Public Health Outcomes Framework – Overarching Indicators

Technical User Guide
May 2014, revised February 2019

Contents

Details of the revisions to methodology implemented in May 2017 can be found in sections 3 and 4. These include:

- change to the time periods included in PHOF for the slope index of inequality indicators (page 10)
- use of the Index of Multiple Deprivation 2015 to define deprivation deciles (page 11)
- revision to the methodology for calculation of confidence intervals for the slope index of inequality indicators (page 12)
- use of 90+ as the upper age band for the calculation of life expectancy and healthy life expectancy (pages 14 and 15)

1. Background

In November 2013, Public Health England (PHE) released baseline data for the indicators corresponding to the overarching high-level outcomes in the Public Health Outcomes Framework (PHOF). These have since been updated annually.

0.1. Increased healthy life expectancy.

0.2. Reduced differences in life expectancy and healthy life expectancy between communities.

These indicators are split into a number of sub-indicators. This document provides a brief guide to interpretation of the seven sub-indicators for which data have been released, as well as further technical detail on the data sources and methods of calculation used.

Data for these indicators are displayed in the PHOF data tool:
http://www.phoutcomes.info/

2. Guide to interpretation

0.1i Healthy life expectancy at birth

This is a measure of the average number of years a person would expect to live in good health based on contemporary mortality rates and prevalence of self-reported good health. This indicator is reported for England as a whole, and all upper tier local authorities in England, for periods from 2011-13 onwards. Figures reflect the prevalence of good health and mortality among those living in an area in each time period. For a particular area, it is an estimate of the average number of years a newborn baby would live in good general health **if** he or she experienced the age-specific mortality rates and prevalence of good health for that area in each time period throughout his or her life. The figures are not therefore the number of years a baby born in the area could actually expect to live in good general health. This is because the health prevalence and mortality rates of the area are likely to change in the future and because many of those born in the area will live elsewhere for at least some part of their lives.

The prevalence of good health is derived from responses to a question on general health in the Annual Population Survey (APS) conducted by the Office for National Statistics (ONS). Respondents were asked to assess their own general health, in response to the question "How is your health in general; would you say it was…Very good / Good / Fair / Bad or Very bad?" The responses "Very good" and "Good" are categorised as 'Good' general health and "Fair", "Bad" or "Very bad" as 'Not Good' general health.

Healthy life expectancy is a measure of a population's general health, it does not provide an indicator of functional health status, such as whether daily activities are restricted because of health problems. The figures are based on people living in private households; they exclude residents of communal establishments except NHS housing and students in halls of residence where inclusion takes place at their parents' address.

A brief summary of the methods of calculation and data sources for the healthy life expectancy indicator can be found in Section 4 of this document. ONS have also issued a statistical bulletin for this indicator. This includes more detail on the method of calculation and analyses of the results. ONS have also published figures for English regions to accompany results for upper tier local authorities:

https://www.ons.gov.uk/releases/healthstatelifeexpectanciesuk2015to2017

0.1ii Life expectancy at birth

This is the average number of years a person would expect to live based on contemporary mortality rates. This indicator is reported for England as a whole, and all upper and lower tier local authorities in England, for periods from 2001-03 onwards. Figures reflect mortality among those living in an area in each time period. For a particular area, it is an estimate of the average number of years a newborn baby would live **if** he or she experienced the age-specific mortality rates for that area for the time period throughout his or her life. The figures are not therefore the number of years a baby born in the area could actually expect to live. This is because the mortality rates of the area are likely to change in the future and because many of those born in the area will live elsewhere for at least some part of their lives.

This indicator provides context to the indicator of healthy life expectancy (0.1i), which estimates how many years of the estimated length of life will be lived in good general health.

