increase in life expectancy for granted.

Other experts argue that these extrapolations do not take into account underlying changes in causes of death. The increase in life expectancy at birth in the first half of the 20th century had other causes than the increase in the second half. Thus although there has been a continuation of the increasing trend in life expectancy, there have been different types of underlying changes. Whereas the increase in life expectancy in the first half of the 20th century was mainly caused by a decline in mortality from infectious diseases at young ages, the decline in the second half of the 20th century was mainly caused by a decline in mortality from cardiovascular diseases in late middle age. A further substantial increase in life expectancy can be realised only by a strong reduction in mortality rates at advanced ages. It is not self-evident that this would result in the same pace of change in life expectancy at birth as in the last decades. Nevertheless, as declines in mortality rates at advanced ages have been substantial, there are no signs that we are approaching a limit in life expectancy. Hence a further increase in life expectancy may be expected in future decades.

Will changes in life style lead to a strong increase in life expectancy?

Two main determinants of changes in life expectancy are changes in life style and medical progress. If the proportion of people with healthy life styles (moderate physical activity, not smoking, healthy diet, moderate use of alcohol) would rise substantially, this would have a considerable effect on the level of life expectancy. However, the question is how likely this is. The rising prevalence of obese people, particularly among the youth, does not suggest that a significant rise in the proportion of people with healthy life styles will easily be achieved. Moreover, life styles are to an important extent associated with socio-economic status and differences in socio-economic status do not show any tendency of declining.

Will medical progress lead to a strong increase in life expectancy?

If medical progress would result in a strong reduction in mortality due to cancer and cardiovascular disease, the two main causes of death, this would result in a rise in life expectancy of several years. However, a substantial further rise could only be achieved by a strong reduction in mortality due to diseases at advanced ages. This may be much more difficult to realise than reductions of mortality at middle age, as mortality at advanced ages often cannot simply be attributed to one single disease, but is related to frailty which manifests itself in comorbidity. Thus medical advance in the treatment of one disease may lead to only a limited gain in the duration of life as the patient may die from another disease.

Will there be convergence in mortality across European countries?

Differences in life expectancy between the new Member States and the EU15 countries may be expected to decline. Economic growth and improvement of health care may lead to a relatively strong increase in life expectancy in the new Member States. The effect of differences in life style is much more uncertain. The substantial differences in life expectancy across EU15 countries have not disappeared during the last decades. Thus one may question whether it is likely that they will disappear in the future.

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