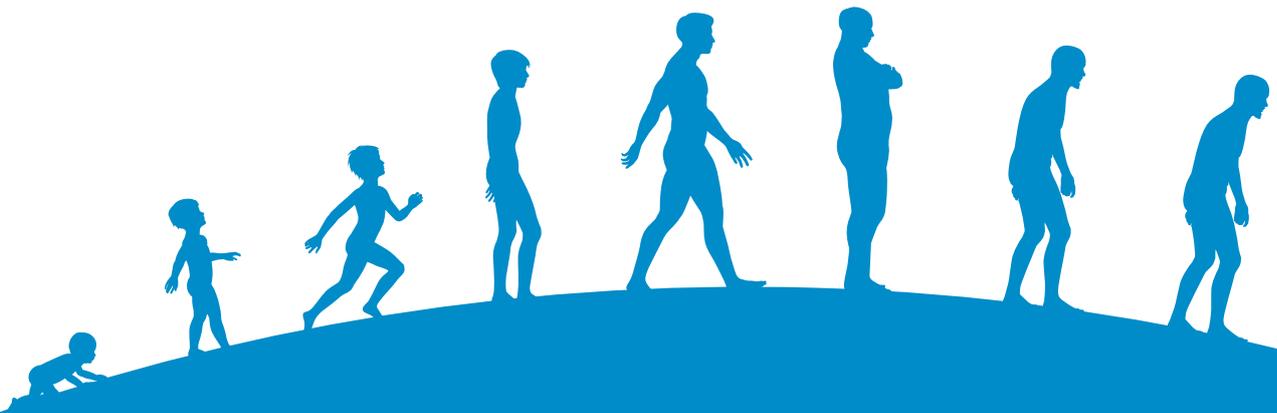


# A Long Lifespan, but Not for All

How social divisions affect life expectancy



## Imprint

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# CONTENTS

KEY POINTS .....	2
1. WHERE WE ARE TODAY .....	3
2. WHAT LENGTHENS AND WHAT SHORTENS LIFE? .....	10
3. THE CONSEQUENCES OF LIVING LONGER .....	16
4. BIG DIFFERENCES .....	21
4.1 USA .....	21
4.2 GERMANY.....	24
4.3 EASTERN EUROPE .....	25
4.4 DEVELOPING AND EMERGING COUNTRIES .....	26
5. WHAT COMES NEXT?.....	31
6. WHAT NEEDS TO BE DONE?.....	36
REFERENCES .....	38

# KEY POINTS

All over the world, average life expectancy has been rising steadily, steeply and seemingly unstopably for more than a century now. Previously, it had always remained low and been prone to dramatic dips caused by famines, epidemics, wars and natural disasters. Global life expectancy has risen from an estimated 30 or so years around 1900 to an average of some 71 years today – a gain in lifespan of about three-and-a-half years per decade. Women in Japan, who are now the world leaders in terms of longevity, live to be almost 87 on average.

The rise in life expectancy began in countries that industrialised early. Thanks to better nutrition and hygiene, access to clean drinking water and medical advances like vaccinations and antibiotics, those countries witnessed a decline in the incidence of infectious diseases that had previously been major killers, particularly among children. With increasing prosperity, cardiovascular diseases like arteriosclerosis, heart attacks and strokes replaced infectious diseases as the most frequent causes of illness and death. From the 1960s onwards, new drugs and therapies, combined with a greater awareness of the risks of eating the wrong food, smoking and not exercising, were able to reduce the incidence of these so-called “diseases of civilisation”. In addition, thanks to modern medicine, it has become possible to prolong the lives of those suffering from such diseases. Thus, in most industrialised countries the decline in mortality is spreading to include ever older cohorts.

In the less developed parts of the world the rise in life expectancy began later, and there have been periods when it has stagnated or even fallen, especially as a result of the HIV/AIDS epidemic, which from the 1990s onwards claimed many lives, particularly in Africa and Asia. Today there is still a gap of 17 years between the predominantly wealthy regions of the world and Africa; but even in the emerging and developing countries, the trend is an upward one.

Can life expectancy go on rising indefinitely? Longevity optimists are convinced that there are already people alive today who could, in principle, live to be 150. Their view is supported by the fact that life expectancy has repeatedly exceeded what was thought to be the upper limit and there is no sign of this upward tendency levelling off. In addition, biomedical research is leading some people to believe that one day we will be able to halt aging and postpone dying.

But at the same time, developments are putting a brake on this rise in life expectancy in certain regions or strata of society. Health, and hence life expectancy, are determined mainly by two factors: social status and level of education. In many industrialised countries, society is split into groups that live to a very old age and remain fit and healthy and other, less privileged groups that tend to engage in risky behaviour, suffer from life’s stresses, fall ill more frequently and die earlier. This is particularly evident in the United States, where the difference between the county with the highest life expectancy and that with the lowest is around 20 years. But in Germany, too, there are major regional and social differences. And the gap seems to be widening. What is more, the aging of

society is sending health costs soaring. All in all, this means that even if certain individuals break longevity records, it is likely to be more difficult for average life expectancy to continue to rise in the future.

In the developing world, the longevity trend is threatened in regions where far too many people, above all children under the age of five, still die of infectious diseases. Prevention is, in fact, relatively simple: mosquito nets can protect against malaria, condoms against contracting HIV/AIDS. But often the money for or the access to these means is lacking – or people are unaware of how to avoid risks. Malnutrition, which makes people more vulnerable to infections and prevents them from realising their potential, remains widespread, despite progress in many areas. And because better-off middle classes are emerging everywhere, the number of people who are clinically obese is rising rapidly too. This “double burden of illness” is one of the challenges that needs to be overcome if the goal is to achieve more health equality. Because only in this way can those at a disadvantage with respect to life expectancy catch up.

Can life expectancy go on rising indefinitely? The answer to this question remains open. But there are other much more important questions: How will we deal with becoming ever older? How can we remain healthy for as long as possible? And how can we shape an aging society? Chapter 6 summarises the main areas where action can be taken.

# 1

## WHERE WE ARE TODAY

### Longevity records and averages

All living things die eventually. Even unicellular organisms, which multiply by dividing or budding, are subject to aging processes that ultimately lead to the termination of life functions.<sup>1</sup> However, the timespan between the beginning of life and death varies enormously from one individual to another. One specimen of the ocean quahog (*Arctica islandica*), a variety of clam, holds the longevity record in the animal kingdom – researchers dated its age to 507.<sup>2</sup> By contrast, gastrotrichs, microscopic worms that live in the water and are commonly referred to as hairybacks, live for only three to four days after hatching.<sup>3</sup>

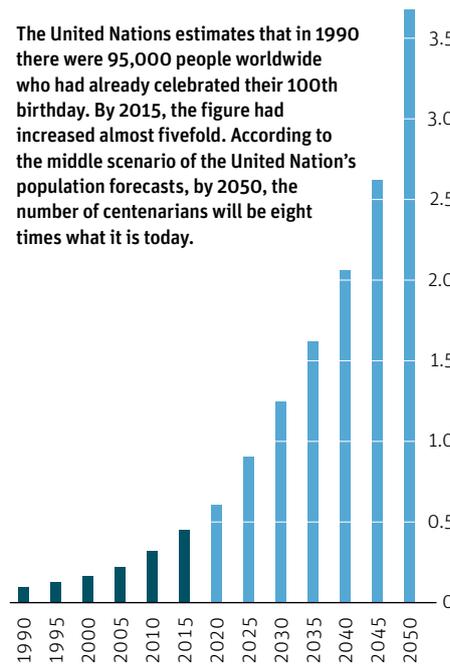
How long can *Homo sapiens* live? To date, the record lifespan is 122 years and 164 days: Jeanne Calment, a French woman died at this truly biblical age in 1997.<sup>4</sup> The maximum attainable age for humans has risen by around 20 years since the beginning of the 19th century. In the industrialised countries the number of people living to at least 100 has doubled each decade since 1950.<sup>5</sup> Worldwide there are currently 43 people who have already celebrated their 110th birthday, so-called “supercentenarians”. With a few exceptions they all live in the industrialised world, mainly in Japan, the United States and Europe.<sup>6</sup>

There have always been individuals who have lived to a relatively old age. Until the early modern age, however, many people fell victim to infections, other diseases or injuries before reaching adulthood. In 1872,

one newborn in four in the German Empire did not survive the first year.<sup>7</sup> In order to measure how long people lived in a particular region at a particular time and in order to compare one population with another, the key figure to use is not the maximum possible lifespan but the average life expectancy.\* This statistic denotes the average number of years a person can expect to live at birth if the current mortality risks do not change (see the box on p. 4).

### Not enough birthday candles

**The United Nations estimates that in 1990 there were 95,000 people worldwide who had already celebrated their 100th birthday. By 2015, the figure had increased almost fivefold. According to the middle scenario of the United Nation's population forecasts, by 2050, the number of centenarians will be eight times what it is today.**



**Number of people aged 100 or over worldwide in millions, 1990 to 2050, projections from 2020 onwards**  
(Data source: UN Population Division<sup>8</sup>)

### The “epidemiological transition”

In the pre-modern era it was mainly epidemics like the plague, cholera, typhoid and smallpox that sporadically decimated populations and sent the death rate soaring; other major causes of death were hunger and chronic malnutrition, natural disasters and wars. Today, ischaemic heart disease, including heart attacks, and strokes top the list of the ten leading causes of death worldwide (see the box on p. 6).

This change in ranking by cause of death plus the overall decline in mortality and the consequent rise in life expectancy reflect socio-economic developments that began in Europe with industrialisation. In 1971, the American epidemiologist Abdel R. Omran introduced the model of the “epidemiological transition” for the first time. He described this transition in terms of three phases that had taken place slowly in the West and more quickly in Japan and were still in progress in the developing world. In the first phase, the “age of pestilence and famine”, average life expectancy still fluctuates strongly both upwards and downwards but remains low overall. In the second phase, epidemics gradually decline, leading to a decrease in mortality and a gradual increase in life expectancy up to an age of about 50. In the third phase, “man-made” diseases – in other words, those conditioned by lifestyle – finally replace infections as the leading causes of death, according to Omran.<sup>10</sup>

\*Unless otherwise specified, all figures in this report refer to average life expectancy at birth.

## Life, death and mortality risk

Alongside the birth rate and the balance between immigration and emigration, the mortality rate is a major factor in demographic developments. It is usually expressed in terms of the number of deaths per 100,000 inhabitants, either overall or classified according to age group and cause of death.

In order to assess the mortality of a population independently of its size and age structure, **mortality tables** are used. These contain statistical models based on data about the number and age of those who have died over a certain period as well as about the average population. This allows the probability of mortality for persons of a certain age to be calculated. A mortality table shows, for each gender, how many people who were alive at the beginning of the period in question have died and how many are still alive.

The probable **average life expectancy** for a particular birth cohort can be calculated using the mortality tables for the previous period. In Germany, official statistics record mortality for periods of three years. Thus current life expectancy figures are derived from the trend discernible in the mortality tables for 2013 to 2015, which is used to predict how long those born today will live on average – assuming that mortality conditions remain constant.

The mortality tables for each period can also be used to determine how long a particular age group, say the 60 or 65 year olds, can expect to live on average. This is called **age-adjusted life expectancy** or life expectancy at that age. In statistical terms, today's pensioners may have a longer average overall life expectancy than today's newborns, since people who have lived beyond their 65th birthday have already left many mortality risks behind them.<sup>9</sup> Unless otherwise specified, life expectancy in this study always refers to **life expectancy at birth**. Depending on the source and point in time when the calculation is made, there may be some discrepancy in the given values, since full data sets are not available for all countries.

Whether these transitions happen stepwise or continuously is a matter of controversy. What we do know, however, is that they do not happen of their own accord. Historically, whenever the mortality of populations or particular groups declined, this could be attributed to initial observations and scientific findings and the subsequent measures and awareness derived from them: wherever there was clean drinking water and proper sewage disposal, wherever

vaccinations and antibiotics were able to check the spread of infectious diseases and wherever there was comprehensive medical care available, people started to live longer.<sup>11</sup> At first, this had a positive effect mainly on the chances of survival of children and youths, since the risk of dying as a result of an infection or parasite infestation is particularly high in the early years of life. People who had already reached adulthood began to benefit from the general decline in mortality only in the 20th century because, among other reasons, living and working conditions improved.<sup>12</sup>

## The cardiovascular revolution – and setbacks

Since the late 1960s, new drugs and therapies, combined with greater awareness of the risks of a diet containing too much salt and fat, for example, have led to a situation where mortality from vascular diseases, heart attacks and strokes has declined markedly. Hence the gain in the number of years lived has spread to ever older cohorts. The impact was so strong that the term “cardiovascular revolution” was coined. Some see it as the fourth stage of the epidemiological transition.<sup>19</sup>

Some researchers even believe that the world entered a fifth phase in the 1990s – when in some places mortality started to rise again. This was due to new dangers, such as the spread of HIV/AIDS, the renewed outbreak of infectious diseases thought to have been conquered, such as tuberculosis, new kinds of epidemics, as well as the proliferation of autoimmune and inflammatory diseases.<sup>20</sup> The global increase in clinical obesity, which can have far-reaching effects on general health, is seen as part of this fifth phase.<sup>21</sup>

All this demonstrates that socio-economic development and the epidemiological transition do not necessarily bring advances in life expectancy. There are also setbacks, since over time the framework conditions that determine death rates and life expectancy trends develop very differently, even in countries where the process of industrialisation began early and especially in the developing world.<sup>22</sup>

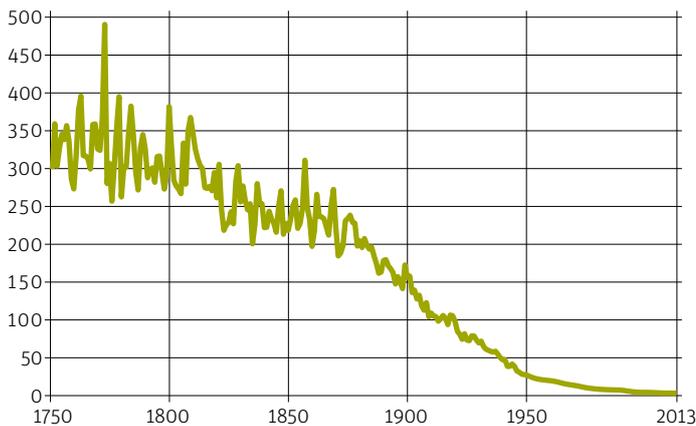
## A historically unprecedented increase

Around 1900, global average life expectancy was about 30. This is an estimate only, since at that time there were scarcely reliable data available for the less developed countries. In Great Britain, the figure at that time was 45.6, in Germany about 43.<sup>23</sup> The increase in life expectancy that began thereafter is historically and biologically unprecedented. By the middle of the 20th century, the global average had already risen to around 47. And the upward trend is continuing: the mortality tables for the period 1995 to 2000 show a global average of 65.6, and the most recent evaluations – from the period 2010 to 2015 – yield a figure of around 70.5.

For the latter period, the population with the highest average life expectancy – almost 84 – are the inhabitants of Hong Kong, the Special Administrative Region of China.<sup>24</sup> In terms of figures for whole countries, Japan is the global leader, with an average life expectancy of 83.7, closely followed by Switzerland, Singapore, Spain, Australia, Italy, Iceland and Israel – all highly developed states. But the gap between Japan and the country bringing up the rear, the West African state of Sierra Leone, is currently around 34 years. There are major differences within Europe, too: in some Southern and Western European countries people are living to the age of 82 and over, while the average inhabitant of the Russian Federation does not even live to see his/her 70th birthday.<sup>25</sup>

Why is this the case? What will happen in the future? Can these differences be reduced? And can the trend go on indefinitely? In order to find answers to these questions we look below first of all at the development of life expectancy to date, both globally and in individual regions. We describe which factors were responsible for the remarkable increase in life expectancy in the part of the world that developed early, factors that have paved the way for a similar development in emerging and developing countries. We briefly outline how this rise in life expectancy, together with the decline in fertility rates, has affected the societies and the economies of the industrialised nations (and by now the first emerging countries). We go on to consider the data situation for the various regions. Finally, we show which trends are emerging and which strategies might be able to overcome the differences mentioned.

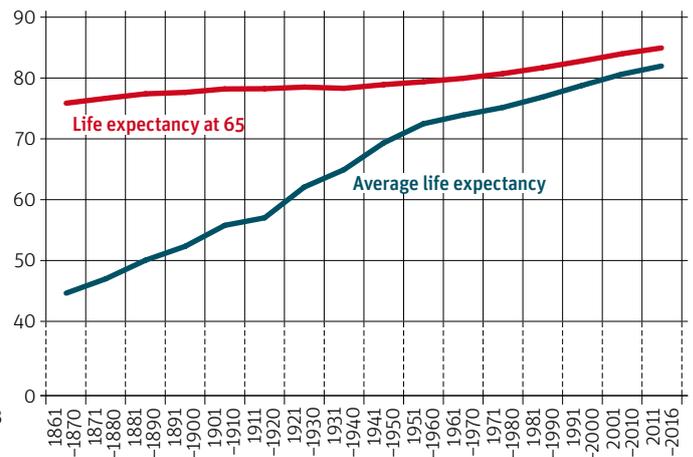
### First, child mortality declines...



Number of children per 1,000 live births who die within the first five years of life in Sweden, 1751 to 2013  
(Data source: Our World in Data)

In Sweden, reliable records of life expectancy go back to 1751. Until the end of the 19th century, child mortality was higher there than it is today in a developing country like Angola. It was not until the second half of the 19th century that Sweden developed from a backward agricultural country into an industrialised one. During this period, child mortality declined markedly and life expectancy rose steadily. From the middle of the 20th century onwards, mortality also began to decline in older cohorts and age-adjusted life expectancy at the age of 65 increased.