A brief summary of the methods of calculation and data sources for the life expectancy indicator can be found in the technical guide in Section 4 of this document. ONS have published life expectancy at birth data for each time period alongside figures for life expectancy at age 65. These include figures for English regions as well as data for local authorities:

https://www.ons.gov.uk/releases/healthstatelifeexpectanciesuk2015to2017

0.2iii Inequality in life expectancy at birth

This indicator provides information on inequalities in life expectancy at birth between communities. The Slope Index of Inequality (SII) is a measure of the social gradient in life expectancy, i.e. how much life expectancy varies with deprivation. It takes account of health inequalities across the whole range of deprivation within an area and summarises this in a single number. This represents the range in years of life expectancy across the social gradient from most to least deprived.

The chart in Figure 1 illustrates how the SII is calculated. Within each upper and lower tier local authority, the population has been divided by level of deprivation, based on the Index of Multiple Deprivation 2015. This has been done by ranking Lower Super Output Areas (LSOAs) from most to least deprived. These have then been divided into 10 groups, or deprivation deciles, with approximately equal numbers of LSOAs in each. Decile 1 contains people living in the most deprived parts of the local authority and Decile 10 contains people in the least deprived parts. Life expectancy at birth has been calculated for each of these deciles, illustrated by the blue dots in Figure 1. (Life expectancy at birth is defined in Indicator 0.1ii and notes on the definitions of LSOAs and deprivation can be found in the following Section 3).

In Figure 1, the life expectancy figures have been plotted to take account of their population size (see Section 4 for details). The red line on the chart is a linear regression line of best fit for the data, calculated by the least squares method. The SII is simply the gradient of that line, or the difference between the top of the line (at 100% on the horizontal axis) and the bottom (0% on the horizontal axis). In the example in Figure 1, the regression line goes from 78.0 to 85.9 years. This gives an SII of 7.9 years (with a 95% confidence interval of 6.7 to 9.1 years). The range in life expectancy across the social gradient from most to least deprived in this local authority is therefore 7.9 years.

Figure 1 – Life expectancy by deprivation decile and the slope index of inequality
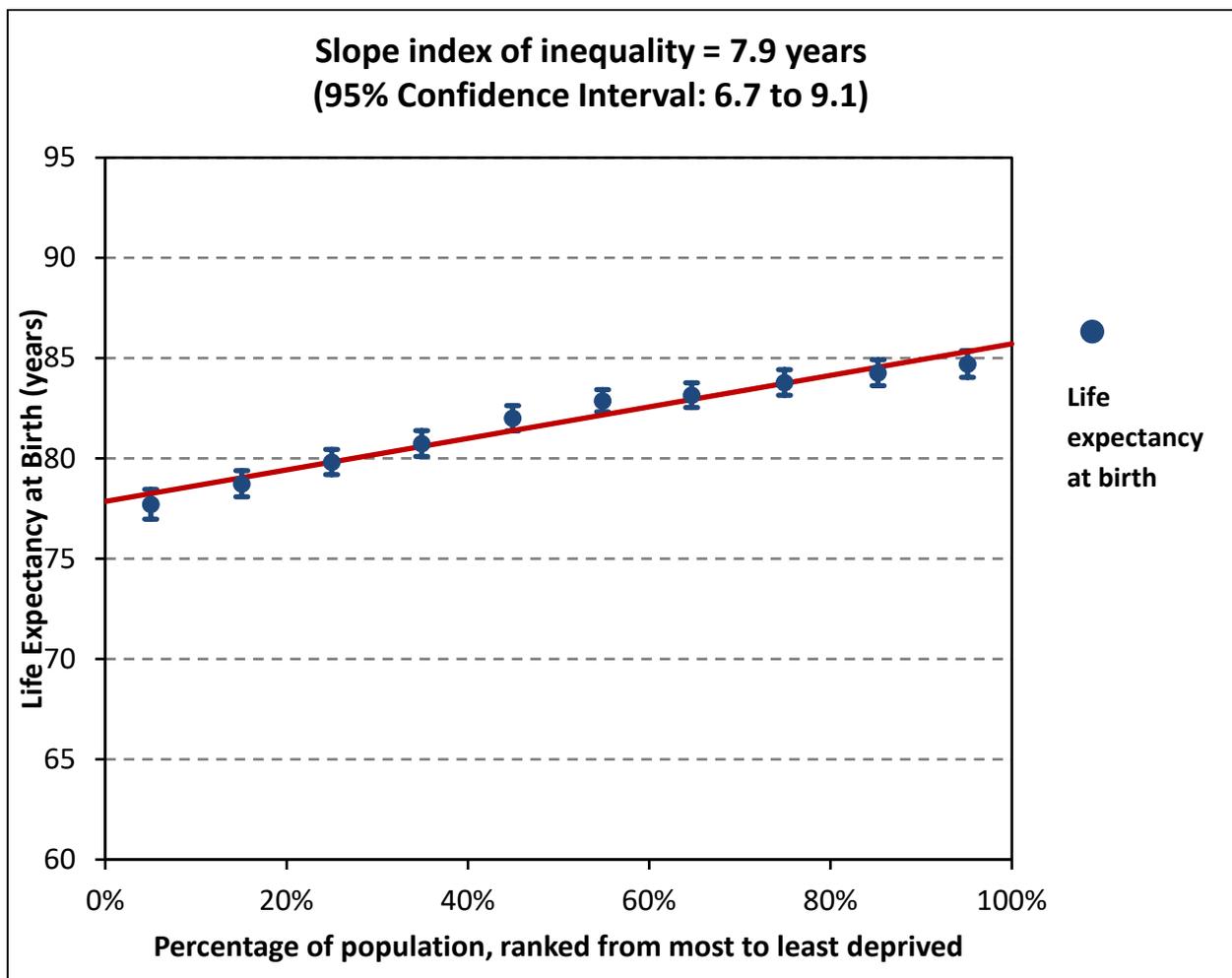
The SII results for England and English regions are calculated in the same way, but with LSOAs ranked from most to least deprived within England as a whole, to form national deprivation deciles, and within regions as a whole to form regional deprivation deciles.

