

Chapter 5

Mortality Assumptions for Sweden. The 2000–2050 Population Projection



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5.1 Mortality Projection in Sweden

A new population projection for Sweden is prepared every third year with minor updates in between. Statistics Sweden is responsible for the projections.

Ideally, mortality projections should be made in a process-oriented manner. In practice, however, they are mainly based on trend extrapolations of period mortality rates for the last 50 years. The critical component in the assumptions concerns the ages of 50 and above. The problem is to handle both short-term and long-term developments, especially when there is a trend shift like the one today with a temporary slow-down in the mortality decline for middle-aged women. Does this change mark a new trend or not? Most users are mainly interested in the short-term development, *i.e.* in the next year or the next 5 years. Others have a time horizon of 50 years or longer. There are three alternative assumptions: no change in mortality, mortality decline according to the main alternative, and a more pronounced mortality decline.

The assumption of the future mortality decline is based not only on the observed trend but adjusted for other information such as smoking behavior.

For the coming projection we plan to base the analysis more on cohort mortality.

Mortality in Sweden has fallen ever since the mid-nineteenth century. In the beginning, the change was mainly due to a reduced risk of dying of infectious diseases and deficiency diseases. The factors underlying the greater chances of

To a large extent, this is a translation from Swedish of Chapter 3.3 in the publication *Sveriges framtida befolkning. Befolkningsframskrivning för åren 2000–2050. Demografiska rapporter 2000:1* SCB. (Sweden's future population. Population forecast for the years 2000–2050. Demographic reports 2000:1, Statistics Sweden). ISBN 91-618-1068-1.

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survival were economic, social and sanitary improvements, and, not least, medical advances such as the introduction of vaccines and antibiotics.

More recent developments – say, since 1950 – have brought a continued decline in mortality. Changes in the last few decades have largely concerned chronic illnesses, including cardiovascular diseases and cancer, which are the major causes of death. The reasons for the changes in what are sometimes called the diseases of wealthy societies are a transition to a healthier lifestyle and improved medical care, leading to a considerable increase in survival at advanced ages. The decline in mortality at ages above 65 began considerably earlier for women than for men.

5.2 Sharply Lower Mortality in 1950–1999

In the second half of the twentieth century, mortality fell sharply. The risk of death has been reduced by more than half among men below the age of 50 and women below the age of 80. The drop in infant mortality has been particularly dramatic. In 1950, 21 of 1000 children born died before their first birthday. In 1999, just three per thousand live-born children died in their first year.

Among adult men, however, the risk of death changed relatively little in the period 1950–1975. For part of this period, there was even an observable increase in mortality, largely among middle-aged men. Since 1975, however, male mortality has declined substantially, by an average of about 2% per year among men between young middle age and the age of about 80, (see Fig. 5.1).

Among women, we see a decline in mortality throughout the post-1950 period. The annual rate of mortality reduction has averaged 1–2%. At ages in excess of

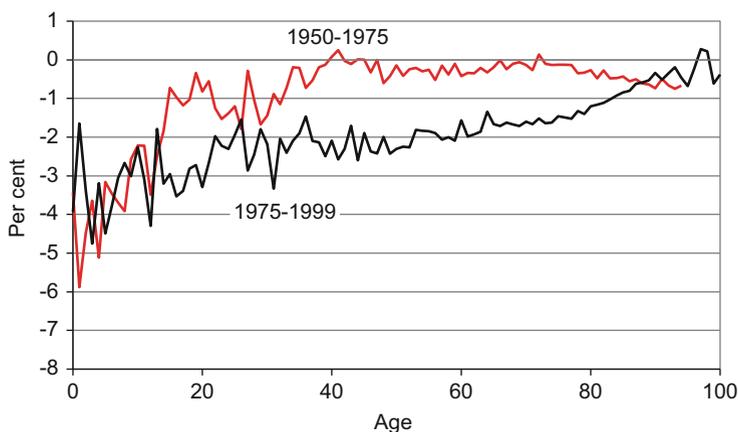


Fig. 5.1 Annual reduction of risk of death at different ages for two periods, 1950–1999. Men

