# Life Expectancy and Cardiovascular Mortality in Europe

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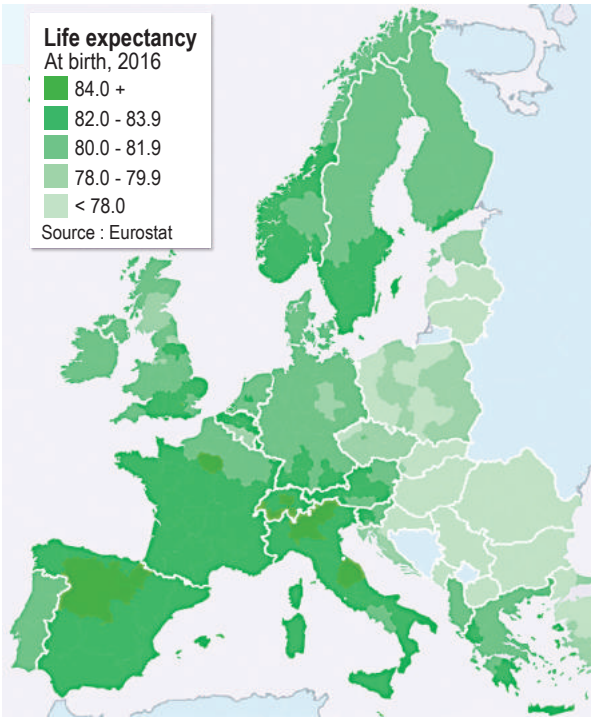
**Abstract**

Over the last decades important changes in exposure to risk factors, cardiovascular morbidity and mortality have taken place in different parts of the world. In this manuscript we describe the presence of cardiovascular risk and the prevalence of cardiovascular diseases in Europe. Important differences in risk factors were found between European countries. Cardiovascular mortality rates also show tremendous differences among European countries with a striking pattern: much lower cardiovascular mortality rates are observed in Western countries compared with Eastern Europe. These differences can be partly explained by a greater cardiovascular risk in Eastern Europe but socio-economic factors and the quality of health care also play an important role. Finally the significant changes that have occurred in death due to cardiovascular diseases and cancer are described and discussed

**Keywords:** cardiovascular diseases in Europe, cardiovascular morbidity, cardiovascular risk

Anno 2019 cardiovascular diseases (CVD) remain the most important causes of death worldwide. Nearly 18 million people die from CVD per year according to the World Health Organization (WHO). Also in "Europe" CVD remain the most important cause of death. The latest data for life expectancy at birth in Europe are shown in Figure 1. The most striking overall difference between countries is the much lower life expectancy in the Eastern part of Europe. This difference can for a significant part be explained by a much higher CVD mortality in Eastern Europe. Explanations for other differences e.g. those between West-European countries and those within countries are not so obvious. In this paper we will describe important changes in risk factors, causes of death and mortality that took place in Europe in recent years and what can be expected in the near future.



Comparisons with other regions in the world will occasionally be made. "Europe" in this paper is usually defined as the 53 members states according to the WHO (www.who.int) or the 57 member states of the European Society of Cardiology (ESC): most countries according to the WHO and, in addition, most countries bordering the Mediterranean sea (see be website of ESC: www.escardio.org).

The most important forms of CVD are ischemic heart disease (IHD) and stroke. If CVD data are discussed they comprise all forms of CVD. Occasionally data on IHD and stroke are provided separately. Many data discussed in this document come from the World Health Organization (WHO), World Bank and the Institute for Health Metrics and Evaluation and were analyzed by the ESC Atlas group and reported in a special article in the European Heart Journal[1].

## Risk Factors for CVD

Blood pressure, cholesterol levels, diabetes and smoking status are the most important risk factors for CVD. This is nicely illustrated in a long-term US study: participants in the study who were 55 years of age and who had an optimal risk factor profile (defined as total cholesterol < 180 mg/dl, blood pressure < 120/80 mm Hg, nonsmoking and nondiabetic status) had a substantially lower risk of death from CVD through the age of 80 years (figure 2A and 2B)[2]. When we look at these risk factors in Europe important observations can be made. The prevalence of raised blood pressure overall is higher in men than in women and higher in the eastern part of Europe for both men and women. Between 1980 and 2014 systolic blood pressure in ESC member states came down from 134 to 120 mmHg in women and from 138 to 130 mmHg in men. In 2014 mean systolic blood pressure was lowest in countries with a high income.

