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What is the best measure of how long people might live?

Introduction

This Briefing Note discusses the construction of different estimates of life and healthy life expectancies as well as their strengths and weaknesses.

Key Message

Cohort life expectancies are a measure of how much longer a person can expect to live.

Period life expectancies are a measure of current mortality risk and are most useful as a tool for comparing two subgroups of a population.

Healthy life expectancies are calculated on a period basis and the definition of healthy is generally both self-assessed and subjective.

Cohort healthy life expectancies cannot be robustly calculated.

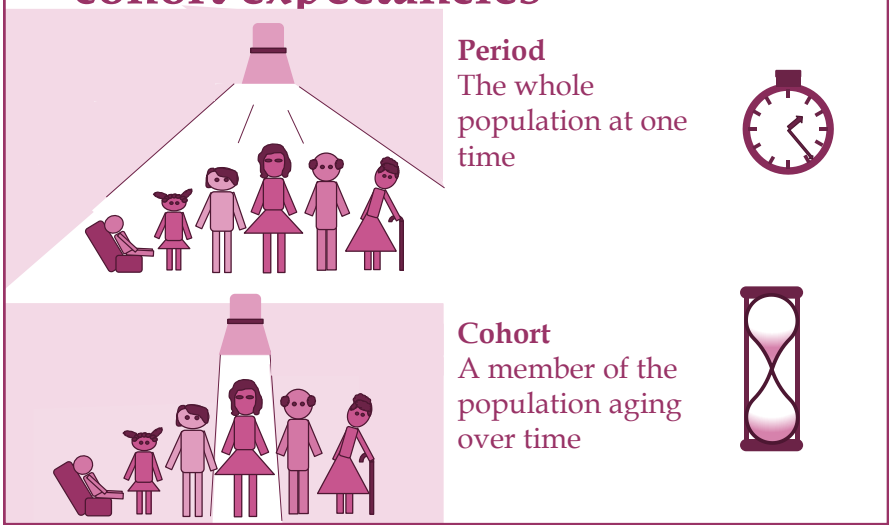
What is an expectancy and why would we want to estimate one?

Life expectancy estimates represent an average time until death. Healthy life expectancy and Disability-free life expectancy (DFLE) represent the amount of future lifespan expected to be in good health or without disability (allowing for periods of poor health before death).

These expectancies are a statistical tool and omit much detail, including the potential variation in an individual's future lifespan. They could be knocked over by a bus tomorrow or end up celebrating their 100th birthday.

These statistics are useful to understand the potential outcome for members of a population as well as the relative risks experienced by subsets of the population.

Chart 1: period and cohort expectancies



Period and Cohort

The treatment of risk over time results in two different measures which can be applied to groups with similar characteristics, [Chart 1]:

- Cohort expectancies represent the expectation of an outcome for a member (or cohort) of the population, allowing the risk to evolve over their future lifetime. This presents the potential lifespan of a member of the population;
- Period expectancies represent the risk applicable across the population at a particular point (or period) in time. This presents a snapshot of the risk.

Life expectancy estimates

Life expectancy estimates tend to be derived from data obtained through observation of the population over a period of time. The Office for National Statistics (ONS) produces projections every two years. The most recent projections were published in 2015 and are derived from experience up to 2014.

Cohort life expectancy

A cohort life expectancy represents the number of years an individual would expect to live. These are generally broken down by age and sex, and may allow for other sub-groups of the population, such as country in the UK.

These represent the future life expectancy of members of the population.

For a man reaching the age of 60 it depends when they were born as to how much longer they can expect to live [Chart 2]. People are living longer due to improvements in health care

Chart 2: life expectancy

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Male cohort life expectancy

Age	2016	2021	2026
60	26.1	26.7	27.3
65	21.5	22.1	22.6
70	17.1	17.7	18.3

Male period life expectancy

Age	2016	2021	2026
60	23.2	24.1	25.0
65	19.1	20.0	20.8
70	15.3	16.1	16.9

- A man born in 1956 would be 60 in 2016, 65 in 2021 and 70 in 2026.

and other external and environmental factors, and someone born ten years later can expect to see one more birthday than someone ten years older.

As an individual survives to older ages they can expect to live beyond their original life expectancy. For a man born in 1956, at age 60 their life expectancy is to age 86.1, and at age 70 it is to age 88.3. While the future mortality rates they are expected to experience remain identical the increase is a result of those who died in their 60s being removed from the cohort.

