Office for National Statistics

Socioeconomic inequalities in avoidable mortality QMI

Quality and Methodology Information for socioeconomic inequalities in avoidable mortality, detailing the strengths and limitations of the data, methods used and data uses and users.

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Next release:
To be announced

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1 . Output information

National Statistic	
Data collection	Death registrations
Frequency	Annual
How compiled	Administrative data processing
Geographic coverage	England and Wales
Related publications	Avoidable mortality in the UK
Last revised	29 April 2019

2 . About this Quality and Methodology Information report

This quality and methodology report contains information on the quality characteristics of the data (including the European Statistical System five dimensions of quality) as well as the methods used to create it.

The information in this report will help you to:

- understand the strengths and limitations of the data
- learn about existing uses and users of the data
- understand the methods used to create the data
- help you to decide suitable uses for the data
- reduce the risk of misusing data

3 . Important points

- Socioeconomic inequalities in avoidable mortality presents statistics on the number of avoidable deaths and the age-standardised mortality rates by England and Wales' respective indices of multiple deprivation (IMD) deciles, sex and cause as well as absolute (slope index of inequality) and relative (relative index of inequality) measures of inequality.

- The deaths included in the avoidable mortality definition are defined using the International Classification of Diseases, 10th Revision (ICD-10).

- With advances in medical technology and wider public health interventions, deaths from conditions previously not avoidable may have since become avoidable, which means the avoidable mortality definition requires review, and if appropriate, revisions.

- The statistics are compiled using information supplied when a death is registered.

- Avoidable mortality data for England and Wales are held by the Office for National Statistics (ONS).

- National deciles of area deprivation are created through ranking small geographical populations known as Lower layer Super Output Areas (LSOAs) according to their deprivation score and grouping them into 10 divisions.

- Each decile represents approximately 10% of the national population, with decile 1 containing the 10% most deprived LSOAs and decile 10 containing the 10% least deprived.

4 . Quality summary

Overview

It is widely accepted that the contribution of healthcare to improvements in population health ought to be quantified. Avoidable mortality, which is based on the concept that premature deaths from certain conditions should be rare and ideally should not occur in the presence of timely and effective healthcare, is used as an indicator to measure this contribution.

With advances in medical technology and wider public health interventions, deaths from a condition previously not avoidable may have since become avoidable. This means that when the avoidable mortality definition is updated, it may not be appropriate to reproduce previously published data using the revised definition. The time series in this article uses two different avoidable mortality definitions; 2001 to 2013 uses the previous definition and 2014 onwards uses the new definition.

Avoidable mortality was not intended to serve as a definitive source of evidence of differences in effectiveness of healthcare systems. While a specific condition can be considered avoidable, this does not mean that every death from that condition could be averted. This is because factors such as lifestyle, age, disease progression at diagnosis and potential existence of other medical conditions are not considered. Instead, this measure was designed to highlight areas of potential weaknesses in healthcare that could benefit from further in-depth investigation. Therefore, a degree of caution is recommended when interpreting the data.

Uses and users

This high-level outcome measure acts as a guide to the performance of health systems in terms of prevention and healthcare interventions. Statistics on avoidable mortality are used by central government, Public Health England, Public Health Wales, NHS England, NHS Wales, academia and charitable organisations working to reduce the prevalence of specific diseases and conditions deemed to be avoidable causes of death. Avoidable deaths also provide context to the success of primary preventative actions aimed at reducing risk factors for disease, such as smoking, in the population as well as indicating the quality and timeliness of healthcare interventions, such as by-pass surgery.

Strengths and limitations

Strengths

Socioeconomic inequalities in avoidable mortality in England and Wales are created using information supplied when a death is registered and mid-year population estimates, which gives complete population coverage. As such, estimates have a sufficient standard of precision to detect statistically significant differences between deprivation levels and to track improvement over time. Comprehensive population coverage ensures these statistics are representative of the underlying population at risk.

Coding for cause of death is carried out according to the World Health Organisation (WHO) ICD-10 and internationally agreed rules.

The use of standardised automated coding software and the application of an agreed definition of avoidable, preventable and amenable mortality means the underlying data on cause of death are robust.

Statistics on avoidable mortality are presented based on the year these deaths were registered rather than the year of occurrence; this method is used because there is a requirement for consistent and timely data, despite a potential limitation in data quality caused by registration delays.

We report three statistical measures: age-standardised rates and absolute and relative measures of inequality. Age-standardisation is undertaken using the European Standard Population 2013 (Word, 206KB); age-standardisation weights data according to its age structure, thereby enabling populations with different age structures to be compared validly.

Limitations

As the time series uses two different avoidable mortality definitions (2001 to 2013 and 2014 onwards), the ability to conduct time series analyses is constrained as the figures are not directly comparable.

In a very small number of cause of death breakdowns, the number of deaths is either too small to report an age-standardised rate or too small to report a rate with reliability.