The SII gives a description of the extent of inequality in each local authority, and is broadly comparable between areas. Some areas have more diverse populations than others, in terms of deprivation. Because life expectancy and deprivation are so strongly correlated, local authorities with a wider range of deprivation will tend to have greater ranges of life expectancy and therefore a larger SII.

While the SII is broadly comparable between areas, the deprivation deciles are defined separately for each local authority based on the local range of deprivation in the area. The most deprived 10% of the population in a local authority with a high level of deprivation might not therefore be comparable with the most deprived 10% of the population in a more affluent local authority. When interpreting the slope index figures it is therefore important to consider them in the context of the

local authority's overall life expectancy at birth (Indicator 0.1ii) or the gap between life expectancy in the local area and the value for England (0.2iv).

The 10% most deprived population within a local authority may also not correspond to the 10% most deprived population identified in the national deprivation deciles within England. Some local authorities do not contain the full range of national deprivation deciles, and will not therefore have any of their population resident in LSOAs which are classified as amongst the least or most deprived deciles in England.

An SII figure is provided for England to indicate the extent of inequalities in life expectancy across the whole country, which can be measured over time. The SII for England should not be considered as a comparator for the local authority figures, however. The SII for England takes account of the full range of deprivation and mortality across the whole country. This does not therefore provide a suitable benchmark with which to compare local authority results, which take into account the range of deprivation and mortality within much smaller geographies. For this reason, the SII results for local authorities in the PHOF tool are not colour coded to show whether they are statistically higher or lower than the England value and the England figures are presented separately from the figures for local authorities.

Similarly, an SII figure is provided for each of the English regions to indicate the extent of inequalities in life expectancy within the region. As with the England figure, these should not be considered as a comparator or benchmark for the local authority figures, and are therefore presented separately from the figures for local authorities.

