General Register Office for Scotland
information about Scotland's people

Life Expectancy for Scotland: Methodology Guide

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1.   Introduction

This paper describes the methodology used to produce life expectancy figures by the National Records of Scotland (NRS) for areas within Scotland. These figures are produced every year based on data from the previous 3 (or 5) years for various geographical areas within Scotland.

NRS publish the definitive sub-Scotland level life expectancy figures. The definitive Scotland-level life expectancy estimates are published by The Office for National Statistics (ONS) on behalf of NRS and can be found here: http://www.ons.gov.uk/ons/rel/subnational-health4/life-expec-at -birth-age-65/2004-06-to-2008-10/statistical-bulletin.html The Information Services Division (ISD) within the NHS National Services Scotland publish Scotland's definitive healthy life expectancy estimates, alongside the corresponding life expectancy estimates for the same time periods and geographies, to allow an estimation of the time expected to be spent in 'not good' health and can be found here: http://www.scotpho.org.uk/hle/.

2.   An introduction to life expectancy figures

2.1   Coverage of life expectancy figures

The latest life expectancy figures can be found on the NRS web site – via the Life Expectancy Statistics page:- www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/life-expectancy

The available figures are split under three sections:-

Life Expectancy at Scotland Level
This section contains the Scottish Interim Life Tables and Scottish Decennial Life Tables. The Interim Life Tables are published annually and give statistics on period life expectancy by age and sex. The Decennial Life Tables are published every 10 years and are based on the mortality experience of Scotland's population during the three years centered on a census year.

Life Expectancy at Scottish Administrative Area Level
Life expectancy report on figures for administrative areas within Scotland, including both Council and NHS board areas.

Life Expectancy at Special Area Level
NRS publish a report on Life Expectancy in Special Areas (Urban/Rural, Deprivation and Community Health Partnership) within Scotland. Life expectancy data is also published for Scottish Parliamentary Constituency Areas, Scottish Council Areas split by Deprivation and Intermediate Zones.

All of NRS published life expectancy data includes life expectancy at birth for males and females with confidence intervals. The reports for life expectancy at administrative areas and special areas also include abridged life tables for the geographical areas covered within the reports.

The Scotland-level life expectancy estimates given in NRS publications are for use only as a comparator for the corresponding sub-Scotland-level figures. The definitive Scotland-level life expectancy estimate (based on interim – between Census years - life tables) is published by the Office for National Statistics (ONS): National Statistics Online - Interim Life tables. The differences occur because of the differences between complete (single year of age) and abridged (grouped years) life tables, as well as the number of years data used in calculating the life expectancy figures.

The life expectancy figures produced by NRS are all period life expectancies. Period life expectancies are calculated using age specific mortality rates for a given period, with no allowance for any actual or projected future changes in mortality. This means that period life expectancy at birth for a given time period and area is an estimate of the average number of years a new born baby would survive if he/she experienced the particular area's age specific mortality rates for that time period throughout his/her life. The figures reflect mortality among those living in the area in each period, rather than the mortality among those born in each area. Life expectancy at birth is not the number of years a baby born in the area during the specified time period is expected to live (although the term "can expect to live" is often used for ease of reading), both because death rates are likely to change in the future and because many of the new borns may live elsewhere for at least some part of their lives.

Cohort life expectancies are worked out using age-specific mortality rates which allows for known or projected changes in mortality rates from relevant year based population projections can be accessed from the ONS website at: http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=15098.

Life expectancy figures used for international comparisons are taken from the Eurostat website: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database.

2.2   Uses of life expectancy figures

Life expectancy at birth provides a useful summary of mortality rates actually experienced over a given time period.

Life expectancy also provides an objective means of comparing trends in mortality, over time, between areas of a country and with other countries. This is of particular use in monitoring and investigating health inequality issues across Scotland and in setting public health targets.

Life expectancy figures are also used to help deliver local and national health services.

3. Methodology for producing life expectancy statistics

3.1 Input data

Population and death data are required to calculate life expectancy figures.

To calculate life expectancy at administrative areas within Scotland, the mid year population estimates published by NRS (http://www.nrscotland.gov.uk/statistics-and -data/statistics/statistics-by-theme/population/population-estimates) given by council and NHS board area by sex and 5 year age groups are used. More information about the methods used to produce them can be found here: www.nrscotland.gov.uk /files/statistics/population-estimates/mid2011/mye-methodology.pdf

Death data for calendar year by date of registration and by age at death in the same format as the population data are also used and obtained from the Vital Events branch in NRS.