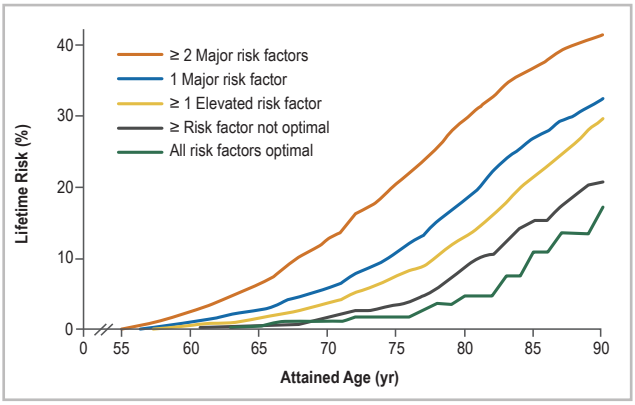



**Figure 2A:** Lifetime Risk of Death from Cardiovascular Disease among Black Men and White Men at 55 Years of Age, According to the Aggregate Burden of Risk Factors and Adjusted for Competing Risks of Death.[2]

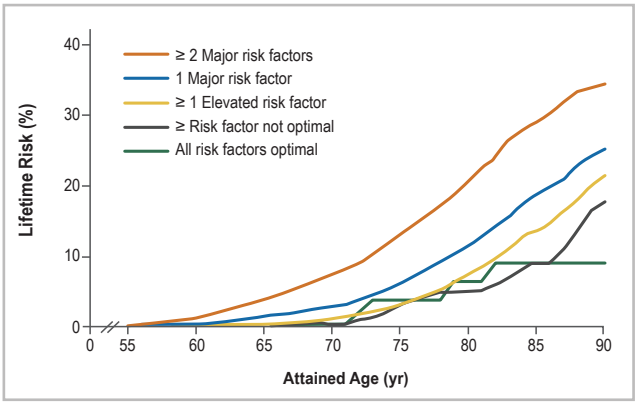



**Figure 2B:** Lifetime Risk of Death from Cardiovascular Disease among Black Women and White Women at 55 Years of Age, According to the Aggregate Burden of Risk Factors and Adjusted for Competing Risks of Death.[2]

**Cholesterol** is a major target of risk reduction and globally 33 % of IHD can be attributed to hypercholesterolemia. In general hypercholesterolemia is most common in high-income countries, thus in the Western world. Between 1980 and 2009 mean cholesterol levels declined from 217 to 197 mg/dl in the ESC member states. The incidence of hypercholesterolemia was 18.9 % and 19.0 % in women and men in high-income countries and 12.0 % and 10.0 % respectively in middle-income countries. A greater decline of cholesterol levels was found in high income countries.

It is estimated that > 25% of all Europeans are smokers. The prevalence of smoking ranges from < 15% in some Scandinavian countries to > 50 % in countries of the previous Soviet Union. Between 1995 and 2014 the average prevalence of smoking declined from 21.4 % to 16.1 % in women and from 37% to 16.9 % in men (data from only 28 and 27 countries in women and men, respectively). It is very important to distinguish the acute and long-term harm of smoking. Obviously smoking enhances the development of atherosclerosis but smoking has also a strong pro-thrombotic effect. When a smoking ban was introduced in public places and restaurants in Western European countries, already after a few months a significant reduction in the incidence of acute myocardial infarction was observed which is difficult to explain by an effect on the development of atherosclerosis .The disappearance of the pro-thrombotic effect of smoking, which occurs immediately after smoking cessation, most likely explains the striking reduction in the risk of acute myocardial infarction.