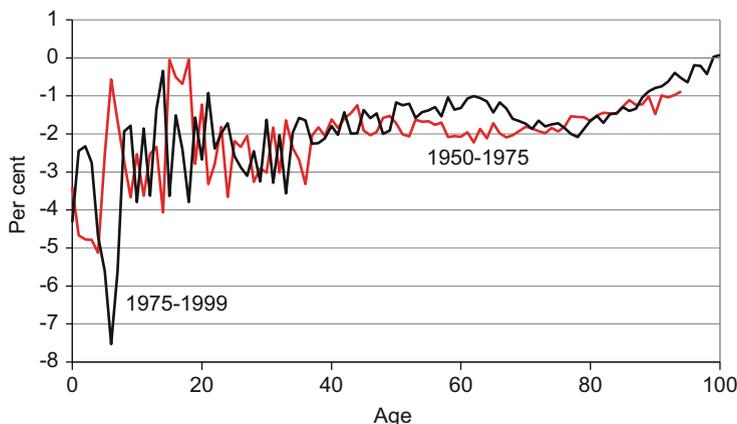


Fig. 5.2 Annual reduction of risk of death at different ages for two periods, 1950–1999. Women

85, the reduction of mortality has been somewhat lower. However, over the last 10 years the rate of mortality reduction among uppermiddle-aged women has slowed slightly, (see Fig. 5.2).

We may add that in recent years severe influenza epidemics have occurred more frequently. This has had a serious effect on many elderly people. The long-term rise in women’s annual average life expectancy has therefore slowed temporarily after each influenza epidemic. One reason why women’s average life expectancy is affected most is that a larger proportion of elderly women than men reach advanced ages.

5.3 Reasons for the Decline in Mortality in 1980–1999

Assumptions about future mortality trends are based on changes in mortality over the past two decades. During this period, the decline in male mortality has strongly resembled the decline in female mortality. In spite of this close correspondence, around 1980 the situation differed for men and women aged over 50 – and these are critical ages in the assumptions used in the forecast.¹

The rising mortality observable for men until the end of the 1970s was caused by an increase in deaths due to cardiovascular diseases and cancer. Changes in lifestyles helped to break this trend in the 1980s, when mortality began to fall. The proportion of people smoking every day has declined since the end of the 1970s, a tendency with a significant impact on the trends for cardiovascular diseases and cancer. Less

¹Except in the very long term, assumptions on relative changes in younger age groups have a limited impact on the numerical strength of the population, since mortality is so low at these ages.

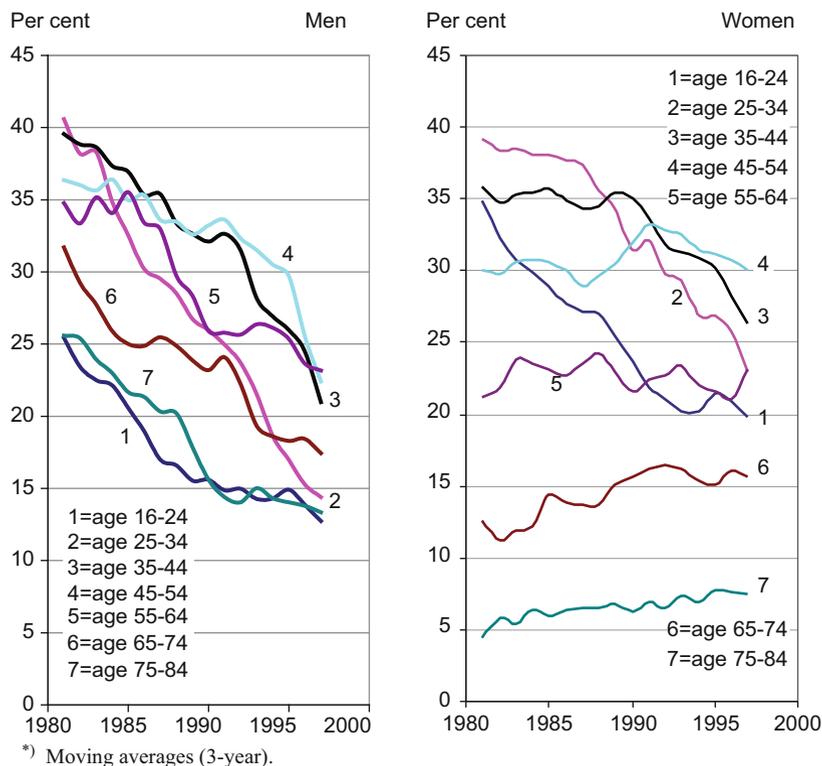


Fig. 5.3 Proportion of daily smokers by sex, 1981–1997. (Moving averages (3 year). Source: living conditions survey. (ULF, Statistics Sweden))

fatty food and increased exercise have probably been other important factors behind the decline in cardiovascular diseases. Alcohol consumption has also fallen during this period.

