Background information

for a Gapminder Power Point presentation
about life expectancy

Life expectancy is an important measure of a country's overall health. A Power Point presentation that explains the basics of life expectancy is available at:
www.gapminder.org/downloads/life-expectancy-ppt

This document provides background information to the presentation. The information is not essential for the presentation and is for reference only.

About this document

This background information is intended for teachers who are using the Gapminder Power Point presentation about life expectancy (available at: www.gapminder.org/downloads/life-expectancy-ppt). The Power Point presentation in question focuses on two key messages:

1. Life expectancy is an *average*. Most people live either much longer or much shorter than what the life expectancy indicates.
2. When life expectancy is low, this is mostly due to a very high *child mortality rate*. Those that survive the dangers of childhood can expect to live to a relatively old age, even in countries with very low life expectancy.

The "teacher's guide" (also available at the link above) explains how you can teach using the Power Point presentation. This background information is intended to complement the "teacher's guide". We explain why child mortality is so important for life expectancy. We also explain how life expectancy differs from some other possible ways of measuring health.

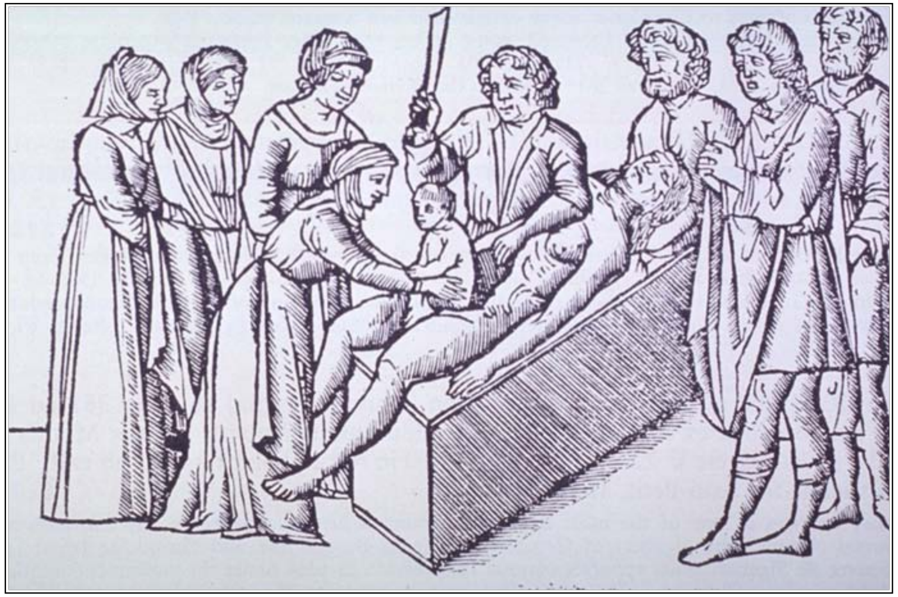
This background is not essential to using the Power Point presentation in your teaching, but we hope you can use it as a reference for some of the possible questions about life expectancy.

Content

The dangers of childhood

Being born is a very strenuous experience, one of the most strenuous in your life. Many things can go wrong. If your mother is not well fed and healthy, if those helping with the delivery have no training or experience and lack equipment and medicines, then the risks to your life are high.

Once you are born you are totally dependent on the help of others. Breastfeeding, if you receive any, provides your only protection against all the diseases you now are exposed to as you have not yet acquired any immunity to infections. You will grow very quickly, which will be very demanding. Many things can therefore still go wrong. If you are not well fed, if you live in a place without proper sanitation, if your surroundings are unhealthy, or if you have no access to medicines or health care then the risks to your life are high.



Our capacity to perform safe deliveries has improved greatly over the ages. This drawing illustrates a medieval caesarean section.

As you grow older you will acquire immunity, you will gain the capacity to better take care of yourself and you will be less vulnerable. Step by step, the risks to your life will decline if you survive the first dangerous years. As a teenager and young adult you will have better chances of survival, even if you lack sufficient food, sanitation and health care.

Inevitably, of course, the risk of death will increase again as the weaknesses of old age set in. Sooner or later the end will come, even under the best of circumstances, but it is not until quite late in life that you face the same high risks of dying as during the first crucial hours of your life. Thus, it is not only in old age that the risk of death is high, but also at the beginning of life.

Luckily, our capacity to better the chances of survival has improved greatly. The chances of remaining healthy increase sharply if sanitation is improved, if people are able to eat properly and if good health care is available. If these sorts of conditions improve, the risk of dying decreases at all ages.

When health conditions improve it is the high risks during the first crucial years that decrease the most. The risks related to old age can be mitigated, but the end result of aging remains inevitable. Furthermore, the potential for improvement during adulthood is relatively limited, since the risks to adults are typically *relatively* modest, even when conditions are harsh. However, the risks during delivery and during the first crucial years can be greatly reduced. Deliveries by well nourished and healthy mothers attended by skilled staff with access to good health care all greatly reduce the risks during and after a delivery.