It is estimated that the prevalence of diabetes in 2014 is around 6.5% in the ESC countries. Most of these cases are type 2 diabetes. In 2014 Egypt, Lebanon and Turkey had the highest prevalence (16.6, 14.9 and 14.8 %, respectively). Much lower rates (< 3 %) were found in some poor Eastern European countries (e.g. Moldova, Georgia, Armenia). In the time frame 1995-2000 to 2014 the average prevalence of diabetes increased in both middle-income and high- income countries. Data on obesity are more or less in line with those on diabetes. E.g. female obesity was most common in Turkey where one in three women is obese.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Behavioral factors such as alcohol consumption and lack of physical exercise do have an impact on CVD and should be also be considered as risk factors. In subjects > 15 years of age in ESC member states for which data are available the average alcohol consumption averaged 8.7 L/capita/year (calculated as amount of pure alcohol in liters consumed over a calendar year). Large differences were observed with the highest consumption in countries that were part of the previous Soviet Union and the lowest consumption in countries with a large Islamic population. Little change in alcohol consumption was found between 1996-2000 and 2014. Insufficient physical activity in adults in ESC member states, graded via questionnaires is estimated at 30.1% in women and 22.7% in men across the ESC member states. In general physical activity was higher in middle-income countries as compared to higher income countries. Physical inactivity is becoming a major problem in Western countries. In high-income ESC member states participation in at least 1 hour of moderate to vigorous physical activity per day among children aged 11, 13 and 15 years was 20,14 and 9% in girls and 29, 23 and 19% in boys. Much higher percentages were observed in middle-income countries, especially in boys.

## Mortality as reported by the ESC Atlas of Cardiology

In global terms citizens of the EU live 2.5 years longer than in the US and 4.6 years longer than in China. In a large report from the ESC Atlas mortality data from 47 of 56 ESC member countries were collected and analyzed1. These reported mortality data are the most recent ones but in some countries (7/47) they date from 2010 or even before. Also the quality of the data varies between countries. The latest available data indicate that CVD is responsible for almost 4 million deaths each year in the ESC countries (45% of all deaths). CVD accounted for a larger proportion of all deaths in women (49%) compared with men (40 %). Stratification by national income indicates a much lower CVD mortality in high income countries vs middle or low income countries. After CVD, cancer was the next most common cause of death accounting for 23% of all deaths. Importantly, in high income countries (Belgium, Denmark, France, Italy, Luxembourg, Netherlands, Norway, Portugal, Slovenia, Spain and the UK) cancer has become the most common cause of death in men. In women this is only the case in Israel and Denmark.

More meaningful comparisons between countries can be made with age-adjusted mortality rates (removing impact of differences in population age structure). The average age-standardized mortality rates for IHD across ESC member countries (using data from 2014) were 241 per 100 000 in women and 384 per 100 000 in men. Using the latest available data, the countries with the highest rates were Belarus, Kyrgyzstan, Republic of Moldova, Russian Federation, and Ukraine with rates of > 500 for women and > 800 for men. At the other end of the spectrum, countries with the lowest rates were France, Luxembourg, the Netherlands, Portugal, and Spain where rates were < 60 in women and < 120 in men per 100. Age-standardized stroke mortality (latest available data 2014), averaged across ESC member countries, was similar between women and men (133 and 173 per 100 000 people). For individual countries, rates ranged from < 55 per 100 000 women and < 60 per 100 000 men in France, Israel, Luxembourg, and Switzerland (as well as women in Spain) to > 300 per 100 000 people for both sexes in Bulgaria, Kyrgyzstan, Russian Federation, and North Macedonia (also men in Republic of Moldova).

Temporal changes by national income status: Complete prevalence data for IHD mortality across three time periods between 1985 and 2014 were available for 38 ESC member countries. During that period, the average age-standardized mortality due to IHD declined from 374 to 209 deaths per 100 000 in women and from 586 to 339 deaths per 100 000 in men. All of the 27 high-income countries for which data were available recorded a decline in IHD mortality, averaging 286 to 129 deaths per 100 000 in women and 508 to 227 deaths per 100 000 in men. In middle-income countries, the average mortality also declined during this period in both women (591 to 405 deaths per 100 000) and men (779 to 614 deaths per 100 000). At a national level, however, the pattern was inconsistent and while many countries showed variable reductions in IHD mortality, it increased in Kyrgyzstan and Bosnia and Herzegovina in both women and men and also in men from Ukraine. There have been similar trends in age-standardized stroke mortality, with steady declines occurring since the 1980s in most high-income ESC member countries and more recent declines in middle-income countries. Trends in premature (< 65 years) IHD and stroke mortality have also been similar, with consistent declines in the high income member countries of the ESC, and more volatile trends in middle income countries.