### ...later older people start to live longer



Average life expectancy and age-adjusted life expectancy of 65 year olds in years in Sweden, 1861 to 2015  
(Data source: Statistics Sweden<sup>13</sup>)

## The most frequent causes of death

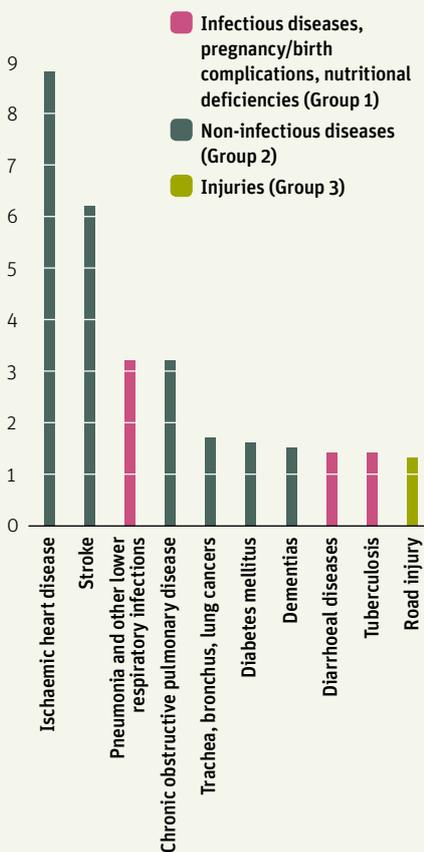
In global terms non-infectious diseases are today the most frequent cause of death – and increasingly so. In first place come cardiovascular diseases. Over the past 15 years, circulation disorders of the coronary arteries, which can lead to a heart attack, and strokes claimed the most lives in absolute terms.

But if the population as a whole is taken into account and regions divided into poor, medium and rich, a rather different picture emerges, although in many less developed countries there are no reliable statistics on causes of death, so the data are often based on estimates or models. In low-income countries more than half (52 percent) of all deaths are attributable to the causes in “Group I”: as defined by the World Health Organization (WHO), this encompasses infectious diseases, complications during pregnancy and birth and nutritional deficiencies. In high-income countries, less than seven percent of deaths can be attributed to such causes, which are characteristic for an early stage of the epidemiological transition.

The reverse is true of the non-infectious diseases, which are included in Group II of causes of death and which are responsible for 70 percent of all deaths worldwide. Alongside chronic diseases of the respiratory tract such as COPD or asthma and diabetes, cardiovascular disease and cancer play a major role.<sup>14</sup> The share of the two last-named causes of death is 37 percent in low-income countries but 88 percent in wealthy nations. In other words: in industrialised countries nine out of ten deaths are attributable to cardiovascular disease or cancer.<sup>15</sup>

## Heart disease number one killer worldwide

56 million people died worldwide in 2015, more than a quarter of them from coronary circulation problems or strokes. Of the ten leading causes of death worldwide, the majority could be avoided or postponed through a healthy lifestyle.



The ten leading causes of death worldwide in millions of deaths, 2015 (Data source: WHO<sup>15</sup>)

## Poor more prone to infections

Infectious diseases claim by far the most lives in poor countries. In first place is pneumonia and other infections of the lower respiratory tract. HIV/AIDS disappeared from the global list of the ten leading causes of death in 2015 but remains one of the main causes of death in the poorest regions of the world.



The ten leading causes of death in low-income countries in number of deaths, 2015 (Data source: WHO<sup>15</sup>)

Some traditional mortality risks are no longer as threatening as they used to be. Hunger, natural disasters, life-threatening working conditions and outbreaks of violence and war still claim many lives at the regional and local level but are of little significance on a global scale. The incidence of cancer is increasing worldwide and is likely to rise further as a result of demographic aging, but thanks to new methods of treatment, patients with some types of cancer do survive today.<sup>16</sup>

A large number of people still die of infectious diseases as well as pneumonia, diarrhoea, HIV/AIDS, tuberculosis and malaria, most of which could be controlled with antibiotics, better hygiene and modern drugs and, above all, through preventive

measures. But in these cases there are often indirect causes of death: a general lack of money or the misallocation of resources, for example in health and education.

Among the environmental causes of death, air pollution is the most significant risk to health in global comparison: one death in eight is caused by particulate matter and toxic combustion residues in the air people breathe.<sup>17</sup> In almost all major cities in low- and middle-income countries, the quality of the air does not comply with WHO norms. Open fireplaces inside huts and houses still cause many diseases and deaths, too, particularly in Southeast Asia and in the WHO region of the Eastern Mediterranean, which stretches from Pakistan to North Africa.<sup>18</sup>

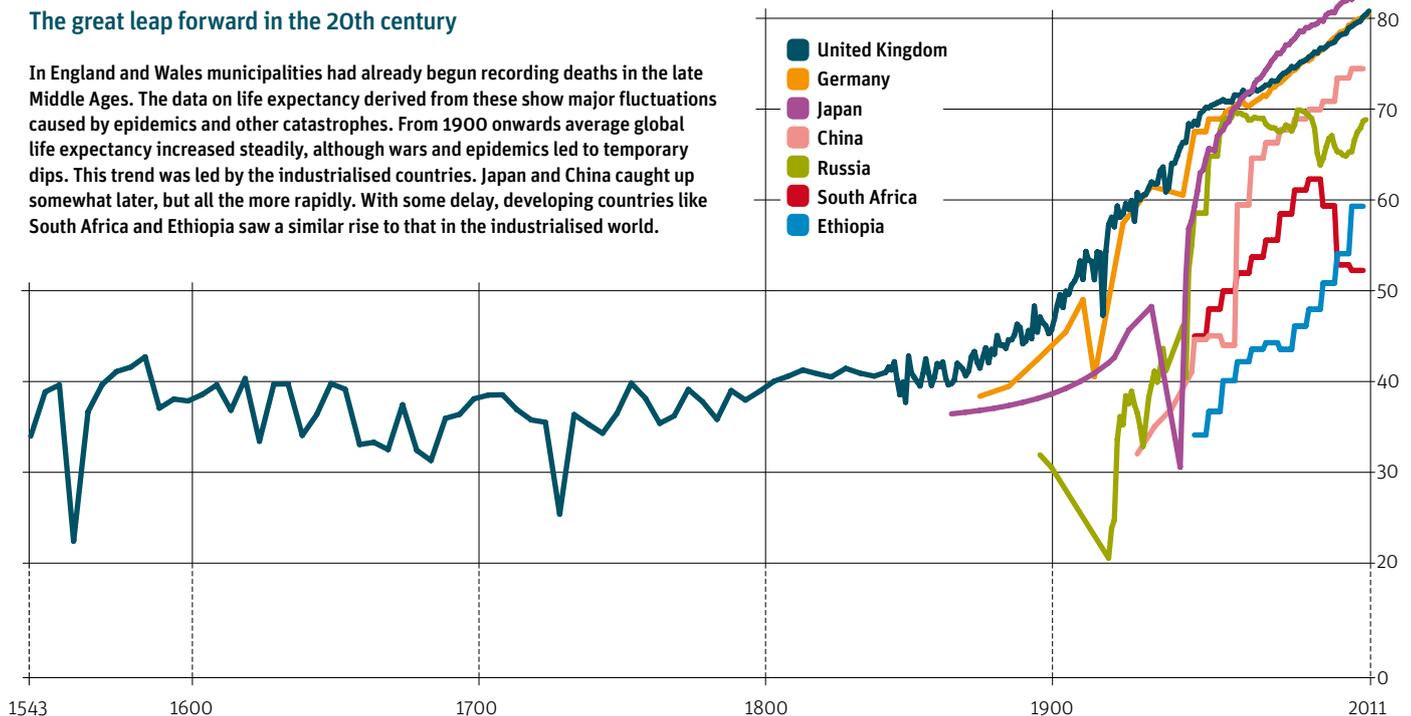
## A steep hypothesis: further linear rise

Although life expectancy has risen for both sexes in the past 200 years, women have always maintained the lead over men (see the box on p. 9). At the beginning of the 20th century, non-Maori women in New Zealand held the world life expectancy record. But in the 1930s they were overtaken by Norwegian women. From mid-century onwards, Icelandic, Dutch, Swedish and, for a short period, Swiss women alternated at the top of the longevity league table. Since the early 1990s, Japanese women have nearly always been ahead.

Average life expectancy in years for selected countries, 1543 to 2011  
(Data source: Our World in Data<sup>26</sup>)

## The great leap forward in the 20th century

In England and Wales municipalities had already begun recording deaths in the late Middle Ages. The data on life expectancy derived from these show major fluctuations caused by epidemics and other catastrophes. From 1900 onwards average global life expectancy increased steadily, although wars and epidemics led to temporary dips. This trend was led by the industrialised countries. Japan and China caught up somewhat later, but all the more rapidly. With some delay, developing countries like South Africa and Ethiopia saw a similar rise to that in the industrialised world.



The demographers Jim Oeppen and James Vaupel at the Max-Planck Center on the Biondemography of Aging at the University of Southern Denmark in Odense have analysed these data mathematically and shown that the record for longevity has increased in an almost linear fashion for the past 160 years. Oeppen and Vaupel conclude from this that the maximum life expectancy could theoretically continue to increase linearly too.<sup>27</sup> In 2016, James Vaupel's team formulated a mathematical rule using data

from 44 countries with a high average life expectancy. According to this rule, the range of variation within a population decreases over time: thus the more the life expectancy of a society increases, the less variation there will be in the age at which people die.<sup>28</sup>

### Convergences and divergences

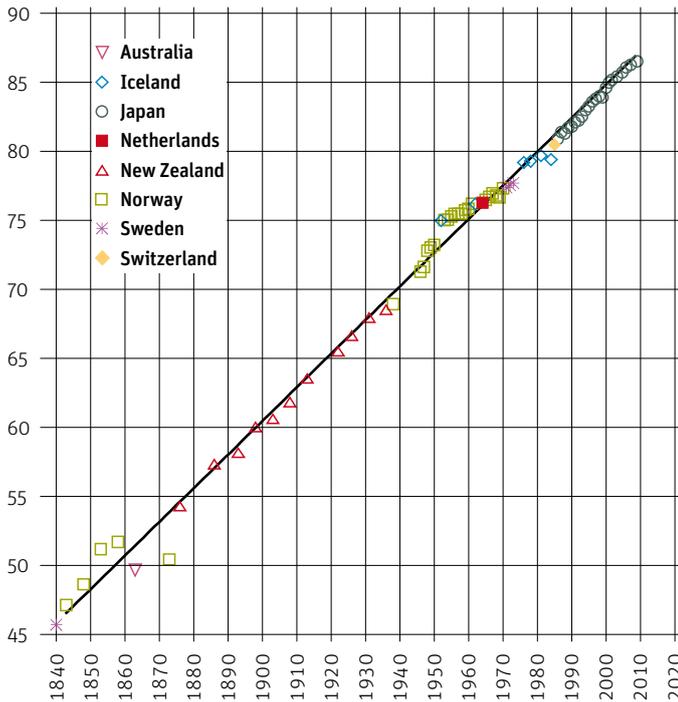
If one looks not at the record figures but at the average and the variance between countries with respect to life expectancy, a rather diffuse picture emerges. The differences between rich and poor countries have indeed diminished over time. For most

countries, a clear upward trend can discern from 1960 onwards. But this rise is far from linear. From the 1980s until the turn of the millennium, Africa recorded either stagnation or a decline in life expectancy, primarily owing to the HIV/AIDS epidemic.<sup>30</sup>

Within Europe, too, life expectancy took a very different course after 1900: initially, the differences between countries became larger because in Southern, Central and Eastern Europe mortality due to infections fell more slowly than in the north of the continent. But from 1920 onwards, these gaps increasingly narrowed; by 1960 the differences in life expectancy for men had shrunk to a minimum and by 1970 for women as well.<sup>31</sup> But as early as 1965 the trends began to diverge again, above all because life expectancy behind the Iron Curtain, in Eastern Europe and the former Soviet Union was no longer rising or had even gone into decline.<sup>32</sup>

### Change at the top of the longevity league

If we record the highest average life expectancy year on year – it is always the figure for women that is used, because it is higher than that for men – and join the dots, we obtain something approaching a straight line sloping upwards. The biondemographers Jim Oeppen and James Vaupel published the relevant graph for the first time in 2002 in their much cited work titled *Broken Limits to Life Expectancy*. Because every supposed upper limit has so far been exceeded, Oeppen and Vaupel concluded that a linear rise in the maximum age would continue.

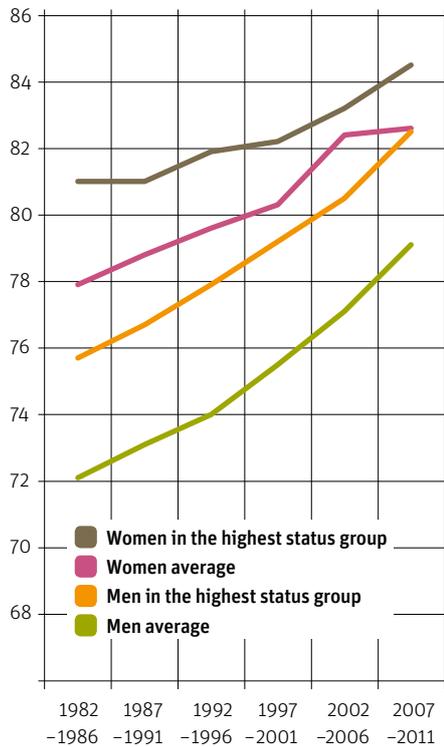


The highest average life expectancy reached for women for the respective year, 1840 to 2014 (Source: Oeppen & Vaupel<sup>29</sup>)

The gap between female and male life expectancy widened in the industrialised countries in the 20th century. In some of these countries, it has recently narrowed again. These developments were attributable less to biological than to external factors, i.e. cultural, social and environmental influences. First of all, the high risk of women dying at a young age from complications during pregnancy or birth declined. At the same time, men were increasingly being exposed to health-threatening working conditions and other risks like dangerous driving, violence and suicide. Above all, however, the consumption of tobacco – which is considered to be the most significant measurable factor – increased. In countries where women took up smoking, for example in Denmark, the Netherlands and the United States, the rise in female life expectancy slowed down for a while in the 1980s and 1990s.<sup>33,34</sup>

## British men of high social status live as long as average British women

Normally women live longer than men on average. Between 1982 and 2011, the female lead in England and Wales shrank from 5.8 to 3.5 years. Detailed statistical analyses suggest that during this period, at least highly qualified men in positions of professional responsibility reached the average female life expectancy.



Development of life expectancy of men and women in the highest status group and on average in England and Wales since 1982  
(Data source: Office for National Statistics<sup>36</sup>)

## Men are less robust, women are ill more often

Numerically, there are slightly more boys than girls among newborns: the ratio is 105 to 100. But girls survive the first five years of life more often than do boys, so that the number of men and women is balanced again in later life. Age-adjusted life expectancy is likewise higher for women than for men at age 50. This inequality between the sexes continues to this day, even if it has varied according to country and over time.

There is no clear explanation for why women live longer. Various biological factors may play a role. Women have two X chromosomes, men only one. If a gene on an X chromosome occurs in an unfavourable variant, women are able to compensate for this if a better variant of the gene in question on the second X chromosome becomes dominant. Men do not have this “reserve”. It is also possible that the mitochondria play a role. These “power stations of the cell” have their own genome and are almost always passed on to children by the mother; mutations that accumulate here over time tend to be harmful only for male offspring, not for female.<sup>37</sup> In addition, there are indications that the female body is better equipped to cope with stress. Hormones influence life expectancy, too: the female hormone oestrogen protects against cardiovascular diseases; as has recently been discovered, it may also contribute to slowing the depletion of the protective caps on the ends of the chromosomes called telomeres, thus slowing down the aging process.<sup>38</sup>

However, throughout their adult lives women have a higher morbidity than men. The reason for this “morbidity-mortality paradox” has not been entirely explained either. One reason might be precisely the overall higher mortality of men: while men tend to die more quickly from cardiovascular disease, women and physically more robust men continue to live with such diseases. Another hypothesis is based on the finding that connective tissue reacts more to female hormones and that for this reason the incidence of illnesses of the joints and bones is especially frequent among women.

In this context, it is interesting to look at developments in the United Kingdom: here men have come a very long way towards catching up with women – and those in the highest socio-economic group, which includes doctors, architects and lawyers, have even reached average female life expectancy. Contributing factors have been, on the one hand, the decline of traditional male occupational domains such as heavy

industry and mining and, on the other, lifestyle factors such as men of higher social status increasingly abstaining from smoking.<sup>35</sup> This development can be seen as indicating that socio-economic conditions have a decisive impact on life expectancy.

# 2

# WHAT LENGTHENS AND WHAT SHORTENS LIFE?

## Social status and education are decisive

In 1980, a working group chaired by Sir Thomas Black revealed a shocking finding for Great Britain: since the National Health Service (NHS) was founded in 1948, health inequality, especially measured in terms of mortality, had not, as expected, been reduced, but instead had increased. Not so much because the NHS had failed, but above all owing to marked differences in income, level of education, diet and living and working conditions, all of which have an impact on health. The British government, which had commissioned the “Black Report”, apparently found the results so shameful that it all but kept them under wraps.<sup>1</sup>

In the meantime, many studies have shown that mortality, and hence life expectancy, depend in key ways on socio-economic status. The latter is determined not only by the income of a person or a population group, but also by employment and professional status, by living situation and family status, and by social inclusion and satisfaction – as well as by the highest level of education attained. The last-mentioned is one of the most important factors in the development of life expectancy.<sup>2</sup>

In the industrialised countries, investment in education resulted early on in a lower number of teenage pregnancies and an overall reduction in the fertility rate. One consequence of this development was that, in expectation of a longer life, broad sectors

of the population invested more resources in their own social and professional advancement and that of their offspring.<sup>3</sup> Historically, reforms that gave a broad sector of the population access to schooling have always brought about an improvement in the state of a population’s health and consequently a rise in life expectancy. In Finland, a major literacy campaign in the second half of the 19th century helped the population to overcome starvation and misery, while later reforms paved the way for a higher level of education – and an ever longer life. Since 1959, when it was granted the ability to elect its own government for the first time, the Southeast Asian city-state of Singapore has developed from a malaria-infested behemoth full of brothels and opium dens into a knowledge mecca. Singapore was able to bring down the initially extremely high level of child mortality almost to zero and now occupies third place worldwide in terms of life expectancy.