Figures for the life expectancy SII indicators have been released for England as a whole from 2001-03 onwards, and for all English regions and upper and lower tier local authorities from 2010-12 onwards. These data use rebased population estimates for the relevant years derived from the 2011 Census.

0.2iii Inequality in life expectancy at 65

This sub-indicator was published in PHOF for the first time in February 2018, to provide information on inequalities in life expectancy at age 65 between communities. Similarly to main indicator 0.2iii described above, it shows the range in life expectancy at age 65 across the social gradient from most to least deprived, and can be data can be interpreted in the same way.

The calculation of this indicator is consistent with main indicator 0.2iii. The slope index of inequality is calculated using life expectancy at age 65, and the population aged over 65 in each deprivation decile.

Data for 2010-12 onwards are included in the PHOF tool.

Life expectancy for deprivation deciles

Figure 1 illustrates how the SII indicators are based on estimates of life expectancy for deprivation deciles. Life expectancy at birth and life expectancy at age 65 has therefore been calculated for each deprivation decile within each local authority, region, and England as a whole. These figures can be accessed from the *inequalities* tab within the PHOF tool (from this tab, select indicator 0.1ii life expectancy at birth or age 65, and there will then be an option to partition data by deprivation deciles. These can be displayed for deciles within England or for a selected local authority). Decile data can also be downloaded from the PHOF tool from the *download* tab.

0.2ii Number of upper tier local authorities for which the local SII in life expectancy (as defined in 0.2.iii) has decreased

This is a summary measure of the number of local authorities for which local within-area inequalities in life expectancy (as measured by Indicator 0.2iii) have decreased. It shows a count of the number of upper tier local authorities where the SII measure has decreased since the baseline time period, and is currently available from 2011-13 onwards, showing the number where SII has decreased since 2010-12.

Please note that the data for this indicator was revised in May 2017 due to changed methodology for the calculation of the SII. Data published in May 2017 uses 2010-12 as the baseline instead of 2009-11 previously used. Data which were previously available in PHOF are not comparable with the current data.

0.2iv Gap in life expectancy at birth between each local authority and England as a whole

This indicator provides context for the indicator of inequality in life expectancy within each English local authority (0.2iii) by giving the difference between life expectancy at birth in a whole local authority area and the England value for life expectancy at birth. This provides an indication of overall life expectancy in the local authority relative to the level for England. Figures are provided for upper and lower tier local authorities from 2001-03 onwards.

0.2v Slope index of inequality in healthy life expectancy at birth based on national deprivation deciles of LSOAs within England

This indicator has been calculated using the same definition of healthy life expectancy described for indicator 0.1i. The slope index of inequality has been calculated using the method described above for the SII in life expectancy (0.2i).

Healthy life expectancy at birth for deprivation deciles

For healthy life expectancy, figures for deprivation deciles at England level are published by ONS: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthinequalities/bulletins/healthstatelifeexpectanciesbyindexofmultipledeprivationimd/previousReleases

0.2vi Slope index of inequality in healthy life expectancy at birth, based on Middle Super Output Areas within upper tier local authorities

Data for this indicator were included in the PHOF for the first time in February 2016, to provide a local measure of inequality in healthy life expectancy at birth.

Healthy life expectancy was calculated for each MSOA within England for the period 2009-13. The methodology is described for indicator 0.1i, however an alternative data source was used for self-rated general health. This indicator uses data from the 2011 Census (since this is available at small area level) whereas indicator 0.1i uses self-rated general health from the ONS Annual Population Survey. The use of the 2011 Census, also means that this indicator includes data on self-rated health for residents of communal establishments.

To calculate the SII, within each local authority MSOAs were ranked from most to least deprived, using the Index of Multiple Deprivation 2015. To allow for differences in population size between MSOAs, each was given a rank score based on the midpoint of its range in the cumulative distribution of the local authority's population. If the most deprived MSOA contained 5% of the local authority's population, its rank score would be 5/2=2.5. If the second most deprived MSOA included 12% of the population, its rank score would be 5+(12/2)=11. The healthy life expectancy for each MSOA is plotted against this rank score and a population-weighted regression line is fitted to the data by the least squares method. The SII is the gradient of the resulting fitted line, thus representing the absolute difference in healthy life expectancy between the most and least deprived areas within a local authority.