## The interplay of healthy life style, socioeconomic status and quality of health care

In high-income countries a healthy life style and a well-organized health care system are responsible for a significant decline in CVD mortality over the last 40 to 50 years. In a study performed on US data, the causes of the decline in mortality from coronary heart disease between 1980 and 2000 in adults was examined. In this study it has been estimated that approximately half of the observed decline in mortality may be attributable to reductions in major risk factors and approximately half to evidence-based therapies[3] (Figure 3). This is probably also the case in Western European countries. As a result of the sharp decline in CVD mortality, cancer has become the main cause of death in some of the Western European countries (cfr supra). However, within these countries differences in life expectancy (and in CVD mortality) between regions still exist (e.g. Belgium North vs South, France North vs South, Germany West vs East). Similarly large disparities in total burden of CVD persist between US states[4]. They can be explained for a great part by differences in socioeconomic status and an associated different exposure to known risk factors. However socioeconomic status cannot explain all differences in life expectancy and CVD mortality. An extreme

example in this regard is the surprising observation that life expectancy today in the US and in Cuba is more or less the same in spite of the fact modern high tech procedures cannot be performed in most places in Cuba. The lack of high tech medicine in Cuba is probably compensated by an excellent free health system focused on prevention. It is only when life style (primary prevention), health care (evidence based medicine) and socioeconomic status (income and social security) are all three optimal in the total population of a country that a (very) low CVD mortality and a (very) high life expectancy can be expected. Examples are Japan, Switzerland, Sweden, and Australia.[5] (Figure 4).