The evident rise in mortality for men until the end of the 1970s was not observable among women. However, a slight tendency towards higher mortality due to ischemic diseases has been discernible, along with a relatively sharp rise in mortality from lung cancer. Nevertheless, total mortality fell, though at a lower rate. The reasons for the reduction in female mortality over the last 20 years have probably been about the same as those affecting male mortality, but with one major exception: the proportion of smokers has continued to increase gradually at more advanced ages. This is due to a generational change involving smokers. The proportion of women who have smoked at some time increases in each successive generation over the age of about 30, (see Fig. 5.3). In spite of this, mortality from cardiovascular diseases has diminished, whereas mortality due to lung cancer, which is linked more closely to smoking habits, has continued to rise.

The medical treatment of cardiovascular diseases in particular has improved, and this has had a significant impact on the decline in the risk of death. A simple indicator of the changes is that mortality due to cardiovascular diseases (heart attacks) has fallen considerably more rapidly than the risk of falling ill (incidence).

5.4 Higher Average Life Expectancy in 1950–1999

Mortality trends since 1950 have resulted in an increase in the average life expectancy of men from 69 to 77 years, an average increase of 0.16 years per calendar year. For women average life expectancy went up from 72 to 82 years, an average increase of 0.20 years per calendar year.

Table 5.1 below shows changes in life expectancy between different periods in the second half of the twentieth century. Table 5.1 also reveals the positive impact on average life expectancy (at birth) of the improvements in mortality at different ages. The gains for men in recent years consist mainly of mortality improvements among

Table 5.1 Change in average life expectancy at birth between different periods (in years)

Sex period	Change (in years)			
	Total	of which in age group		
		0–19	20–64	65–
Men				
1951–55 to 1956–60	0.7	0.3	0.3	0.1
1956–60 to 1961–65	0.4	0.3	0.1	0.0
1961–65 to 1966–70	0.3	0.3	–0.1	0.1
1966–70 to 1971–75	0.2	0.3	–0.1	0.1
1971–75 to 1976–80	0.4	0.3	–0.0	0.1
1976–80 to 1981–85	1.1	0.2	0.5	0.4
1981–85 to 1986–90	0.8	0.0	0.4	0.4
1986–90 to 1991–95	1.2	0.2	0.6	0.5
1991–95 to 1998 ^a	1.3	0.1	0.6	0.5
Women				
1951–55 to 1956–60	1.2	0.3	0.6	0.4
1956–60 to 1961–65	1.0	0.2	0.3	0.5
1961–65 to 1966–70	0.9	0.3	0.2	0.5
1966–70 to 1971–75	1.1	0.2	0.2	0.7
1971–75 to 1976–80	0.9	0.2	0.1	0.5
1976–80 to 1981–85	1.0	0.1	0.3	0.6
1981–85 to 1986–90	0.7	0.1	0.1	0.5
1986–90 to 1991–95	0.8	0.1	0.2	0.5
1991–95 to 1998 ^a	1.0	0.1	0.3	0.6

Total change and distribution by different age intervals

^a1998 is the last point in time (the distance from the middle year of the previous period is 5 years here, as in the other cases)

young and middle-aged men, but improvements among the elderly have also made a major contribution. For women, the trend among the elderly accounts for most of the increase in average life expectancy over the same period.