## Frontrunners benefit more from the increase

In almost all countries for which data are available, university graduates on average live between two and twelve years longer than their compatriots who have attended only primary school or no school whatsoever.<sup>4</sup> The scientific elite enjoys particular longevity: members of the Royal Society in Great Britain and the national academies in Germany, Austria and Russia have an above-average life expectancy. And in this group mortality at age 65 has fallen more rapidly than the national average. Comparisons over time show that although

people from all educational levels have benefited from the cardiovascular revolution and the fall in mortality for those of advanced age, they have not done so to the same extent: more educated people have always been able to enjoy greater gains in lifespan.

Even in the most developed countries with the least social inequality, differences in mortality based on educational level have increased. In Scandinavia, Finland, Belgium, France and Switzerland the life expectancy of the more educated has risen more steeply than in segments of the population with little education.<sup>5</sup> Thus in Finland, life expectancy at the age of 40 rose for everyone between 1971 and 1995, but well-educated married men and women gained more years than the average population – and that despite their life expectancy already being higher than average at the beginning of the period under observation. In this “frontrunner” group, the incidence of potentially avoidable causes of death, such as diseases contracted by smoking or alcohol consumption, traffic accidents, murders and suicides, was much lower than in other population groups.<sup>6</sup> Worldwide, the biggest disparity between people with different levels of educational attainment is to be found in Lithuania, Estonia and Russia. Russian men with the lowest level of education die on average 13 years earlier than male academics.<sup>7</sup>

## Development can also cause disease

The wealth-related risks that threaten a rise in life expectancy can be counted on one hand: **smoking, alcohol and drugs, unhealthy food, lack of exercise, overweight.** However, volumes could be written about the consequences of these avoidable lifestyle factors for health and mortality. Below is just a brief overview using statistics from the World Health Organization.

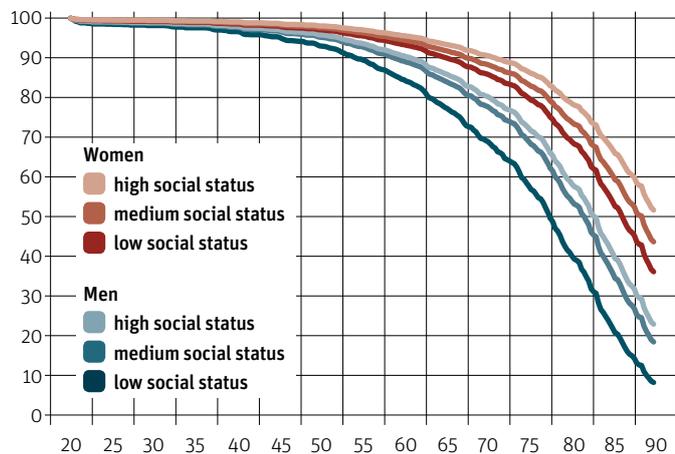
## The poor and less educated die earlier

In Germany, women and men of a higher socio-economic status live much longer than comparative groups of middle or low status. This was revealed by a statistical evaluation based on the Federal Health Survey. The differences can be explained partly by the more risky behaviour of the lower status group with respect to health, the authors write: if one omits smoking, obesity and lack of exercise from the equation, “the differences in mortality risk observed between the different status groups decrease by 28 percent for women and 24 percent for men”.

**Smoking:** The burning of cigarettes releases more than 4,000 chemical compounds into the body. Alongside nicotine, which produces the desired psychoactive effect, these include at least 250 substances that, when inhaled, irritate the mucous membrane or cause other kinds of damage and more than 50 carcinogenic substances, such as benzopyrenes.<sup>28,29</sup> The link between tobacco consumption, lung cancer and the narrowing of the coronary arteries was scientifically proved by the early 1960s at the latest. But it took a lawsuit by 46 US states against “Big Tobacco” demanding compensation for the public costs of treating diseases caused by tobacco consumption to make the cigarette industry cut down on advertising and sponsoring, especially that aimed at teenagers.<sup>30</sup> Today, every packet of cigarettes carries warnings that smoking accelerates the aging of the skin, damages the bronchia, clogs up blood vessels, increases the risk of strokes and heart attacks and can cause cancer. It has also

been known for some time that breathing in these toxic substances in smoke-filled rooms can damage the health of non-smokers as well.<sup>31</sup>

Although the proportion of smokers has fallen over the past 25 years, around a billion people still light up every day, roughly every fourth man and every 20th woman. The majority of smokers, almost 80 percent, live in medium- or low-income countries, where the burden of disease and mortality is particularly high. In 75 of 187 countries studied, the average daily consumption of tobacco per capita is 20 cigarettes or more. Large shares of male smokers are found in Indonesia, in Russia and its neighbouring states, in China and its southern neighbours, but also in Greece and some Balkan states. After high blood pressure, smoking is the second most significant risk factor for premature death.<sup>32</sup> Smoking kills around six million people every year, ten percent of whom are passive smokers.<sup>33</sup>



Estimated probability of survival in percent for 18 to 90 year olds by socio-economic status and sex in Germany, 2011 (Source: Robert Koch-Institut<sup>8</sup>)

## Learning means being able to assess risks better

Why is this the case? People with more education have easier access to information about which kinds of behaviour are beneficial or detrimental to their health. And they are more motivated to use knowledge to take preventive measures and are thus better able on average to control risk factors than are people with little education.<sup>9</sup> This is exemplified by how smoking habits have changed in Germany: since the link between smoking, lung cancer and pathological changes in the coronary arteries was scientifically proved in the 1960s, smoking in Germany has become mainly a habit of the

less educated, of lower earners and of the socially disadvantaged, while the share of smokers in the upper stratum of society has more than halved and in the middle stratum fallen by more than a quarter.<sup>10</sup>

In the United States the life expectancy of college graduates has risen further over the past 20 years, while it has stagnated among those who have no more than a high school education, in other words secondary school or lower. This is the case irrespective of skin colour. There is, however, a link with tobacco consumption: that the mortality gap between

segments of the population with different levels of education has become so wide can be attributed by a factor of at least a fifth to smoking as a risk to health.<sup>11, 12</sup>

It is obvious that those who are intelligent enough are more likely to obtain a higher education in an elitist educational system if they are not prevented from doing so by low social status. Yet more important for the link between education and health is the fact that formal education, particularly during adolescence, when the neuronal circuits in the brain are completely rewired,

further cognitive capacity: logical thinking and the ability to combine knowledge, risk assessment and decision-making.<sup>13</sup> American psychologists found evidence for this in a field study of a rural region of Ghana and in an evaluation of data from nine African countries: after excluding all

**Alcohol and other drugs:** In most countries the consumption of brewed, fermented or distilled drinks is legal. But excessive consumption over a longer period results in diseases of the liver and pancreas, nerve damage and impaired brain function; it also increases the risk of cancer and causes mental and physical addiction. There is more danger of hurting oneself or others through accidents or acts of violence. Furthermore, addiction can lead to depression, anxiety and social isolation.

A good five percent of the years lost worldwide through disease or premature death (Disability Adjusted Life Years or DALYs) are attributable to alcohol. Each year, 3.3 million people die of the consequences of alcohol abuse, which is almost six percent of all deaths – these are, however, unevenly distributed: alcohol accounts for 7.6 percent of deaths among men worldwide and four percent of those among women. Men drink much more than women: in 2010, per capita consumption of pure alcohol was 21.2 litres for men and 8.9 litres for women.<sup>34</sup>

Other psychoactive substances, whether legal or illegal, regarded as “soft” or “hard”, are consumed by between 155 million and 250 million people worldwide, according to the latest estimates (from 2008). That is between 3.5 and 5.7 percent of the world population aged 15 to 64. The most widely used drug is cannabis, with an estimated 129 million to 190 million consumers, followed by amphetamines and related stimulants, cocaine and opioids. Of the last-named, heroin is probably the best known, but this group also includes powerful painkillers like morphine, oxycodone and fentanyl, which are obtainable only on prescription and can likewise be addictive. The consumption of psychoactive substances causes “significant health and social problems for the people who use them, and also for others in their families and communities”, is how the WHO described the effects in rather sober and brief terms. An estimated 0.7 percent of the global burden of disease was accounted for in 2004 by cocaine and opioids. In the countries for which figures are available, the social costs of illegal drugs amount to two percent of GDP.<sup>35</sup>

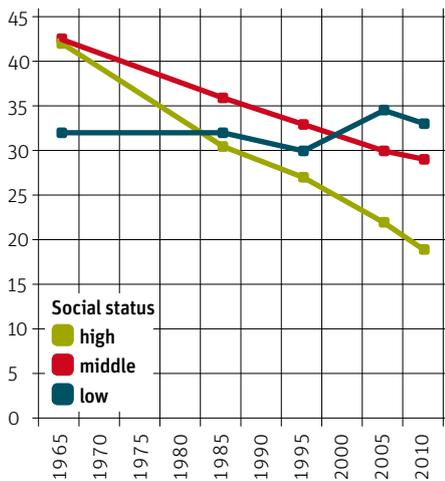
**Diet:** Malnourishment comes in several different forms: malnutrition, supernutrition and nutritional deficiencies. The number of those suffering from malnutrition has fallen by 200 million over the past 20 years. But there has been an increase in the number of those who eat too much, especially too much salt, fat and sugar, reflected in the rising incidence of clinical obesity and the metabolic diseases associated with that condition (see the section “Overweight”). At the same time, even if a sufficient number of calories are consumed, vitamin and mineral deficiencies, especially among children, can lead to development and growth disorders and to health deficits and cognitive limitations.

Malnourishment in any form not only makes people ill and shortens their lives, it also prevents them from realising their full potential and reduces their productivity – with corresponding negative social and economic effects. It is estimated that the costs of obesity, hunger and micronutrient deficiencies amount to four to five percent of global GDP.<sup>36</sup> Malnourishment has an impact not only on the health and mortality of the individual; a tendency to be overweight as well as deficiency diseases can be passed on to offspring via epigenetic mechanisms.<sup>37</sup>

kinds of other potential contributing factors they found that people who had at least primary education were able to put into practice more effectively advice about how to protect themselves from infection and used condoms more often than those without any school education whatsoever.<sup>14</sup> Being informed and able to evaluate information thus protects people against the kind of irrational behaviour that is still widely prevalent, especially in Africa with respect to the transmission of the HI virus – with fatal consequences.

### The more privileged smoke ever more rarely

At the beginning of the 20th century, smoking was customary among the wealthy. Nowadays it is widespread mainly among socially disadvantaged groups of the population – even though smoking a packet of cigarettes a day has become very expensive. A similar change has taken place in other industrialised countries.



Share of smokers as a percentage of population over 14 by socio-economic status in West Germany, from 1995 Germany as a whole, 1965 to 2010 (Data source: Institut für Demoskopie Allensbach<sup>15</sup>)

**Lack of exercise:** More and more people have sedentary occupations. Cars, escalators, lifts, remote controls, ready-made foods, delivery services and other achievements of civilisation have made life more comfortable – but have also resulted in less physical activity. Exercise in everyday life and sports not only keep the musculoskeletal system fit, they also increase the amount of energy used and thus reduce the risk of becoming overweight. Furthermore, they strengthen the immune system, can help to alleviate migraine and depression and prevent certain kinds of cancer. A lack of physical activity is the fourth most significant risk factor for worldwide mortality and is considered the main cause of up to a quarter of cases of breast and bowel cancer, more than a quarter of cases of diabetes and almost a third of ischaemic heart disease worldwide.<sup>38</sup>

### Dying early after a life of poverty

Wealth-related risks such as smoking, poor diet, lack of exercise and being overweight are generally less prevalent the more educated the population or group in question is. With one exception: in wealthy, more advanced countries, clinical obesity is most common among less educated people; but in poor countries, it is the better educated who become obese, as an evaluation of data from 70 countries showed. The higher GDP is, the more the incidence of obesity moves into the less educated groups.<sup>16</sup> Socio-economic status has the greatest impact on people who gain weight easily: a British study, which included gene analyses, demonstrated that

**Overweight:** According to the WHO definition, the threshold between normal weight and overweight is a body mass index (BMI) of 25, calculated as body weight in kilograms divided by height in metres squared. Persons with a BMI of more than 30 are considered clinically obese. Since fat tissue, which accumulates mainly in the stomach region compared, for example, with the area of the thighs, is associated with a higher risk of metabolic and cardiovascular disease, the waist measurement must also be taken into account when considering whether a person is overweight. The threshold for obesity is 88 centimetres for women and 102 centimetres for men.<sup>39</sup>

The cause of obesity is a fatal combination of predisposition, too much food on offer and lack of exercise. Over time, the accumulated fat tissue takes control of the metabolism: using its own hormones, it destroys the brain's normal regulation of appetite, weakens the effect of insulin, controls processes in the liver and triggers inflammatory reactions. Obesity is a disease with consequences: besides type 2 diabetes, it can lead to fatty liver disease and high blood pressure, arteriosclerosis, gout, arthritis, various types of cancer

among people with the same predisposition and similar food on offer, it is income that decides how much body fat is accumulated by each individual: on average 3.8 kilograms among the less privileged half and only 2.9 kilograms among the wealthier.<sup>17</sup>

and fertility disorders. Extremely obese people with a BMI of 40 or more have a reduced life expectancy – more than 14 years less than people of normal weight.<sup>40</sup>

In the industrialised countries, overweight has “risen to epidemic proportions”, as a study by the Organisation for Economic Cooperation and Development (OECD) found. According to this study, on average every second person in the OECD countries was overweight and every sixth obese in 2010. It forecast that the proportion of overweight persons in the population would continue to increase by about one percent a year until 2020. The United States and Mexico, both of which are OECD member states, had the highest shares of overweight people, Japan and Korea the lowest. But rates “have been increasing consistently over the past three decades everywhere”, it went on. Children are also ever more affected. According to the OECD study, both governments and the private sector, including the food and beverage industry, have played key roles in this epidemic.<sup>41</sup>

In the less privileged social segments of the industrialised countries it is not only the wealth-related risks mentioned above that are more prevalent; other risks and diseases are concentrated here too. According to a study on adult health in Germany, 18 to 79 year olds of low socio-economic status develop diabetes more often than those of

Wherever societies have become more prosperous, there is more and better food available; on the other hand, some people adopt poor eating habits. The incidence of obesity has increased markedly in low- and middle-income countries since the 1990s, and it is especially prevalent among older women in urban regions.<sup>42</sup> The incidence of type 2 diabetes is currently increasing more rapidly in poorer countries than in rich ones.<sup>43</sup>

Of the estimated 43 million children of pre-school age worldwide who were overweight or obese in 2010, 35 million lived in developing countries. Another 92 million are regarded as at risk of becoming overweight. The overall incidence of overweight and obesity among children in this age group rose between 1990 and 2010 from 4.2 percent to 6.7 percent. In Africa, the continent on which the most people starve worldwide, the figure was 8.5 percent in 2010 and could rise to 12.7 percent by 2020. In Asia, overweight and obesity are less prevalent among pre-school children than in Africa; the share there is just under five percent, but at 18 million the absolute number is much higher owing to the larger population.<sup>44</sup>

middle or high status and have a higher risk of depressive symptoms, clinical obesity and physical inactivity.<sup>18</sup> Persons of low social status are more often affected by chronic illness, psychosomatic complaints, injuries and disabilities sustained through accidents. The Robert Koch Institute writes: “They are worse at evaluating their own health and more frequently report health-associated restrictions in their everyday lives.”<sup>19</sup>

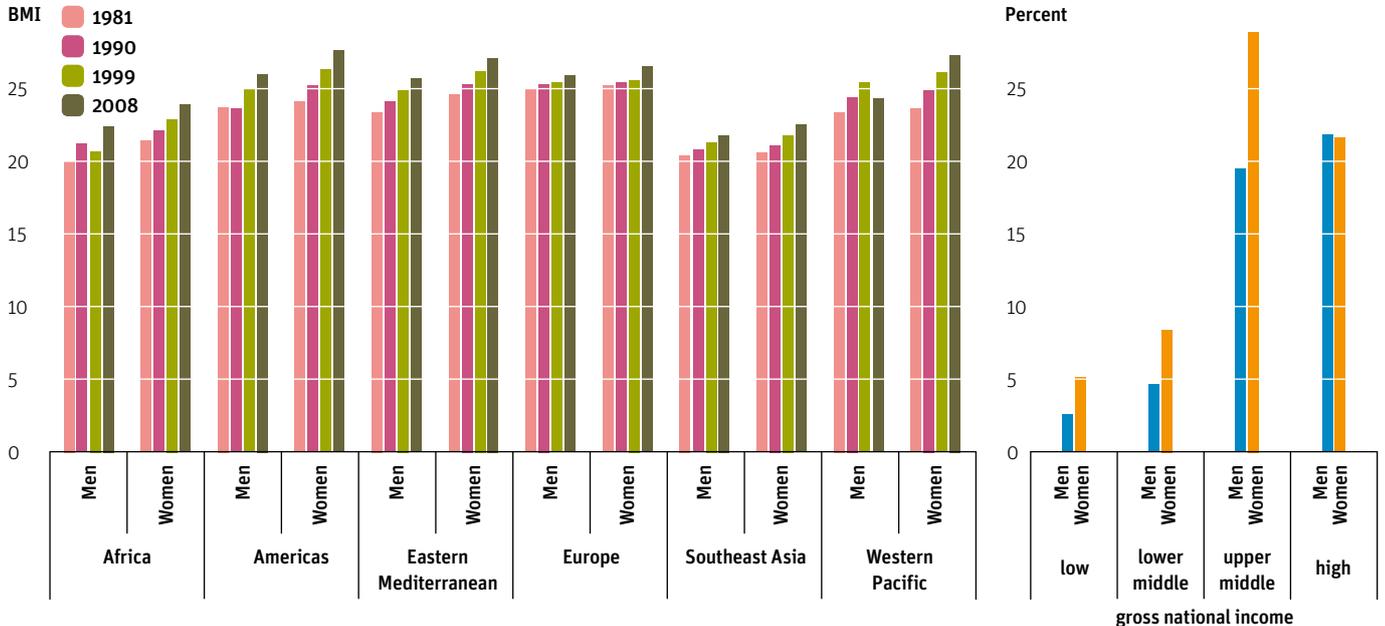
According to data from the mortality tables for 1995 to 2005 and from the German Socio-economic Panel (SOEP), a survey published regularly, women in the lowest income group in Germany have a life expectancy of 8.4 years less than those in the highest income group; among men, the difference is 10.8 years. For healthy life expectancy – in other words, total life expectancy minus the number of years that a person spends with health impairments – the difference between the lowest and the highest income groups is as much as 13.3 years for women and 14.3 years for men.<sup>20</sup>

Here, too, education, or a lack thereof, may serve as an explanation: a good education paves the way to higher-paid professions, to better working and living conditions and to financial security in old age.<sup>21</sup> Worse working conditions in badly paid professions, existential worries, unemployment and unfavourable living circumstances, on the other hand, cause stress and can make people physically and mentally ill.<sup>22</sup>

According to epidemiologists, societies in which the gap between poor and rich is larger are generally less physically and mentally healthy and drug abuse and clinical obesity are more prevalent.<sup>23</sup> This means that if inequalities are perpetuated or even increase, average life expectancy will be reduced, at least in certain regions, and its continued rise threatened.