It is our practice not to calculate rates based on less than 10 deaths, as they are imprecise and susceptible to inaccurate interpretation; age-standardised rates based on 10 to 19 deaths are marked with a “u” to warn users that their reliability is low.

As certain causes of death contained within the definition of avoidable mortality are both preventable, and amenable to healthcare, it is not possible to mutually exclusively determine the proportion of avoidable deaths that are preventable through wider public health actions and that are amenable to healthcare once the condition has manifested and therefore no longer preventable.

5 . Quality characteristics of the avoidable mortality data

Relevance

The concept of avoidable mortality was first introduced by Rutstein and others in the 1970s who argued that, to develop effective indicators of healthcare, lists of diseases that should not (or only infrequently) give rise to death or disability should be drawn up.

Rutstein also noted that the list of conditions considered to be avoidable would need to be updated in light of improvements in medical knowledge and practice, as well as social and environmental changes. Although avoidable mortality has been researched for the last three decades, there is little consensus among researchers about how to define it.

The list of causes of death used in defining avoidable mortality is primarily based on the cause lists produced by Nolte and McKee (2004) and Page, Tobias and Glover (2006). These cause lists were updated and amended to make them more relevant to the UK and to take account of more recent developments in healthcare public health policy. Changes to these lists were influenced by Wheller and others (2007), Avoidable mortality in the European Union: Towards better indicators for the effectiveness of health systems (AMIEHS, 2011) and views of respondents to the 2011 and 2015 consultations.

The measures of avoidable, preventable and amenable mortality represent a high-level outcome measure of the performance of health systems in terms of prevention and healthcare interventions.

Accuracy and reliability

Mortality statistics achieve 100% coverage, as it is a legal requirement that all deaths are registered. However, in some cases the registration of a death may not take place in the same calendar year as the death occurred. This is most likely to occur in cases where the death is referred to a coroner and an inquest is held. Deaths are referred to a coroner in cases where the cause of death is unknown, where the deceased was not seen by a doctor before or after death or where the death was violent, unnatural or suspicious. If the coroner chooses to hold an inquest, the death can only be registered once the inquest has taken place.

The accuracy of mortality statistics is dependent on the quality of information supplied when the death is registered. An incorrect underlying cause of death may be provided by the doctor completing the death certificate. Many thousands of practicing doctors complete death certificates and the nature and amount of training they have had in death certification varies greatly. Inaccurate information may also be supplied by the informant (usually a relative of the deceased) who must use the death certificate to register the death with the registrar. It is not possible to measure the magnitude of errors such as these.

Further information about the process involved in death registration and the checks carried out on the data we hold to ensure their quality can be found in the Mortality statistics QMI and in the Methods used to produce the avoidable mortality data section within this report.

Coherence and comparability

Avoidable mortality statistics are based on death registrations data. We hold data for England and Wales, and deaths of non-residents are excluded when England and Wales are presented separately.

The European Union have aligned their definition of avoidable mortality with the Office for National Statistics (ONS) definition and therefore there is scope to make comparisons with other European Union nations. However, variant definitions are used internationally, which the Organisation for Economic Co-operation and Development (OECD) is addressing through efforts to agree an internationally recognised definition.

As the avoidable mortality definition is subject to change over time, the scope for comparable data over long time frames using the same definition is hindered. However, given that knowledge of preventative actions grows and healthcare technology improves, causes of death previously not considered avoidable may become avoidable in future.

Accessibility and clarity

Our recommended format for accessible content is a combination of HTML webpages for narrative, charts and graphs, with data being provided in usable formats such as CSV and Excel. Our website also offers users the option to download the narrative in PDF format. In some instances, other software may be used, or may be available on request. Available formats for content published on our website but not produced by us, or referenced on our website but stored elsewhere, may vary. For further information please refer to the contact details at the beginning of this report.

For information regarding conditions of access to data, please refer to the following links:

- Terms and conditions (for data on the website)
- Accessibility

In addition to this Quality and Methodology Information, basic quality information relevant to each release is available in the Quality and methodology section of the relevant article.

Timeliness and punctuality

The provisional date for the annual release of Socioeconomic inequalities in avoidable mortality is pre-announced on the GOV.UK website and on the ONS release calendar 12 months in advance. The date is then finalised at least one month before publication. The timeliness of this release has improved, as it is now published at the beginning of May rather than in July.

For more details on related releases, the GOV.UK release calendar is available online and provides 12 months' advance notice of release dates. In the unlikely event of a change to the pre-announced release schedule, public attention will be drawn to the change and the reasons for the change will be explained fully at the same time, as set out in the Code of Practice for Statistics.

Concepts and definitions

The first definition of avoidable mortality was developed in consultation with experts for the specific purpose of quantifying the number of avoidable deaths from 2001 onwards. This means that the causes of death are consistently defined using the International Classification of Diseases, 10th Revision (ICD-10).