5.5 Future Mortality

As stated above, improved living conditions in a range of areas are significant factors underlying the decline in mortality in recent decades. Given present trends, there is reason to hope for continued improvements in living conditions and lifestyles. We know that fewer and fewer young people are taking up smoking and increasing numbers are exercising regularly in their spare time, factors that are important to health and life expectancy. It is worth noting that even if no major improvements were to occur in future, the long-term (longitudinal) impact on mortality at a given age would be similar to that observed to date (perhaps for several decades). In certain cohorts, people could enjoy a favourable life expectancy throughout their entire lives, assuming the levels attained in the 1980s and 1990s are sustained (for factors like consumption, exercise, and men's smoking habits).

Nevertheless, there are lifestyle factors that give rise to concern. Even if smoking is now becoming less common among young people, there is a considerable difference between the smoking habits of elderly and middle-aged women, (see Fig. 5.3). At present, relatively few elderly women are smokers or former smokers. The number will increase during the forecast period, as those who are middle-aged grow old, and this may put a brake on the decline in mortality. As a result, we have assumed that the long-term decline in mortality will be less marked for women than for men. The increasing proportion of people who are overweight, greater stress in professional life, and a possible rise in alcohol consumption in the future are some examples of trends that could slow the decline in mortality. Better information on health matters and improvements in workplace organisation, in the broad sense of this term, may moderate such effects.

Medical progress has had a positive impact on mortality trends. In all probability, the positive trend observed until now in the medical area will continue, and these medical advances may help to improve quality of life and increase life expectancy. The possible impact of potential breakthroughs in genetic engineering and biotechnology surpasses our present comprehension. However, as serious illnesses become more curable, a higher proportion of elderly people will have previously had such illnesses. Despite successful treatment at the time, this factor may have a negative impact on mortality among the very oldest.

Thus, numerous trends may potentially have a – positive or negative – impact on mortality. However, it is hardly possible to quantify the effect of these factors with any precision. We should bear in mind that until now, mortality has changed slowly. Accordingly, we assume that in the immediate future, mortality will continue to follow the trend prevailing up to this point. In the longer term, we assume that the

reduction in the risk of death will continue throughout the forecast period² but will be slowed somewhat by the negative risk factors indicated above. It is far from clear when this slowdown in the reduction of mortality will set in and how significant it will be. Our assumptions have been guided in part by the growing uncertainty of assessments as the time elapsed increases. Here we have assumed a reduced decline in mortality for women from 2010 onwards and for men from 2015 onwards. The difference between men and women is due in part to our assumption that longitudinal effects will cease to be felt sooner among women than among men, since the decline in mortality started earlier among women than among men. We also put a brake on the decline towards the end of the forecast period. The reason is that the overall picture of causes of death may change by then. We should bear in mind that most of the extrapolated reduction in mortality is connected with cardiovascular diseases. In 30–40 years time, this cause-of-death category may well be considerably reduced, even at relatively advanced ages. The other causes of death, which are declining more slowly, will thus acquire greater significance in relative terms and will then automatically entail a slower decline in total mortality.

5.6 Assumptions Used in the Forecast for the Immediate Future

We have based our assumptions regarding mortality in the immediate future on observed risks of death during the period 1995–1999, extrapolated until 2000, (see Fig. 5.4).

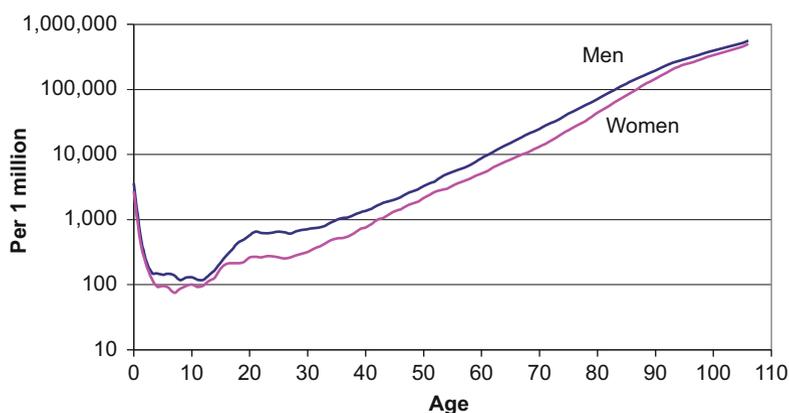


Fig. 5.4 Risks of death in 2000 by age and sex. Per million

²It may be noted that this assumption is very far-reaching in statistical terms, since in effect we are extrapolating 50 years forward in time from a 20 year trend (at least for men).