## Increasingly overweight

Humanity is becoming ever fatter. The average Body Mass Index (BMI) has risen continuously in all WHO major regions (see map on p. 27) since 1981 (left-hand side). The share of the world's population who are obese, i.e., have a BMI of 30 or more, has almost doubled over this period: among men it has risen from 5 to 10 percent, among women from 8 to 14 percent.<sup>24</sup> As can be seen in the small graphic, the largest proportion of obese adults in 2008 was not in the wealthiest countries but in the group of emerging countries with upper middle income.



Average BMI among women and men in the six WHO major regions, 1981 to 2008 (left-hand side) and share of persons with a BMI of 30 or more among the population aged 20 or over in percent, by sex and World Bank income group, 2008

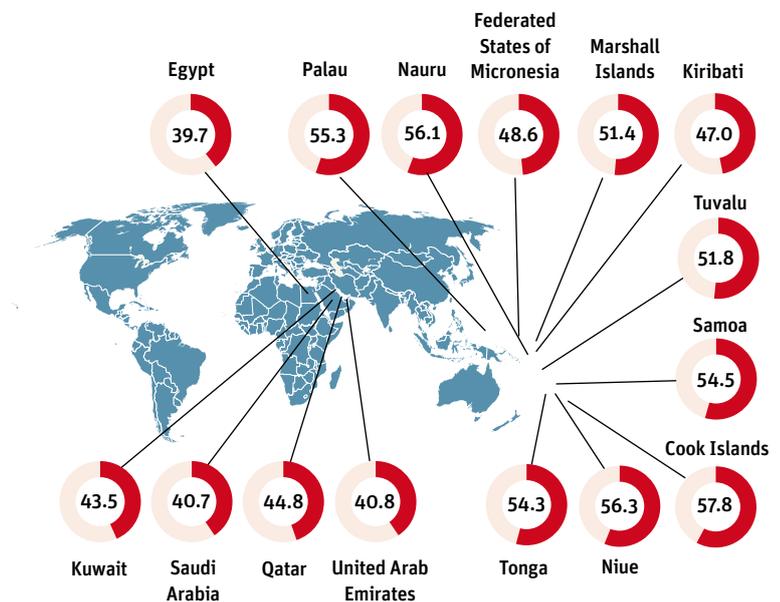
(Data source: WHO<sup>25</sup>, Bhurosy & Jeewon<sup>26</sup>)

## Where the most obese women live

Obesity is a disease that can lead to severe secondary diseases. Overall, women are more affected than men. The highest incidence of obesity among women is on the small island states in the Pacific, which are poor or very poor (see page 29). They are closely followed by women in Qatar, one of the world's wealthiest countries, and in other Arab states.

The 15 countries worldwide with the highest share of women aged 18 and older with a BMI of 30 or more, in percent, 2014

(Data source: WHO<sup>27</sup>)



# 3

# THE CONSEQUENCES OF LIVING LONGER

## Population growth and aging

The global life expectancy gains of the 20th century were reflected, initially, in an unprecedented growth of the world population. When the mortality of a population declines, it is often the case that the birth rate decreases, too, although as a rule this does not happen until years later. The number of the planet's inhabitants has more than quadrupled from 1.6 billion people around 1900 to 7.6 billion today. Not – as a representative of the United Nations commented without mincing his words – “because people suddenly started breeding like rabbits; it’s just that they stopped dying like flies”.<sup>1</sup>

It was in Europe, where life expectancy began to rise at an early stage, that population growth first started to gather pace too. Until around 1950, the number of inhabitants of the industrial nations grew significantly faster than that of the less developed countries. But in the 1960s, the baby boom that North America, Australia and Western Europe all experienced after the Second World War came to a halt. Almost everywhere, the total fertility rate fell below 2.1 children per woman – the so-called replacement level, that is, the rate that would be required to maintain the size of the population in the long term without immigration.

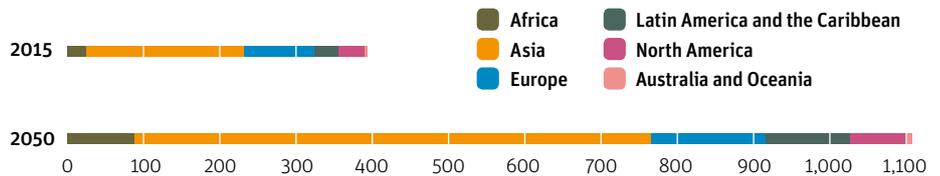
The combination of a declining birth rate and a constantly increasing life expectancy – the so-called demographic transformation – led many societies to age rapidly. In 1950, every tenth inhabitant of Germany was 65 or over; today every fifth inhabitant belongs to the “65+ generation” and by 2060 it is likely to be almost every third. Those over 80 accounted for just one percent of the population in 1950; meanwhile, their share has increased to more than five percent and is expected to more than double to 13 percent by 2060.<sup>2</sup> And while centenarians were once considered a rarity, in recent years the German president has had to send birthday greetings to as many as 7,200 people who have turned 100 or more.<sup>3</sup> With the over 64s accounting for 21 percent of the population, Germany is the third-oldest country – along with Portugal – in the world. In Europe, only Italy has a larger share of older people (22 percent) and in the global comparison only Japan (26 percent).<sup>4</sup>

## Changes in society

Aging poses enormous challenges for society and policymakers. The growing share of old and very old people contrasts with the dwindling share of people of working age. If the retirement age remains at the current level everywhere, pensions systems, among other things, may well experience difficulties – especially if, as is the case in Germany, they are based on a pay-as-you-go scheme. In addition, an aging society can lose some of its innovative strength.<sup>6,7</sup> Economic performance can suffer.<sup>8</sup> And consumption patterns change: while there is growing demand for healthcare services and products, older people tend to eat less and buy fewer clothes and electronic devices than do younger people.

## How the world is turning grey

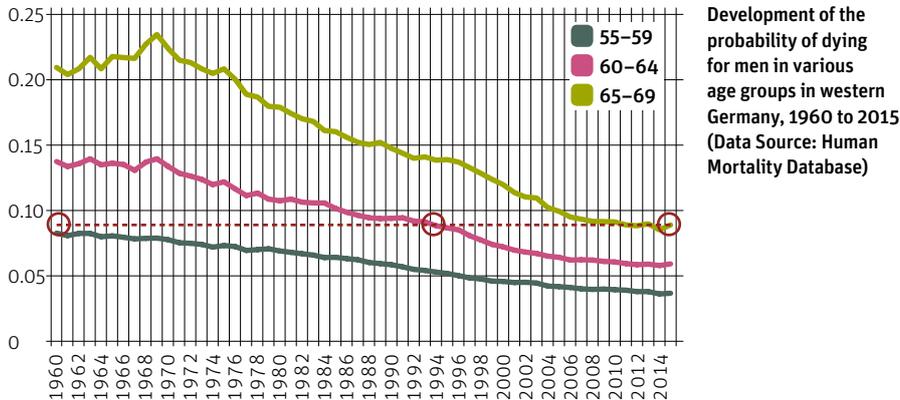
The aging of societies is rapidly advancing even in those regions of the world that are still relatively young today. By 2050, the absolute number of the over 69 year olds in Asia is likely to increase most owing to the continent’s large population.



Number of people 70 or over worldwide by main region, 2015 and forecast for 2050 (Data source: United Nations Population Division<sup>5</sup>)

## 70 is the new 60

The more advanced the age, the higher the risk of dying. This continues to apply today. But over time, the value for a given mortality rate has shifted into ever older age groups. In the industrial nations, this trend is particularly evident – a sign that the state of health of older people has constantly improved. In Germany, today's 65 to 69 year olds are as fit as the 60 to 64 year olds were some 20 years ago and they have almost the same risk of dying as the 55 to 59 year olds at the beginning of the 1960s.



Moreover, aging pushes up healthcare costs. In Germany, spending on health – that is, the total amount of expenditure by the state, by the health, nursing-care, accident insurance and pension funds, by employers and by private households – rose from just under 2,000 EUR per inhabitant in 1992 to some 4,200 EUR per inhabitant in 2015. And in the last four years, expenditure on health has grown more rapidly than GDP.<sup>9</sup> Per capita medical costs – the amount of money spent directly on medical treatment, preventive measures, rehabilitation and nursing care – are disproportionately higher the older the individual is: in 2008, it was already more than twice as high for the 65 to 84 year olds in Germany as the average of 3,100 EUR per inhabitant and almost five times as high for the over 84s.<sup>10</sup>

If and by how much costs rise also depends on the state of health in which people spend their later years. In most industrial nations, at least the “young old”, those between the ages of 65 and 69, are much healthier and fitter than previously. Even suffering from more than one disease at the same time – multi-morbidity in specialist jargon – does not prevent many older people today from regarding themselves as healthy and coping independently with everyday tasks. High blood pressure, elevated blood lipid levels and arteriosclerosis can all be controlled through medication and close monitoring. Medical treatment, equipment and replacement body parts allow patients with diabetes, kidney deficiency or arthrosis to lead a life without too many restrictions. Even centenarians are often astonishingly fit. Studies in Denmark, Greece, the United States, Canada, Australia, Japan and Germany have found that while only a handful of them are 100 percent healthy, many continue to be still largely independent.<sup>11,12,13</sup>

## Does getting older mean staying healthier longer?

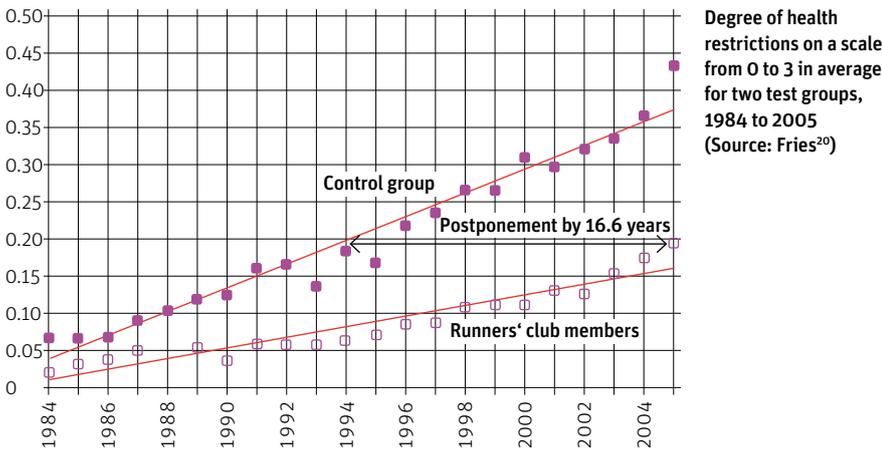
However, it is a fact that the risk of cardiovascular diseases, cancer, chronic lung illnesses, diabetes and dementia increases from 65 onwards. High blood pressure – a risk factor for heart attacks and strokes – has been diagnosed at least once in more than 50 percent of the 65s and over in Germany while in the age group below the figure is just 36 percent. An even more marked increase is evident in angina pectoris, heart failure and cardiac arrhythmia among those who have passed retirement age. And the older the individual, the greater the probability of suffering from several ailments at the same time.<sup>14,15</sup>

Thus, is having to deal longer with age-related illnesses the price we have to pay for living to an older age? Or will these illnesses be postponed, giving us more healthy years to enjoy?

The answer to this question remains open to this day. According to the expansion or medicalisation theory, which the American psychiatrist and epidemiologist Ernest Gruenberg put forward for discussion in 1977, the increase in human life expectancy means that in old age, people live more years in ill health because they are now surviving not only infections but also chronic diseases more frequently and for longer periods thanks to ever improved treatment. Given the aging of the population, the number of the chronically ill and multi-morbid is likely to increase overall.<sup>16</sup> As a result, expenditures on treatment will rise too.

## Do sport and live longer symptom-free

James Fries, the founder of compression theory, was able to prove in longitudinal studies that there is a link between lifestyle, health and mortality. From 1984 onwards, he compared at intervals the state of health of 538 members of a runners' club for 50 year olds with that of 423 healthy people aged 50 and over who did no strenuous sport. Comparable physical restrictions appeared in the men and women doing endurance sports almost 17 years later than in the control group, and the runners lived longer as well. Based on a review of various studies, Fries came to this conclusion in 2011: "If we can accomplish morbidity compression without a strategy, as over the past thirty years, then we should be able to further improve if we have a plan."<sup>21, 22</sup>



Compression theory, which was first made public by the American philosopher and physician James Fries in 1980, is based on a more optimistic view of demographic development. According to that theory, chronic illnesses that are typical in old age shift increasingly to the end of the individual's lifetime and thus the period of restricted health becomes shorter in percentage terms.<sup>17, 18</sup> Accordingly, absolute compression occurs when the age at which these illnesses first appear increases more rapidly among the average population than life expectancy. As Fries recognised, this happens first and foremost among those who adopt a healthy lifestyle.<sup>19</sup>

## Both compression and expansion are possible

In the meantime, researchers have developed an overarching model for the aging of populations. It describes four developments that at times are evident in parallel. First, more people with illnesses survive, which means expansion overall. Second, while chronic illnesses become frequent as a result of demographic aging, medicine enables people to survive for ever longer periods. Third, new generations that are healthier than previous ones and have adopted a correspondingly healthier way of life start to live longer, which leads to compression overall. Fourth, a growing cohort of very old and frail people could cause renewed expansion over time.<sup>23</sup> Studies of centenarians indicate that the last of these developments could occur.<sup>24</sup>

There is some evidence to suggest that compression theory applies mainly to population groups that earn more, are well educated and in general can reckon with living longer than those with low incomes and little education. Conversely, expansion theory appears to be more applicable to the latter group.<sup>25</sup> To put it more bluntly: the socially disadvantaged not only die at an earlier age, they also spend more time being ill than those belonging to the higher strata of society.

## Even those countries that are still young today will grow older

In rich countries, there are many signs that compression has taken place in the past twenty years, above all as regards the ability to cope independently with day-to-day tasks and the burden imposed by illnesses or disabilities, according to a review of various studies. But the same review concludes that it is difficult to say whether this trend will continue. In middle- and low-income countries, on the other hand, there is nothing to suggest compression has occurred. On the contrary, in the future they could witness expansion – that is, the disease burden imposed by older inhabitants could increase if lifestyle risk factors such as poor diet and obesity become more widespread and chronic illnesses increase. What is certain is that in the long term, societies will age even in those countries where the population is still young today and that this will have a significant impact on their healthcare systems.<sup>27</sup>

If we look at the development of "healthy life expectancy" for older people, we see that even those countries where aging has resulted in compression could witness expansion once again in the longer term. The healthy life expectancy for 65 year olds is calculated from the life expectancy at

that age minus the number of years that the average 65-year-old person will spend with health problems during the remainder of his/her life – that is, with physical or mental illnesses, disabilities or problems caused by injuries.<sup>28</sup>

In the 28 EU states, the range is from almost 17 years in full health for 65-year-old women and more than 15 such years for men in Sweden to 4.3 years for women in Slovakia and just 4.0 for men in Latvia. Between 2010 and 2014, the EU-28 average healthy life expectancy for 65 year olds decreased. Those countries that recorded a decline during this period are Bulgaria, Lithuania, Portugal, Austria and Germany. In all other countries, the number of illness-free remaining years rose.<sup>29</sup>

## Higher expenditures do not necessarily mean better health

What does all this mean for cost development? One thing is certain: in the industrial nations, child and maternal mortality can barely decrease any further. Western Europe, North America and Japan have reached a stage at which mortality in old age is declining faster than among young people.<sup>30</sup> However, lower infant and child mortality was relatively inexpensive to achieve and gave a huge boost to average life expectancy: if there are more people reaching 60 or 70 instead of just two or three years of age, it will tangibly boost average life expectancy. Today, the situation is different. The mortality of older people can be further deferred only through ever

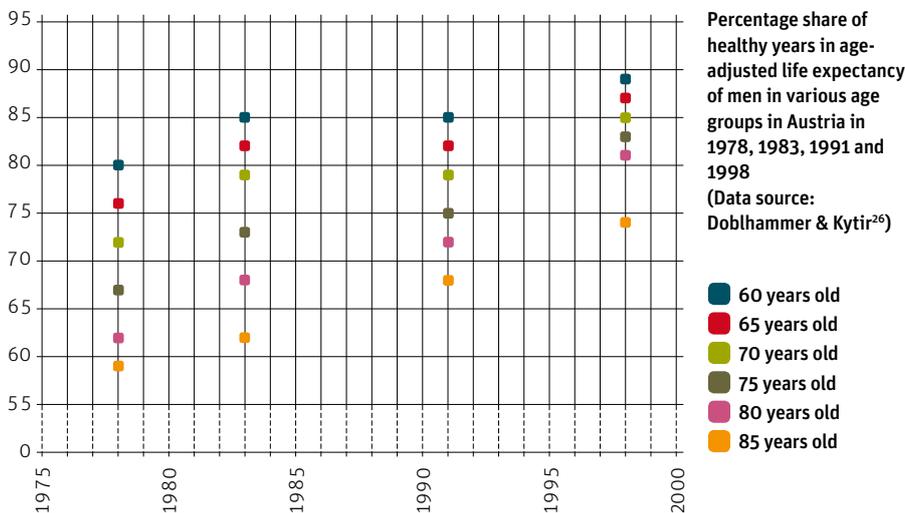
higher expenditures and with comparatively little impact. And if the share of old and very old people increases, even the healthcare systems of rich countries could reach their limits.