These figures are based on data from the 2011 Census and so will be produced for one time point only.

These data are taken from an ONS report (produced in conjunction with PHE) on inequalities in healthy life expectancy and disability-free life expectancy:

https://beta.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/inequalityinhealthandlifeexpectancieswithinuppertierlocalauthorities/2009to2013#

3. Technical notes

Geographies

Data for healthy life expectancy (0.1i) and inequality in healthy life expectancy (0.2vi) have been released for upper tier local authorities. These are English counties, unitary authorities, London boroughs and metropolitan county districts. Figures have not been calculated for the City of London and the Isles of Scilly because of the small populations in these areas. Figures for overall life expectancy (0.1ii), the SII in life expectancy (0.2iii) , and the life expectancy gap with England (0.2iv) are provided for both upper and lower tier local authorities, the latter being county districts within English counties. Figures for regions use the boundaries of the former English Government Office Regions.

Four of the SII indicators (0.2i, 0.2iii, 0.2v and 0.2vii) are based on LSOAs - small areas of relatively even size (around 1,500 people) of which there are now 32,844 in England, based on 2011 LSOA boundaries.

Time trends

Data for the indicators of healthy life expectancy (0.1i), and the SII in healthy life expectancy (0.2v) form the start of a new data series.

ONS have been publishing data on life expectancy at birth for local authorities for many years, and these data for life expectancy at birth from 2001-03 onwards are now included in the PHOF data tool.

Time trends in the SII in life expectancy at birth for local authorities from 2010-12 onwards were published within the PHOF tool in May 2017. These latest figures are not comparable with the data previously published in PHOF for 2002-04 to 2012-14. The latest PHOF data incorporate three key methodological changes (outlined in sections 3 and 4 below):
- use of 90+ as the upper age band for calculation of life expectancy deciles instead of 85+
- use of the Index of Multiple Deprivation 2015 instead of the Index of Multiple Deprivation 2010
- revision of the methodology used to calculate confidence intervals

These changes mean that the previous trend data published in PHOF are not comparable. Charts for each local area showing the impact of these changes are available on the PHOF Further Information page.

Time trends for the SII in life expectancy at birth for 2001-03 to 2009-11 at England level only were added to PHOF in August 2018, and use the Index of Multiple Deprivation 2010.

Time trends for the SII in life expectancy at age 65 are published for 2010-12 onwards.

Deprivation

For the SII indicators, deprivation has been defined using the Index of Multiple Deprivation 2015 (IMD 2015). IMD 2015 is constructed from 37 indicators grouped into 7 domains: Income, Employment, Health and Disability, Education Skills and Training, Barriers to Housing and Services, Living Environment, and Crime.

In May 2017 the SII data published in PHOF has been calculated using IMD2015 to define deprivation for 2010-12 onwards. This is a change from the previously available data in PHOF where the Index of Multiple Deprivation 2010 (IMD 2010) had been used to define deprivation.

The approach for the overarching indicators of inequality in PHOF previously, has been to monitor how inequalities in life expectancy between the most and least deprived areas, as identified in the baseline data, have changed over time. IMD 2010 was used to define deprivation for the whole time series from 2002-04 onwards.

However, this is problematic in local areas where there have been significant changes in levels of deprivation within the local area over time. An apparent narrowing of the life expectancy gap in 2013-15, for example, based on IMD2010, may reflect a narrowing of inequality in life expectancy, or that the deprivation deciles are no longer groupings of similarly deprived areas. This would mean that the deprivation deciles are less homogenous, thereby concealing inequality within the local authority.