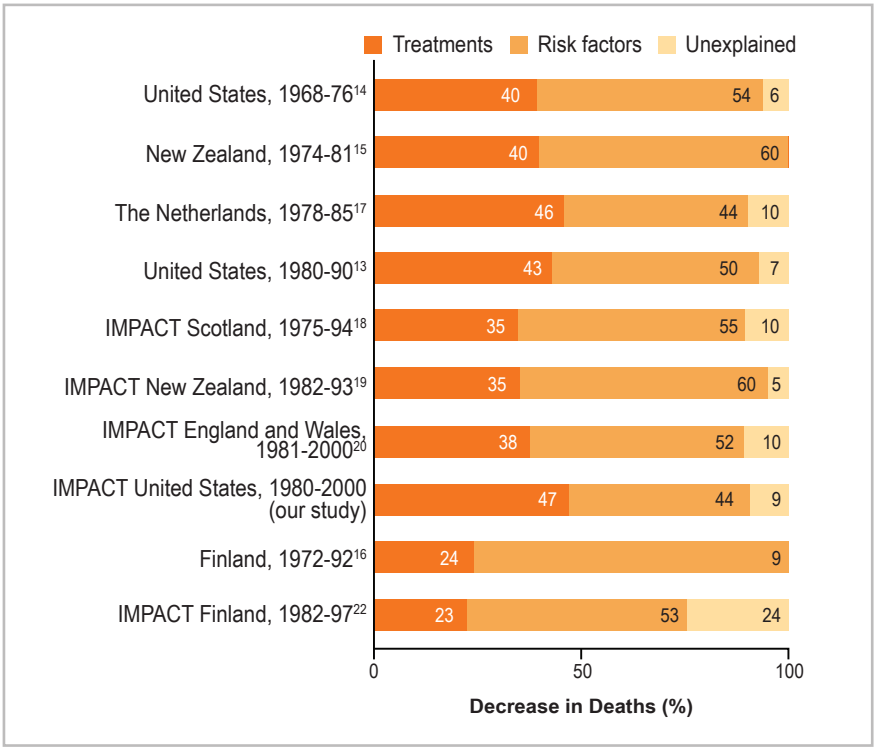


**Figure 3:** Decrease in Deaths from Coronary Heart Disease Attributed to Treatments and Risk-Factor Change.[6]

| Rank (highest to lowest) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Determinants of health** | | | | | | | | | | | | |
| Smoking, % of population aged ≥ 15y who smoke daily | France 22.4 | Germany 20.9 | CHE 20.4 | NLD 19 | Japan 18.2 | Denmark 17 | UK 16.1 | Canada 14 | Australai 12.4 | US 11.4 | Sweden 11.2 | 16.6 |
| Alcohol consumption, L per capita in population aged ≥ 15y | France 11.9 | Germany 11 | Australia 9.7 | UK 9.5 | CHE 9.5 | Denmark 9.4 | US 8.8 | Canada 8.1 | NLD 8 | Sweden 7.2 | Japan 7.2 | 9.1 |
| Obese or overweight, % of population aged ≥ 15y | US 70.1 | Australia 63.4 | UK 62.9 | Canada 60.3 | Germany 60 | France 49 | Sweden 48.3a | NLD 47.4a | Denmark 47.4a | CHE 41a | Japan 23.8 | 55.6 |
| **Life expectancy** | | | | | | | | | | | | |
| Life expectancy in total population at birth, mean, y | Japan 83.9 | CHE 83 | Australia 82.5 | France 82.4 | Swedan 82.3 | Canada 81.7 | NLD 81.6 | UK 81 | Denmark 80.8 | Germany 80.7 | US 78.8 | 81.7 |
| Health-adjusted life expectancy, mean, y | Japan 74.9 | CHE 73.1 | France 72.6 | Canada 72.3 | NLD 72.2 | Sweden 72 | Asutralia 71.9 | UK 71.4 | Germany 71.3 | Denmark 71.2 | US 69.1 | 72 |
| Life expectancy for woman aged ≥ 40y, mean, y | Japan 47.7 | France 46.4 | CHE 45.8 | Australia 45.4 | Sweden 44.8 | Canada 44.8 | Germany 43.9 | NLD 43.9 | UK 43.7 | Denmark 43.4 | US 42.6 | 44.8 |
| Life expectancy for men aged ≥ 40y, mean, y | CHE 42 | Japan 41.8 | Australia 41.7 | Sweden 41.5 | Canada 41.1 | NLD 40.8 | France 40.6 | UK 40.5 | Denmark 39.8 | Germany 39.4. | US 38.7 | 40.7 |
| **Maternal and infant health** | | | | | | | | | | | | |
| Maternalmortality, deaths per 100000 live births | US 26.4 | UK 9.2 | Germany 9 | France 7.8 | Canada 7.3 | NLD 6.7 | Japan 6.4 | CHE 5.8 | Australia 5.5 | Sweden 4.4 | Denmark 4.2 | 8.4 |
| Infant mortality, deaths per 100 live births | US 5.8 | Canada 5.1 | UK 3.9 | CHE 3.9 | France 3.8 | Denmark 3.78 | Germany 3.3 | Australia 3.2 | Sweden 2.5 | NLD 2.5 | Japan 2.1 | 3.6 |
| Neonatal mortality, deaths per 1000 live births | US 4 | Canada 3.2 | CHE 3.1 | Denmark 3 | UK 2.7 | Canada 44.8 | NLD 2.5 | Germany 2.3 | Australia 2.3 | Sweden 1.7 | Japan 0.9 | 2.6 |
| Neonaral mortality, deaths per 1000 live births excluding < 1000g | Denmark 2.09 | NLD 1.96 | UK 1.77 | Canada 1.63 | US 1.61 | Sweden 1.56 | Germany 1.49 | France NA | CHE NA | Japan NA | Australia NA | 1.7 |
| Low birth weight, % of total live births | Japan 9.5 | US 8.1 | UK 6.9 | Germany 6.6 | NLD 6.5 | Australia 6.4 | Canada 6.3 | France 6.2 | Dendark 5 | Sweden 4.4 | CHE NA | 6.6 |