In the past few decades, countries with a high level of national income have consistently spent more on health and continue to spend almost twice as much as those with a low income, above all because of rapid advances in research and treatment.<sup>31</sup> But life expectancy does not necessarily increase as a result of higher expenditures. The best example here is the United States: despite the reform of the healthcare system, which was implemented in 2010 after lengthy political wrangling, around nine percent of the adult population still do not have any health insurance. Of those who are insured, more than two thirds are covered by the private sector for illness, mainly through their employers – in some cases subsidised – and the remainder through state-funded programmes.<sup>32</sup> Today, in GDP terms, the US has the highest public expenditure on health in the world. By contrast, the share of GDP that Great Britain with its public healthcare system spends on health is just over two thirds of the US share. Nonetheless, British life expectancy is some two years higher than that of the US. And Japan, whose expenditure share is comparable to that of Britain, holds the record for life expectancy.<sup>33,34</sup>

However, the example of the British healthcare system – the National Health Service (NHS) – shows that not only medical progress but also aging sends costs soaring – until they can no longer be met. The NHS funds itself mainly from tax revenues and to a small extent from social insurance contributions. It offers all inhabitants of the country free outpatient and inpatient treatment as well as preventive screenings, operations and nursing care, regardless of previous illnesses and level of income, albeit

## Healthy for ever longer

The healthy life expectancy is calculated by combining data on life expectancy and state of health. Researchers analysed the answers given by 60 to 89 year olds in Austria in four survey rounds conducted from 1978 onwards. For the question about state of health, there were five possible answers ranging from “very good” to “bad”. All those who responded in the range from middling to very good were categorised as being “in good health”. In relation to remaining life expectancy, the average number of healthy years has increased over time. Thus, in 1998, 70-year-old men could reckon with spending 85 percent of their remaining lifetime in good health, which was significantly more than for men of the same age 20 years earlier.



without free choice of physician and hospital. Under this system, people have to pay extra only for prescriptions, dental treatment and eyeglasses.<sup>35</sup>

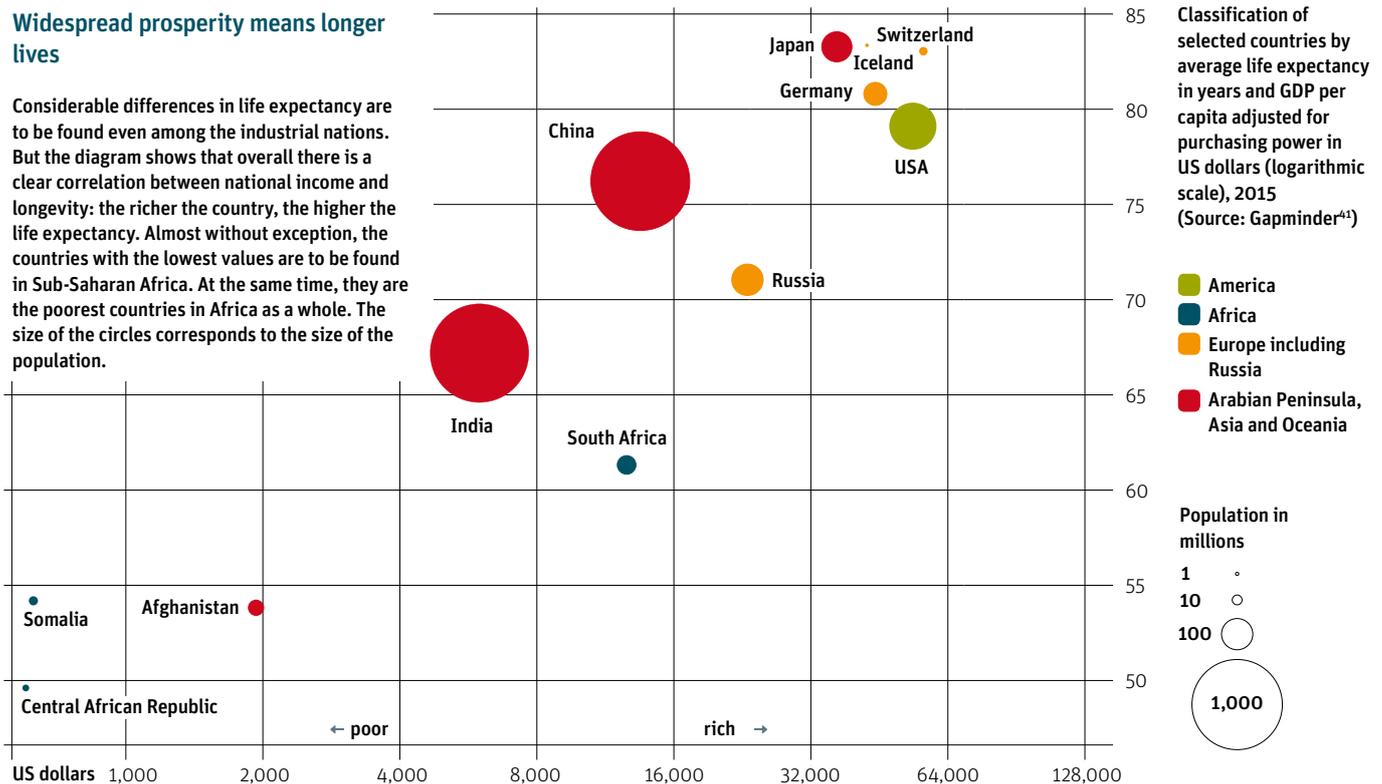
But recently, costs have exploded, not least – according to the British Medical Association – because there are an ever-increasing number of older people with chronic illnesses who need treatment. Drastic savings had to be made. Staff were laid off and the system partly reformed. However, complaints about the shortage of physicians, the long waiting periods and bottlenecks even in the case of emergency care have increased. At the beginning of 2017, physicians and hospitals sounded the alarm, charitable organisations and leading NHS employees sent an open letter to Prime Minister Theresa May

demanding fundamental reform and higher levels of funding.<sup>36</sup> As British epidemiologists were able to show, the cuts already made were the main reason why in 2015 the highest increase in mortality was recorded in England and Wales since the end of the Second World War: 30,000 deaths more than the average for this period with a peak in the wet and cold month of January 2015, during which the majority of those who died were older people.<sup>37</sup> While there may be no connection with this development, the average life expectancy in Great Britain sank by 0.4 years in 2015 compared with the previous year.<sup>38</sup>

Experts from the Institute of Health Metrics in Washington estimate that healthcare expenditures in the coming 20 years will increase significantly all over the world: from just over nine trillion US dollars at present to more than 24 trillion US dollars in 2040. However, both the extent of the increase and the financial sources are likely to vary considerably from country to country. In particular, poor countries will be noticeably less able to rely on financial support for their healthcare systems from richer countries. While such support increased markedly between 2000 and 2010, it has since barely risen. Support for HIV/AIDS programmes is already falling.<sup>39, 40</sup>

### Widespread prosperity means longer lives

Considerable differences in life expectancy are to be found even among the industrial nations. But the diagram shows that overall there is a clear correlation between national income and longevity: the richer the country, the higher the life expectancy. Almost without exception, the countries with the lowest values are to be found in Sub-Saharan Africa. At the same time, they are the poorest countries in Africa as a whole. The size of the circles corresponds to the size of the population.



# 4

## BIG DIFFERENCES

### The story so far

Until now we have seen that life expectancy has steadily increased worldwide. Thanks to advancements in modern medicine and progress in disease prevention, mortality in the wealthy countries is shifting to an ever more advanced age. While this means that certain population groups repeatedly break longevity records, the less privileged are left behind. If these differences are perpetuated or become even larger, this will inevitably have consequences for average life expectancy. The rise in health costs associated with aging societies may mean that even the wealthiest of the wealthy countries will be unable to continue increasing life expectancy.

The following examples from the parts of the world where industrialisation took place early show where the obstacles are and where the above-mentioned trends are becoming more pronounced. The examples from the developing world illustrate that the goal of reducing health inequality is still far from being achieved.

### 4.1 The United States: High costs, a major social gulf

In December 2016, the US National Center for Health Statistics announced a surprising finding: the average life expectancy of Americans fell in 2015 over the previous year by five weeks to 78.8 years, after having risen, albeit slightly, for two decades.<sup>1</sup>

At first glance, the decline seems negligible, but it demonstrates the continuation of various unfavourable trends. First, in 2015, mortality for eight of the ten leading causes of death increased; these include cardiovascular diseases, still the number one cause, and strokes – both of these illnesses had been becoming less prevalent until then. Second, the increase in mortality affected mainly middle-aged and younger people, less so older people. Mortality as a result of injuries sustained in accidents, since 1980 the leading cause of death among 25 to 44 year olds and over time a more common cause of death among 45 to 64 year olds, rose by almost seven percent, according to the latest statistics. Third, in recent years it is above all non-Hispanic white Americans – both men and women – whose life expectancy has either stagnated or fallen. The gap between Afro-Americans and whites has thus shrunk to 3.4 years, smaller than it has ever been.<sup>2,3</sup>

The average life expectancy of the US population is generally lower than in most other industrialised nations and is roughly on a par with the much poorer Central American countries of Costa Rica and Cuba.<sup>4,5</sup> According to earlier studies, the differences between the United States and comparable countries are mainly due to higher mortality among those under 50 in the United States: the main causes of death in this age group were noncommunicable diseases, complications in pregnancy and birth, road traffic accidents, gunshot wounds and drug abuse.<sup>6,7</sup>

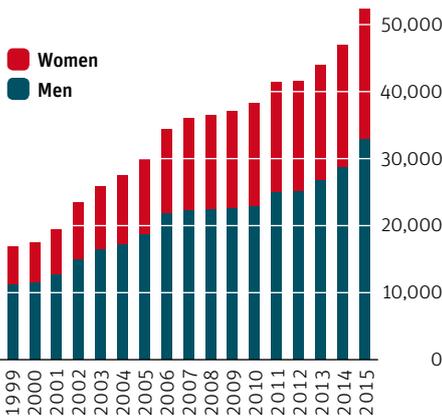
### Drugs epidemic

Although drug overdoses are not among the ten leading causes of death in the United States, heroin use and addiction have increased enormously in recent years, disproportionately among the white population.<sup>8</sup> The number of heroin deaths thus rose from 0.6 deaths per 100,000 inhabitants in 2004 to 3.3 in 2014 – a five-fold increase in mortality that affects mainly 25 to 54 year olds.<sup>9</sup>

Another cause for concern is the abuse of prescription painkillers. The number of prescriptions for opioids, substances with an effect similar to that of morphine such as fentanyl or oxycodone, which are prescribed following surgery, for instance, has almost tripled in the last 15 years. Since patients often prolong treatment of their own accord or pass on these drugs to relatives or friends, there is a flourishing black market for them. As much as 70 percent of drug abuse may be attributable to access to substances of this kind prescribed for other people.<sup>10</sup> The number of addicts has thus

### Ever more drug victims

The number of deaths caused by drugs has more than tripled in the United States since the turn of the millennium. The overwhelming majority of the victims have always been whites of European origin. 2015 saw a record number of victims in the 45 to 54 age group. The rise was largely due to the abuse of heroin and prescription painkillers whose effect is similar to morphine.



**Drug overdose deaths in the US, 1999 to 2015**  
(Data source: US National Center for Health Statistics<sup>13</sup>)

increased and mortality has risen. Health experts have already warned that the “opioid epidemic” must be halted once and for all, a further escalation prevented and a strategy developed for alleviating pain through substances that are non-addictive.<sup>11,12</sup>

The widespread use of drugs of all kinds means that diseases caused directly by drug use count among the ten most common health impairments in the United States. According to Global Burden of Disease (GBD) statistics, there is no other country with such a high socio-economic index – with the exception of Australia – in which this is the case.<sup>14</sup> Among these mainly highly developed countries, the United States has the lowest healthy life expectancy: women live an average of 69.5 years without health impairments, men 66.8 years. By comparison: in Canada, both women and men can expect to have another three healthy years on average. Throughout Western Europe, women can expect to live on average until 70 or more without health impairments, men until 68.8.<sup>15</sup>

### Major gulf between rich and poor

Compared with other industrialised nations, the gulf between rich and poor is particularly large in the United States. In the Gini Index (GI), a measure of income inequality on a scale of 0 to 100, the United States scores 41 and is thus on a par with Russia, Turkey and Morocco. By comparison, in Western Europe Sweden comes closest to income equality with a GI of 25, Germany scores 28 and the United Kingdom and Italy come last with a GI of 36.<sup>16</sup>

In the United States, how healthy people are, the age at which they die and the cause of death are closely linked with income, social status, level of education and skin colour. And the differences are becoming bigger. In 2006, researchers used data on skin colour and various county-level socio-economic indicators to divide the population into eight different groups. The difference in life expectancy between the best and the worst of these “eight Americas” was 15.4 years for men and 12.8 years for women.<sup>17</sup> In 2008, a similarly small-scale analysis revealed that mortality differences in individual districts had increased since the early 1980s. The gap between rich and poor was particularly evident among women: for 19 percent of women, life expectancy had either remained the same or fallen, but this was true for only four percent of men. The researchers identified smoking and the diseases associated with it together with high blood pressure and obesity as the main reasons for this development.<sup>18</sup>

In the country as a whole, the difference in life expectancy between the richest and the poorest one percent of the population has already risen to 14.6 years for men and 10.1 years for women on average.<sup>19</sup> The differences are not getting any smaller: in 2014, there was a gap of around 20 years between the county with the highest life expectancy and that with the lowest.<sup>20</sup>

## Poor prospects, structural racism

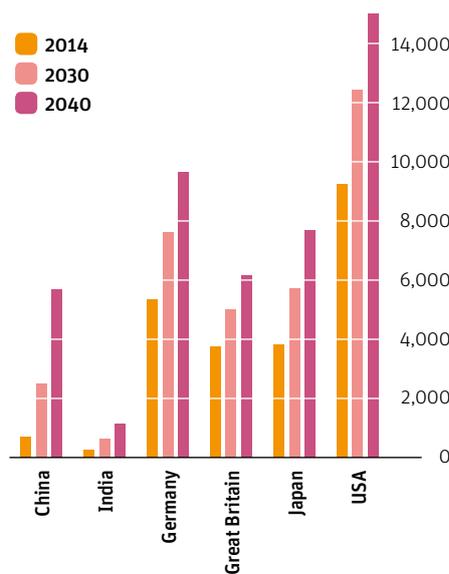
The income gap is in itself not the main cause of these differences. The economist Anne Case and Angus Deaton, winner of the Nobel Prize for economics, have examined why life expectancy among white, middle-aged non-Hispanic Americans with a low level of education has fallen disproportionately. Case and Deaton identified “deaths of despair” as the reason: the dwindling prospects for poorly qualified people on the labour market are driving the once proud white working class into illness, alcohol and drug addiction and suicide.<sup>21</sup> Epidemiologists have identified another driver of increasing health inequality: “structural racism”, which puts ethnic minorities, above all Afro-Americans, at a disadvantage in education, housing, work, the media, criminal justice and healthcare.

Thus the US health system itself is contributing to the widening health gap.<sup>22</sup> It is true that those with good health insurance coverage are able to consult specialists and have access to the latest therapies and technologies. But therein lies the problem: the United States is the only wealthy nation that does not provide universal healthcare. Before the Obama government’s health reform, the health costs of 16 percent of the population were covered neither by health insurance nor by a government health programme for older and poor people. Although that share has fallen to around nine percent since the reform, it is still high compared with other countries and may rise again as a result of a reform of the reform. Those without health insurance rarely go to the doctor or to preventive screening, since they have to pay for such visits entirely out of their own pockets. For this reason, they

are often diagnosed with diseases like cancer only at a late stage. While they are given emergency treatment, they may have to foot the bill for it later. Most of those without health insurance belong to the low-income or poor segments of the population. And even those who are insured often have to pay large sums for treatment themselves because their health insurance covers only part of the cost.<sup>23</sup>

## Where health costs are exploding

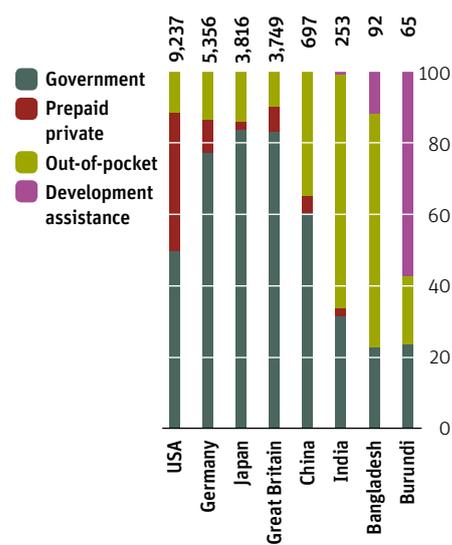
Using past data for 184 countries since 1995, researchers have calculated models for the future development of health expenditure. According to these models, China is likely to experience the largest relative increase in health expenditure, albeit from a comparatively low base. In the next 25 years, China expects this expenditure to rise eightfold, but even then it will be below that of the US today.



Health expenditure per capita in selected countries in US dollars, 2014, forecasts for 2030 and 2040 (Data source: Dieleman et al.<sup>25</sup>)

The most expensive health system in the world is also one of the least effective. According to a new study, an estimated 30 percent of the astronomically high annual US health expenditure of 3.2 trillion US dollars is spent on “waste, inefficiencies and excessive prices”. At the same time, health disparities persist or are even worsening and the health and financial burdens of chronic illness and disability are straining families and communities. Political measures and improvements to the infrastructure are urgently needed, according to that study.<sup>24</sup>

Health expenditure per capita in the United States is the highest in the world; in Sub-Saharan Africa it is the lowest. Burundi has the highest share in the world of health expenditure financed from development aid donated by wealthy countries. In countries where very little money is spent on health today, the rise in expenditure is expected to be negligible; those states will continue to rely on financial support.