The ICD-10 is the standard diagnostic tool for epidemiology, health management and clinical purposes. It is used to classify diseases and other health problems recorded on many types of health and vital records including death certificates and health records. In addition to enabling the storage and retrieval of diagnostic information for clinical, epidemiological and quality purposes, these records also provide the basis for the compilation of national mortality and morbidity statistics by World Health Organisation (WHO) member states. It is used for reimbursement and resource allocation decision-making by countries.

We plan to review and, if appropriate, revise the definition of avoidable mortality periodically to account for advancements in medicine and wider public health policy. Following such a review, we will not rebase published figures using the revised avoidable mortality definition. This is because deaths from the conditions listed in the definition have to be avoidable through the medical or wider public health context at the time of death.

In 2015 we conducted a public consultation to review the definition of avoidable mortality. Following this, a revised definition was published in May 2016 and from the data year 2014 onwards we have implemented this new definition.

The impact of this change was small when considering overall avoidable mortality rates, however, for amenable mortality alone there was a significant increase in age-standardised mortality rates. This is in most part due to the reclassification of chronic obstructive pulmonary disorder as both amenable and preventable. Further information on the new definition and its impact on the reporting of avoidable mortality statistics can be found on the ONS Review of Avoidable Mortality Definition. As well as revising the existing definition, a new separate indicator of avoidable mortality in children and young people (aged 0 to 19 years) was developed.

The three concepts we report on in this article are:

- avoidable mortality
- amenable mortality
- preventable mortality

Avoidable mortality

Avoidable deaths are all those defined as preventable, amenable, or both, where each death is counted only once. Where a cause of death falls within both the preventable and amenable definition, all deaths from that cause are counted in both categories when they are presented separately.

Amenable mortality

A death is amenable (treatable) if, in light of medical knowledge and technology at the time of death, all or most deaths from that cause (subject to age limits if appropriate) could be avoided through good quality healthcare.

Preventable mortality

A death is preventable if, in light of understanding of the determinants of health at the time of death, all or most deaths from that cause (subject to age limits if appropriate) could be avoided by public health interventions in the broadest sense.

Table 1 provides the avoidable mortality definition for 2001 to 2013.

Table 1: Avoidable mortality definition for 2001 to 2013

Condition group and cause	ICD-10 codes	Age	Amenable	Preventable
Infections				
Tuberculosis	A15-A19, B90	0-74	•	•
Selected invasive bacterial and protozoal infections	A38-A41, A46, A48.1, B50-B54, G00, G03, J02, L03	0-74	•	
Hepatitis C	B17.1, B18.2	0-74	•	•
HIV/AIDS	B20-B24	All	•	•
Neoplasms				
Malignant neoplasm of lip, oral cavity and pharynx	C00-C14	0-74		•
Malignant neoplasm of oesophagus	C15	0-74		•
Malignant neoplasm of stomach	C16	0-74		•
Malignant neoplasm of colon and rectum	C18-C21	0-74	•	•
Malignant neoplasm of liver	C22	0-74		•
Malignant neoplasm of trachea, bronchus and lung	C33-C34	0-74		•
Malignant melanoma of skin	C43	0-74	•	•
Mesothelioma	C45	0-74		•
Malignant neoplasm of breast	C50	0-74	•	•
Malignant neoplasm of cervix uteri	C53	0-74	•	•
Malignant neoplasm of bladder	C67	0-74	•	
Malignant neoplasm of thyroid gland	C73	0-74	•	
Hodgkin's disease	C81	0-74	•	
Leukaemia	C91, C92.0	0-44	•	
Benign neoplasms	D10-D36	0-74	•	
Nutritional, endocrine and metabolic				
Diabetes mellitus	E10-E14	0-49	•	•
Drug use disorders				

Alcohol related diseases, excluding external causes	F10, G31.2, G62.1, I42.6, K29.2, K70, K73, K74 (excl. K74.3-K74.5), K86.0	0-74		•
Illicit drug use disorders	F11-F16, F18-F19	0-74		•
Neurological disorders				
Epilepsy and status epilepticus	G40-G41	0-74	•	
Cardiovascular diseases				
Rheumatic and other valvular heart disease	I01-I09	0-74	•	
Hypertensive diseases	I10-I15	0-74	•	
Ischaemic heart disease	I20-I25	0-74	•	•
DVT with pulmonary embolism	I26, I80.1-I80.3, I80.9, I82.9	0-74		•
Cerebrovascular diseases	I60-I69	0-74	•	
Aortic aneurysm and dissection	I71	0-74		•
Respiratory diseases				
Influenza (including swine flu)	J09-J11	0-74	•	•
Pneumonia	J12-J18	0-74	•	
Chronic obstructive pulmonary disorder	J40-J44	0-74		•
Asthma	J45-J46	0-74	•	
Digestive disorders				
Gastric and duodenal ulcer	K25-K28	0-74	•	
Acute abdomen, appendicitis, intestinal obstruction, cholecystitis/lithiasis, pancreatitis, hernia	K35-K38, K40-K46, K80-K83, K85, K86.1-K86.9, K91.5	0-74	•	
Genitourinary disorders				
Nephritis and nephrosis	N00-N07, N17-N19, N25-N27	0-74	•	
Obstructive uropathy and prostatic hyperplasia	N13, N20-N21, N35, N40, N99.1	0-74	•	
Maternal and infant				
Complications of perinatal period	P00-P96, A33	All	•	