Hence, as conditions improve, more children survive their very first years, and those that survive childhood also face a somewhat lower risk of dying during adulthood. All in all, this means that the average life span increases. Accordingly, when life expectancy is high, this is mostly due to a very low *child mortality rate*. This fact is one of the two key messages of the Power Point presentation. The other key message is to reiterate the fact that life expectancy is an average, something we turn to in the next section.

"The dance of death". A medieval woodcut that illustrates the high child mortality of the time.

Life expectancy is an average

One key message in the presentation is to emphasise the fact that life expectancy is an average. Many students forget this, and start to think of life expectancy as the "normal" or typical age of death. However, any average can hide different levels of variation. When it comes to life expectancy, variation is typically large, especially when life expectancy is low.

Consequently, in a society with a low life expectancy, such as Burundi, life expectancy has little to do with the "typical" life span, and this is illustrated by the example in the Power Point presentation. Let us take an even more extreme example than Burundi: Sweden in the famine year of 1773. In this truly disastrous year, Swedish life expectancy was only 18 years, much lower than in present day Burundi. If we think of these 18 years as the typical life span in Sweden we would get a very strange picture of Sweden: It would essentially be a society without any adults.

However, this low life expectancy was mainly due to the fact that *three* out of five newborn Swedes could expect to die in childhood. These childhood deaths dragged the average age down significantly. On the other hand, one in five could expect to live to a relatively old age (to their late 50s or early 60s), even in such extreme circumstances. Hence, only a minority of newborns could expect to live approximately 18 years.

How we selected the examples

In the presentation we illustrate life expectancy with five life spans of five newborns from each country. Figure 1 below shows the Burundian examples. The examples we use are a simplification, of course. Figure 2 on the next page, however, presents a graph that is a little more realistic, with 100, rather than 5, newborn Burundians. As before, each bar represents one newborn, and the height of the bar represents their expected life span. We have arranged the bars so that the person with the shortest expected life span is the first to the left, followed by the rest in increasing order. Each bar could be thought of as representing 1 percent of newborns.

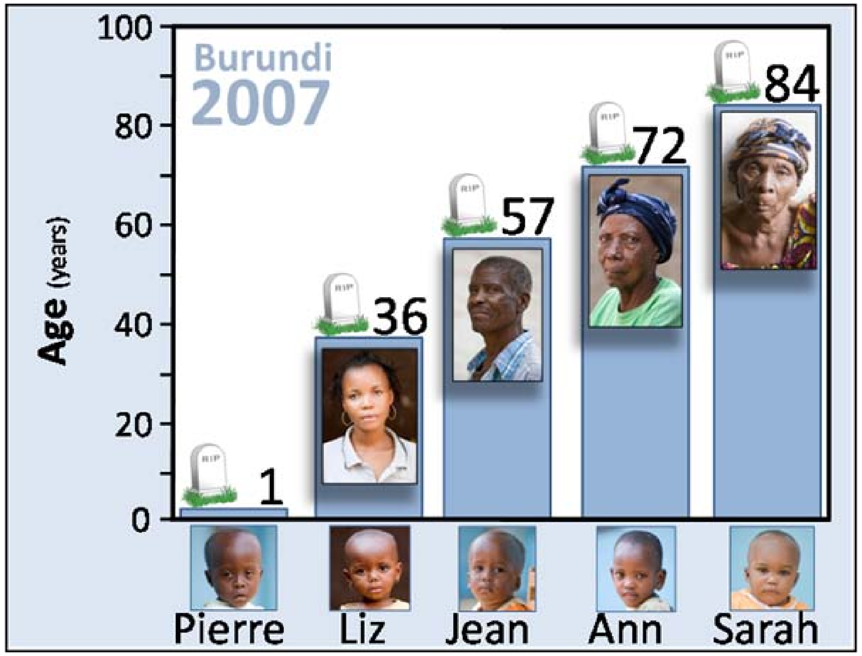


Figure 1: The five examples for Burundi.

When we constructed the five examples we divided these 100 newborns into five equally sized groups (i.e., groups of 20 people). To "represent" this group we chose the person that was "halfway" between the person with the shortest life span and the person with the longest life span in the group (see figure 2). Hence, in figure 2 we used the life span of the 10th person from the left for Pierre, the life span of the 30th person from the left for Liz, and so on.[1]

The next figure, figure 3, displays the life spans of 100,000, rather than 100, newborns. There are too many newborns to draw a bar for each of them. We have therefore used a line instead, but the principle is the same: we have to imagine that all 100,000 newborns are lined up from left to right, sorted by their expected life spans. This graph also includes a line for Sweden.

Our examples, however, could not illustrate the fact that children also die in Sweden. Only some 0.25 percent of infants die during their first year in Sweden, so it is only when we magnify the lower left-hand corner of figure 3 that these infants can be seen.

[1] Or, in technical terms: we used the 10th, the 30th, the 50th, the 70th and the 90th percentile of the age distribution in each of the countries' life tables.