We assume that risk of death will subsequently be reduced according to the pattern shown in the figures below. Among men, we assume that the risk of death will decline by 1.5% per year at ages below 45, at a somewhat faster rate between 50 and 75, and at a gradually declining rate at more advanced ages. These reductions in the risk of death largely correspond to the trend observable in the 1990s among middle-aged and older men. We assume that this reduction in risk of death will continue unchanged until 2015.

For women, the risk of death has diminished over time in about the same way as for men. For the period until 2010, we have assumed an annual reduction in the risk of death of 1.5% up to the age of 80, in accordance with the trends observed in the 1990s.

It should be noted that the change in the rate of reduction in mortality at different dates proceeds in stages (linear progressive reduction). The transition to a new rate of reduction occurs over a 4-year period (for men in 2015–2018 and for women in 2010–2013).

5.7 Assumptions Used in the Forecast for the Longer Term

Among men, we assume that the annual rate of reduction during the period 2018–2039 will be 75% of its original level. After this, the rate of reduction will gradually decline over a 4-year period until it reaches 50% of the original level (due to the change in the overall composition of causes of death, see Fig. 5.5).

Fig. 5.5 Annual reduction of risk of death among men, by age. Per cent

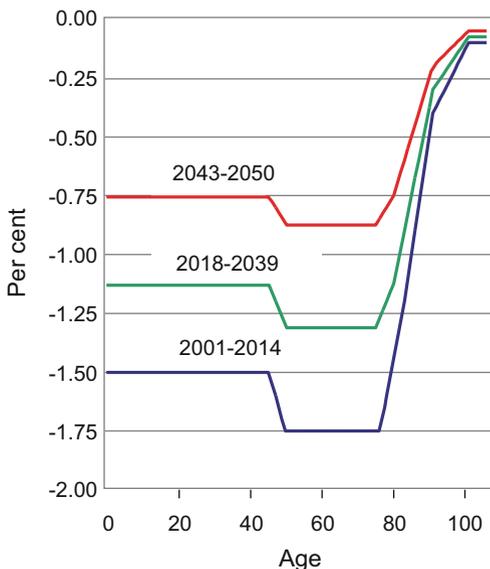
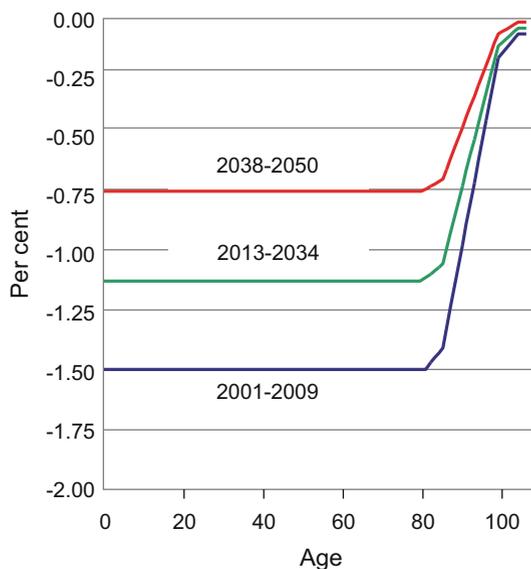


Fig. 5.6 Annual reduction of risk of death among women, by age. Per cent



Among women, we assume that the risk of death will be reduced at a slightly slower pace beginning in 2010. We set the rate of reduction at 75% of its original level over the period 2013–2034 and at half its original level in 2038–2050, (see Fig. 5.6).

Behind these assumptions, there is substantial uncertainty regarding the speed at which the chances of survival are capable of changing over so long a period of extrapolation. However, the future may bring both a more rapid slow-down in the decline in mortality and new medical advances resulting in sharply lower risks of death.

5.8 Mortality Trends over the Period 1950–2050

Figure 5.7 summarizes mortality trends between 1950 and 2050. A logarithmic scale has been used, thus making it possible to compare the mortality trends for different ages. The fact that the curves have the same slope shows that the percentage change in the risk of death has been the same.