Congenital malformations, deformations and chromosomal anomalies	Q00-Q99	0-74	•	
Unintentional injuries				
Transport Accidents	V01-V99	All		•
Accidental Injury	W00-X59	All		•
Intentional injuries				
Suicide and self inflicted injuries	X60-X84, Y10-Y34	All		•
Homicide/Assault	X85-Y09, U50.9	All		•
Misadventures to patients during surgical and medical care	Y60-Y69, Y83-Y84	All	•	•

Table 2 provides the avoidable mortality definition for 2014 onwards.

Table 2: Avoidable mortality definition for 2014 onwards

Condition group and cause	ICD-10 codes	Age	Amenable	Preventable
Infections				
Intestinal infectious diseases	A00-A09	0-14	•	
Tuberculosis	A15-A19, B90	0-74	•	•
Selected invasive bacterial and protozoal infections	A38-A41, A46, A48.1, B50-B54, G00, G03, J02, L03	0-74	•	
Hepatitis C	B17.1, B18.2	0-74	•	•
Pertussis (whooping cough)	A37	0-14	•	•
Measles	B05	1-14	•	•
Rubella	B06	0-14		•
Other infections (Diphtheria, Tetanus, Poliomyelitis and Varicella)	A35, A36, A80, B01	0-74	•	•
HIV/AIDS	B20-B24	All	•	•
Neoplasms				
Malignant neoplasm of lip, oral cavity and pharynx	C00-C14	0-74		•
Malignant neoplasm of oesophagus	C15	0-74		•
Malignant neoplasm of stomach	C16	0-74		•
Malignant neoplasm of colon and rectum	C18-C21	0-74	•	•
Malignant neoplasm of liver	C22	0-74		•
Malignant neoplasm of trachea, bronchus and lung	C33-C34	0-74		•
Malignant melanoma of skin	C43	0-74	•	•
Mesothelioma	C45	0-74		•
Malignant neoplasm of breast	C50	0-74	•	•
Malignant neoplasm of cervix uteri	C53	0-74	•	•
Malignant neoplasm of bladder	C67	0-74	•	
Malignant neoplasm of thyroid gland	C73	0-74	•	
Hodgkin's disease	C81	0-74	•	

Leukaemia	C91, C92.0	0-44	•	
Malignant neoplasm of testis	C62	0-74	•	
Malignant neoplasm of unspecified parts of uterus and body of uterus	C54-C55	0-44	•	
Benign neoplasms	D10-D36	0-74	•	
Nutritional, endocrine and metabolic				
Diabetes mellitus	E10-E14	0-74	•	•
Diseases of the Thyroid	E00-E07	0-74	•	
Addison's disease	E27.1	0-74	•	
Drug use disorders				
Alcohol related diseases, excluding external causes	F10, G31.2, G62.1, I42.6, K29.2, K70, K73, K74 (excl. K74.3-K74.5), K86.0	0-74		•
Illicit drug use disorders	F11-F16, F18-F19	0-74		•
Neurological disorders				
Epilepsy and status epilepticus	G40-G41	0-74	•	
Cardiovascular diseases				
Rheumatic and other valvular heart disease	I01-I09	0-74	•	
Hypertensive diseases	I10-I15	0-74	•	
Ischaemic heart disease	I20-I25	0-74	•	•
DVT with pulmonary embolism	I26, I80.1-I80.3, I80.9, I82.9	0-74		•
Cerebrovascular diseases	I60-I69	0-74	•	
Aortic aneurysm and dissection	I71	0-74		•
Respiratory diseases				
Influenza (including swine flu)	J09-J11	0-74	•	•
Pneumonia	J12-J18	0-74	•	
Chronic obstructive pulmonary disorder	J40-J44	0-74	•	•