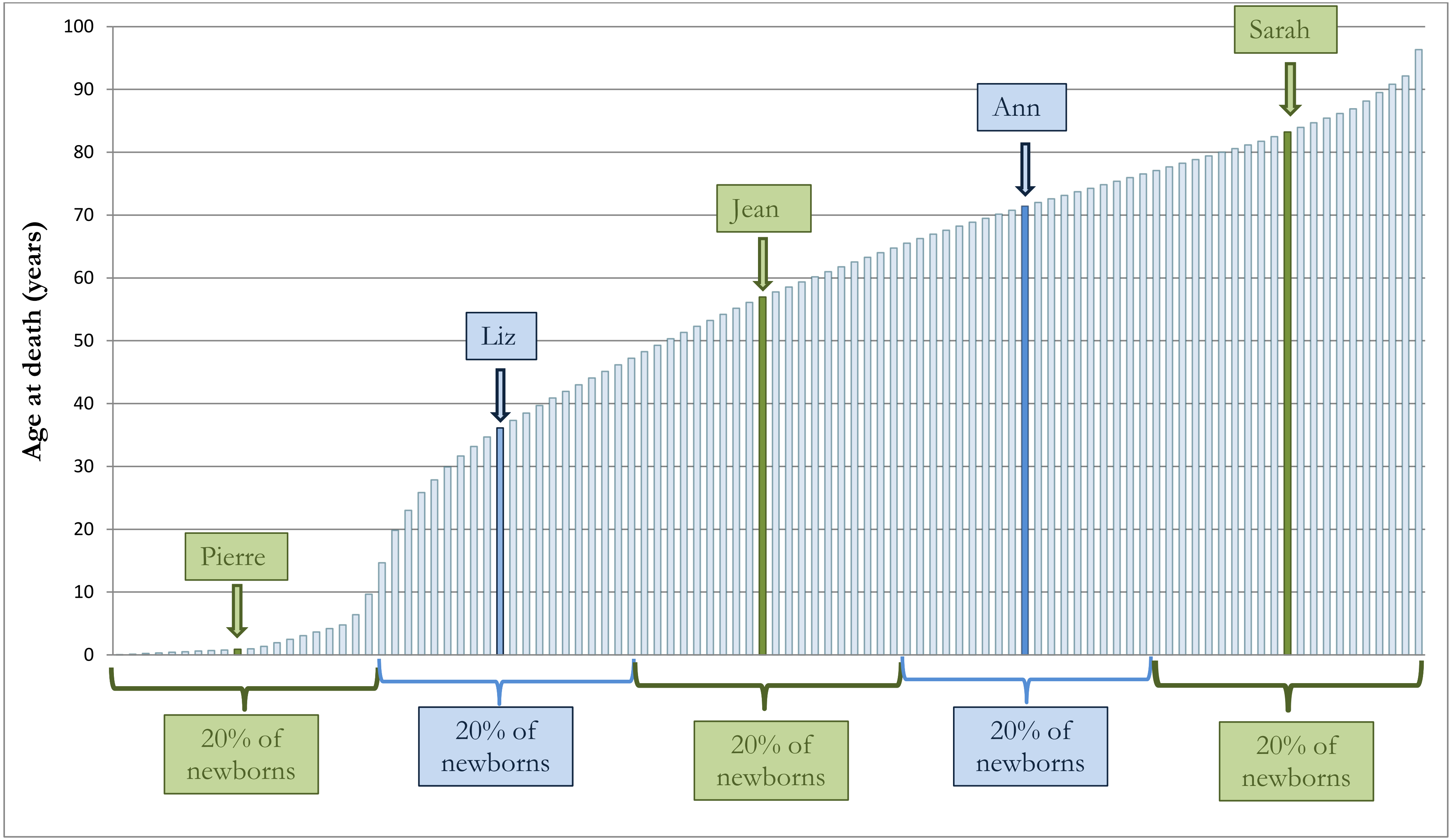


Figure 2: The expected life spans of 100 newborn Burundians. Each bar represents one newborn, which, in turn, represents 1% of the population. The height of the bar represents the expected life span of the person. The data refers to the situation in 2007.

