Office for National Statistics

Socioeconomic inequalities in avoidable mortality QMI

Quality and Methodology Information (QMI) report 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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1 . Output information

- National Statistic: yes

- Data collection: death registrations

- Frequency: annual

- How compiled: administrative data processing

- Geographic coverage: England and Wales

Related publications:

- [Avoidable mortality in the UK](#)

- [Socioeconomic inequalities in avoidable mortality, Wales](#)

- [Socioeconomic inequalities in avoidable mortality, England](#)

2 . About this Quality and Methodology Information report

This Quality and Methodology Information report contains information on the quality characteristics of the data (including the European Statistical System's 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

- decide suitable uses for the data

- reduce the risk of misusing the 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' Indices of Multiple Deprivation deciles and quintiles respectively, sex and cause as well as absolute measures of inequality (Slope Index 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.

- An Organisation for Economic Co-operation and Development working group created a [harmonised avoidable mortality](#) definition to be used internationally; the Office for National Statistics (ONS) implemented this definition in 2020 for data years 2001 onwards.

- Avoidable mortality data for England and Wales are held by the ONS.

- National deciles of area deprivation are created through ranking small geographic 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.

- National quintiles of area deprivation are created through ranking small geographic populations known as LSOAs according to their deprivation score and grouping them into five divisions.

- Each quintile represents approximately 20% of the national population, with quintile 1 containing the 20% most deprived LSOAs and quintile 5 containing the 20% least deprived.

4 . Quality summary

Overview

It is widely accepted that the contribution of health care to improvements in population health ought to be quantified. Avoidable mortality is used as an indicator to measure this contribution. It 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 health care.

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 health care 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, UK Health Security Agency, Office for Health Improvement and Disparities, 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 (MYEs), 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 Organization (WHO) International Classification of Diseases, 10th revision and internationally agreed rules.

The use of standardised automated coding software and the application of an agreed definition of avoidable, preventable and treatable 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 two statistical measures: age-standardised rates and absolute measures of inequality. Age-standardisation is undertaken using the European Standard Population 2013 (Word, 206KB), and it weights data according to its age structure, thereby enabling populations with different age structures to be compared validly.

Limitations

In a 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 fewer than 10 deaths, and rates based on 10 to 19 deaths are marked with a "u" to warn users that their reliability is low.

Recent improvements

In 2020, the new avoidable mortality definition, created by an Organisation for Economic Co-operation and Development working group, was implemented. The definition was introduced for data years 2001 onwards, replacing the two definitions previously used. A public consultation was run on the definition and an impact paper (Word, 731KB) was created.

Following user feedback, we have produced figures by cause and sex for quintiles in Wales in the 2020 data release rather than by deciles.

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 health care, 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.

With advances in medical technology and wider health interventions, the definition of avoidable mortality requires regular review as deaths from conditions previously not avoidable may have since become avoidable. Two public consultations were previously conducted in 2011 and 2015 to consult with statistical users, academics, and experts to determine the causes of death that should be included in our definition.

Internationally, several definitions of avoidable mortality are used to inform the impacts of preventive and healthcare programmes, which constrains cross-country comparisons.

In 2017, an Organisation for Economic Co-operation and Development (OECD) working group on avoidable mortality was set up to look further into these definitions and seek agreement on a definition that can be used for international comparisons. The overall mandate of this group was to compare the selection of causes of death and age groups considered to be preventable and treatable in current leading lists of avoidable mortality and to recommend a universal avoidable mortality definition.

In 2018, the OECD released their [proposed definition of avoidable mortality](#), which has been adopted by Eurostat. We ran a [consultation](#) in 2019 to seek users' views on the implementation of the new definition of avoidable mortality. The new definition was implemented in 2020.

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

Individual deaths are assigned to geographical areas by linking the postcode of usual residence of the deceased to the latest version of the [National Statistics Postcode Lookup](#). Avoidable mortality figures are produced using the latest boundaries in place at the time. For the release in March 2022, figures have been updated back to 2001 using August 2021 boundaries, therefore they may differ from previously published figures.

Additionally, we have revised data back to 2001 to take on the latest guidance on producing figures by Index of Multiple Deprivation (IMD). For death registrations between 2001 and 2008, we have used Lower-layer Super Output Area (LSOA) 2001 codes and LSOA 2011 codes for all other years, therefore figures will differ from previously published.

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 in England and Wales 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. The Office for National Statistics (ONS) holds data for England and Wales. Deaths of non-residents are excluded when England and Wales are presented separately.

As the new definition of avoidable mortality is to be implemented internationally, we should expect in the future to be able to make comparisons across countries.

Accessibility and clarity

Our recommended format for accessible content is a combination of HTML web pages 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 the ONS website but not produced by the ONS, or referenced on the ONS 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

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. Statistics are published around March (15 months after the end of the reference period), following the release of the final annual death registrations data in July and the Avoidable mortality in the UK release in February.