Asthma	J45-J46	0-74	•	
Selected respiratory diseases	J00-J06, J20-J22, J30-J39	1-14	•	
Digestive disorders				
Gastric and duodenal ulcer	K25-K28	0-74	•	
Acute abdomen, appendicitis, intestinal obstruction, cholecystitis/lithiasis, pancreatitis, hernia	K35-K38, K40-K46, K80-K83, K85, K86.1-K86.9, K91.5	0-74	•	
Genitourinary disorders				
Nephritis and nephrosis	N00-N07, N17-N19, N25-N27	0-74	•	
Obstructive uropathy and prostatic hyperplasia	N13, N20-N21, N35, N40, N99.1	0-74	•	
Maternal and infant				
Complications of perinatal period	P00-P96, A33	All	•	
Congenital malformations of the circulatory system	Q20-Q28	0-74	•	
Spina Bifida	Q05	0-74		•
Unintentional injuries				
Transport Accidents	V01-V99	All		•
Accidental Injury	W00-X59	All		•
Intentional injuries				
Suicide and self inflicted injuries	X60-X84, Y10-Y34	All		•
Homicide/Assault	X85-Y09, U50.9	All		•
Misadventures to patients during surgical and medical care	Y60-Y69, Y83-Y84	All	•	•

For most of the causes of death included in our avoidable definition there is an upper age limit of 74 years. This is because deaths at older ages are often difficult to attribute definitively to a single underlying cause and the chances of death are more affected by coexisting medical conditions and other factors.

It is important to note that our definition of avoidable mortality is different to the measure of avoidable deaths in hospital that NHS trusts are required to publish figures on. We use a defined set of underlying causes of death that have been approved through consultation with users and expert guidance. It includes conditions where it is reasonable to expect deaths to be avoided through good quality healthcare, even after the condition has developed (amenable mortality), as well as those where it is possible to prevent the condition from occurring in the first place (incidence reduction) through wider public health interventions, such as those targeted at reducing the incidence of smoking (preventable mortality). The avoidable deaths in hospital measure is based on a record review of a sample of deaths deemed to be due to problems in care. Avoidable deaths in hospital data are not intended to be comparable and are not collated centrally.

Indices of Multiple Deprivation (IMD)

The national deprivation deciles are scores based on the area as a whole and not everyone within a Lower layer Super Output Area (LSOA) necessarily experiences the same level or type of deprivation. For example, some unemployed individuals live in less-deprived LSOAs, while some higher-income individuals live in more-deprived LSOAs.

Similarly, deciles are a broad grouping and the levels of deprivation and the underlying factors determining the LSOA-level deprivation score will vary within the decile. Those LSOAs at the higher and lower end of each specific decile may vary considerably from each other. The widest variation in level of deprivation exposure is found between deciles 1 and 10.

England's Index of Multiple Deprivation (IMD) is calculated using seven domains:

- income
- employment
- education, skills and training
- health and disability
- crime
- barriers to housing and services
- living environment

Different versions of the IMD were used for the time series:

- IMD 2004 was used for data years 2001 to 2005
- IMD 2007 was used for data years 2006 to 2008
- IMD 2010 was used for data years 2009 to 2013
- IMD 2015 was used for data years 2014 to 2017

The Welsh Index of Multiple Deprivation (WIMD) is based on eight domains:

- income
- employment
- health
- education
- access to services
- community safety
- physical environment
- housing

Different versions of the WIMD were used for the time series:

- WIMD 2005 was used for data years 2001 to 2006
- WIMD 2008 was used for data years 2007 to 2009
- WIMD 2011 was used for data years 2010 to 2013
- WIMD 2014 was used for data years 2014 to 2017

Using area-based deprivation as a measure of socioeconomic circumstances in cross-sectional analysis has its limitations. In addition to the issues of using the IMD and WIMD to classify everyone living in such areas, there is also the issue of health-related migration, whereby more healthy people are likely to move and cluster in less deprived areas and the other way around, which will to some extent exaggerate the relationship between area deprivation and health.

In most cases, IMD and WIMD deprivation scores accurately linked onto the LSOAs. However, for 5% of the LSOAs this was not possible because of geography boundary changes that were implemented in 2011. For these cases, an average deprivation score of all LSOAs was calculated and an average score imputed to these select LSOAs.

Geography

The socioeconomic inequalities in avoidable mortality article covers deaths registered in England and Wales only and excludes deaths of non-residents.

Output quality

The production of avoidable mortality statistics relies upon the availability of the annual death registrations data for England and Wales. Additionally, coding and quality assurance of death registration data is time-consuming. For it to be published earlier, provisional data would need to be used and would need to be subsequently revised. Users have not indicated that they are unhappy with this balance between timeliness and quality.

In England and Wales deaths should be registered within five days of the death occurring, but there are some situations that result in the registration of the death being delayed. Deaths considered unexpected, accidental or suspicious will be referred to a coroner who may order a post-mortem or carry out a full inquest to ascertain the reasons for the death.

Statistics on avoidable mortality are presented based on the year these deaths were registered rather than the year of occurrence. This method is used because there is a requirement for consistent and timely data, despite a potential limitation in data quality caused by registration delays. For most of the causes included in the avoidable mortality definition, deaths would be registered in the same year they occurred. However, for causes such as intentional injuries that were referred to a coroner for further investigation, deaths may not be registered in the same year they occurred.