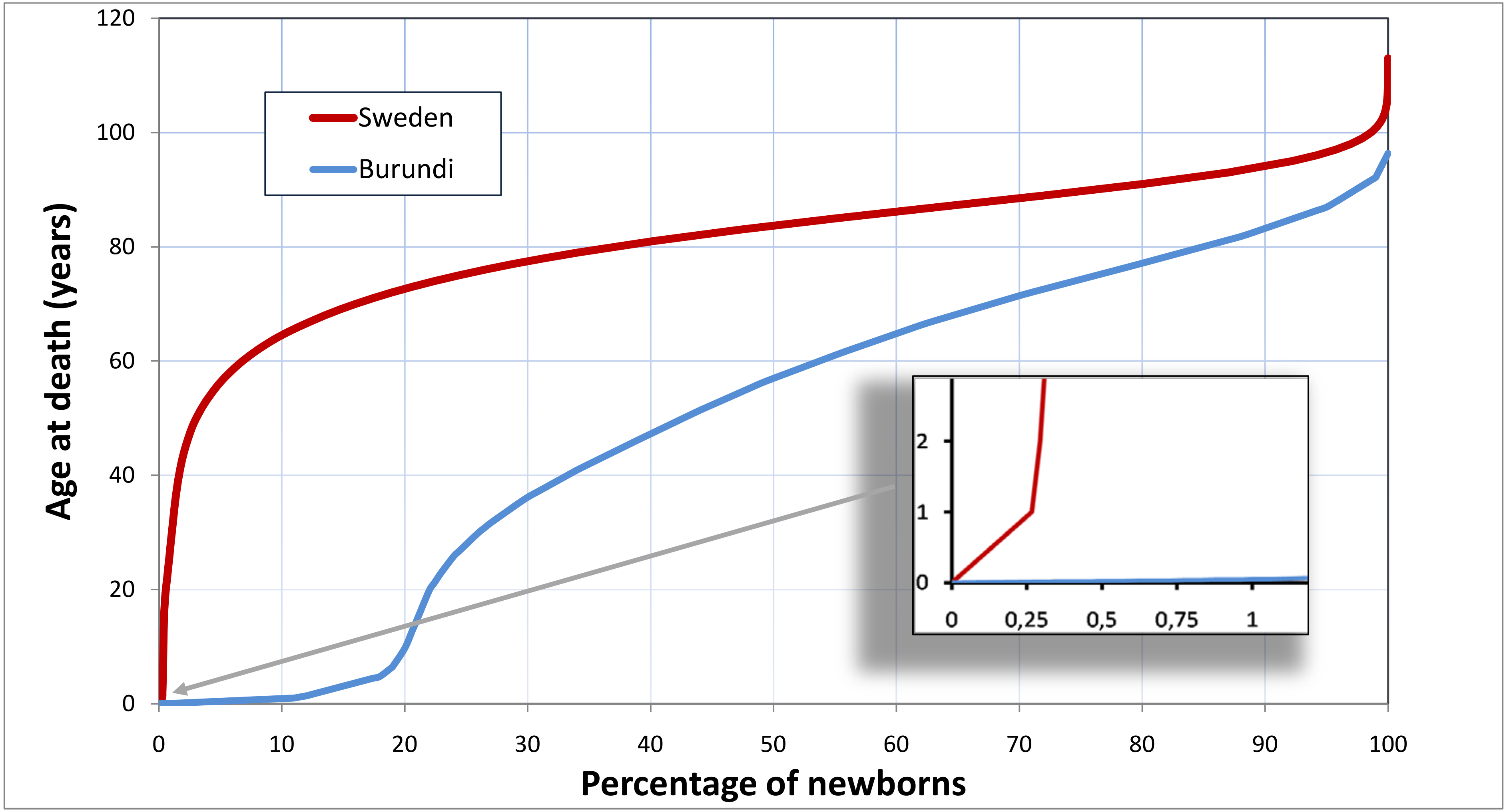


Figure 3: The expected life spans of 100,000 newborn Swedes and 100,000 newborn Burundians. All the newborns have been arranged according to their life spans. For example, the height of the blue line at 33% (i.e. 40 years) means that 33% can expect to die before the age of 40. This data refers to the situation in 2007. The lower left-hand corner has been magnified in the box.

Life expectancy reflects one year

Students sometimes ask how it is possible to know the life expectancy in 2007. Almost everyone born in 2007 must still be alive, students say, so how can we know how long they will live? Furthermore, when students see how life expectancy develops over time, as you can do in Gapminder World online, they are intrigued by the fact that life expectancy seems to change a lot from year to year. How is this possible?

The answer to both these questions is that life expectancy measures how long newborns will live on average *if conditions remain as in the specific year* indefinitely. Accordingly, the life expectancy for Sweden in 2007 measures how long newborns in Sweden would live if the conditions in Sweden in 2007 were to remain unchanged indefinitely. We will explain this in detail later on.

Alternative measurements

To be more precise we should call our measurement *period* life expectancy. The addition of "*period*" clarifies that we only measure health during one specific year, as explained above.

This specification is important, since it is possible to calculate an alternative measure that is called *cohort* life expectancy. Cohort life expectancy measures how long people born in a specific year actually lived on average. Whenever we mention life expectancy, without specifying whether it is period or cohort life expectancy, we mean period life expectancy.

There are also many other possible ways of measuring life spans in a country, e.g. the average age at death and forecast life span. To understand how period life expectancy is calculated, it can help to first understand how some of these alternative ways are calculated, how they differ from period life expectancy and why we choose to use period life expectancy rather than any of the alternatives.

1. Mean age of death during a year. Imagine if we looked up all the obituaries during a single year, noted the ages at death and calculated the mean of all those ages. That would be the mean age of death. The problem with this mean is that it is influenced by the age structure in the country, i.e. it matters how many old and how many young people there are in the country in that particular year.

To see this, let's take a hypothetical country that experienced an extreme baby boom 20 years ago. The country would have an exceptionally large number of 20-year-olds, and some of them would certainly die at the age of 20. So even if the percentage of 20-year-olds that die is as low as in neighbouring countries, the number of 20-year-olds that die would still be quite high. All these deaths would drag down the average age of all deaths for that year.

A population that experienced a baby boom 20 years ago will contain many young people. Young people will therefore show up more often in all statistics, including in the number of deaths.