For more details on related releases, the GOV.UK website 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

Avoidable mortality is 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 Organization (WHO) member states. It is used for reimbursement and resource allocation decision-making by countries.

In 2020, the new avoidable mortality definition created by an OECD working group was implemented. The definition was introduced for data years 2001 onwards, replacing the two avoidable mortality definitions previously used. Further information on the new definition and its impact on the reporting of avoidable mortality statistics can be found via the ONS Review of the avoidable mortality definition.

The three concepts we report on in the avoidable mortality bulletin are:

- preventable mortality: causes of death that can be mainly avoided through effective public health and primary prevention interventions (that is, before the onset of diseases or injuries, to reduce incidence)

- treatable mortality (previously known as amenable mortality): causes of death that can be mainly avoided through timely and effective healthcare interventions, including secondary prevention and treatment (that is, after the onset of disease, to reduce case fatality)

- avoidable mortality: avoidable deaths are all those defined as preventable or treatable

Table 1: Avoidable mortality definition for 2001 onwards

Condition group and cause	ICD-10 codes	Age	Treatable	Preventable
Infectious diseases				
Intestinal diseases	A00-A09	0-74		•
Diphtheria, Tetanus, Poliomyelitis	A35, A36, A80	0-74		•
Whooping cough	A37	0-74		•
Meningococcal infection	A39	0-74		•
Sepsis due to streptococcus pneumonia and sepsis due to haemophilus influenzae	A40.3, A41.3	0-74		•
Haemophilus influenza infections	A49.2	0-74		•
Sexually transmitted infections (except HIV/AIDS)	A50-A60, A63, A64	0-74		•
Varicella	B01	0-74		•
Measles	B05	0-74		•
Rubella	B06	0-74		•
Viral Hepatitis	B15-B19	0-74		•
HIV/AIDS	B20-B24	0-74		•
Malaria	B50-B54	0-74		•
Haemophilus and pneumococcal meningitis	G00.0, G00.1	0-74		•
Tuberculosis	A15-A19, B90, J65	0-74	• (50%)	• (50%)
Scarlet fever	A38	0-74	•	
Sepsis	A40 (excl. A40.3), A41 (excl. A41.3)	0-74	•	
Cellulitis	A46, L03	0-74	•	
Legionnaires disease	A48.1	0-74	•	
Streptococcal and enterococci infection	A49.1	0-74	•	
Other meningitis	G00.2, G00.3, G00.8, G00.9	0-74	•	
Meningitis due to other and unspecified causes	G03	0-74	•	
Neoplasms				

Lip, oral cavity and pharynx cancer	C00-C14	0-74		•
Oesophageal cancer	C15	0-74		•
Stomach cancer	C16	0-74		•
Liver cancer	C22	0-74		•
Lung cancer	C33-C34	0-74		•
Mesothelioma	C45	0-74		•
Skin (melanoma) cancer	C43	0-74		•
Bladder cancer	C67	0-74		•
Cervical cancer	C53	0-74	• (50%)	• (50%)
Colorectal cancer	C18-C21	0-74	•	
Breast cancer (female only)	C50	0-74	•	
Uterus cancer	C54, C55	0-74	•	
Testicular cancer	C62	0-74	•	
Thyroid cancer	C73	0-74	•	
Hodgkin's disease	C81	0-74	•	
Lymphoid leukaemia	C91.0, C91.1	0-74	•	
Benign neoplasm	D10-D36	0-74	•	
Endocrine and metabolic diseases				
Nutritional deficiency anaemia	D50-D53	0-74		•
Diabetes mellitus	E10-E14	0-74	• (50%)	• (50%)
Thyroid disorders	E00-E07	0-74	•	
Adrenal disorders	E24-E25 (except E24.4), E27	0-74	•	
Diseases of the nervous system				
Epilepsy	G40, G41	0-74	•	
Diseases of the circulatory system				