Health expenditure per capita in US dollars and share by origin in percent for selected countries, 2014 (Data source: Dieleman et al.<sup>25</sup>)

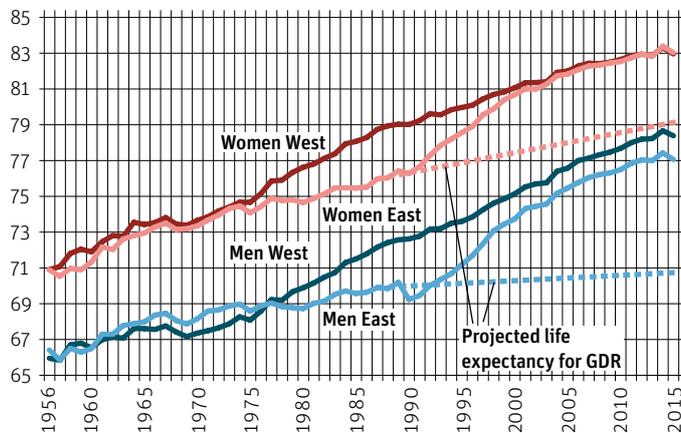
## 4.2 Germany: Good healthcare, rising costs

While Germany was still divided, life expectancy rose more or less equally on either side of the Wall. But from the mid-1970s onwards, the increase in the GDR slowed down – in parallel with similar developments in the other countries of the former East bloc. If the trend from the period prior to the fall of the Wall in 1989 had continued, women in East Germany would have died on average four years earlier and men six years earlier than is the case today. Almost immediately after the end of the GDR had been signed and sealed, life expectancy dipped, at least initially, especially among young and middle-aged men, many of whom died of “external causes”, namely in car accidents. However, in 1991, East Germany began to catch up with the west. Just a decade later, women in the east had reached the same life expectancy as those in the west. East German men, on the other hand, are only now approaching the life expectancy of West German men.<sup>26</sup>

Much of this leap can be explained by the different focus in the health systems of the two German states. In the former GDR, the main priority was to maintain the health of the working population. Treatment of cardiovascular diseases, which tend to affect older people, remained secondary – unlike in West Germany, where modern medicine has done much to reduce the mortality of those of pension age. In the early 1990s, mortality from cardiovascular disease in the east was about one and a half times that in the west for both men and women.<sup>27</sup> East Germans over 60 have benefited from 80 percent of the additional lifespan gained through the delayed “cardiovascular revolution”.<sup>28</sup>

### Delayed revolution

Until the mid-1970s, life expectancy rose by a similar rate in the two German states. But thereafter the increase slowed in the GDR, and shortly after the political upheavals of 1989, life expectancy in the east dipped, especially among men. Later the East Germans quickly caught up.



Average life expectancy by sex in East and West Germany, 1956 to 2015; projected life expectancy trend if the GDR had continued to exist until 2015 based on mortality data for the GDR for the 1970s and 1980s, 1990 to 2015 (Data source: Human Mortality Database/Vogt<sup>30</sup>)

Demographers in Rostock have calculated that the social expenditure that has flowed into the east since reunification has increased average life expectancy by about three hours per year.<sup>29</sup>

### Geriatric medicine is expensive

Germany thus provides an excellent example of the significance of comprehensive healthcare for the life expectancy of a population. However, this comes at a cost. While the 65+ generation in the world's third-oldest nation may be mostly fit, active and interested, engage in voluntary work and vote in elections, read a lot and use electronic communications media, the share of older and very old people in the population is growing.<sup>31,32</sup> The baby boom generation are due to reach pension age around 2030 and only around 2060, when this generation reach the end of their lifespan, is the ratio between the generations likely to become more balanced again. Germany is among the world's very wealthy countries. While

its health expenditure is average, it has a highly developed and, compared with that of other countries, very accessible health system.<sup>33</sup> Nevertheless, the question remains whether certain kinds of healthcare need to be rationed owing to steadily rising costs. On the one hand, because the population is aging and, on the other, because medical advances are constantly improving. But at the same time, these advances are making ever more expensive the treatment of cardiovascular diseases, which in Germany are responsible for the greatest losses in disability-adjusted life years (DALYs) and are the leading cause of death. The same is true for cancer, the second most common cause of death. The cost issue may be exacerbated by the fact that Germany does not do particularly well on healthy life expectancy in European comparison.<sup>34</sup>

## South-north divide in life expectancy

What is surprising is that there are marked regional disparities and differences between the various population groups with respect to health, mortality and life expectancy, even though universal healthcare is available and income inequality is relatively low. The Gini coefficient is around average for the OECD states. Although the differences in life expectancy between the federal states (Länder) have narrowed in the last 20 years,<sup>35</sup> the population in the south of the country continues to enjoy greater longevity. Baden-Württemberg has both the highest female life expectancy (83.9) and the highest male life expectancy (79.5). Bringing up the rear for women is the Saarland (82.1) and for men Saxony-Anhalt (76.2).<sup>36</sup> If we look at the figures for smaller administrative entities, the differences become far more marked, especially for the male population: in the wealthy Bavarian district of Starnberg, newborn boys have an average life expectancy of 81.5 years, while in the former shoe-making centre of Pirmasens in Rhineland-Palatinate, they can hope to live only to the age of 73.4 – a difference of more than eight years.<sup>37</sup>

## 4.3 Eastern Europe: Bitter setbacks

The division of Europe was tantamount to a natural historical field study from which to examine the effects of health policy, the Dutch public health expert Johan Mackenbach wrote. More than a quarter of a century after the fall of the Iron Curtain, Europe is still divided in terms of health and mortality. Around 1960, the countries in the south and east of the continent had almost caught up with those in the west and north. Since then, life expectancy in Western Europe has risen by ten years on average and that in Eastern Europe by only seven. The difference is greater than it was in 1960. In some Eastern European countries and among certain population groups in the east of the continent, life expectancy stagnated in the final years of the communist era and thereafter; in some cases, it plummeted and even today has still not returned its former level.<sup>38</sup>

In the communist states the “cardiovascular revolution”, which above all older people in Western Europe had to thank for a longer life, did not happen – this was clearly illustrated by the example of the two German states. However, the social upheavals following the end of the political division of Europe and the collapse of the Soviet Union in 1991 had the biggest impact on life expectancy. Thereafter, it developed very differently in different countries.

Of the former Soviet republics, only the Baltic States, which now belong to the EU, experienced a rapid rise in life expectancy. Scarcely had they become independent than all three set about launching a health reform in the 1990s. Estonia was the first to reap the benefits, which manifested themselves in a rise in life expectancy. In Latvia and

Lithuania, where economic development was more sluggish, life expectancy for men plummeted sharply and then began to rise again only gradually. The reason is a higher mortality on account of excessive alcohol consumption and associated cardiovascular diseases, which were especially characteristic of men in the former East bloc and in some cases still are today.<sup>39</sup> In Belarus, Moldova, Ukraine and Russia, life expectancy is currently just over 70 years. This is the lowest in Europe and is roughly on a par with developing countries like Bangladesh and Guatemala.<sup>40</sup>

## On the brink of a new epidemic?

In Russia, the excessive consumption of vodka and tobacco means, as in the past, that mainly men of working age die early, are susceptible to secondary diseases or become occupationally disabled. As a result of new regulations, mortality due to alcohol has fallen recently, but the incidence of dangerous drinking habits – which includes the imbibing of industrial alcohol – remains one of the highest in the world.<sup>41,42</sup>

The social upheavals after the end of the Soviet Union not only led to insecurity in Russia but also to enormous income inequality. The health system, which was already under-financed and backward in the Soviet era, continues to this day to function poorly, despite reforms.<sup>43,44</sup> Cardiovascular

diseases, at 56 percent, remain the number one cause of death in Russia, while another contributing factor is poor diet, which increases the risk of obesity and diabetes.<sup>45,46</sup> But infectious diseases like tuberculosis and hepatitis are widespread too. And HIV/AIDS has become rampant: while new cases of infection with the virus have fallen almost everywhere in the world, including Africa, the number of new cases rose by almost 60 percent from 2010 to 2015 on the territory that stretches from eastern Siberia via the Caucasus and the Central Asian republics to Poland.<sup>47</sup> Eighty percent of new cases are in Russia, where the number of officially registered HIV-positive persons reached the million threshold in 2016. According to the head of Russia's Federal AIDS Centre, there may in fact already be 1.5 million cases and the number is predicted to rise to three million by 2020. He warns that the country is on the brink of an epidemic, which could spread to the entire population.<sup>48</sup>

However, the government and the powerful Orthodox Church have been in denial about the problem for a long time. Drug addiction, prostitution and homosexuality are considered amoral or criminal. According to media reports, some people regard HIV/AIDS as the “hoax of the century” and the high figures for Russia as “a campaign by the West”.<sup>49</sup> There is a lack of available information about how the virus is transmitted. Therapies for heroin addiction using methadone are illegal. NGOs are allowed to provide addicts with clean needles but are under observation as “foreign agents” and receive no support from the state. In order to avoid social stigma, many endangered people do not have themselves tested, and only a quarter of those with the virus receive antiretroviral drugs, which allow them to live with the virus and reduce the risk of infecting others.<sup>50</sup> Only recently did the government acknowledge that the situation is “critical”. In early 2017, it launched an HIV strategy and promised additional funding.<sup>51</sup> Whether this funding will materialise is questionable given the economic crisis in Russia.

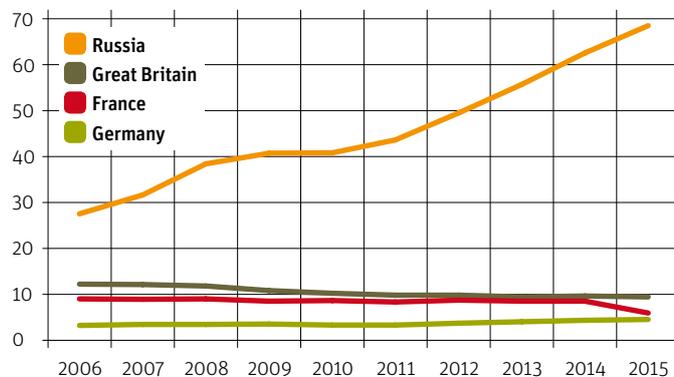
#### 4.4 Developing and emerging countries: A big leap forwards, despite bad habits

In the less developed, poorer countries, the rise in life expectancy picks up pace as soon as the average income increases, more money is invested in education, health and hygiene, and the supply of food and access to clean drinking water improves.<sup>54</sup> In Latin America, East Asia and the Middle East-North Africa region the rise between 1980 and 2015 was higher than would have been expected from socio-economic development over the same period.<sup>55</sup>

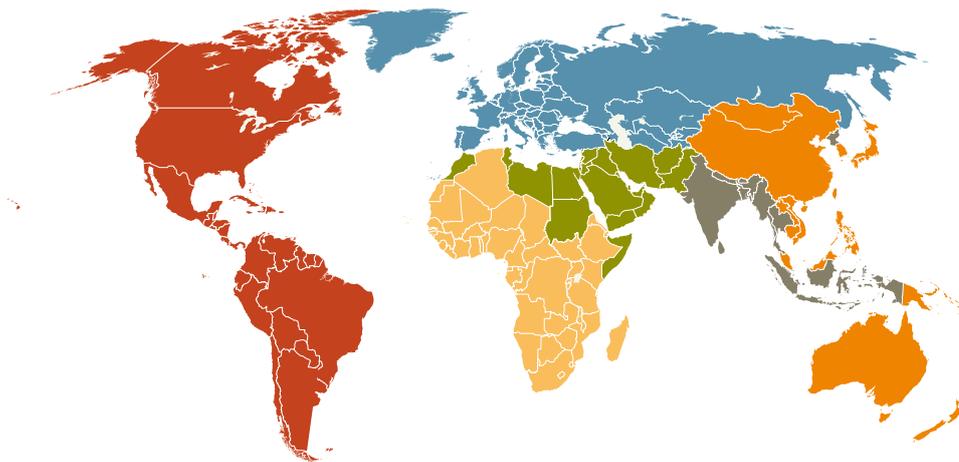
In some regions, however, life expectancy temporarily declined during this period. One reason for this is that armed conflict as a cause of death has increased since 2011, especially through the wars in the Middle East and North Africa. In 2014, two thirds of all deaths resulting from conflicts worldwide were accounted for by the three wars still being waged in Afghanistan, Iraq and Syria.<sup>56</sup>

#### An unacknowledged problem

The WHO recorded more than 150,000 new cases of HIV/AIDS in 2015 for the WHO region that comprises Russia, Ukraine, the Central Asian states and Turkey. Well over 120,000 of the new cases diagnosed were accounted for by the eastern part of the region, 98,000 in Russia alone. That is more than a doubling within a decade.<sup>53</sup>

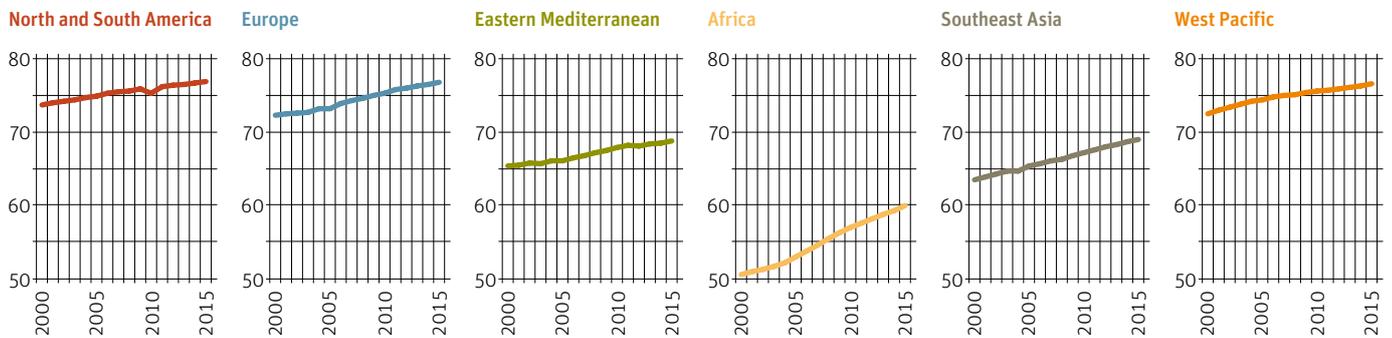


Number of new HIV diagnoses per 100,000 inhabitants in selected countries, 2006 to 2015 (Data source: ECD<sup>52</sup>, own calculations)



## Gradually catching up

The WHO regions include poor and rich countries. In the regions Europe, Americas and West Pacific, countries classified as high-income – like Germany, the US and Australia – make up a bigger share of the total population, so the overall life expectancy is higher there. The gap in life expectancy between the wealthier and the poorer regions has become smaller over the last 15 years, but it is still considerable.



Development of average life expectancy in years by world region, 2000 to 2015  
(Data source: WHO/World Bank 2017<sup>62</sup>)

The greatest impact was on men in Syria: their average life expectancy fell by around 12 years between 2010 and 2015.<sup>57</sup>

In Africa, the rise in life expectancy of the 1990s almost ground to a halt when the HIV/AIDS epidemic became rampant. In some countries south of the Sahara, there was even a fall in life expectancy. Since 2000, however, the continent has been recovering in leaps and bounds, mainly because mortality for HIV/AIDS has receded markedly

through the use of antiretroviral drugs, but also because progress has been made in the fight against malaria and child mortality.<sup>58</sup> Within 15 years, life expectancy in Africa has risen on average by 9.4 years. That is almost double the global increase over the same period. Of the six major WHO regions, Africa has experienced the most growth but – with an average age of 60 – still has the lowest average life expectancy.<sup>59</sup> Indeed, the ten countries in the world with the lowest life expectancy are all in Sub-Saharan Africa. The lowest of all is in Sierra Leone, where it is around 50.<sup>60</sup>

The difference between life expectancy in the two WHO regions Africa and Europe has shrunk by almost five years since 2000.<sup>61</sup> Nevertheless, the developing and emerging countries are still below the global average. And the gap with the longevity records in the industrialised nations is huge. The developing and emerging countries face a multitude of challenges when it comes to improving the health of their populations and reducing mortality.

The specialist literature contains a long list of influences that cause far too many people to fall ill and die, especially in the world's poorer regions. Besides HIV/AIDS, they include infectious diseases like malaria, tuberculosis and diarrhoea, environmental factors such as poor-quality drinking water and a lack of hygiene, smog in big cities as well as the smoke from open fires inside dwellings, malnourishment in all its forms and often inadequate medical care. Another exacerbating factor is that, particularly in African countries, persistent high birth rates consume resources. The low level of education has a negative effect, too, on the state of health and life expectancy. Some of the above-mentioned factors compound one another: in places where violence and conflicts claim many lives, hunger and physical and mental illnesses follow. And in places where knowledge is lacking about the connection between living conditions and disease, infections can easily spread.