Now, imagine a neighbouring country, where the health conditions are exactly the same as in the first country. This country, however, experienced an extreme baby boom *90 years* ago, not 20 years ago. There are consequently more 90-year-olds in this country, and, accordingly, the number of deaths among 90-year-olds will also be high. These deaths would push *up* the average age of all deaths.

A population that experienced a baby boom many decades ago will contain many old people. Hence, old people will figure more prominently in all the statistics.

So the mean of the ages of deaths would be significantly higher in the second country, despite health conditions being exactly the same as in the first country.

2. Cohort life expectancy. Cohort life expectancy is the average age at death of those born in a particular year. Let us, for example, look up all those that were born in Sweden in, say, 1860. In that year 133,162 babies were born in Sweden. By 1965 the last of them had died, at the age of 105 year. If we calculate the mean of the ages at death of all of these 133,162 people we find it is 48 years. This is the cohort life expectancy for 1860.

This seems to be quite a reasonable measurement of health. However, there are at least two good reasons for not using this measurement. First, we can only calculate this measurement once everyone in the cohort has died. For example, we had to wait until 1965 to obtain the measurement for the cohort of 1860. We would probably have to wait until at least 2120 to calculate it for 2007. Hence, although this measurement can be quite useful for historical studies, it is of little use if we want to examine our contemporary world.

Secondly, this measurement reflects the health conditions over the entire period during which the cohort lives. Therefore, in the aforementioned example the measurement reflects the health conditions during 1860 to 1965. It reflects the conditions for newborns as it was in 1860, but this is only a small part of the story. It also reflects the conditions for children and teens in the 1860s and 1870s, as well as reflecting how the conditions for adults improved during the late 19th century. Furthermore, it reflects how the Spanish flu epidemic of 1919 affected all those still alive (then 59 years old). It also reflects the medical advances in the mid-20th century that affected the chances of survival of seniors. So, if we want to measure health in a specific year, whether 1860 or 2007, we have to look for another measurement.

A British school class for boys. They were probably born in 1925. In cohort life expectancy we follow the lives of everyone born in the same year, i.e. a birth cohort.

3. The *forecast* mean age of death of those born in a particular year. If we are happy with the cohort measure above but do not want to wait more than 100 years to obtain it for 2007, then we could perhaps attempt to make some sort of prediction. This would then be a *forecast* cohort life expectancy for 2007.

This measurement would, of course, be based on a lot of guesswork. We would, for example, have to guess how medical advances over the next century will affect those born in 2007. We would also have to make guesses about future new diseases, and how these would affect the cohort of 2007. The measurement would, also, like any cohort life expectancy, reflect the health conditions all the way up to some time in the early 22nd century. If we want to measure the health situation in 2007, we need some other measurement.

What period life expectancy *is*

We have now looked at some alternative ways to measure life span in a country. All of them have some shortcomings if we want to measure health during a specific year. Let us now look at period life expectancy, the measurement we have been using, and see exactly what it measures.

The question we asked in the Power Point presentation about the newborn Burundian was: "How long would they live if conditions remain as in Burundi in 2007 throughout their entire lifetime." What does this mean? A forecast cohort life expectancy, as mentioned above, requires us to make assumptions about how health will develop in the future.

What we will do instead is to make the assumption that *nothing will change* in the future. So if we want to calculate life expectancy for Sweden in 2007 we assume that everything in Sweden remains as it was in 2007: health care neither improves nor deteriorates, no new diseases appear and none of the old ones disappear. If we do this, we obtain a measurement that only reflects the situation in 2007.

What we do is to look at the *risk* of death in different age groups during 2007. For example, we know how many 20-year-olds there were in 2007, and we know how many of those died during the year. If we divide the latter figure by the former, we get a measure of how dangerous it was to be a 20-year-old in Sweden in 2007.

We can make the same calculation for all age groups. When we have done this, we will have put a figure on all the risks of death throughout life, as they were in Sweden in 2007.

The next step is to perform a hypothetical experiment: What if we had a large number of newborns, say 100,000, and exposed them to the risk we have calculated for the first year. We then take those that survive and expose them to the risk of the second year. We continue doing this until all have died. We have now calculated the life spans of each of the 100,000 hypothetical individuals. This is normally called a life table. Drawing a graph of this results in figure 3 above. The final step is to take the mean age of deaths for all of these 100,000 imaginary people. This is the period life expectancy.

So how does period life expectancy differ from the other alternative measures we mentioned? Let's go through them again, one by one.

1. Period life expectancy versus the mean age at death. The mean age of death is based on the *number* of deaths in each age group, e.g. the *number* of dead 20-year-olds. On the other hand, when we calculate the period life expectancy we use the *risk* of death in each age group, i.e. we divide the number of dead 20-year-olds by the *total* number of 20-year-olds. This means that it does not matter whether there was a baby boom 20 years ago.

2. Period versus cohort life expectancy. Period life expectancy only measures the conditions during one year (e.g. 2007), whereas cohort life expectancy measures the conditions during more than one century. This difference means that period life expectancy tends to fluctuate much more than the cohort measure.