Measuring the inequality in life expectancy between most and least deprived areas in each time period, using the Index of Multiple Deprivation which most closely aligns with the time period of the life expectancy data would reduce this issue, meaning the SII measure more accurately reflected inequality within each area at a given time period. This is the approach that is now being taken for the PHOF SII measures.

IMD2015 is constructed using data mostly from 2012/13. Therefore using IMD2015 to group areas into deciles for the life expectancy time periods that it most closely aligns with (2010-12 to 2013-15) should produce a more accurate way of identifying areas with similar levels of deprivation.

Time trends for the SII in life expectancy at birth for 2001-03 to 2009-11 at England level only were added to PHOF in August 2018, and use the Index of Multiple Deprivation 2010.

The indicator of inequality in healthy life expectancy within local authorities (0.2vi) is based on the Index of Multiple Deprivation 2015 scores for MSOAs which were calculated by PHE and are available in the Public Health England Local Health tool: http://www.localhealth.org.uk

Deprivation deciles

In order to create deprivation categories for the calculation of the SII measures, LSOAs within England were ranked from most to least deprived and then divided into ten categories with approximately equal numbers of LSOAs in each. Within each region and local authority, this process was repeated to assign LSOAs to regional and local deprivation deciles within each area.

Where the number of LSOAs within an area was exactly divisible by the number of deprivation categories, this could be done precisely. E.g. Where there are 150 LSOAs within a local authority (LA), each deprivation decile in that LA has 15 LSOAs. Where the number of LSOAs was not exactly divisible, then the 'extra' LSOAs were allocated to deprivation categories in a systematic way.

The number of LSOAs was divided by the number of deprivation categories to derive the number after the decimal point. E.g. If assigning 163 LSOAs to deprivation deciles within an LA then the number after the decimal point is 3 (163/10 = 16.3). In this case the three 'extra' areas were assigned to the 1st, 2nd and 4th quintiles.

The table below shows the deciles which receive extra LSOAs, depending on the number after the decimal point. In these tables, the first decile is the most deprived, and it can be seen that the 'extra' LSOAs have been weighted towards the most deprived categories rather than the least.

A tool for assigning deprivation categories can be downloaded from:
https://fingertips.phe.org.uk/profile/guidance

Number after the decimal point	Quintiles allocated 'extra' LSOAs
.1	1
.2	1, 6
.3	1 ,4, 7
.4	1, 3, 6, 8
.5	1, 3, 5, 7, 9
.6	1, 2, 4, 6, 7, 9
.7	1, 2, 3, 5, 6, 8, 9
.8	1, 2, 3, 4, 6, 7, 8, 9
.9	1, 2, 3, 4, 5, 6, 7, 8, 9

Confidence Intervals

Each of the indicators has been released with 95% confidence intervals. These provide a range of values which describe uncertainty around the calculated values. This uncertainty arises from factors which influence the indicators which may be subject to chance, such as random fluctuation in the numbers of deaths occurring in an area. Two of the healthy life expectancy indicators are also based on data from the Annual Population Survey, which questions only a sample of the population. Uncertainty can therefore also arise from random differences between that sample and the population itself. A 95% confidence interval implies that 95 times out of 100, the interval will include the true underlying value.

For the SII indicators, the confidence intervals are calculated by simulation. This new method for the calculation of the confidence intervals around the SII values was implemented in PHOF in May 2017. Previously confidence intervals had been calculated which reflected how well the slope line (the red line in Figure 1) fitted the decile life expectancy figures. However this method did not take into account that the decile life expectancy figures themselves were subject to variation.

The simulation technique estimates the degree of uncertainty of the SII measure, taking into account the variability of the decile life expectancy figures. For each decile, the life expectancy (LE) has been calculated along with its standard error (SE). These SEs give information about the degree of uncertainty around each of the life expectancy values: essentially it describes a statistical distribution for each decile. Using a random number generating algorithm, a random value is taken from each decile LE distribution and the SII recalculated. This is repeated a million times, to build up a distribution of SII values based on random sampling from the decile LE distributions. The 2.5% and 97.5% values from this distribution of SII values is then reported as the 95% confidence interval for the SII.