Condition	ICD code	Age	Col 1	Col 2
Aortic aneurysm	I71	0-74	• (50%)	• (50%)
Hypertensive diseases	I10-I13, I15	0-74	• (50%)	• (50%)
Ischaemic heart diseases	I20-I25	0-74	• (50%)	• (50%)
Cerebrovascular diseases	I60-I69	0-74	• (50%)	• (50%)
Other atherosclerosis	I70, I73.9	0-74	• (50%)	• (50%)
Rheumatic and other heart diseases	I00-I09	0-74	•	
Venous thromboembolism	I26, I80, 182.9	0-74	•	
Diseases of the respiratory system				
Influenza	J09-J11	0-74		•
Pneumonia due to streptococcus pneumonia or haemophilus influenza	J13-J14	0-74		•
Chronic lower respiratory diseases	J40-J44	0-74		•
Lung diseases due to external agents	J60-J64, J66-J70, J82, J92	0-74		•
Upper respiratory infections	J00-J06, J30-J39	0-74	•	
Pneumonia, not elsewhere classified or organism unspecified	J12, J15, J16-J18	0-74	•	
Acute lower respiratory infections	J20-J22	0-74	•	
Asthma and bronchiectasis	J45-J47	0-74	•	
Adult respiratory distress syndrome	J80	0-74	•	
Pulmonary oedema	J81	0-74	•	
Abscess of lung and mediastinum pyothorax	J85, J86	0-74	•	
Other pleural disorders	J90, J93, J94	0-74	•	
Diseases of the digestive system				
Gastric and duodenal ulcer	K25-K28	0-74	•	
Appendicitis	K35-K38	0-74	•	
Abdominal hernia	K40-K46	0-74	•	
Cholelithiasis and cholecystitis	K80-K81	0-74	•	

Other diseases of gallbladder or biliary tract	K82-K83	0-74	•	
Acute pancreatitis	K85.0, K85.1, K85.3, K85.8, K85.9	0-74	•	
Other diseases of pancreas	K86.1, K86.2, K86.3, K86.8, K86.9	0-74	•	
Diseases of the genitourinary system				
Nephritis and nephrosis	N00-N07	0-74	•	
Obstructive uropathy	N13, N20-N21, N35	0-74	•	
Renal failure	N17-N19	0-74	•	
Renal colic	N23	0-74	•	
Disorders resulting from renal tubular dysfunction	N25	0-74	•	
Unspecified contracted kidney, small kidney of unknown cause	N26-N27	0-74	•	
Inflammatory diseases of genitourinary system	N34.1, N70-N73, N75.0, N75.1, N76.4, N76.6	0-74	•	
Prostatic hyperplasia	N40	0-74	•	
Pregnancy, childbirth and the perinatal period				
Tetanus neonatorum	A33	0-74		•
Obstetrical tetanus	A34	0-74		•
Pregnancy, childbirth and the puerperium	O00-O99	0-74	•	
Certain conditions originating in the perinatal period	P00-P96	0-74	•	
Congenital malformations				
Certain congenital malformations (neural tube defects)	Q00, Q01, Q05	0-74		•
Congenital malformations of the circulatory system (heart defects)	Q20-Q28	0-74	•	
Adverse effects of medical and surgical care				
Drugs, medicaments and biological substances causing adverse effects in therapeutic use	Y40-Y59	0-74	•	
Misadventures to patients during surgical and medical care	Y60-Y69, Y83-Y84	0-74	•	
Medical devices associated with adverse incidents in diagnostic and therapeutic use	Y70–Y82	0-74	•	
Injuries				

Transport Accidents	V01-V99	0-74	•
Accidental Injuries	W00-X39, X46-X59	0-74	•
Intentional self-harm	X66-X84	0-74	•
Event of undetermined intent	Y16-Y34	0-74	•
Assault	X86-Y09, U50.9	0-74	•
Alcohol-related and drug-related deaths			
Alcohol-specific disorders and poisonings	E24.4, F10, G31.2, G62.1, G72.1, I42.6, K29.2, K70, K85.2, K86.0, Q86.0, R78.0, X45, X65, Y15	0-74	•
Other alcohol-related disorders	K73, K74.0-K74.2, K74.6	0-74	•
Drug disorders and poisonings	F11-F16, F18-F19, X40-X44, X85, Y10-Y14	0-74	•
Intentional self-poisoning by drugs	X60-X64	0-74	•
Provisional assignment of new diseases			
COVID-19	U07.1-U07.2	0-74	•

Source: Organisation for Economic Co-operation and Development

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 may 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.

For all 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 co-existing 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 health care, even after the condition has developed (treatable 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.

Geography

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

Output quality

Socioeconomic inequalities in avoidable mortality is published 15 months after the reference period. The production of these statistics relies on the availability of the annual death registrations data for England and Wales and the publication of Avoidable mortality in the UK.

Coding and quality assurance of death registration data is time-consuming, and final figures are not available until several months after the reference period. For them 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 the majority of the causes included in the avoidable mortality definition, deaths would be registered in the same year they occurred. However, for causes such as 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, the ONS itself independently determines the focus, content, commentary, illustration, and interpretation of these measures presented in bulletins. We provide early access for quality assurance to a small number of people working in other government bodies for general comment on the plausibility of our findings.

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 treatable and 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 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.

Standard error

In previous publications, the [standard error](#) for age-standardised rates was calculated using a simple approximation method, as shown in this section. 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 [European Standard Population 2013 (Word, 206KB)](#)). 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:

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

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.

The choice of the method used in calculating confidence intervals 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 confidence intervals 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 confidence intervals instead of a normal approximation method.