5.9 Higher Average Life Expectancy

According to our estimates, average life expectancy for men will rise from 77.1 in 2000 to 82.6 in 2050, while the corresponding figures for women are 82.1 and 86.5. As shown in Table 5.2, we are forecasting a slower increase in average life

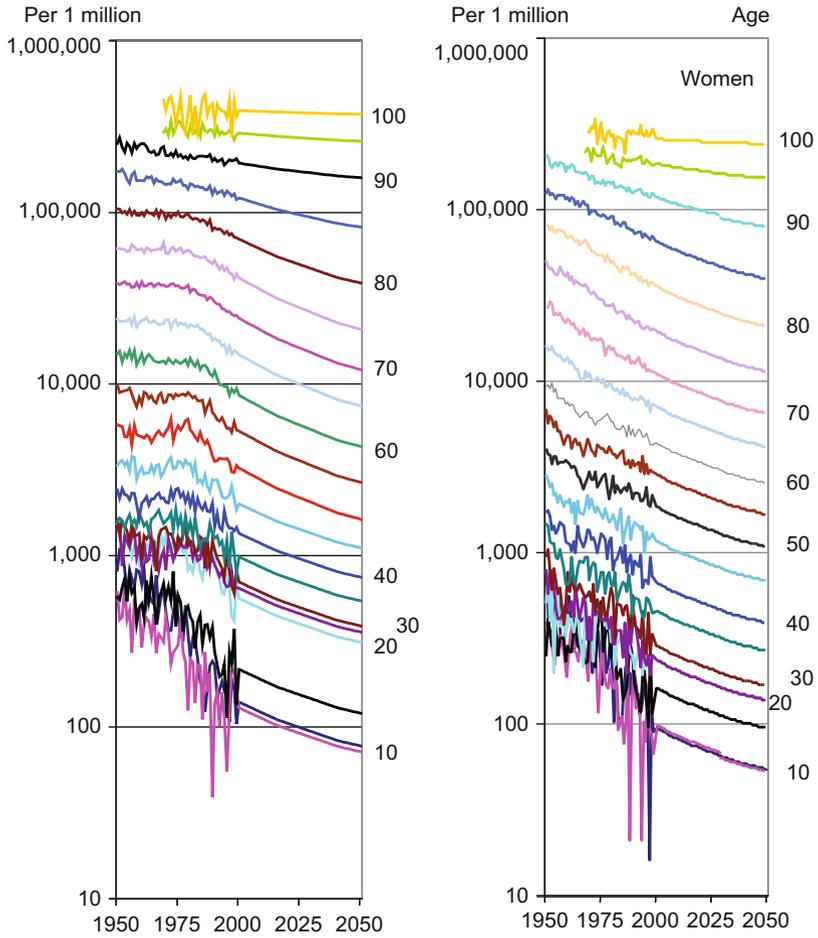


Fig. 5.7 Mortality trends by age 1950–1999 and assumed mortality 2000–2050. Men and women. Per 1 million

Table 5.2 Average life expectancy at birth and at age 65, 1951–2050

Year	At birth		At age 65	
	Men	Women	Men	Women
1951–60	70.9	74.1	13.9	15.0
1961–70	71.7	76.1	13.9	16.1
1971–80	72.3	78.1	14.1	17.5
1981–90	74.0	79.9	14.9	18.7
1991–95	75.6	81.0	15.7	19.4
2000	77.1	82.1	16.5	20.1
2010	78.7	83.4	17.6	21.1
2020	80.0	84.4	18.4	21.8
2030	81.0	85.2	19.1	22.5
2040	82.0	86.0	19.8	23.0
2050	82.6	86.5	20.3	23.5

expectancy over the coming 50-year period than we have observed over the past 50 years. We estimate that average life expectancy at 65 will rise by 3.8 years for men and 3.4 years for women over the next 50 years.

5.10 Assumptions Regarding Mortality Trends in Some Countries

For the sake of comparison with assumptions regarding future mortality trends in other countries, we have provided average life expectancies according to population forecasts for a number of countries in Europe and for the USA and Japan, (see Tables 5.3 and 5.4).