Calculation of cohort life expectancy

Future life expectancy is generally estimated through the construction of a life table. Life tables include the probability of dying for an individual at a particular age in a particular year. They are derived from historical information and estimates of future mortality rates. Future mortality rates are generally extrapolated using current mortality trends.

The cohort life expectancy of an individual aged 65 in 2016 would be based upon the mortality of someone aged 65 in 2016, 66 in 2017, 67 in 2018, 68 in 2019, and so on [Chart 3].

As a result of making assumptions around future mortality rates the projections are not certainties and become less certain over a longer lifespan.

Uses of cohort life expectancy

Cohort life expectancies represent the number of years an individual may live on average. These have applications in anything to be assessed over the lifecourse of an individual, such as projected pension income.

Limitations of cohort life expectancy

The most significant limitation of cohort projections is the construction of future mortality assumptions. Due to the judgements in the assumption setting process it is generally not possible to make justifiable assumptions at a particularly granular level. The ONS restricts its production of cohort-based projections to be based upon age, gender and country of origin.

Period life expectancy

Period life expectancy is a measure of instantaneous mortality rates and does not take into account any future changes in longevity (over the period people will actually be living in). Because it is not based upon mortality rates developing over the lifespan of individuals it is possible to produce more granular statistics.

Projected period life expectancy (e.g. period life expectancy in 2016 based on 2014 data) will take account of expected changes in mortality between the mortality investigation and the future date (2014-2016), but still does not account for the changing mortality thereafter. Assuming mortality rates are expected to improve in the future, period life expectancy will be lower than cohort life expectancy.

Calculation of period life expectancy

The underlying approach to the calculation is very similar to cohort calculations, except the mortality rates used are only from the base year.

The period life expectancy of an individual aged 65 in 2016 would be based upon the mortality of

someone aged 65 in 2016, 66 in 2016, 67 in 2016, 68 in 2016, and so on [Chart 3].

The assumptions around the change to future mortality rates to produce projected period life expectancy require judgement in setting. However the length of the projected period only extends as far as the base year and not over the projected future lifespan of an individual alive in that year.

Chart 3: the mortality rates used

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Projected male mortality rates per 100,000 by age and year

Age	2016	2017	2018	2019	2020	…
65	1,183.83	1,123.64	1,099.77	1,077.73	1,057.06	…
66	1,294.54	1,227.25	1,200.08	1,175.20	1,152.19	…
67	1,421.65	1,345.83	1,314.70	1,286.26	1,260.27	…
68	1,567.13	1,481.30	1,445.11	1,412.53	1,382.95	…
69	1,732.21	1,635.58	1,593.39	1,555.79	1,521.67	…
…	…	…	…	…	…	…

Rates used to calculate period life expectancy

Rates used to calculate cohort life expectancy

Uses of period life expectancy

Period life expectancies are most useful as a tool for comparing relative mortality rates between two subgroups of a population (e.g. to make regional comparisons), or for analysing small populations where suitable mortality improvers cannot be robustly produced. They can be calculated with greater certainty at a more granular level than cohort life expectancies, such as by local authority.

Limitations of period life expectancy

It is important to recognise that these do not represent the expected future lifespan of a member of the population. This is due to no account being made of changes to mortality rates over the lifespan of an individual, but is an instantaneous measure of current mortality experienced in the population.

A woman aged 65 is not expected to live for three and a half more years if they were to live in Camden as opposed to Sutton [Chart 4].

Given the use of these rates to analyse small sub-groups of the population there may only be a limited number of observations available, particularly at higher age ranges which will reduce the certainty of the result. This is generally mitigated through a confidence interval applied to the result.

Health estimates

Healthy life expectancy and disability free life expectancy statistics represent the period of future life spent in good health. They account for current rates of morbidity (the chance of falling ill) and mortality (the chance of dying).

The definition of "good health" is not standardised and varies between statistics. Even the definition of "disability free" is not fixed, particularly over time. Furthermore the assessment is subjective and survey responses are generally self-reported.

Health estimates are almost universally period projections based only upon the current prevalence of poor health (equivalent to period life expectancy) and do not account for future changes either to mortality or morbidity.