Why you can trust our data

The User guide to mortality statistics provides detailed information on the processing and quality of mortality data for England and Wales. Internal consistency checks are conducted to eliminate any errors made during the recording of deaths, and to ensure the annual dataset is complete. Any concerns relating to cause of death are referred to a medical advisor or medical epidemiologist.

In the compilation of these statistics, ONS itself independently determines the focus, content, commentary, illustration and interpretation of these measures presented in articles.

6 . Methods used to produce the avoidable mortality data

How we collect the data, main data sources and accuracy

Socioeconomic inequalities in avoidable mortality is compiled using information supplied when a death is registered. A record for each death registered in England and Wales is held on the Office for National Statistics (ONS) Death Registrations Database. Further details about the information held on the ONS Death Registrations Database, as well as the methods used to quality assure the data, can be found in the User guide to mortality statistics.

The definition of avoidable deaths only includes those causes considered preventable or amenable to healthcare. The definition allows for consistent comparisons over time.

Age-standardised rates were not calculated where there were fewer than 10 deaths in a year. It is our practice not to calculate rates based on such small numbers, as they are imprecise and susceptible to inaccurate interpretation. Age-standardised rates based on 10 to 19 deaths are marked with a “u” to warn users that their reliability is low.

Age-standardised rates and absolute and relative measures of inequality are published with 95% confidence intervals to allow users to identify significant differences between sexes and deprivation levels over time. Significance is assigned on the basis of non-overlapping confidence intervals. As a general rule, if the confidence interval around an estimate overlaps with the interval around another, there is no significant difference between the two estimates. While more formalised and accurate methods of significance testing are available, the non-overlapping confidence interval method is used because it is both simple to calculate and easily understood.

How we process the data

All deaths in England and Wales are coded by the ONS according to the International Classification of Diseases, 10th Revision (ICD-10) produced by the World Health Organisation.

Avoidable deaths are all those defined as preventable, amenable (treatable) or both, where each death is counted only once. Where a cause of death is both preventable and amenable, all deaths from that cause are counted in both categories when they are presented separately.

The number of deaths where an avoidable condition was included as the underlying cause on the death certificate, by sex and age group (under 1 year, 1 to 4 years, 5 to 9 years, 10 to 14 years and so on to 85 to 89 years and 90 years and over) for England and Wales are extracted from the ONS Death Registrations Database.

How we analyse the data

Three mortality indicators are presented in the annual article – age-standardised mortality rates and absolute and relative measures of inequality.

Age-standardised mortality rates

Age-standardised mortality rates are calculated using the number of deaths and mid-year population estimates provided by our Population Estimates Unit. Information about the methods used to calculate mid-year population estimates can be found in the Methodology guide for mid-year population estimates.

Age-standardised mortality rates are calculated using the direct method of standardisation, while the 2013 European Standard Population (ESP) is used as the standard population. Age-standardised rates make allowances for the differences in the age structure of a population, over time and between sexes. The age-standardised rate for a specific cause of death is that which would have occurred if the observed age-specific rates for that cause had applied in the given standard population. In this method, the age-specific rates for each year are applied to a standard population structure to obtain the number of cases expected in each age group in the standard population. The numbers of expected cases are then added up across all age groups and divided by the total standard population to obtain a summary rate figure.

This Microsoft Excel template demonstrates how age-standardised rates and 95% confidence intervals are calculated.

Age-standardised rates are calculated as follows:

$$\frac{\sum_i w_i r_i}{\sum_i w_i} \times 100,000$$

where:

- i is the age group (under 1 year, 1 to 4 years, 5 to 9 years, 10 to 14 years and so on to 85 to 89 years and 90 years and over)
- w_i is the number, or proportion, of individuals in the standard population in age group i
- r_i is the observed age-specific rate in the subject population in age group i, given by:

$$r_i = \frac{d_i}{n_i}$$

where:

- d_i is the observed number of deaths in the subject population in age group i
- n_i is the number of individuals in the subject population in age group i

We recommend the use of an abridged version of the ESP in the table with an upper age limit of 90 years and over. This is because official population denominators for the oldest age group in the ESP (95 years and over) are not available for all geographical area levels.

Table 3 provides details of the 2013 European Standard Population, by age group.