**Figure 4:** Health Care Spending in the United States and Other High-Income Countries.[5]


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## The cost of health care

It has been estimated that the annual cost of CVD to the EU community (28 countries belonging to the European Union) is around 169 billion per year. Similar data from other European countries are not available or less reliable. However, it has also become clear that implementing a healthy life style and offering optimal health care for all citizens is expensive, and the reason why both can only be achieved in high income countries. In addition, an important evolution has taken place since the beginning of this century. Severely ill and increasingly elderly patients with very complex conditions are now being treated with sophisticated therapies (e.g. a patient in cardiogenic shock being treated with ECMO, left ventricular assist devices, heart transplantation in patients above the age of 65 years etc.). As a result improvements in CVD mortality are obtained at very high (unsustainable?) increases in cost. A nice example in this regard are the data from 200 years of hospital costs and mortality of a well-known hospital (Massachusetts General Hospital) published in the New England Journal of Medicine[7] (Figure 5). The authors of this article conclude that improvements in in patient mortality may be coming at unsustainable increases in cost. This may even be a greater problem in the near future with the development of new treatments for cancer which has become the number one cause of death in some Western countries (cfr supra).Treatments with proton therapy and immune therapy are extremely expensive and the survival benefit so far has been modest.

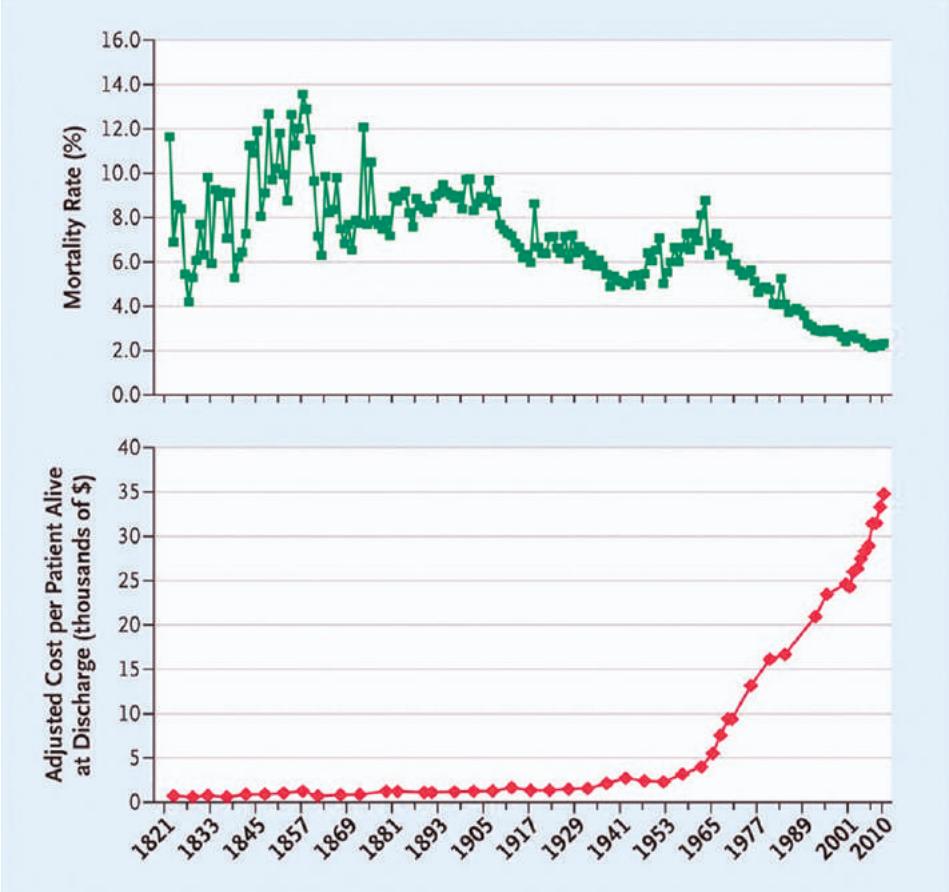


**Figure 5:** Two hundred years of hospital costs and mortality.[7]

## Predicting CVD mortality globally and in Europe

In a recent article published in The Lancet, a forecast of life expectancy, years of life lost (YLL) and all cause and cause-specific mortality in 2040 for 195 countries and territories is presented[8]. Remarkable differences between super-regions were found (Figure 6). Important changes are forecasted in South and Southeast Asia. In these regions, life expectance is expected to increase from 63.6 years in 1980 to 79.8 years on average in 2040 with non-communicable diseases (for a great part CVD and cancer) becoming the most important cause of death (83.2%). A similar trend is predicted in central and Eastern Europe while in Western Europe (high income countries) smaller shifts are forecasted (predicted life expectancy increase from 73.7 in 1980 to 82.5 years on average in 2040 with non-communicable disease becoming the cause of death in 85.7 % of the cases.