### **HIV/AIDS: The example of South Africa**

Around seven million people in South Africa live with the HI virus. That is almost a fifth of the population aged 15 to 49. In global comparison, only neighbouring Swaziland has a higher share, although the data for the underdeveloped tiny kingdom of 1.3 million inhabitants are likely to be less accurate than decimal places would suggest: according to UNAIDS, 28.8 percent of 15 to 49 year olds carry the virus.<sup>63</sup>

In South Africa, a total of 180,000 lives were claimed by HIV/AIDS in 2015.<sup>64</sup> Life expectancy fell from 62 years for the period 1990–1995 to 52 in 2000–2005, although in the meantime it has increased to 57 again. Nevertheless, average life expectancy is unlikely to return to its former level before 2030.<sup>65</sup> HIV/AIDS is much more prevalent among women than among men and the incidence is disproportionately high in poor young women, who generally have a lower status in a patriarchal culture; moreover, violence (including sexual violence) against women is widespread.<sup>66,67</sup> Underprivileged individuals with little education lack information about how the virus is transmitted and an awareness about how to behave. They also lack access to tests and medical care.<sup>68</sup>

The South African government has succeeded in its efforts to enable those infected to receive affordable treatment with antiretroviral drugs. In 2015, however, more than half of those with HIV/AIDS were still not receiving treatment. And despite numerous information and prevention campaigns being run and the world's largest condom distribution programme being launched, the government failed to achieve its goal of halving the number of sexual transmissions of the disease by 2015.<sup>69</sup>

Given that in 2000 the then president, Thabo Mbeki, and his health minister were still publicly expressing doubts that the disease was caused by a virus, the country has come a long way. But in terms of the goals set by the United Nations, South Africa still has a long road ahead: it needs to invest much more money and above all make its health system more efficient.<sup>70</sup>

### **Child mortality: The example of Angola**

In 2015, 5.9 million children died worldwide before reaching their fifth birthday. That is less than half as many as in 1990. Since then, the child mortality rate – the number of deaths among the under-fives per 1,000 live births – has more than halved too, from 91 to 43. After the United Nations had declared in 2000 that one of its Millennium Development Goals was a two-thirds reduction in global child mortality by 2015, the decrease intensified. Twenty-four of the poorest countries have even exceeded this goal, including Ethiopia, Bangladesh, Cambodia and Uganda. But all in all, only 62 countries have achieved it. With the exception of Afghanistan, the 20 countries with the highest child mortality are all in Sub-Saharan Africa. Half of them are at war or politically unstable.<sup>71,72</sup>

The civil war in Angola ended in 2002. The country is now a democracy, enjoys political stability and, thanks to its oil reserves, is the third-strongest economy in Sub-Saharan Africa. Nevertheless, children in Angola have the worst chances of survival in the world. There is huge income disparity. A small elite enjoys all kinds of luxuries. Corruption is hindering development. Particularly in rural areas, the population is poor and the

consequences of the war are still evident today: the reconstruction of the destroyed infrastructure has been slow and large areas remain riddled with land mines. In addition, healthcare is worse in rural areas than in the cities.<sup>73</sup> The situation became worse after the oil price fell by 40 percent in 2015: the government cut the health budget and the price of food rose. In 2016, there was an outbreak of yellow fever and, after four years of poor yields, the harvest failed almost completely owing to drought.<sup>74</sup> Even if people still have staples like rice and the customary cassava or maize porridge to eat, many suffer from nutritional deficiencies.

As a result of malnutrition, poor hygiene and inadequate medical care, 157 children of every 1,000 live births in Angola die in the first five years of life, mainly of pneumonia, diarrhoea or malaria.<sup>75</sup> By comparison: in Germany, four children per 1,000 live births die before the age of five.<sup>76</sup> The high child and maternal mortality rates are among the reasons why life expectancy in Angola – at just over 52 – is one of the lowest in the world.<sup>77</sup>

### **Wealth-related risks despite poverty: The example of the Pacific islands**

Even when poor countries develop economically, even when they have accomplished the demographic and epidemiological transition, it does not mean that their populations are necessarily healthier or that they will live as long as those in the industrialised countries. Although more people have access to a more varied diet, they often adopt “Western” eating habits. Instead of eating simple traditional

dishes and vegetables they start to consume more meat and more processed foods containing sugar and fat. And, above all, they eat too much. As a consequence of urbanisation, motorisation and an increase in sedentary occupations, they also get less exercise.<sup>78</sup> This increases the risk of overweight and obesity and all the associated secondary illnesses.

The highest share of obese men and women live not, as might be expected, in the United States, where typically Western food has been widely available for a long time. Rather, they are to be found in the island states of the Pacific – even though most are poor or very poor.<sup>79</sup> This has not always been the case. The latest studies support the hypothesis that “thrifty” genes have been particularly well preserved in the native populations. These gave the first settlers on these islands a survival advantage because their genetic make-up allowed them to store excess calories for times of famine.<sup>80</sup> This adaptation to periods in which food is in short supply has, however, become a disadvantage ever since trade relations and development aid enabled the import of sugary drinks and processed and preserved foods on a large scale and at prices below those of fresh fish.<sup>81,82</sup>

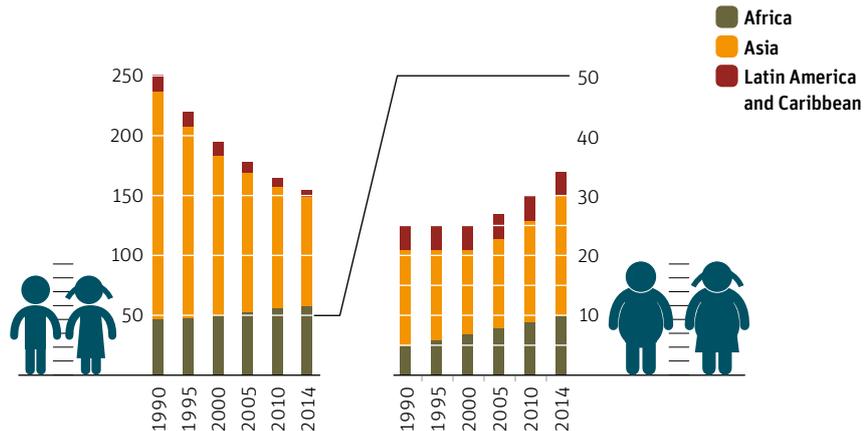
Nauru already had the world’s highest proportion of clinically obese people in 1975: around 40 percent of all men and even 52 percent of all women aged 18 and over had a BMI of at least 30. The reason for this was that following independence in 1968, the inhabitants of this tiny island state were finally able to profit themselves from phosphate mining. However, they invested their newly acquired wealth not in securing their future but in luxury goods. Soon the reserves of guano were used up, the environment destroyed, the state practically bankrupt – and in the meantime the people had become overweight.

Among the Pacific island states, only the women on Palau came anywhere near the obesity rate of Nauru in 1975. They were followed by the women in Kuwait and the United Arab Emirates, initially at least. But within four decades, the Cook Islands have moved to the top of the table; and of the ten countries with the highest proportion of female clinical obesity and the nine countries with the largest share of male clinical obesity, all are Pacific island states.<sup>83</sup>

While corpulence has in the meantime become the norm and in some cases even a status symbol, around 40 percent of the total of almost 10 million island inhabitants now suffer from noncommunicable diseases, especially cardiovascular ones, type 2 diabetes and high blood pressure. These illnesses cause three quarters of all deaths and their treatment consumes between 40 and 60 percent of total health expenditures. And they are occurring at an ever younger age.<sup>84</sup> On Kiribati, people live on average to around 66 years, on Samoa to 74 years. They thus die almost 16 or 8 years, respectively, earlier than the New Zealanders.<sup>85</sup> In some island states, life expectancy is stagnating or even threatening to fall.<sup>86</sup> The governments of these states have acknowledged the problem – not least because of the foreseeable rise in costs, which could place a further burden on their already small budgets. Efforts, especially in schools, to propagate a healthier lifestyle are proving to have their limits: high-calorie but nutrient-poor snacks and meals are regarded as more attractive.<sup>87</sup>

## Malnutrition has many facets

If children's growth is stunted for their age, it is a sign of long-term malnutrition, recurrent infections or infestation by parasites and is often associated with retarded mental development. According to the World Health Organization, this is one of the main obstacles to human development. Although the world population has grown since 1990, there are fewer under-fives today who are underdeveloped – but they continue to number well over 160 million. Over half of them live in Asia and more than a third in Africa, where the absolute number is still continuing to rise. At the same time, the number of under-fives who are overweight for their age is growing both in Africa and in other poor regions of the world.<sup>94,95</sup>



Number of stunted under-fives in millions by world region, 1990 to 2014

Number of overweight under-fives in millions by world region, 1990 to 2014

(Data source: Global Nutrition Report 2016<sup>93</sup>)

## Overabundance and undernourishment: The double burden

Generally speaking, since the 1990s the number of cases of clinical obesity has increased to alarming proportions in the developing and emerging countries, especially among women in urban regions.<sup>88</sup> In countries classified by the World Bank as having upper-middle income economies, the share of obese people is overall higher than in the wealthy countries, among women even significantly higher.<sup>89</sup> The incidence of overweight and obesity among children in developing and emerging countries is growing at a rate almost one third higher than in the wealthier countries.<sup>90</sup> And these countries have moved more quickly and more radically to the stage when noncommunicable, mostly avoidable diseases like diabetes, heart attacks and strokes become the leading causes of death than did the industrialised countries.<sup>91</sup>

Thus the mortality rate from cardiovascular diseases among 35 to 64 year olds was already higher in India in 2005 than it had been in the United States before that country began to address the problem in the 1950s through treatment and prevention.<sup>92</sup>

Unlike the technological leap that many African developing countries made – from zero means of communications to the mobile phone – this form of leapfrogging has had negative consequences. And it frequently affects those countries in which many people still go hungry, become ill and die, in which anaemic mothers bear underweight babies, in which children, even if they survive, are retarded in their development and are less productive as adults.<sup>96</sup> These countries bear a “double burden of malnutrition”. Undernourishment, nutritional deficiencies and overnourishment occur not only in parallel within the same population but also successively in the same individual over time. Thus, owing to a metabolically determined re-programming of the genes, nutritional deficiencies in childhood may result in a tendency to gain weight and a

higher risk of diabetes and heart disease in adulthood<sup>97</sup> – this is one of the factors driving the continuing increase in overweight and obesity.<sup>98</sup> In Indonesia, around a fifth of households have both underweight and overweight members, and such households tend to be those of higher socio-economic status. The situation is better only when the household is headed by a woman and has a well-networked social environment.<sup>99</sup>

In only a few countries does underweight occur more frequently than overweight. Practically all developing countries – especially in Asia and Africa – carry the double burden of malnutrition together with that of infectious diseases such as HIV/AIDS, tuberculosis and malaria.<sup>100</sup> And it is precisely these countries – with their mostly poorly developed health systems – that are neither politically nor economically equipped to deal with this burden.<sup>101</sup>

# 5

## WHAT COMES NEXT?

### South Korea on its way up

Life expectancy will continue to rise – at least in the 35 OECD member states. Moreover, it will do so with a probability of at least 65 percent for women and no less than 85 percent for men. This was the result reached by a team of biostatisticians at the beginning of 2017 with the help of a calculation method that combined several models. According to them, South Korea is likely to experience the strongest growth and even overtake Japan. Among South Korean boys born in 2030 the average lifespan will almost certainly be more than 80 years and with 27 percent probability more than 85 years. The top performers are likely to be South Korean girls, for whom there will be a 90 percent probability of having a life expectancy of 86.7 years. And the chances of their lifespan exceeding 90 years are 57 percent or almost two to one.

The authors of the study point out that in their forecasting, they were unable to take into account “completely unexpected events” or changes in the framework conditions that have an impact on the health of the population. Furthermore, the model does not permit any conclusions to be drawn on which factors will send the life expectancy of a given country soaring. The reasons for arguing that there will be a continued increase relate exclusively to the past. Mortality has declined in Japan and South Korea because growing prosperity and more widespread education have led, among

other things, to better diets in childhood and adolescence, because the healthcare systems in these countries are accessible to all and, in addition, because they are rapidly absorbing advancements in medical technology. In some other OECD countries, too, the population has profited – and is likely to continue to profit – from functioning healthcare and social systems, medical provision that enables the prevention and early detection of cardiovascular diseases and cancers, fewer road traffic accidents and more non-smokers as well as a very low child mortality rate.<sup>1</sup> In view of the success achieved to date, the head of the study, the epidemiologist Majid Ezzati of Imperial College, London, believes it is possible that the average projected life expectancy of more than 90 years among some populations has by no means reached its upper limit yet.<sup>2</sup>

### In search of the upper limit

This raises many questions. First and foremost, the one mentioned right at the beginning of this study: What is the limit to the lifespan of *Homo sapiens*? And the next question: Can the average really increase over time to reach today’s record levels? And if so, what would that mean for the aging of societies?

Let us take one question at a time. Numerous scientists are querying whether there is a biological upper limit for the human lifespan. Among them are many longevity optimists. Their main argument is that since 1840, the average life expectancy has constantly risen by 2.5 years per decade. That is more than 90 days each year or six hours every single day. Even the highest age that certain groups have reached over time has so far risen linearly, as Jim Oeppen and James Vaupel

### Where the oldest benefit most from the decline in mortality

New model calculations suggest that life expectancy will continue to rise in all 35 OECD member states until 2030. According to the biostatisticians who did those calculations, almost everywhere it is, above all, the elderly who are profiting from the continued decline in the mortality rate. However, in Macedonia the younger age groups are likely to make gains, too – a sign that the former Yugoslav republic remains at the level of a developing country.



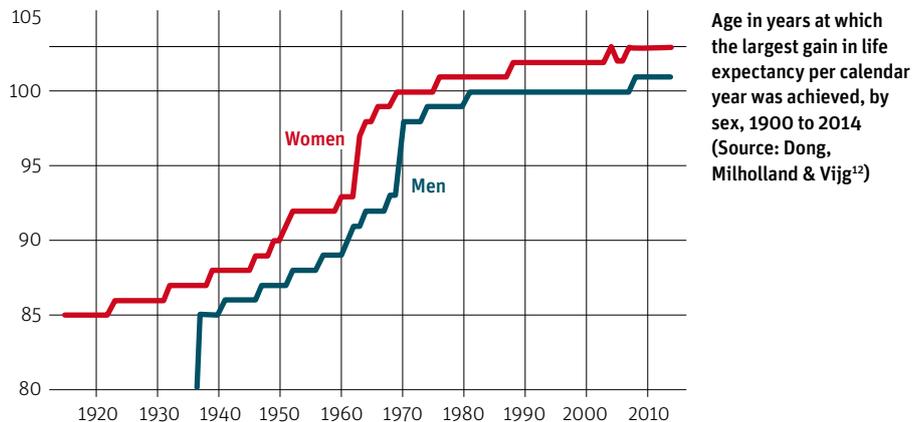
have shown (see p. 8). James Vaupel, the former director of the Max Planck Institute for Demographic Research in Rostock, tirelessly points out that the demographic development has disproved the experts, who time and again predicted that the ceiling had been reached at a certain age.<sup>4</sup> According to his team's projections, at least half of those born in some industrial countries from 2000 onwards could live to be more than 100 years old – and the trend is an upwards one.<sup>5</sup> The general opinion that nothing can be done about aging and its consequences is “just completely totally wrong”, according to Vaupel.<sup>6</sup> He is convinced that the problem of reducing the mortality rate among the very old is “not unsolvable”.<sup>7</sup>

Two US scientists have waged a bet. In 1999, the zoologist and gerontologist Steven Austad said that human beings could live to be 150 years old and that there were people already alive today who might reach that age. For his part, the biodemographer S. Jay Olshansky doubted that this would be the case: the human body was not made to function for more than about 130 years and it was not possible to predict at present that this limit could be breached as a result of biomedical developments. Each of the two has paid 150 US dollars into an investment fund. If it can be proved by 1 January 2150 that one person in the world has reached the age of 150 in full possession of his/her mental faculties, Austad's descendants or – if there are no longer any still alive – his university will receive the wagers plus the accumulated gains. If it cannot be proved – and if the fund continues to grow as it has until now – Olshansky's heirs stand to pocket millions.<sup>8</sup>

In 2016, the two gamblers doubled the stakes. They did so because a team led by the geneticist Jan Vijg had statistically evaluated information about centenarians that was available in the age and longevity databases

## Has the plateau been reached?

The constant rise in life expectancy in the industrial countries is thanks largely to the survival probability for older people having increased in past decades. But according to an analysis of demographic data from 40 countries and regions, this trend is not unlimited: the scientists used available data to determine for each year the age at which the biggest gain in age-adjusted life expectancy was recorded, and they depicted the change over time in graphic form. Since the 1980s, this value has barely increased.



and had come up with the following finding: In France, Japan, the US and Great Britain, the oldest age reached by a human being had risen from the 1970s onwards, but the curve had flattened out from the mid-1990s onwards. According to this study, the natural limit was 115 years. The chances of reaching 125 were less than 1 to 10,000.<sup>9</sup> Thus the record of 122 years and 146 days, which was held by Jeanne Calment, is very unlikely to be beaten. The Indonesian Mbah Gotho is supposed to have been 146 years old when he died in May 2017. But an expert from the Gerontology Research Group, whose list of “supercentenarians” includes only those people 110 or over who have a valid birth certificate, regards this as fiction. Indonesia has been officially recording births only since 1900.<sup>10,11</sup>

## Still no miracle cure against aging

For some – scientists and science-savvy laymen alike – the work carried out by Vijg's team gives no reason to doubt that at some point, human beings will break through this supposed upper limit. Thanks to biomedical research, mankind will be able to halt the aging process in the not too distant future and, if not prevent people from dying, at least continue to delay death for longer and longer.