Table 3: The 2013 European Standard Population

Age group (years)	Population (number)	Abridged version
Under 1	1,000	1,000
1 to 4	4,000	4,000
5 to 9	5,500	5,500
10 to 14	5,500	5,500
15 to 19	5,500	5,500
20 to 24	6,000	6,000
25 to 29	6,000	6,000
30 to 34	6,500	6,500
35 to 39	7,000	7,000
40 to 44	7,000	7,000
45 to 49	7,000	7,000
50 to 54	7,000	7,000
55 to 59	6,500	6,500
60 to 64	6,000	6,000
65 to 69	5,500	5,500
70 to 74	5,000	5,000
75 to 79	4,000	4,000
80 to 84	2,500	2,500
85 to 89	1,500	1,500
90 to 94	800	-
95 and over	200	-
90 and over	-	1000
Total	100,000	100,000

Source: Eurostat

Standard error

In previous publications, the standard error for age-standardised rates was calculated using a simple approximation method. The standard error is denoted as SE(ASR) and calculated as:

$$SE(ASR) = \frac{ASR}{\sqrt{N}}$$

where:

- ASR is the age-standardised rate
- N is the total number of deaths in all age groups in each year

The age-standardised rate is a weighted sum of age-specific death rates where the age-specific weights represent the relative age distribution of the standard population (in this case the 2013 ESP). Therefore, it is more accurate to calculate its variance as the sum of the age-specific variances and to estimate its standard error as the square root of the variance. This is calculated as follows:

$$SE\left(ASR\right) = \sqrt{\frac{\sum_i \left(w_i^2 \cdot \frac{r_i^2}{d}\right)}{\left(\sum_i w_i\right)}}$$

where:

- w_i is the number of individuals in the standard population in age group i
- r_i is the crude age-specific rate in the local population in age group i
- d_i is the number of deaths in the local population in age group i

The standard error calculation has now been modified so that it takes into account the variance of the weighted sum of age-specific rates.

Confidence intervals for age-standardised mortality rates

The mortality data in this release are not subject to sampling variation as they were not drawn from a sample. Nevertheless, they may be affected by random variation, particularly where the number of deaths or probability of dying is small. To help assess the variability in the rates, they have been presented alongside 95% confidence intervals (CIs).

The choice of the method used in calculating CIs for rates will, in part, depend on the assumptions made about the distribution of the deaths data these rates are based on.

Traditionally, a normal approximation method has been used to calculate CIs on the assumption that avoidable deaths are normally distributed. However, if the number of avoidable deaths is relatively small (fewer than 100), it may be assumed to follow a Poisson probability distribution. In such cases, it is more appropriate to use the confidence limit factors from a Poisson distribution table to calculate the CIs instead of a normal approximation method.

The method now used in calculating CIs for rates based on fewer than 100 deaths was proposed by Dobson and others (1991). In this method, CIs are obtained by scaling and shifting (weighting) the exact interval for the Poisson distributed counts (number of deaths in each year). The weight used is the ratio of the standard error of the age-standardised rate to the standard error of the number of deaths. The lower and upper 95% confidence limits are denoted as ASR_{lower} and ASR_{upper}, respectively, and calculated as:

$$ASR_{lower} = ASR + \left(D_l - D\right) \cdot \sqrt{\frac{v\left(ASR\right)}{v\left(D\right)}}$$

$$ASR_{upper} = ASR + (D_u - D) \cdot \sqrt{\frac{v(ASR)}{v(D)}}$$

Where:

- D_l and D_u are the exact lower and upper confidence limits for the number of deaths, calculated using confidence limit factors from a Poisson probability distribution table
- D is the number of deaths in each year
- v(ASR) is the variance of the age-standardised rate
- v(D) is the variance of the number of deaths

Where there are 100 or more deaths in a year the 95% confidence intervals for age-standardised rates are calculated using the normal approximation method as follows:

$$ASR_{LL/UL} = ASR \pm 1.96 \cdot SE$$

Where:

$ASR_{LL/UL}$ represents the upper and lower 95% confidence limits, respectively, for the age-standardised rate

Measures of inequality

In this article both absolute and relative measures of inequality were used. Absolute measures of inequality quantify the difference in health outcomes between the most and least deprived. Relative measures quantify the magnitude of the difference, that is, how many times the health outcome is greater or lesser in the most compared with the least deprived. The two main inequality indicators reported use weighted linear regression to model the inequality in avoidable mortality across deprivation deciles by taking account of the size of the gaps across all adjacent deciles and the relative contributions they make to the overall inequality.

Slope index of inequality (SII)

The slope index of inequality (SII) is reported using positive values to demonstrate increasing avoidable mortality rates with increasing deprivation rather than decreasing avoidable mortality with decreasing deprivation. The relative rank, a measure of socioeconomic advantage used as the explanatory variable in the model, ranges from 0 (most deprived) to 100 (least deprived) so for this outcome, which grows with increasing deprivation, the actual SII value is negative. For example, when we report an SII value of 461.0 in age-standardised rates, it represents an absolute gap (mortality difference) of 461.0 deaths per 100,000 people. This can also be expressed as an additional 461.0 deaths per 100,000 people experienced by the most deprived compared with the least deprived populations.

The SII was calculated in the statistical software package Stata, and quality assured in another statistical software package, R. Deciles were ordered by decreasing area deprivation, that is, from the most to the least deprived. The fraction of the total population in each decile (f) was calculated. The cumulative frequency (ci), that is, the cumulative sum of the population in successively less-deprived deciles, was also obtained and the relative deprivation rank (x) for each decile was calculated as:

$$x = c_{j-1} + (0.5f)$$

This formula calculates the relative deprivation rank for use in the SII calculation. The SII (slope of the regression line) was then estimated by regressing age-standardised rates for each decile against the relative deprivation rank (x), weighted by the population in each decile.