This new method produces more precise confidence intervals and allows greater discrimination between areas and over time.

In the PHOF tool, the 95% confidence intervals have been used to indicate whether values for local authorities are statistically significantly higher, lower or similar to the value for England. This has not been indicated for the SII in life expectancy however for local authorities and regions (0.2iii and 0.2vii) for the reasons detailed in Section 2 on the interpretation of these indicators.

Populations

Following the 2011 Census, ONS has revised its time series of mid-year population estimates. ONS carries out this process of revision after every census, as the census provides the most complete information about the population. All of the PHOF overarching indicators using population data from 2002 onwards have now been calculated with rebased population estimates for the relevant time periods, and are final figures.

In 2018 ONS revised the mid-year population estimates for 2012 to 2016. PHOF indicators for life expectancy and the slope index of inequality in life expectancy for all data points which include these time points are based on the new population data.

4. Calculation of indicators

0.1i Healthy life expectancy at birth

Healthy life expectancy has been calculated by ONS using abridged Sullivan life tables, for males and females separately using 5 year age bands. A Sullivan life table extends the traditional life table by partitioning years lived into favourable and unfavourable health states to provide an estimate of healthy life expectancy for males and females at birth and each geographical unit. In addition to the number of deaths and mid-year population estimates used in a traditional life table, the Sullivan life table also incorporates the proportion of people reporting their general health as good or very good from a data source, in this case from the Annual Population Survey. In response to the question "How is your health in general; would you say it was…", responses "Very good" and "Good" are categorised as 'Good' health and "Fair", "Bad" or "Very bad" as 'Not Good' health.

In November 2016, ONS implemented a revised methodology for the calculation of healthy life expectancy, to use an upper age band of 90 and over, whereas previously the upper age band was set to 85 and over. The change was made to reflect an increasing proportion of deaths at ages 85 and over, and results in greater accuracy of healthy life expectancy estimates. In addition, the method used to impute health state prevalence for children and the oldest age groups has been revised to use Census data, as this is considered the best estimate of health state prevalence. These new methodologies have been applied to healthy life expectancy estimates from 2009-11 onwards. A detailed explanation of the changes and the impact on healthy life expectancy estimates can be found on the ONS website:
https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/methodologies/methodchangestolifeandhealthstateexpectancies

The 95% confidence intervals calculated around the healthy life expectancy estimates for each area follow the methodology outlined in "Health Expectancy Calculations by the Sullivan Method: A Practical Guide".[1] This methodology assumes that if the sample size of the survey producing the prevalence rates is not very large compared with the population on which the mortality data are based, then the variance from the mortality rates is negligible. Therefore only the variance of the health prevalence rates is used when calculating the confidence intervals for healthy life expectancy in this output. The Annual Population Survey used for estimating the health prevalence has a complex design; this is taken account of in the confidence interval calculation. Further detail on this indicator can be found in the statistical bulletin on the ONS website:

https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/healthstatelifeexpectanciesuk/2013to2015

0.1ii Life expectancy at birth and age 65

This indicator was calculated by ONS using abridged life tables (based on five-year age groups) constructed using standard methods.[2,3] Separate tables were constructed for males and females using numbers of deaths registered in calendar years and annual mid-year population estimates. A life table template which illustrates the method used to calculate life expectancy (and 95% confidence intervals) can be found on the ONS website:
https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/datasets/healthstatelifeexpectancytemplate

In November 2016, ONS implemented a revised methodology for the calculation of life expectancy, to use an upper age band of 90 and over, whereas previously the upper age band was set to 85 and over. The change was made to reflect an increasing proportion of deaths at ages 85 and over, and results in greater accuracy of life expectancy estimates. The new methodology has been applied to life expectancy estimates from 2001-03 onwards. A detailed explanation of the methodology change and the impact on life expectancy estimates can be found on the ONS website:
https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/methodologies/methodchangestolifeandhealthstateexpectancies

The 95% confidence interval (CI) for each area was calculated using the revised Chiang method (Chiang II). The calculation also includes an adjustment to include a term for the variance associated with the final age interval as developed by Silcocks.[4] Use of the Silcocks method in the calculation of confidence intervals for life expectancy was implemented by ONS in November 2016, and has been applied to life expectancy estimates from 2001-03 onwards.