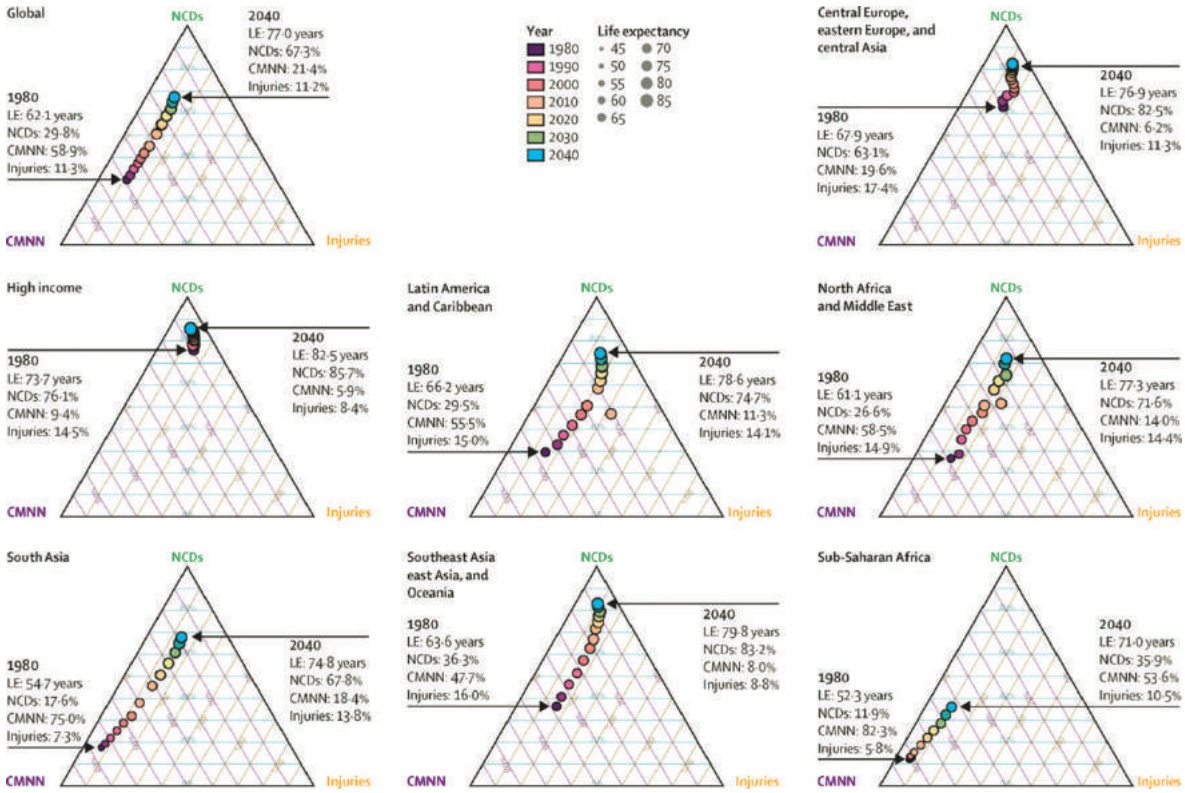


**Figure 6:** Forecasting life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: reference and alternative scenarios for 2016-40 for 195 countries and territories.[8]

## Conclusions

Life expectancy in South and South-East Asia will increase in the next decades. Non-communicable diseases will become the main cause of death as in Western countries. Preventive measures will be critically important to avoid a large transient increase in CVD mortality in the next decade In addition an affordable and guidelines recommended health care system for all citizens will be needed to get life expectance figures similar to those currently seen in West European countries.

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