Scientists have already spent numerous people years and millions in research money on investigating the mystery of aging – and perhaps discovering a rejuvenation cure or anti-aging medicine. According to the results obtained to date from studies on twins as well as on families or population groups in which a conspicuously large number of people live to a very old age, longevity can be at most 25 percent attributed to genetic influences. There are dozens of genes that have an effect on the aging process but are

unable per se to make their carriers live a long time. This can be achieved only by individual gene variants that are extremely rare.<sup>13</sup> Researchers are therefore trying to find out, above all, which molecular processes cause cells to age. This much is clear: over the course of a person's life, the functional ability of his/her biological system to correct "internal" errors – such as can occur every time a cell divides – or to repair the damage by external means gradually diminishes. Changes to the genetic molecule DNA can lead to the uncontrolled division of cells and the formation of tumours. The body's own "rubbish disposal" is no longer able to dispose of the "senescent" cells that have stopped dividing either owing to errors or damage. But because these continue to send signals to the immune system, inflammatory responses can be triggered that promote the development of arteriosclerosis, arthritis, dementia or cancer. In addition, each time a cell divides, the protective caps at the end of chromosomes – so-called telomeres – get shorter and shorter until such a time as when, towards the end of the person's life, they can no longer carry out their protective function.<sup>14</sup>

Decoding these complex processes requires much time and effort. It is likely to be a while yet before medicine is able to intervene in them both in a targeted manner and without side effects.<sup>15</sup> Currently, researchers are carrying out studies on human beings into whether the diabetes drug Metformin has rejuvenating properties.<sup>16</sup> And they are also trying to find out whether aging can be delayed through regular short periods of fasting or extremely low-calorie diets that include all essential nutrients.<sup>17</sup>

For practical and ethical reasons, scientists are conducting experiments on fruit flies, round worms, mice and other "model organisms". They are researching why

the naked mole rat lives longer than other rodents, remains fertile to an old age and never gets cancer. They have rejuvenated older mice with the blood of young mice and they have also investigated whether the memory performance of the former improves when they receive human umbilical cord plasma.<sup>18</sup> And they have increased the lifespan of mice by up to 60 percent by mixing medication used in organ transplants to suppress the immune system into the feed of the mice.<sup>19</sup>

But the results that are obtained from laboratory animals or human cells cultivated in laboratories cannot be automatically applied to human beings.<sup>20</sup> While molecules are constantly being discovered that play a "key role" in this or that metabolic process and in the aging of cells, no approach has yet been found that would result in a pharmacological or medical fountain of youth. This does not stop the California-based SENS Research Foundation from believing "that a world free of age-related disease is possible".<sup>21</sup> Investors such as the Silicon Valley billionaire Peter Thiel are investing large sums of money in the hope that one day researchers will succeed in being able to manipulate the aging of human beings and exert more control over the time of death.<sup>22</sup>

## Differences remain

This leads us to the next question: What would it mean if they were to succeed in doing so? Can the average life expectancy increase over time to reach today's record levels or even exceed them? Without wishing to lapse into pessimism, it has to be said that various factors suggest it may not continue rising at all. First and foremost, there are the large differences described in previous chapters. These show where the largest catch-up potential is to be found – namely, in minimising for *everyone* those risk factors

that can be influenced by education, socio-economic development and healthcare systems that provide both widespread prevention and treatment. As long as this is not achieved, the considerable differences in healthy life expectancy and mortality will persist or even increase. Unfavourable economic framework conditions and the growing inequality of income and wealth distribution in many countries are likely to further exacerbate this effect.<sup>23</sup>

As long as only a well-educated, high-income, married and socially networked "vanguard" can reckon with an above-average lifespan and as long as nothing changes for the less privileged part of the population, the average will in any case remain below the level at which it could be – this is the conclusion reached by scientists at the Rostock Max Planck Institute who examined the development of age-adjusted life expectancy for forty year olds in Finland, Norway and Sweden between 1970 and 2000: the gap between the "vanguard" and the rest of the population grew bigger and bigger during this period. A subset of the "vanguard" – married and well-educated women – had gained a lead of eight years over the remaining population by the end of the survey period.

According to the researchers, this is an indication that even in egalitarian societies like the Nordic ones, there are crucial differences not only in healthcare provision but also "in lifestyles and in social and environmental conditions" whereby both material and individual factors are important. It is likely that the less privileged part of the population will "find their own pathway and simply reduce mortality with a time lag in the same way . . . as the 'vanguard' group".<sup>24</sup>

This formulation voices the hope that the lead currently enjoyed by individual groups demonstrates the potential of the rest of the population and that in one way or another, the latter will indeed catch up. According to another study, in which researchers conducted an international comparative analysis of life expectancy according to educational level, further groundbreaking medical successes would be necessary – for example, in the treatment of dementia – for the total population to reach the record levels of the highly educated. Meanwhile, other factors could stand in the way of a further increase in the average life expectancy of the total population; these include the increase in the number of divorces, unfavourable economic framework conditions and a growing share of the overweight and smokers.<sup>25</sup>

## The next health revolution

The effects of the social divide along health lines in the industrial nations can be explained in biological terms. The lower the socioeconomic status, the higher the subjectively experienced stress level, as a study in Germany has shown: the body reacts by emitting the stress hormone cortisol, which triggers the so-called fight or flight responses in situations of acute danger and has a protective function. However, if the state of alarm persists, then the release of insulin increases, the supply of blood to the organs worsens, the immune system is inhibited and inflammatory processes are perpetuated, which, in turn, promote the development of cardiovascular diseases. Moreover, chronic stress can affect sleep, the ability to learn, memory and concentration and increase the risk of depression and other mental problems.<sup>26</sup> Seeking to overcome stress by smoking, consuming alcohol and excessive eating only make these effects even worse.<sup>27</sup>

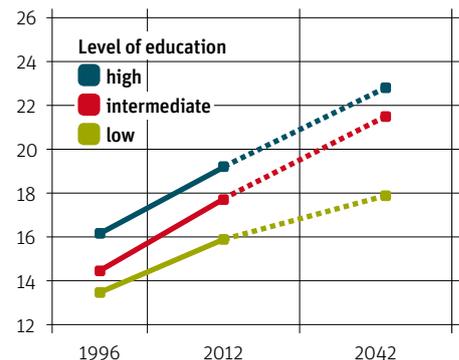
There are indications that factors such as lack of exercise, overweight and smoking, which occur disproportionately often among groups of a low social status, increase the natural shortening of the protective caps at the end of chromosomes, the telomeres, and thereby accelerate the aging process and promote the development of cancer.<sup>28</sup> Moreover, it has been established that it is not only in those directly affected that over- and under-nourishment raises the risk of overweight, diabetes and other diseases later in life. Through “epigenetic” changes in the genetic material, they continue to have an impact on the descendants’ risk of becoming ill even in middle or old age.<sup>29</sup>

It follows from this that we cannot wait for science to find perhaps an effective means against aging and the associated constraints that is both free of side effects and inexpensive. Nor can we concentrate on further reducing the mortality rate among old people in highly developed countries. As Chapter 3 showed, this comes at a high cost that even the rich nations cannot afford in the long run. Rather, the central question is how the existing and at times growing differences in the mortality of social groups and whole populations can be reduced.

This is also a question of the allocation of funds. Even though it probably sounds cynical, it is the case that the money invested in Germany and elsewhere in technical and medical advancements in order to alleviate the effects of lifestyle-related illnesses or to prolong surviving various types of cancer by several weeks or months could be used to eliminate the infections that in developing countries continue to claim the lives of many children under the age of five. That would be the next health revolution.

## A longer life for all – albeit with a growing educational divide

Owing to incomplete data, forecasts about the further development of life expectancy for individual socioeconomic groups are few and far between. Researchers at the University of Rostock have used the annual survey of the work force in the Netherlands to calculate the trend for selected groups. According to their research, the age-adjusted life expectancy at 65 is continuing to rise overall in the Netherlands but the existing differences based on educational level could further increase in the future.



Development of age-adjusted life expectancy at 65 for men with higher, intermediate and lower levels of education in the Netherlands, in years, 1996 to 2012, projection to 2042 (Data source: van Baal et al.<sup>31</sup>, own graph)

## What could stop the continued increase?

Moreover, many results show that prolonging the lifespan of human beings is not a one-way street. Recent developments – for example, the rampant obesity epidemic and the increase in diabetes – threaten to undermine the improvements achieved to date and possibly even lower the life expectancy of large parts of the population. In 2005, Jay Olshansky and his colleagues developed a model showing to what extent obesity and its secondary diseases could have an impact on life expectancy in the US. They found that the US population could lose two to five years over the coming fifty years.<sup>30</sup>

Overall, it seems more likely that the inequalities will increase both within and among industrial nations. The fact that children who were born in Spain in 2014 can reckon with living for more than 83 years but those in Bulgaria with just 74.5 years has sent alarm bells ringing for Europe's health experts: at the beginning of 2017, EuroHealthNet, a network of 21 health organisations, including Germany's Federal Centre for Health Education, called on policymakers to finally recognise the "central role that health and healthy equity play in building strong and sustainable social market economies".<sup>32</sup>

In addition, existing differences in South Korea continue to raise doubts whether the above-mentioned forecast for life expectancy in that country will prove correct. The East Asian country has made impressively rapid economic progress over the past forty years or so. From 1970 to 2010, the average life expectancy increased by almost 19 years and the educational level rose sharply. However, it is university graduates who have profited most from the decline in the mortality rate, while among those with just primary or even lower education this trend has hardly left a mark.<sup>33</sup> While the latter group is small, the fact that the health differences have persisted despite remarkable developmental progress is another sign that equal educational opportunities must be the top priority if the average life expectancy is to remain at the same level or even to increase.

## Using the years gained

That leaves the third question: What happens if we all continue to get older? In view of the continued upward trend, the issue of just how old we can become is no longer of such interest for demographic research, says Mikko Myrskylä, the current director of the Max Planck Institute for Demographic Research in Rostock: "That's why today the question of the century in demography is how will we spend the years that we gain? Healthy or sick? Productive and working or in retirement? Will we be able to live independently or will we be in a nursing home?"<sup>34</sup>

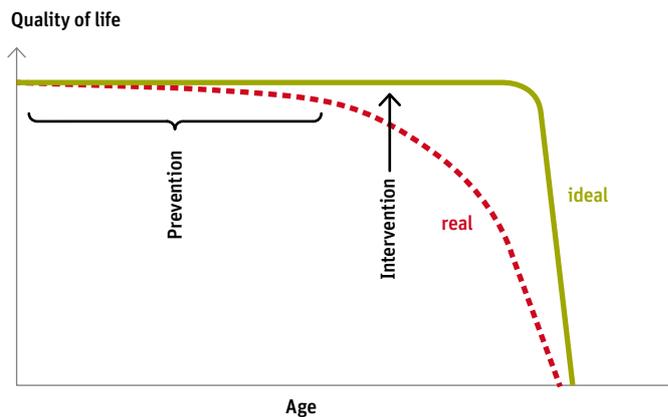
The chances of remaining in good health for longer and leading an independent life are good – as long as certain prerequisites exist: peace-time and economically favourable framework conditions, functioning healthcare provision, prevention as an integral part of behaviour at the level of society as a whole and the private individual as well

as education, good living conditions and intact social networks. Ensuring that these preconditions are in place already poses considerable challenges at every level in the industrial countries. But they are bigger still in the developing countries. The following chapter summarises in which areas action needs to be taken.

But before that, just one more question: What do people actually want? For most, an especially long life is not considered most worth striving for, as shown by a representative survey conducted in the US, Brazil, Japan and Italy. Respondents were asked to say what is important for them when they think about their own death, and it was only in Brazil that high priority was given to the answer "living as long as possible". In the other three countries, at least 60 percent of respondents agreed with each of the following answers: being comfortable/without pain, having your wishes for care followed, family not burdened financially and having loved ones around you.<sup>35</sup>

## Desire and reality

Most people would like to remain healthy for a long time so that they could then die as quickly and painlessly as possible. The green line shows this ideal scenario. However, the reality, represented by the dotted line, is that most have a different fate: ailments and disabilities increase with age. A health-promoting lifestyle in younger years and suitable medical treatment in old age increase the chances of achieving one's desires.



Model of the compression theory: Quality of life during one's lifetime, real and ideal (Data source: Stanford Center on Longevity<sup>36</sup>, own graph)

# 6

## WHAT NEEDS TO BE DONE?

Since 2012, researchers at Columbia University in New York have conducted an annual survey of people in 155 countries in which they ask them how satisfied they are with their lives – for example, with respect to environmental conditions, access to education or trust in politicians and in the economy. The latest *World Happiness Report* reveals major differences between countries. Nevertheless, most people have a sense of well-being if the following six factors are favourable: health, income, perceived absence of corruption in government and business, perceived freedom to make life decisions, friends one can count on and the good feelings that come from being charitable.<sup>1</sup>

Well-being and hence health and life expectancy thus depend largely on economic developments, social cohesion and the educational level of populations. The above-mentioned factors should be understood as an appeal to governments and civil society to create favourable conditions for the well-being of the world's populations. So what needs to be done?

### 1. Create equal opportunities

Health disparities should not be a consequence of social disadvantage. In many industrial countries the gap between poor and rich is growing visibly. This is not only of social and political significance, as the OECD has determined: if entire groups of the population are prevented from realising their potential, this can stand in the way

of economic progress. The OECD believes redistribution efforts should focus mainly on families with children and on young people, for it is in these groups that the foundations are laid for the development of human capital and of the skills and abilities that make life-long learning possible.<sup>2</sup> Education is not only crucial for work and income; it also influences individual behaviour and hence health and life expectancy.

### 2. Achieve prevention

It has long been known that refraining from smoking, having a balanced diet and taking 10,000 steps a day help to prevent “diseases of civilisation”, some forms of cancer and dementia. It is also known that the means for preventing many infectious diseases are relatively simple: mosquito nets reduce the incidence of malaria, condoms prevent the transmission of HIV/AIDS. However, everyone needs to be aware of these facts. Besides the political will, this requires investment in prevention strategies and the recognition that they will pay off in the long term, because they will save healthcare costs.

### 3. Control the risk factor diet

In places where there is a shortage of food, the primary task is to ensure a reliable food supply. But in places where highly processed food with a high salt, fat and/or sugar content is cheaper than fresh fruit and vegetables, nuts and fish, countermeasures need to be taken. An extrapolation from dozens of studies on diet makes clear why

this is the case. The conclusion is, namely, that if people everywhere ate ten 80 gram portions of fruit and/or vegetables every day, 7.8 million premature deaths could be prevented worldwide. Even adhering to the current recommendation of “five a day” would considerably reduce the risk of stroke, cardiovascular diseases and cancer.<sup>3</sup>

The food industry bears a great responsibility: it can change the composition of its products or at least provide more transparency about ingredients and calories, for example using a “traffic light” system. It can restrict advertising, especially that which targets vulnerable groups such as children and adolescents and encourages them to consume sweets and soft drinks.

Containing the dangers to health posed by the food industry is a task for society as a whole. But change requires state intervention. Governments can try to convince consumers of the importance of a healthy diet via information campaigns; they can make healthy alternatives more accessible and more affordable via subsidies and regulations, via a “sugar tax” on sweet drinks or by banning trans-fatty acids, as has already happened in some countries.<sup>4</sup>

### 4. Control the risk factor smoking

The campaign against tobacco consumption has already achieved a great deal. To judge by the latest statistics on the global burden of disease and premature deaths, however, governments should on no account relax their efforts to warn about the dangers of smoking

and to ban smoking at least in public places.<sup>5</sup> On the Tobacco Control Scale for 2016, Germany came in second to last among 35 European states for the second time in a row, followed only by Austria.<sup>6</sup> As a signatory to the WHO's Tobacco Framework Convention, the Federal Republic had pledged to implement "a comprehensive ban on all forms of tobacco advertising" by 2010. But today it is the only member of the EU that still allows public advertising for cigarettes. Draft legislation for a ban on poster and cinema advertising of cigarettes by 2020 has been tabled, but so far the lobby for the cigarette industry has prevented this legislation being debated in the German parliament.

### 5. Improve healthcare systems

The main task of the industrialised countries is to make their healthcare systems fit for the future and get a handle on costs. In many countries savings have already been made. There must be discussions about the cost effectiveness and the rationing of certain procedures/services. At the same time, there is a need to evaluate whether cuts and savings will not lead to higher costs in the long term.

Despite some progress, healthcare disparities continue to exist in developing countries. These include gaps in medical care in poorly accessible rural areas and problems like access to clean water, which have an impact on the health and life expectancy of populations. For the foreseeable future, the poorest states are unlikely to be able to do without the support of wealthy countries for their underfinanced healthcare systems. One suggestion has been to link the provision of financial assistance to efforts by the governments of poor countries to do more towards prevention and the medical care of their citizens.<sup>7</sup>

### 6. Reduce child mortality

Despite major progress, far too many children still die before reaching their fifth birthday – 16,000 every day. The causes of these deaths are undernourishment, pneumonia, perinatal complications, diarrhoea and malaria. In many cases these lives could be saved by taking relatively simple measures, such as breastfeeding regularly and for a sufficient period. Qualified attendance by midwives or trained lay people before, during and after births would further reduce not only child but also maternal mortality.<sup>8</sup> Further progress could be made if child marriages – which remain widespread in poor regions with significant gender inequality – were made socially taboo, since very young girls run a high risk of complications in pregnancy.

### 7. Make use of research findings

"Never before have we been so forewarned of the dangers that await us if we do not act now", was how one epidemiologist summed up the latest Global Burden of Disease report.<sup>9</sup> Large data sets, huge computing capacity and brilliant minds provide the basis for identifying trends and adjusting social and political action accordingly.

### 8. Plan healthy cities

Urbanisation is still advancing, above all in Asia and Africa. However, there are many disadvantaged neighbourhoods or districts not only in the megacities of developing regions, but also in the agglomerations in industrialised countries; living in these places makes people ill and may shorten their lives. Here healthy food is less accessible than junk food. Journeys to the workplace are often long and public transport links insufficient. Opportunities to relax or take exercise are few and far between. Cramped living conditions, noise and poor air quality

cause stress and have an impact on both subjectively perceived and actual health. Wherever possible, districts and whole cities should be designed to do away with inequalities, to create mixed neighbourhoods and to make environmentally friendly mobility possible for everyone through efficient public transport systems.

### 9. Plan for old age

In countries where "70 is the new 60", the traditional age threshold of 65 has become obsolete. Thus there needs to be a change in mindset. Scientists have come up with an idea that might help: assuming that life expectancy continues to rise and the constant of 65 is replaced as a measure of age by the respective average remaining 15 years of life, the phase of old age would be pushed steadily upwards. The aging of society would then slow down.<sup>10</sup>

The traditional division of life into three stages – education/training, work and retirement – can no longer be applied. First, changes in the labour market require lifelong learning. Second, the lack of children will mean that older people will have to work for longer than before. Third, in the long term it will be possible to finance pensions only if the retirement threshold is shifted upwards. People will have to work longer in the future but also incrementally reduce the hours they work. And policymakers will have to plan carefully to make the healthcare and social systems viable for the future, to support the growing share of older people in the population and to ensure they receive pensions.

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+++ record age 122 +++ low life expectancy in the past owing to hunger, epidemics and wars +++ historically unprecedented rise in the 20th century +++  
ctancy +++ major regional and social differences +++ early death follows a life of poverty +++ the well-educated tend to live longer +++ undernourishment