0.2iii Inequality in life expectancy at birth (and inequality in life expectancy at age 65)

These indicators were calculated by PHE using mortality data from ONS and ONS mid-year population estimates for LSOAs for the relevant time periods. LSOAs within England were ranked from most to least deprived and then divided into national deprivation deciles with approximately equal numbers of LSOAs within each of the ten categories. Within each region and local authority, this process was repeated to assign LSOAs to regional and local deprivation deciles within each area (method described above).

Deaths were assigned to 2011 LSOA boundaries using the May 2018 National Statistics Postcode Lookup file for all time periods. The mortality data and population estimates were aggregated into deprivation deciles for each local authority, region, and for England as a whole, and life expectancy figures with confidence intervals were then calculated, using the methodology described in section 0.1ii above.

As illustrated in Figure 1, the SII is calculated using population-weighted linear regression and it represents the hypothetical absolute difference in life expectancy between the extremes of deprivation within a local authority or within England as a whole.

While the deprivation deciles have roughly one-tenth of the population in each, they are not precisely equal because they are aggregated up from LSOAs. The horizontal x-axis along the bottom of the chart in Figure 1 represents the whole population of an area (a local authority or England as a whole). Each blue dot in Figure 1 represents the life expectancy for each deprivation decile. If Decile 1 includes exactly 10% of the population, the first blue dot is positioned at 5%, the mid-point of the range of population covered by that decile. If the second decile includes 11% of the population, this would cover the range from 10% to 21%, so the midpoint is 15.5%, and that is where the point would be located on the x-axis. For life expectancy at birth, the all age population was used, and for life expectancy at age 65, the population aged 65 and over was used. The 0% and 100% points on the x-axis nominally represent the most and least deprived individuals in the area. The red line on the chart is a linear regression line of best fit for the data, calculated by the least squares method. The SII is the gradient of the resulting fitted line, i.e. m in the equation $y = mx + c$.

Confidence intervals are calculated around the gradient of the line using the simulation method described in the confidence interval section above.

The SII, along with other methods of measuring inequalities, are explained in a ScotPHO guide.[6]

In some local authorities a meaningful life expectancy estimate cannot be calculated for every local deprivation decile because of the population of the deprivation decile is lower than 5,000, the count of deaths in an age group is higher than the population estimate for that age group, there are zero deaths in the 90+ age group, or because there is large uncertainty in the life expectancy value (where confidence intervals are wider than 20 years). In these cases, the SII in life expectancy has not been provided in the data tool.

0.2iv Gap in life expectancy at birth between each local authority and England as a whole

This indicator was calculated by PHE using life expectancy at birth figures published by ONS. The life expectancy at birth figure for each local authority was subtracted from the figure for England to give the absolute gap, in years, for each area.

For this indicator, confidence intervals around the life expectancy at birth values for each local authority have been applied to the gap with England figures. The lower and upper confidence limit for each area has been subtracted from the England life expectancy value. (The confidence interval around England itself has been ignored as it is very narrow.) For each local authority, the statistical significance compared with England of its overall life expectancy (0.1ii) and gap with England (0.2iv) is therefore identical.

0.2v Slope index of inequality in healthy life expectancy at birth based on national deprivation deciles of LSOAs within England

This indicator was calculated by ONS based on healthy life expectancy for deprivation deciles.

The calculation of SII and confidence intervals was as described for indicators 0.2i and 0.2iii above.

Enquiries and comments on the PHOF indicators can be e-mailed to phof.enquiries@phe.gov.uk

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