There is wide variation between the different countries. In France and Belgium, it is assumed that average life expectancy for men will increase by nearly 8 years over

Table 5.3 Average life expectancy for men, 2000–2050

Country	Average life expectancy at birth, in years					
	2000	2010	2020	2030	2040	2050
Sweden	77.1	78.7	80.0	81.0	82.0	82.6
France	74.6	76.4	78.0	79.5	80.9	82.2
Belgium	74.4	75.7	77.1	78.7	80.3	82.1
Austria	75.1	76.9	78.5	80.0	81.0	82.0
Switzerland	76.1	77.5	78.8	79.8	80.6	81.3
Finland	73.8	75.6	77.3	78.7	80.0	81.2
USA	74.2	75.5	76.8	78.3	79.8	81.2
Netherlands	75.3	76.6	77.8	78.8	79.5	80.0
Norway	75.8	77.3	78.5	79.4	79.8	80.0
Japan	77.4	78.1	78.6	79	79.2	79.4
UK	75.1	76.6	77.6	78.2	78.7	78.9
Italy	75.9	77.1	78.3	78.3	78.3	78.3
Denmark	73.4	73.5	73.5	73.5	73.5	73.5
Ireland	73.7	75.2	76.4			
Spain	74.1	75.3	76.0			
Germany	73.7	74.8	75.7	76.7	76.9	
Iceland	77.3	77.5	77.5	77.5		

Forecasts in different countries

Source: USA, US Bureau of Census; Japan, Ministry of Health and Welfare; Sweden, Forecast 2000–2050. Other countries: Eurostat, June 2000

Table 5.4 Average life expectancy for women, 2000–2050

Country	Average life expectancy at birth, in years					
	2000	2010	2020	2030	2040	2050
France	83.0	84.8	86.5	87.9	89.2	90.4
Belgium	81.1	82.3	83.6	85.0	86.5	88.1
Austria	81.3	82.8	84.2	85.5	86.2	87.0
Switzerland	83.0	84.4	85.6	86.0	86.4	86.9
USA	79.9	81.4	82.9	84.2	85.4	86.6
Sweden	82.1	83.4	84.4	85.3	86.0	86.5
Japan	84.1	85.1	85.6	86.0	86.3	86.5
Finland	80.9	82.0	83.1	84.0	84.8	85.5
Italy	82.3	83.5	84.7	84.7	84.7	84.7
Norway	81.5	82.7	83.5	84.1	84.4	84.5
UK	80.1	81.5	82.6	83.2	83.6	83.8
Netherlands	80.6	81.1	81.6	82.2	82.7	83.0
Denmark	78.5	78.6	78.6	78.6	78.6	78.6
Spain	81.9	83.0	83.7			
Iceland	81.9	82.1	82.1	82.1		
Ireland	79.4	81.0	82.4			
Germany	80.1	81.1	81.9	82.6	82.9	

Forecasts in different countries

Source: USA, US Bureau of Census; Japan, Ministry of Health and Welfare; Sweden, Forecast 2000–2050. Other countries: Eurostat, June 2000

the next 50 years, while in Japan it is expected to rise by just 2 years. In Sweden, the predicted increase is 5.5 years.

For women, too, there is a considerable range in assumed future mortality. France, Belgium and the USA are predicting that average life expectancy will go up by 7 years, whereas Japan and the Netherlands are anticipating a gain of barely more than 2 years. In Sweden, the rise is expected to be 4.4 years.

5.11 Alternative Assumptions

The purpose of alternative assumptions is to attempt to capture some of the uncertainty in the principal assumption that we have already presented.

Under an alternative assumption with lower mortality, the declining trend in mortality decline during the 1990s will continue uninterrupted throughout the

forecast period until 2050. We assume continuous improvements in lifestyle throughout the period. Moreover, further improvement in medical care and treatment is required (over and above the improvement in the principal assumption), particularly with regard to diseases other than cardiovascular diseases.

In an alternative with higher mortality, we assume no changes in mortality at all in future. Positive and negative lifestyle factors offset each other. This alternative provides a base level for the impact on the population of assumptions regarding mortality; *i.e.*, it functions as a form of sensitivity analysis.

In the first alternative, life expectancy rises from 77.1 in 2000 to 86.1 in 2050 for men and from 82.1 to 89.0 for women. In the second alternative, the figures remain at their initial level throughout the period.

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