The method now used in calculating confidence intervals for rates based on fewer than 100 deaths was proposed by Dobson and others (1991) as described in APHO (2008). In this method, confidence intervals 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 intervals are denoted as ASR $_{lower}$ and ASR $_{upper}$, respectively, and calculated as:

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

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

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:

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

where:

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

Indices of Multiple Deprivation (IMDs)

The national deprivation deciles and quintiles 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 and quintiles are a broad grouping, and the levels of deprivation and the underlying factors determining the LSOA-level deprivation score will vary within the grouping. Those LSOAs at the higher and lower end of each specific decile or quintile may vary considerably from each other. The widest variation in level of deprivation exposure is found between deciles 1 and 10 and between quintiles 1 and 5.

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 2003

- IMD 2007 was used for data years 2004 to 2006

- IMD 2010 was used for data years 2007 to 2010

- IMD 2015 was used for data years 2011 to 2015

- IMD 2019 was used for data years 2016 onwards

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 2004

- WIMD 2008 was used for data years 2005 to 2007

- WIMD 2011 was used for data years 2008 to 2010

- WIMD 2014 was used for data years 2011 to 2014

- WIMD 2019 was used for data years 2015 onwards

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.

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 produced by the World Health Organization.

Avoidable deaths are all those defined as preventable and treatable. The number of deaths where an avoidable condition was included as the underlying cause on the death certificate, by sex and age (under 1 to 74 years) for England and Wales, are extracted from the ONS Death Registrations Database.

How we analyse and interpret the data

Two mortality indicators are presented in the annual bulletin – age-standardised mortality rates and absolute measures of inequality.

Age-standardised mortality rates

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

Age-standardised mortality rates are calculated using the direct method of standardisation, while the European Standard Population 2013 (Word, 206KB) 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 Excel template demonstrates how age-standardised rates and 95% confidence intervals are calculated.

Age-standardised rates are calculated as follows:

$$\frac{\sum\limits_{i} w_i r_i}{\sum\limits_{i} w_i} \times 100,000$$

where:

- i is the age group (under 1, to 70 to 74 years)

- 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

Table 2: The European Standard Population 2013

Age group (years)	Population (number)
Under 1	1,000
1 to 4	4,000
5 to 9	5,500
10 to 14	5,500
15 to 19	5,500
20 to 24	6,000
25 to 29	6,000
30 to 34	6,500
35 to 39	7,000
40 to 44	7,000
45 to 49	7,000
50 to 54	7,000
55 to 59	6,500
60 to 64	6,000
65 to 69	5,500
70 to 74	5,000
Total	91,000

Source: Office for National Statistics

Measures of inequality

In Socioeconomic inequalities in avoidable mortality, absolute measures of inequality were used. An absolute measure of inequality known as the Slope Index of Inequality (SII) quantifies the difference in health outcomes between the most and least deprived. This inequality indicator uses 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.

The 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); therefore, for this outcome, which grows with increasing deprivation, the actual SII value is negative. For example, when we report an SII value of 400.0 in age-standardised rates, it represents an absolute gap (mortality difference) of 400.0 deaths per 100,000 people. This can also be expressed as an additional 400.0 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 (cj), 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 is 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 are then reported as the 95% confidence interval for the SII, rather than that based on 10 observations representing the deciles.

After user feedback, in the latest publication (March 2022) the SII for Wales has been calculated using quintiles rather than deciles. The methodology above remains the same.

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. A back series using the new definition is available from 2001.

Links from the [release calendar](#) make the release date and location of each new release easy to locate. The bulletin can be downloaded free of charge as a PDF and the data tables in Excel format. The underlying data for the charts and tables in the bulletin 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 health.data@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 health.data@ons.gov.uk.

How we review and maintain the data processes

In 2020, the new avoidable mortality definition created by an Organisation for Economic Co-operation and Development (OECD) working group was implemented. In the future, the definition of avoidable mortality will be regularly reviewed.

The definition of avoidable mortality evolves as new knowledge about the aetiology of disease is acquired and improvements to health technologies make certain conditions more treatable 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 have an Avoidable Mortality Stakeholder Interest Group, which we use as a sounding board for testing new ideas for inclusion in our releases. We will also use this group as an overseeing body in future reviews of the definition.

7 . Other information

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

- [Avoidable mortality: National Records of Scotland](#)

- [Health inequalities annual report: Department of Health Northern Ireland](#)

- [Review of avoidable mortality definition 2019 (Word, 730KB)](#)

- [Review of avoidable mortality definition 2019 – data tables (XLS, 99KB)](#)

- [Review of avoidable mortality definition 2019 – consultation response and finalised definition (Word, 421KB)](#)

- [Deaths registered in England and Wales](#)

The Socioeconomic inequalities in avoidable mortality bulletin can be cited as:

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