This can be seen in figure 4 below, which charts both period and cohort life expectancy for Sweden between 1750 and 2007. The period life expectancy fluctuates violently until the early 20th century. It sometimes changes by as much as 20 years from one year to another.

These movements reflect temporary health disasters, such as outbreaks of epidemics, which were quite common in the past. The cohort life expectancy, on the other hand, is much more stable. If we use a period measure, a one-year disaster affects all the age groups. If we use cohort measure, the same disaster will only affect one age group in more than one hundred age groups.[2]

In order to illustrate these differences, let's look at the disastrous year of 1773. In that year Sweden was suffering from the effects of a serious crop failure, and this was followed by several epidemics. The famine that followed the crop failure meant that the epidemics reached truly disastrous proportions.

Child mortality peaked, as usual in disasters like these, and reached extreme levels. Three out of five children died that year. In addition to this, many adults also died.

This meant that the period life expectancy was only 18 years, seen as the sharp dip in the graph above. The fact that life expectancy falls so low is due to our assumption that these disastrous conditions would remain unaltered. The lives of the 100,000 imaginary newborns would certainly be grim if this assumption were true. During the first year, three out of five of them would succumb to the various diseases. In the following years they would, if nothing changed, succumb to any of the other hazards present during the disasters. On average they would live for 18 years, with a few reaching old age.

In reality, however, things turned out somewhat better. The very next year, in 1774, the crop was good, the epidemics subsided and mortality dropped across all age groups. It was, however, still the 18th century, which was a harsher place for survival than present day Burundi, but the emergency had passed. Now "only" two out five children died, while adult mortality also returned to more normal levels. If these conditions remained, the 100,000 imaginary newborns of 1774 could expect to live for an average of 41 years. Consequently the period life expect0ancy increased from 18 to 41 years.

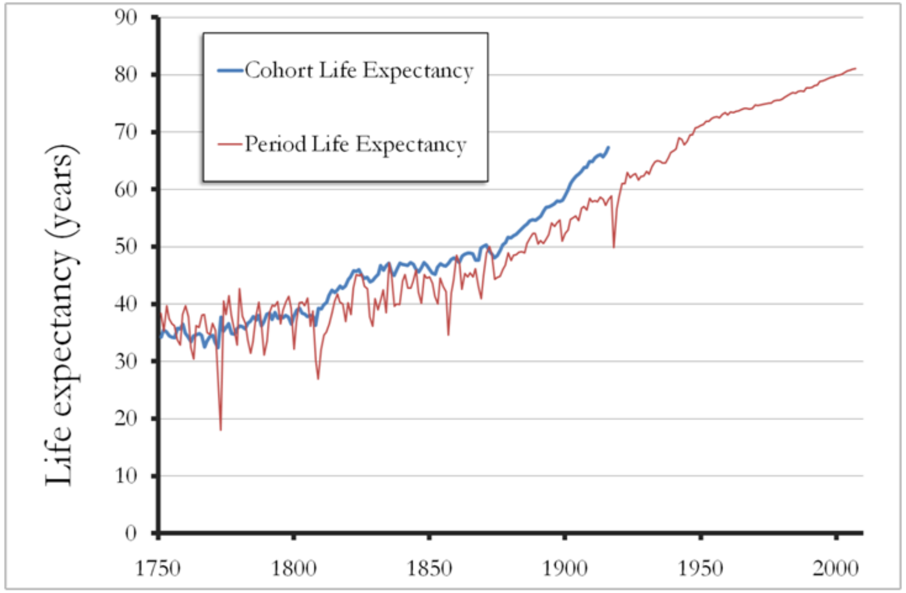


Figure 4: Period and cohort life expectancy in Sweden, 1750 – present day

The cohort life expectancy paints a slightly different picture. This follows what really happened to the birth cohort of 1773. During the first year, three out of five of them would succumb to the various diseases, just the same as in the assumed cohort above. However, those that survived their first year would face a much better situation in their second year, since the famine and epidemics had passed. The following

[2] Note that the cohort measure ends in 1916. This is because there still are significant numbers of survivors in the birth cohorts after 1916. It is therefore not possible to calculate any cohort measure.

years would mostly be quite good by 18th century standards. Those that survived into old age would also benefit from an increasing rate of improvements in health that Sweden experienced during the 19th century, creating substantially better chances of survival in old age compared with the situation in 1773.

The cohort life expectancy in 1773 is consequently much higher than the period life expectancy. This also explains why cohort life expectancy is normally higher than period life expectancy, at least from the beginning of the 19th century: cohort life expectancy reflects the health improvements that were to come.

3. Period life expectancy versus forecast cohort life expectancy. Period life expectancy is not intended to be a forecast for the future lives of newborns. The assumption is that everything remains the same. However, there are reasons to be more optimistic about the future than this. It is much more realistic to assume that health will continue to improve, which means that our best guess for the future is higher than the period life expectancy.

Period life expectancy is not a prediction of how long people will actually live.

Life expectancy in depth

Let's illustrate the things we have discussed so far with a specific example: the period life expectancy for Sweden in 1773. How could we calculate this figure? What follows is a step-by-step description of such a calculation, but we have made several simplifications to the procedure to make it easier to explain (a demographer would have to use a somewhat more complex method than we describe).