The confidence intervals for the SII are calculated using a simulation program. Simulation is a method used to estimate the degree of uncertainty for measures where the statistical distributions underpinning the measure are too complex to analyse mathematically. For each decile, age-standardised rates have been calculated along with its standard error (SE). These SEs give information about the degree of uncertainty around each of the values: essentially it describes a statistical distribution for each decile. Using a random-number-generating algorithm, a random value is taken from each decile age-standardised rate distribution and the SII recalculated. This is repeated many times (for example, 10,000), to build up a distribution of SII values based on random sampling from the decile age-standardised rate 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, rather than that based on 10 observations representing the deciles.

Relative index of inequality (RII)

The relative index of inequality (RII) acts as a ratio showing how much more likely an outcome of interest (in this case avoidable mortality and its components) occurs in the hypothetical most-deprived populations compared with the hypothetical least-deprived populations.

The RII and associated confidence intervals are based on Fieller's method of computing the Kunst Mackenbach RII. Fieller's method uses the following formulae:

$$\text{RIIKM numerator} = \text{mean measure across deciles weighted by decile size} - (SII \times 0.5)$$
$$\text{RIIKM denominator} = \text{mean measure across deciles weighted by decile size} - (SII \times 0.5)$$

The confidence interval (CI) for RIIKM is calculated as:

$$RIIKMCI = \frac{mean\ measure\ across\ deciles\ weighted\ by\ decile\ size - (SII \pm c \times SE(SII)) \times 0.5}{mean\ measure\ across\ deciles\ weighted\ by\ decile\ size + (SII \pm c \times SE(SII)) \times 0.5}$$

Where:

- c is the critical value of the t distribution used in the calculation of the variances of the coefficients
- SE is the standard error of the SII available from the weighted regression equation

How we quality assure and validate the data

Quality assurance is carried out at all stages of production. Specific procedures include:

- independent extraction of base mortality and population data by two research officers
- independent analyses by two research officers and use of check sheets to match analyses before writing up results
- reproducing estimates in the previous publication to ensure they match
- plausibility checking of new estimates through cross-referencing with past publications and more widely what we know about the general trend in mortality
- checks across cause of death components of the definition

How we disseminate the data

Socioeconomic inequalities in avoidable mortality estimates are available online for England and Wales. The data in this release go back to 2001 using the previous mortality definition, and data using the new definition are available from 2014.

Links from the release calendar make the release date and location of each new release easy to locate. The article can be downloaded free of charge as a PDF and the data tables in Microsoft Excel format. The underlying data for the charts and tables in the article can be downloaded, while the digital interactive maps can be embedded into other media.

Other data not published online are available on request by emailing mortality@ons.gov.uk. Metadata describing the limitations of the data for more detailed tables are provided with each individual request. Most queries can be answered from the website datasets or supporting methods documents. Any additional enquires regarding avoidable mortality can be made by emailing mortality@ons.gov.uk.

How we review and maintain the data processes

The definition of avoidable mortality is regularly reviewed. We ran a public consultation in 2015 to review our definition of avoidable mortality. The aim of this consultation was to review and, if necessary, update the current definitions of avoidable mortality and associated age limits. In addition, we wanted to gather user perceptions about implementing a new avoidable mortality indicator for children and young people.

The definition of avoidable mortality changes and develops as new knowledge about the aetiology of disease is acquired and improvements to health technologies make certain conditions more amenable to healthcare intervention. We have a contract with a medical advisor who is an expert in the field of avoidable deaths and we are guided by the advisor as to when a review is pertinent.

We also work with Eurostat and nations within the Organisation for Economic Co-operation and Development (OECD). Recently, we have contributed our knowledge and expertise to an OECD-led working group brought together to develop a harmonised definition of avoidable mortality. Further reviews of the definition will be considered in light of the findings of that working group.

We also have an Avoidable Mortality Stakeholder Interest Group, which we use as a sounding board for testing new ideas for inclusion in our articles. We will also use this group as an overseeing body in future reviews of the definition.

We published a summary of the responses we received to the consultation and we have now developed a revised avoidable mortality definition (Word, 284KB).

7 . Other information

Here are some useful links to other sources of data on avoidable mortality:

- Health at a Glance: Europe 2016 – OECD iLibrary
- Amenable and preventable death statistics – Eurostat
- Review of avoidable mortality definition
- Revised definition of avoidable mortality 2014 (Word, 657KB)
- Impact of change to avoidable mortality definition (XLS, 211KB)
- Avoidable mortality consultation 2015 (Word, 284KB)
- Deaths registered in England and Wales