For life expectancy in special areas published by NRS, small area population estimates (SAPE) (population estimates for data zones) are required by sex and 5 year age groups, as well as death data by the same distribution obtained from the Vital Events branch in NRS. These population and deaths figures are then assigned a lookup and aggregated to the required geography level. The match of data zones to Community Health Partnerships and Scottish Parliamentary Constituency is best fit. There were two deaths in both 2007 and 2009 in the zero age group for which the sex was unclassified, for the purpose of calculating special area life expectancy data for 2007-2009 these deaths were treated as male.

The majority of life expectancy figures published by NRS are a three year average. They are produced by aggregating deaths and population data for the relevant three year period (usually for the three years before publication). Three years of data are needed to provide large enough numbers to ensure that the figures published are sufficiently robust. Similarly ONS use three years of aggregated data for life expectancy data including for the calculation of Scotland's definitive life expectancy figures.

Life expectancy figures for intermediate zones and council area split by deprivation are a five year average to ensure a higher level of statistical robustness due to the small size of some of the geography areas. The useful effects of increasing the size of the number of years used (n) needs to be weighed against the fact that the resultant life expectancy is an average of 5 years and assumes that the underlying life expectancy has not changed over the n years under investigation. For example, if n is equal to ten, then the implicit assumption is that life expectancy has not changed over those ten years. As n increases, the confidence interval decreases, but the validity of the assumption decreases too.

3.2   Calculating life expectancy statistics

NRS use the Chiang II method when calculating life expectancy figures. ONS and ISD also use this method for calculating life expectancy. The methodology of calculating life expectancy is published by ONS and can be found here: Life expectancy at birth: methodological options for small populations.

3.3   Treatment of deaths

Deaths of Scottish residents occurring in Scotland are assigned to place of normal residence. With the exception of life expectancy in intermediate zones, NRS include deaths of non–residents but allocate them to place of death and ignore deaths of Scottish residents occurring outwith Scotland.

Currently ONS, NRS and ISD all differ in the approach taken to deal with non-residents deaths for sub-national life expectancy figures as well as resident deaths that occur outwith each UK constituency country.

ONS include deaths of non-residents for figures that feed into United Kingdom (UK) total figures, as well as the UK, Great Britain (GB) and England and Wales Interim Life Tables. For constituent UK country Interim Life Tables, non resident deaths in England and Wales are allocated to England and non-resident deaths in Scotland are allocated to Scotland. All life expectancy figures calculated by ONS for Northern Ireland include the deaths of non-residents. Otherwise ONS do not include deaths of non-residents nor do they include deaths of English or Welsh residents dying outwith England and Wales.

ISD include deaths of non-residents but impute a pseudo place of residence and ignore deaths of Scottish residents dying outwith Scotland.

When NRS took over the responsibility of calculating life expectancy for intermediate zones from ISD, it was agreed that NRS would continue with ISD's method of imputing a pseudo place of residence for the non-resident deaths when calculating these statistics. Deaths of Scottish residents occurring outwith Scotland are ignored.

Work is planned to bring the methods of the three organisations more in line. NRS is currently investigating, alongside ISD, obtaining the records of Scottish residents dying outside of Scotland.

3.4   Accuracy of results

Life expectancy, like most statistics, is an estimate which is subject to a margin of error. The accuracy of the results can be indicated by calculating a confidence interval (included in the Chiang II method) which provides a range of values within which the true underlying life expectancy would lie (with 95 per cent probability). Life expectancy for an area can be said to be significantly different from, for example the Scottish level, if the 95 per cent confidence intervals do not overlap.

There is no simple 'rule of thumb' for the size of confidence intervals. But they largely depend on the size of the population, so confidence intervals for areas with smaller populations tend to be wider. It is also worth noting that life expectancy results in these areas can be affected by the random variation in the number of annual deaths. This means that the results can vary from year to year.

Life expectancy is subject to random fluctuations in the number of deaths and the age at death.

3.5   Abridged life tables

In the reports for life expectancy in administrative areas and life expectancy in special areas abridged life tables are included. These tables give expectation of life at an 'exact age'. This is the average number of years that those at this age would survive thereafter, if they experienced the particular area's age specific mortality rates for the time period throughout the remainder of their life.

In the extracts from period life tables the column headed l_x shows the numbers who would survive to exact age of x, out of 100,000 persons who, from birth, were subject to the mortality probabilities indicated by the deaths for the corresponding time period. The column headed e_x^0 shows the expectation of life – that is, the average number of years of life left to persons aged exactly x who are subject to the corresponding years mortality probabilities from age x onwards.