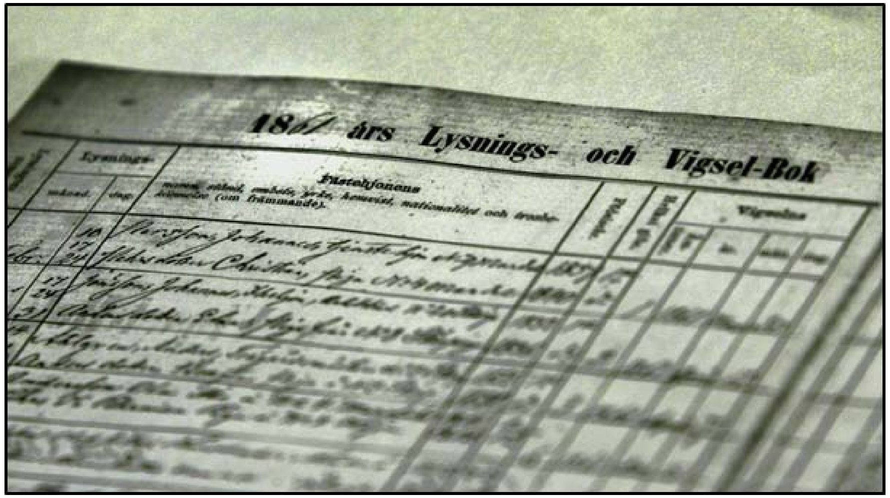
For example, babies are, of course, born every day throughout the year, but it make things much easier if we assume that December 31 each year is the "giving-birth day," and that no one is born on the other days of the year.

The figures we use are based on real statistics, but have been heavily rounded to make it simpler.[3]

The first step is to find the data we need for our calculations: (1) the number of people in each age group at the beginning of 1773, and (2) how many in each of these age groups died during the year.

Luckily, we have this information. In the 18th century each Swede belonged to a parish, and the parish priest kept records of all his parishioners, noting every birth and death. At the end of the year all priests sent in key statistics on their parishioners to the government. Table 1 shows some of the key figures we are looking for (the figures have been rounded for simplicity).

[3] This section is a bit technical, and it is certainly not necessary to know these technicalities to explain what life expectancy is. We have never attempted to explain these technical details to students, and it is probably not a very good idea to do that.



Each parish priest kept a record of vital events, such as births, marriages and deaths. This is a Swedish parish register of marriages from 1861.

At the beginning of 1773 there were 40,000 babies younger than one year old (we call them "zero-year olds"). To keep things simple, we assume that all of them were born on December 31, 1772.

There were also 40,000 one-year-olds at the beginning of 1773, and slightly more – 50,000 – two-year-olds. We have the same information for all the other age groups, but we only display the oldest surviving age group (the 103-year-olds).

Note that these numbers have nothing to do with mortality in 1773. For example, the two-year-olds were all born in 1770. What matters, therefore, is the number of babies born in 1770 and how many of them survived up to the end of 1772. This explains why there are more two-year-olds than one-year-olds: either more children were born in 1770 than in 1771, or more children died among those born in 1771 than among those born in 1770.

Age groups (exact ages)	Born in	Number of people in the age group at the beginning of 1773	How many of those that died during 1773	Percentage that died
0 to 1	1772	40,000	10,000	25%
1 to 2	1771	40,000	6,000	15%
2 to 3	1770	50,000	5,000	10%
…		…	…	…
103 to 104	1669	2	2	100%

Table 1: What really happened in 1773 for each of the age groups. The age groups are defined by their birthdays, e.g. "0 to 1" means everyone that has not yet had their first birthday. Note that each age group is made up of different people born in different years.

The fourth column provides information about how many in each age group died during 1773. For example, amongst those younger than one at the beginning of the year, 10,000 died during 1773, and only 30,000 survived the year.

The second step is to calculate the age-specific death risks during 1773. We do this by dividing the number of deaths in an age group by the number of persons in that age group at the beginning of the year. For example, for the one-year-olds we have 6,000/40,000=0.15. These risks of death are shown in the fifth column. A death risk of 15% during the second year of life is a high risk of death, even for the 18th century, and it reflects the catastrophic conditions in Sweden during this year as a result of a crop failure and multiple epidemics.

The third step is to establish a hypothetical scenario with 100,000 newborns. Note that in the previous steps we looked at the life and deaths of actual people who lived in 1773. These hypothetical 100,000, on the other hand, are just imaginary people that we use for our calculation, and their lives should not be confused with the real lives of the babies that were actually born in 1773. We see how many of these 100,000 survive each year if they were exposed to the death risks we have just calculated. This calculation exercise is shown in table 2 below.

We start with 100,000 newborns. The risk of death during the first year of life is 25%, so 25,000 die (100,000*0.25) and 75,000 are still alive after one year (100,000-25,000). So far the risk of death for our 100,000 imaginary babies is the same as for the babies that actually lived in 1773.

The second year, however, is different. The real babies that survived 1773 would, at the stroke of midnight of the New Year of 1773/74 face a much brighter future: the crop would be a success, the epidemics would subside and the risk of death for one-year-olds would be much lower than in the previous year ("only" 5%).