They are useful statistics allowing comparison between parts of the population [Chart 4]. The expected years with a disability is the difference between life expectancy and disability-free life expectancy.

As expectancies are calculated on a period basis healthy life expectancy does not represent the future number of years a member of the population can expect to spend in good health.

Calculation of healthy life expectations

Health status is based upon prevalence (the chance of being in ill health at a given point in time) rather than incidence (the chance of moving from a healthy state to an unhealthy state), there is no consideration

Chart 4: expectancy of life without a disability

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Females, age 65, period disability free life expectancy by local authority

Local authority name	Life Expectancy (years)	Disability Free Life Expectancy (years)	Expected years with a disability	Proportion of life disability free (%)	Proportion of life with a disability (%)
Richmond upon Thames	23.2	16.7	6.6	71.8	28.2
Kensington and Chelsea	23.8	14.0	9.8	58.9	41.1
Lambeth	21.6	13.7	7.9	63.4	36.6
Sutton	21.1	13.6	7.4	64.7	35.3
Havering	21.7	13.0	8.7	60.0	40.0
Bromley	22.2	12.9	9.3	58.3	41.7
Barnet	22.6	12.4	10.1	55.1	44.9
Camden	24.6	12.2	12.4	49.6	50.4

of the cause of ill-health or disability, nor the duration of the state.

This limits the use of the output to a period style calculation. It is not comparable to cohort life expectancies as these reflect the changes to mortality rates later in life (which are further into the future) when ill-health is more prevalent.

Uses

They provide a useful comparison between subgroups of the population.

Because both mortality and morbidity rates are likely to change over the future lifespan of an individual healthy life expectancies do not represent an average outcome applicable to a member of the population.

Limitations of health projections

Different sources of health assessment will yield different results. Even within a continuous survey the questions used to define the health status of individuals requires subjective self-assessment, which will introduce a bias. The definition of health should be considered in this context. These questions have changed over time and longitudinal comparison can therefore be difficult to make.

Cohort health projections

Ideally to understand the future period of good health an individual could expect to experience over their lifetime you would refer to a cohort healthy life expectancy table.

It is not possible to calculate adequately robust cohort equivalent health estimates with any level of confidence due to the complexities of projecting changes to morbidity rates. This is not helped by a lack of information regarding co-morbidity and an assessment of the potential improvements in healthcare and treatment of particular conditions.

Future morbidity and mortality rates will be influenced by many factors, which will develop over time: lifestyle factors, e.g. considering the rate of smoking by generation at each age; improvements in health care, e.g. the chance of surviving a heart attack; other external factors such as the impact of an economic downturn; an assumed trend to an upper limited lifetime.

For a condition that is debilitating, such as arthritis, its elimination would have little effect upon life expectancy but would result in a reduction in expected years with a disability. Conversely improvements in treatment of cardiac arrests, which generally lead to death rather than disability, would result in an increase in life expectancy, with a resultant increase in expected years with a disability.

More aggregate calculations can be made at population level using current trends. These are used to inform estimates of future health spending.

Conclusions

Different approaches to data gathering will result in different estimates for future expectancy. It is important to apply these expectations consistently with their construction, respecting the period over which mortality and morbidity rates develop.

To understand how long an individual may live it is necessary to consider their cohort life expec-

Chart 5: Summary

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Cohort life expectancy is a measure of how long someone can expect to live

Measure	How long people might live?	What is it?	Is good for	Availability
Cohort life expectancy	✓	A measure of the future lifespan of an individual	Projecting outcomes and costs	Break downs by age, sex and country
Cohort healthy life expectancy	✓			Cannot be robustly calculated
Period life expectancy	✗	A measure of current risks	Comparing population subsets for specific risks	Granular breakdown of a population, by area, socio-economic indicators, conditions…
Period healthy life expectancy	✗			

tancy. However this may not be available at a particularly granular level of detail [Chart 5].

Comparison of the risks different parts of the population are subject to can be achieved through period life expectancies. However these only reflect a snapshot of the risk and do not reflect the changes over the lifespan of members of the population.

All data used in this Briefing Note is taken from ONS 2014-based projection data for mortality rates and life expectancies.
Expectation of Life, Principal Projection, United Kingdom

Healthy life expectancy (HLE) and life expectancy (LE) at age 65 by upper tier local authority (UTLA), England

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