The survivors amongst the imaginary babies, on the other hand, faced a very different new year. At the stroke of midnight of the New Year they would be transported back in time to the previous New Year. They would be one year older, but they would have been transported back to January 1, 1773.[4] They would have to endure the same horrible year that they just had experienced, including the effects of a major crop failure and multiple outbreaks of epidemics.

So while their real-world counterparts were exposed to a death risk of 5%, the imaginary babies are exposed to the 15% risk of 1773. We had 75,000 survivors in the previous year. Now 15% of these will die during their second year, i.e. 11,250 will die (75,000*0.15).

[4] Yes, a little bit like the movie "Groundhog Day".

Age groups	Alive at the start of year	Risk of death (from table 1)	Died during the year	Alive at the end of year
0 to 1	100,000	25%	25,000	75,000
1 to 2	75,000	15%	11,250	63,750
2 to3	63,750	10%	6,375	57,375
...	...	...	...	...
103 to 104	1	100%	1	0

Table 2: The destinies of a hypothetical group of 100,000 people, exposed to the situation in 1773 throughout their entire lives. The age groups are defined by their birthdays, e.g. "0 to 1" means everyone that has not yet had their first birthday. Note that each age group consists of survivors from the original 100,000 babies.

Consequently, at the end of the second year 63,750 are still alive (75,000-11,250). At the stroke of midnight at the end of second year, just when things starts to look a bit brighter, these 63,750 will face the same journey back in time to January 1, 1773.

We continue with this hypothetical experiment, year after year, until no one is left. In this way we end up with a list of the number of people that would die at each age. The first and fourth columns of table 2 show that 25,000 would die between birth and their first birthday, 11,2500 would die between their first and second birthdays.

The full list of all age groups is called *a life table*. Our examples are simplified versions of such life tables for Sweden and Burundi.

The final step is to calculate the mean age at death for the 100,000 imagined persons in the life table. To simplify things, we assume that the 25,000 dead zero-year-olds die exactly halfway through to their first birthday, i.e. at the age of 0.5 years. Similarly we assume that the 11,250 dead one-year-olds die at the exact age of 1.5 years. We make the same assumption for all age groups.

To calculate the mean we first add together the life spans of each person to get the "total" life spans of all the 100,000 imaginary people. This results in:

25,000 dead in their first year * 0.5 years +

11,250 dead in their second year * 1.5 years +

6,375 dead in their third year * 2.5 years +

and so on for each age group... +

1 dead in her 104th year * 103.5 years

= 1,800,000 years

The end result is then divided by the total number of people, 100,000, to see how many years each person gets on average. The answer is 18 years. This is the period life expectancy in 1773.

The real calculation of life expectancy includes a couple more details, so if you want the real number-crunching method we have to refer you to literature on demography. One book we have found useful is "Demography: Measuring and Modeling Population Processes" by Preston, Heuveline & Guillot (2000).

Sources

The data used here is compiled from a variety of sources. Data from high-income countries is mainly from official registers, whereas surveys are a common source in low- and middle-income countries. Such surveys are based on interviews with a representative sample of the population. The uncertainty of the data varies, but there is a consensus regarding the general patterns displayed.

In the interactive version of Gapminder World, at www.gapminder.org/world, you can also see the historical development of life expectancy. Some countries, such as Sweden, have good historical data based on various kinds of registers. In older times these registers were typically maintained by the parish priest, who would take notes on all key events in the lives of parishioners.

The historical life expectancy of the other countries, however, is based on various types of estimates. Sometimes we only know that life expectancy was very low.

When you play the online graph, in the 19th century you can see that some bubbles move up and down a lot, whereas others stay still or only move slowly. Students often ask us if the violent fluctuations are due to poor data for those countries. The answer is actually the opposite: it is the countries with good data that move around a lot.

These movements simply reflect temporary crises, such as famines, outbreaks of epidemics or wars. Such disasters were more common in the past, and are almost totally absent in countries with good health. In countries with less good data we only have estimates for the long-term average of life expectancy. Hence, short-term fluctuations are not visible for those countries.

This is a major shortcoming in our data, since it might give the impression that short-term disasters only occurred in some countries. In reality they occurred, more or less, in all countries in the past, and they still occur in some countries today.

We used Statistics Sweden, www.scb.se, and the Human Mortality Database, www.mortality.org, for the life tables used in the Swedish examples. We used WHO, www.who.int/healthinfo/statistics/mortality_life_tables/en/, for the life tables used for the Burundian examples. We used an earlier version of the WHO data, which has now been revised, so there are some minor discrepancies between the present WHO data and our examples.

The log scale

For income per person we use what is known as a log scale, which expands the scale at low values and compresses the scale at high values. The log scale gives a more accurate picture in many cases. For example, $100 extra per year makes a huge difference for a person earning $400. The same $100 addition might not even be noticed by someone earning $100,000.

Produced by

Mattias Lindgren, the Gapminder Foundation. Version: September 7, 2010

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The Gapminder World graph

An interactive version of the Gapminder World graph is available at: www.gapminder.org/world